1

Lesson learned from the failed cases of spinal reconstruction with customized 3D-printed prosthesis after C2 resection

Background: Currently, there is no perfect prosthesis for the spinal reconstruction after C2 tumor en-bloc resection due to the special geometry and flexibility of the upper cervical spine. The newly developed customized 3D-printed prosthesis claimed to achieve intimate contact to the expected resection scale, ensuring stability through proper osseointegration by its porous structure, thus complications such as prosthesis dislocation or hardware failure can be spared. A few reports with successful short-term results were published.

Objective: The observe the long-term stability of customized 3D-printed prosthesis as patient survival time increases

Method: To describe the treatment history of two cases of C2 vertebral en-bloc resection and reconstruction by customized 3D-printed prosthesis with clinical presentation, radiologic and histological features. The follow-up results of the patients were also presented. The pits and falls of the customized 3D-printed prosthesis in upper cervical spinal reconstruction were discussed.

Results: Both cases has prosthesis dislocation at early or late post-operative follow-up time. Revision surgery with either customized 3D-printed prosthesis or iliac crest bone graft was performed with acceptably clinical results.

Conclusion: Current design and material of the customized 3D-printed prosthesis could not guarantee long-term fusion and stability in the reconstruction of upper cervical spine.

Keywords: customized 3D-printed prosthesis; upper cervical spine; spinal reconstruction; revision surgery; failure.

2

Clinical efficacy of nano-hydroxyapatite/polyamide 66 strut in treating degenerative cervical kyphosis

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Objective: To investigate the clinical efficacy of the nano-hydroxyapatite/polyamide 66 strut in treating degenerative cervical kyphosis.

Methods: The patients with complete follow-up data who underwent the correction surgery of cervical kyphosis from January 2014 to January 2021 were retrospectively analyzed. The gender, age,surgical bleeding, surgery time, complications etc were recorded. The Imaging assessment included cervical curvature, cervical curvature of cervical hyperextension and hyperflexion, segmental curvature, segmental curvature of hyperextension and hyperflexion. Brantigan score was used for the bone fusion. The clinical efficacy was evaluated by VAS, JOA and NDI.

Results: 31 patients were reviewed with a mean follow-up of 21.61 ± 10.85 months. The age, course of disease, surgery time, surgical bleeding, hospitalization cost and hospital stay were 50.48 ± 12.98 years, 18.23±21.85 months, 134.3 ± 57.02 minutes, 110.3 ± 128.1 ml, 54406±17703 yuan and 10.71 ± 5.11 days respectively. There were 27 cases of anterior approach and 4 cases of combined anterior and posterior approaches. At the final follow-up, the VAS, NDI and JOA scores were significantly improved compared with those preoperatively (P<0.05).The cobb angle of the cervical curvature, cervical curvature of cervical hyperextension and hyperflexion, segmental curvature, segmental curvature of hyperextension and hyperflexion were significantly improved compared with those preoperatively (P<0.05). Postoperative complications occurred in 2 cases. The incision hematoma in 1 case which was removed in emergency. One patient who underwent combined anterior and posterior surgeries developed posterior incision infection of Serratia marcescens. After the debridement and antibiotic therapy, the incision recovered.The mean bone fusion time was 4.1 ± 1.3 months. Two cases subsided with a subsidence rate of about 6.45%.

Conclusion: The n-HA/PA66 strut in treating degenerative cervical kyphosis could maintain the height and curvature of fused segment, with low subsidence rate and good fusion efficacy.

3

Posterior decompression and foraminotomy in treating ossification of the posterior longitudinal ligament with radiculopathy: clinical efficacy and radiographic assessment

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Objective: The study aimed to introduce a novel technique of the posterior decompression and foraminotomy in treating OPLL with radiculopathy and to investigated the clinical efficacy and radiographic assessment.

Methods: Between January 2016 and January 2020, the patients of OPLL with radiculopathy who underwent posterior decompression and foraminotomy were enrolled. The posterior decompression was conducted using laminectomy or laminoplasty while the foraminotomy was performed to relieve the nerve root after posterior decompression. Clinical data were collected including Visual Analogue Scale(VAS)score, neck disability index (NDI), Japanese Orthopedic Association (JOA) score, and complications.The imaging evaluation was the CT three-dimensional reconstruction before and after operation which were performed in all patients, observing the morphology of intervertebral foramen at the responsible segment of cervical root symptoms, and measuring the longitudinal diameter, upper anterioroposterior diameter and lower anterioroposterior diameter at the best angle. And the cobb angle was measured at responsible segment curvature and cervical curvature. The SAS software was used to analyze the data.

Results: 26 patients were included with a mean follow-up of 24.29±10.81 months. The age, course of disease, surgery time, intraoperative blood loss,hospitalization cost and hospital stay were 62.71±12.01 years, 11.43±13.67 months, 136.28±26.38 minutes and 164.29±140.58 ml, 800058±22847yuan、13.43±3.45天and days respectively. The distribution types of cervical OPLL were localized in 2 cases, continuous in 11 cases and mixed in 13 cases. There were 15 cases in C5 radiculopathy and 11 cases in C6 radiculopathy. Posterior laminectomy and decompression were performed in 14 cases and laminoplasty in 12 cases. There were 11 cases in 3 segments of surgical levels,,9 cases in 4 segments and 6 cases in 5 segments. At the final follow-up, the VAS, NDI and JOA scores were significantly improved compared with those before operation (P < 0.05). One patient developed left C5 paralysis after operation and underwent revision anterior surgery and the patient achieved good recovery at the final follow-up. There was no significant difference in the longitudinal diameter of the intervertebral foramen of the root responsible segment, the curvature of the responsible segment and the curvature of the cervical spine before and after operation (P>0.05), but the upper anterioroposterior diameter and the lower anterioroposterior diameter of the responsible intervertebral foramen were better improved after operation (P < 0.05).

Conclusion: Posterior decompression and foraminotomy treating OPLL with radiculopathy achieved good clinical and radiographic short-term results.

4

Literature review of anterior bone loss after cervical disc replacement

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In the treatment of cervical disc degeneration disease, cervical disc replacement (Cervical disc replacement, CDR) is a method that can preserve the vitality of the cervical spine. Compared to traditional anterior cervical discectomy and fusion surgery, the technology of mobility(Anterior cervical disease and fusion, ACDF), which can Reduce the pressure on adjacent cervical intervertebral discs to better simulate the physiology of the cervical spine Status. However, with the wide spread use of CDR technology, its related complications There are also increasing reports, mainly including cervical segmental kyphosis and ectopic bone Chemization, osteolysis, prosthesis displacement and subsidence, etc. In recent years, many scholars have paid attention to the anterior bone loss (ABL) of the vertebral body isAs a complication after CDR, the incidence rate is about 44%-64%. Visible ABL is a common complication after CDR surgery. Therefore, we discussed the causes of ABL, providing more ideas for its clinical treatment and research.

5

Cervical Vertebral Bone Quality Score Independently Predicts Zero-profile Cage Subsidence After Single-level Anterior Cervical Discectomy and Fusion

Background: The bone mineral density (BMD) of the patient's spine is closely related to the occurrence of cage subsidence. Cervical VBQ (C-VBQ) has been shown that it can be a valuable tool for predicting cage subsidence following conventional ACDF procedures using the cage with plate. However, there is a notable gap in the literature regarding the relationship between VBQ scores and ZPC subsidence rates in single-level ACDF surgeries.
Objective: This is the first study to evaluate the predictive value of the cervical vertebral bone quality (VBQ) score on zero-profile cage (ZPC) subsidence after anterior cervical discectomy and fusion (ACDF) using the HU value of computed tomography (CT) as the reference.
Methods: A total of 89 patients with at least 1 year of follow-up who underwent single-level ACDF with ZPC were retrospectively and consecutively included. VBQ and HU value were determined from preoperative T1-weighted MRI and CT. Subsidence was defined as ≥2 mm of migration of the cage into the superior or inferior endplate or both using lateral cervical spine radiography. The results were subjected to statistical analysis.
Results: Subsidence was observed among 16 of the 89 study patients (Subsidence rate:18.0%). The mean VBQ score was 2.94±0.820 for patients with subsidence and 2.33±0.814 for patients without subsidence. The multivariable analysis demonstrated that only an increased VBQ score (OR:1.823, 95%CI: 0.918,3.620, p=0.001) was associated with an increased rate of cage subsidence. There was a significant and moderate correlation between HU and VBQ (r = -0.507, P < 0.001). Using receiver operating characteristic curves, the area under the curve (AUC) was 0.785, and the most appropriate threshold of VBQ was 2.68 (sensitivity 72.7%, specificity 82.1%).
Conclusions: The VBQ score may be a valuable tool for independently predicting zero-profile cage subsidence after single-level ACDF.

6

Different MRI-based vertebral bone quality scores for bone mineral density assessment in patients undergoing Cervical Spine Surgery: a comparison study

Background: MRI-based vertebral bone quality (VBQ) was found to accurately predict osteopenia/osteoporosis and postoperative complications in lumbar spine. However, discussion of the efficiency of VBQ in cervical spine is lacking. And measurement methods of VBQ in cervical spine are diverse and not universally acknowledged like lumbar spine.
Objectives: We aimed to compare the predictive performance of three kinds of different Cervical-VBQ (C-VBQ) scores for bone mineral density assessment in patients undergoing cervical spine surgery. HU value of cervical spine was set as a reference.
Methods: Adult patients receiving cervical spine surgery for degenerative diseases were retrospectively included between Jan 2015 and Dec 2022 in our hospital. The VBQ scores and HU value were measured from preoperative MRI and CT. The correlation between HU value/C-VBQs (named C-VBQ1/2/3 according to different calculating methods) and DEXA T-score was analyzed using Pearson's correlation. We evaluated the predictive performance of those two parameters and achieved the most appropriate cutoff value by comparing the receiver operating characteristic (ROC) curves.
Results: 106 patients (34 patients with T ≥ -1.0 vs 72 patients with T < -1.0) were included. According to Pearson correlation analysis, C-VBQ1/2/3 and HU value were all significantly correlated to DEXA T-score (Correlation Coefficient (r):C-VBQ1: -0.393, C-VBQ2: -0.368, C-VBQ3: -0.395, HU value: 0.417, p<0.001). The area under the ROC curve (AUC) was calculated (C-VBQ1:0.717, C-VBQ2:0.717, C-VBQ3:0.727, HU value:0.746). The AUC of the combination
of C-VBQ3 and HU value was 0.786. At last, the most appropriate cutoff value was determined (C-VBQ1: 3.175, C-VBQ2: 3.005, C-VBQ3: 2.99, HU value: 299.85 HU).
Conclusions: Different MRI-based C-VBQ scores can all achieve accurate prediction for opportunistically screening patients with osteopenia and osteoporosis before cervical spine surgery. Among them, C-VBQ calculated in ASIC2-C7/SIT1-CSF performed better. We advised patients with C-VBQ higher than cutoff value to accept further BMD examination.

7

Safety and Efficacy of Anterior Cervical Discectomy and Fusion with Uncinate Process Resection: A Systematic Review and Meta-Analysis

Study design: This is a meta-analysis and systematic review of the available literature.
Objective: In the case of severe foraminal stenosis, conducting uncinate process resection (UPR) during ACDF could achieve complete nerve root decompression and significant relief of neurological symptoms for CR. However, there is some controversy regarding its necessity and safety. This study aims to compare the safety and efficacy of ACDF with UPR and ACDF.
Methods: The following electronic databases were searched: Medline, PubMed, Embase, the Cochrane Central Register of Controlled Trials, Evidence Based Medicine Reviews, VIP, and CNKI. And the following data items were considered: baseline demographics, efficacy evaluation indicators, radiographic outcome, and surgical details.

Results: 10 studies were finally identified, including 746 patients who underwent ACDF with UPR compared to 729 patients who underwent ACDF. The group of ACDF with UPR had statistically longer intraoperative time (95% CI: 4.83, 19.77, P = .001) and more intraoperative blood loss (95% CI: 12.23, 17.76, P < .001). ACDF with UPR obtained a significantly better improvement of Arm VAS at postoperative first follow-up (95% CI: 1.85, .14 P = .02). There was no significant difference found in improvement of Neck VAS at postoperative latest follow-up (95% CI: .88, .27, P = .30), improvement of Arm VAS at postoperative latest follow-up (95% CI: .59, .01, P = .05), improvement of NDI (95% CI: 2.34, .33, P = .14), JOA (95% CI: .24, .43, P = .56), change of C2-C7 lordosis (95% CI: .87, 1.33, P = .68), C2-C7 SVA (95% CI: .73, 5.08, P = .14), T1 slope (95% CI: 2.25, 1.51, P = .70), and fusion rate (95% CI: .83, 1.90 P = .29).
Conclusion: ACDF with UPR is an effective and necessary surgical method for CR patients with severe foraminal stenosis.

8

Research Progress of Atlantoaxial Osteoarthritis: A Narrative Literature Review

Background: Atlantoaxial osteoarthritis (AAOA) is a clinical syndrome that is mainly characterized by occipitocervical and retroauricular pain and cervical rotation disorder, which is different from axial pain, root pain, and spinal cord symptoms caused by lower cervical spine diseases. Owing to the greater range of motion of the joint and the lack of intervertebral disc and strong muscle restraint and protection, degenerative changes are prone to occur. The inadequate comprehension of AAOA can result in misdiagnosis and an erroneous treatment selection in clinical practice.
Objective: To consolidate the current literature related to atlantoaxial osteoarthritis (AAOA) and improve systematic understanding of this clinical syndrome among spine surgeons.
Methods: A comprehensive literature search was performed using PubMed, Ovid MEDLINE, and EMBASE databases and the following search terms: ("C1-C2" OR"C1-2" OR "atlantoaxial" OR "atlanto-axial" OR "C2" OR"C1" OR "atlas" OR "axis") AND ("osteoarthritis"). All articles of any study design addressing AAOA were considered for inclusion. Two authors independently read article titles and abstracts, and the full text of included relevant articles.
Results: There were 54 articles reviewed and consolidated in this narrative review. These articles are roughly divided into the following 5 subcategories: epidemiology and etiology, clinical presentation, radiographic findings, conservative treatment, and surgical indications and treatment options.
Conclusion: AAOA is a clinically common but often overlooked syndrome characterized by persistent occipitocervical pain. The most common cause of AAOA is joint degeneration, which is closely related to age and occupation. AAOA is initially managed with conservative treatment. Atlantoaxial fusion is an option for patients with severe pain who are unresponsive to conservative treatment.

9

Posterior percutaneous endoscopic cervical circumferential decompression assisted by ultrasonic osteotome in the treatment of cervical spondylotic radiculopathy accompanying with osseous foraminal stenosis

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Objective: To observe the clinical efficacy and safety of posterior percutaneous endoscopic cervical circumferential decompression assisted by ultrasonic osteotome in patients of cervical spondylotic radiculopathy (CSR) accompanying with osseous foraminal stenosis.
Materials and Methods: Patients with CSR accompanying with osseous foraminal stenosis underwent posterior percutaneous endoscopic cervical circumferential decompression assisted by ultrasonic osteotome. The neck disability index (NDI), the visual analogue scale (VAS), and the modified MacNab criteria were recorded at each follow-up interval. All patients underwent three-dimensional computed tomography (CT) of the cervical spine within 1 week after surgery to evaluate the decompression effect of osseous foraminal stenosis.
Results: There were 19 consecutive patients in the study. All operations were successfully completed with an average operating time of 75+11minutes. The mean follow-up period was 8.5 months (range: 6-12 months). The NDI and VAS scores for arm/neck pain improved significantly from preoperatively to the last follow-up. The satisfaction rate by modified MacNab criteria was 91.7% on the third postoperative day and 100% on the day of final follow-up. One patient experienced transit fingers numbness. There were no neurological complications such as increased arm pain and decreased limb muscle strength.
Conclusion: Posterior percutaneous endoscopic cervical circumferential decompression assisted by ultrasonic osteotome is an effective treatment for CSR accompanying with osseous foraminal stenosis. The usage of endoscopic-matched ultrasonic osteotome provides a safer and more efficient decompression method for foraminal bony decompression, which plays a positive role in reducing surgical time, improving surgical safety, reducing learning curve and complications.
Keyword ; Ultrasonic Osteotome, Cervical Spondylotic Radiculopathy, Minimally Invasive Technique, Osseous Foraminal Stenosis, Posterior Cervical Foraminotomy

10

Results of 1 Up-1 Down Short Segment Fixation for Thoracic Chance Fracture Non-Union in A Patient with Ankylosed Spine

Short segment fixation has been performed for patients with thoracolumbar spine injuries to restore spinal stability and alignment with satisfactory results. By preserving motion segment, post-operative outcomes are optimised. However, the use of short segment fixation has been advised against in patients with ankylosed spine. In this case report, we share our experience with using short segment fixation in a patient with T12 chance fracture with a background of diffuse idiopathic skeletal hyperostosis (DISH). We describe our techniques and surgical considerations in the management of this patient. Our patient first presented with a severe back pain after a fall and hit his back on the floor. Radiological imaging showed T12 chance fracture with DISH with non-union 9 months later. He underwent posterior dynamic stabilization with monobloc pedicle screws and crosslink with 1 up-1 down. Patient was followed-up and postoperative outcome was optimal. Short segment fixation may be useful to achieve good surgical outcome with appropriate patient selection even in ankylosed spine.

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Deep Learning-Enhanced Hand Grip and Release Test (DL-HGRT) for Degenerative Cervical Myelopathy: Shortening Assessment Duration to 6 Seconds

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Background: The 10-second grip and release (10-s G&R) test, being effective and widely utilized in clinical settings. However, readily accessible, user-friendly, and efficient methods for evaluating hand function based on the 10-s G&R test remain lacking.
Objective: This study explores the use of deep learning-enhanced hand grip and release test (DL HGRT) as a diagnostic and predictive tool for DCM. Methods: The study included 508 DCM patients and 1194 control subjects. The 3D-MobileNetV2 was utilized to analyze and generate a series of parameters. Univariate analyses were conducted to compare differences between the two groups. Additionally, receiver operating characteristic (ROC) curves were employed to assess the performance of the 10-s G&R test in predicting DCM and to evaluate the effectiveness of a shortened testing duration.
Results: Patients with DCM exhibited impairments in most 10-s G&R test parameters. Before Propensity score matching (PSM), the number of cycles provided the best diagnostic performance, with an AUC of 0.85, a sensitivity of 80.12%, and a specificity of 74.29% at the optimal threshold of 20 cycles, followed by average grip time. Following PSM for age and gender, the AUC experienced a slight decrease but remained effective, maintaining a value above 0.80. When considering a shortened testing duration, the average grip time achieved the highest AUC of 0.83 after 6 seconds, plateauing with no significant improvement in extending the duration to 10 seconds, indicating that 6 seconds is an adequate timeframe to efficiently evaluate hand motor dysfunction in DCM based on DL-HGRT.
Conclusion: DL-HGRT demonstrates potential as a promising tool for predicting DCM. Among the G&R test parameters, both cycle count and average grip time prove to be effective. Notably, a testing duration of 6 seconds appears to be sufficient for accurate assessment, enhancing the test more feasible, practical, and user-friendly without compromising diagnostic performance.
Keywords: Degenerative cervical myelopathy, 10-second grip and release test, deep learning, diagnostic performance, shortened assessment duration.

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A comparison of different internal fixation methods for two-level anterior cervical discectomy fusion： a retrospective study with 2-year follow up

Background: To evaluate the clinical and radiological outcomes of two-level anterior cervical discectomy and fusion (ACDF) using titanium plate combined with PEEK interbody cage and ROI-C for treating cervical spondylosis.
Methods: A total of 80 patients were evaluated retrospectively through two groups. At the different time points before and after surgery, the Neck Disability Index (NDI), Japanese orthopedic association (JOA), Visual Analogue Scale (VAS) and Odom's grading system were evaluated to analyze the clinical outcomes. Operation time, blood loss and radiological parameters like global lordotic angle (C2–7 Cobb angle), fused segment angle (FSA), interbody fusion state and cage subsidence were assessed. Reliability was tested using the intraclass correlation coefficient (ICC), standard error of measurement (SEM) and Bland-Altman plot for the measurement of radiological parameters. P<0.05 was taken as statistically significant.
Results: Pre- and intra-operative parameters and Odom's criteria between the two groups were not a significant difference without operation time and blood loss(P>0.05). The Intra- and Inter-observer reliability showed excellent results. The C2-7 Cobb angle and FSA showed a significant improvement in both groups(P<0.05). The interbody fusion status was no significant differences (P>0.05), but the titanium plate presented significant advantage in cage subsidence, the C2-7 Cobb angle and FSA（P<0.05）. Compared with preoperative, the postoperative VAS, JOA and NDI scores in each time point of the two groups had significant differences（P<0.05）.
Conclusions: The two internal fixation devices can achieve similar clinical results for treating 2-level cervical spondylopathy. ROI-C has undoubted advantages in single-segment ACDF. However, for double-level cervical spine surgery, titanium plate combined with cage is the preferred choice because it maintains the cervical spine curvature and avoids cage subsidence. Surgeons should be aware of the related complications to achieve optimal outcomes in choosing two internal fixation devices.

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The severity of preoperative cervical disc degeneration is an important risk factor for cervical fusion failure after anterior cervical discectomy and fusion

Backgroup: The relation between preoperative cervical disc degeneration and cervical fusion after ACDF remains unclear.
Objective: To explore the relation between preoperative cervical disc degeneration and cervical fusion after ACDF.
Methods: We reviewed patients who received ACDF from 2019 to 2021. The Pfirrmann grade was applied to six cervical discs (C2-T1) based on preoperative magnetic resonance imaging. The total degeneration score of six cervical discs was calculated as D Score. A mean degeneration score of operative cervical discs was calculated by dividing the total degeneration score of operative cervical discs by the number of operative segments. Postoperative CT scans were conducted to determine the result of cervical fusion. Univariate and multivariate logistic regressions were used to explore the risk factors for cervical fusion failure. The ROC curves were drawn according to multivariate results.
Results: There were 159 patients in the non-fusion group and 135 patients in the fusion group. Univariate logistic regression showed that age, smoking, hypertension, coronary heart disease, D Score, and Mean Surgery D Score were associated with fusion failure. Hemoglobin, total protein, and albumin were associated with higher fusion rates. D Score (OR 1.887, 95%CI: 1.448-2.458, p = 0.001) and Mean Surgery D Score (OR 8.827, 95%CI: 1.989-39.163, p = 0.004) were independent risk factors of fusion failure. The areas under the ROC curve of D Score and Mean Surgery D Score were 0.904 and 0.875 respectively.
Conclusion: Patients with a higher preoperative D Score (> 23.5) and Mean Surgery D Score (> 4.125) have a higher risk of fusion failure after ACDF.

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Anterior cervical discectomy and fusion with a zero-profile VA spacer device: a clinical and radiological study with two years follow-up

Backgroup: There are two types of the anterior cervical discectomy and fusion (ACDF) procedures for treating cervical spondylosis. One is uninstrumented "stand-alone" bone graft/cage and another is bone graft/cage supplement with plate in front of vertebral bodies. Both procedures have their own advantages and disadvantages. Zero-profile variable-angle (Zero-P VA) spacer combines the advantages of these two typical procedures and potentially avoids the prevertebral soft-tissue disturbance and dysphagia.
Objective: To compare clinical and radiological outcome of ACDF with a Zero-P VA and traditional poly-ether-ether-ketone (PEEK) cage and plate system in cervical radiculopathy/myelopathy cases.

Methods: Authors conducted all patients who underwent one-level ACDF between January 2018 and January 2019 with minimum two years follow-up. Patients either received a Zero-P VA implant or PEEK cage with plating. The Japanese Orthopedic Association (JOA) score and visual analogue scale (VAS) for arm and neck pain were documented. Dysphagia was evaluated using the eating assessment tool-10 (ETA-10). Cervical alignment, fusion rate and postoperative complications were assessed.
Results: Improvements on the JOA and VAS were statistically equivalent between two groups. The ETA-10 score was significantly lower in Zero-P VA group as compared to the cage and plating group ($p<0.05$). At the final follow-up, there were no statistical significant differences in the height of operated segment, cobb angle of fused segment, C2–C7 Cobb angle and fusion rate between two groups ($p>0.05$). However, postoperative complications were slight lower in patient with Zero-P VA group (7.69%) as compared to the cage and plating group (16.67%).
Conclusion: Results with the Zero-P VA spacer used for one-level ACDF were satisfactory. The device is equivalent or superior to the standard cage and plating for preventing postoperative dysphagia and avoiding possible complications associated with an anterior plate

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Posterolateral endoscopic cervical discectomy in the treatment of cervical spondylotic radiculopathy

Background: Currently, the Key-hole approach is used for conventional PECD.This approach is mainly an indirect decompression with a limited decompression range, and it also causes damage to the facet joint.
Objective: This report describes a posterolateral endoscopic cervical discectomy (PLECD) for cervical spondylotic radiculopathy (CSR) and an evaluation of the feasibility, safety, and shortterm clinical effect of this approach.
Materials and Methods: A single-center retrospective observational study was performed with 30 patients managed with PLECD for single-level CSR. Primary outcomes included visual analog scale (VAS) for neck and arm pain, the score of Japanese Orthopedic Association (JOA) and modified MacNab criteria. Radiographical follow-up included the static and dynamic cervical plain radiographs, computed tomographic scans.
Results: A positive clinical response for symptom relief was achieved in all patients. The postoperative CT showed total removal of the lesions.
Conclusions: As an alternative to the described “key hole” approaches of PECD, PLECD through lateral mass is a novel access for CSR and may be considered a valid and safe therapeutic option.
Key words: cervical spondylotic radiculopathy, full-endoscopic cervical discectomy, spine surgery

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Comparison of the differences on cervical sagittal parameters between cervical C3-C6 and C3-C7 "single-door" expansive laminoplasty

Background: cervical laminoplasty is one of the popular procedures for cervical spinal stenosis, including C3-C6 and C3-C7 laminoplasty. However, the changes of the cervical sagittal parameters after different laminoplasty were not clear.
Objectives: The purpose of this study is to compare the differences of cervical sagittal parameters between cervical C3-C6 and C3-C7 “single door” expansive laminoplasty in the treatment of cervical spinal stenosis.
Methods: The clinical data of patients who underwent posterior cervical C3-C6 or C3-C7 expansive open-door (single door) laminoplasty for cervical spinal stenosis in our hospital between January 2016 and June 2021 were retrospectively analyzed. The operation duration, intraoperative blood loss, postoperative drainage, postoperative extubation time, Japanese Orthopaedic Association (JOA) score， improvement rate of neurological function and visual analogue score(VAS) of cervical pain were recorded in these two groups. Cervical sagittal parameters including C2-C7 Cobb angle, C0-C2 Cobb angle, T1 slope and C2-C7 sagittal vertical axis (C2-C7 SVA) were measured on cervical lateral X-ray films before surgery, immediately after surgery and the last follow-up. And the Pavlov ratio of each vertebral body level from C3 to C6 was measured before and immediately after the surgery. The differences of clinical efficacy and cervical sagittal parameters between these two groups were compared.
Results: A total of 65 patients (46 males and 19 females) with cervical spinal stenosis were included, aged 25~80 years (mean 54.8 years). The patients were followed up for 12-28 months (mean 18.8 months).The operation duration, postoperative drainage and extubation time in C3-C6 group were less than those in C3-C7 group ($P < 0.05$). The incidence of postoperative cervical kyphosis in C3-C6 group was 5.4% （2/37） , which was lower than that in C3-C7 group (7.1%, 2/28) ($P > 0.05$). In terms of cervical sagittal parameters, the T1 slope in C3-C6 group was lower than that of C3-C7 group immediately after surgery and at the last follow-up ($P < 0.05$).
Conclusion: The postoperative T1 slope of C3-C6 expansive laminoplasty was smaller than that of C3-C7 expansive laminoplasty, which may be one of the reasons for the low incidence of postoperative cervical kyphosis in patients with C3-C6 laminoplasty.
Key word: cervical expansive open-door laminoplasty; sagittal parameters; cervcal spinal stenosis; postoperative kyphosis

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Radiological Measurement, Clinical Manifestation, and Treatment of Non-traumatic Occipitoatlantal Instability

Background: With only three cases reported, non-traumatic occipitoatlantal instability (OAI) without any congenital syndrome or other disease is extremely rare. While there have been radiological standards for traumatic OAI measuring static dislocation, they cannot evaluate the horizontal hypermobility of the occipitoatlantal joint, which all three previous cases featured.
Objective: We aim to measure the horizontal translation range of motion of the occipitoatlantal joint (occipitoatlantal translation, OAT), and to set a radiological standard for non-traumatic OAI. We also aim to present the first case of non-traumatic OAI with no other apparent disease having anteroposterior occipital translation and atlantoaxial instability, and review previous cases, to summarize their clinical features.
Methods: We included 109 children aged 6-9 and 100 adults aged over 24 who took lateral flexion-extension cervical X-ray, and measured their OAT using a method we newly adapted for non-traumatic OAI. Records of a patient with non-traumatic OAI treated in our hospital were reviewed. We also reviewed previous case reports on non-traumatic OAI with no other apparent disease.
Results: The average values of OAT are not significantly different between the children and adults. However, the 95th percentile of OAT in the children (4.48 mm) is larger than that in the adults (3.52 mm). While 4.59% (5/109) of the children had OAT over 4.5mm, 5.00% (5/100) of the adults had OAT over 3.5mm. The four patients reviewed mainly had upper spinal cord myelopathy, cranial neuropathy, neck pain, and restriction of cervical movement. All four patients were successfully managed using posterior instrumentation and fusion.

Conclusion: Children with OAT over 4.5mm and adults with OAT over 3.5mm should be paid attention to and suspected of non-traumatic OAI. Non-traumatic OAI mainly involve symptoms of upper spinal cord myelopathy, cranial neuropathy, neck pain, and restriction of cervical movement, and can be treated with instrumentation and fusion surgery.

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Myth or Fact: 3D-Printed commercial prosthesis is superior than Titanium mesh cage in anterior cervical corpectomy and fusion?

Background: The anterior cervical corpectomy and fusion (ACCF) has been one of the recognized surgical approaches for treating degenerative cervical spondylotic myelopathy (DCSM) since the 1950s. However, the optimal implant to fill the gap after decompression has been debated, for implants used nowadays are still associated with complications of subsidence or non-union. With the rapid development of the Three-dimensional printing (3DP) technique, the 3DP trabecular structured prosthesis claimed to promote bone in-growth and reduce stress shielding effect with proper trabecular space, thus providing more reliable initial stability. Anterior cervical spinal surgery has been an innovative adopter of 3DP technology for both patient-specific (PS) and commercial implants. Nevertheless, there is a paucity of clinical studies to verify the efficacy of 3DP commercial prosthesis in ACCF.

Objective: This study aims to find out whether 3DP commercial prosthesis is superior than Titanium mesh cage (TMC) in ACCF when treating single-segment DCSM.

Method: The medical records of the DCSM patients who had undergone ACCF from January 2016 to January 2019 in a single center were abstracted. Patients were divided into the 3DP group (28 patients) and TMC group (23 patients) according to the implant type. The hospital stays, operation time, and intraoperative blood loss were compared between the two groups. The modified Japanese Orthopedic Association (mJOA) scores and neck disability index (NDI) were recorded pre-operatively, 2 weeks post-operatively, 3 months post-operatively, 6 months post-operatively, 12 months post-operatively, and 24 months post-operatively for both groups. Radiological data was measured at each follow-up time point to evaluate fusion, subsidence rate, cervical lordosis(CL), fused segment angel (FSA), and mean vertebral height (MVH).

Results: The differences between the two groups in operative time, intraoperative blood loss, and the hospital stay were not statistically significant ($p>0.05$). There were five cases of postoperative dysphagia (2 cases in the 3DP group, and 3 cases in the TMC group), symptoms relieved one week later. No screw loosening, plate breakage was found in either group, and all cases achieved bony fusion at the 24-month follow-up. The difference in improvement rate of JOA and NDI between the two groups was not statistically significant ($p>0.05$). The number of cases with subsidence in the 3DP group in post-operative 3 months, 6 months, 12 months, and 24 months follow- up was 7 (25.0%), 9 (32.1%), 10 (35.7%), and 10 (35.7%), respectively; while the one in TMC group was 6 (28.6%), 7 (33.3%), 8(38.1%), and 8 (38.1%), respectively. The difference in subsidence rates between the two groups at each follow-up time point were not statistically significant($p>0.05$). The postoperative CL improved in both groups when compared with their pre-operative ones ($p<0.05$), but the difference of improvement in CL, FSA, MVH at 24 month follow-up between the two groups was not statistically significant ($p>0.05$).

Conclusion: In treating single-segment DCSM with ACCF, both 3DP commercial prosthesis and TMC achieved similar satisfactory clinical outcomes. However, the 3DP commercial prosthesis was not able to reduce subsidence as it claimed.

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Low regional HU of screw trajectory is one of the risk factors of hardware failure after laminectomy and posterior cervical fusions

Background: For patients with multilevel degenerative cervical myelopathy, laminectomy and posterior cervical fusions (PCFs) with instrumentation are widely accepted technique for symptom relief. However, hardware failure is not rare which results in neck pain or even permanent neurological lesion. The prevalence of hardware-related complications of laminectomy and posterior cervical fusions (PCFs) with instrumentation are lack of in-depth study.

Objective: This study aims to investigate risk factors of hardware failure after laminectomy and posterior cervical fusions (PCFs) with instrumentation in patients with degenerative cervical myelopathy.

Method: Fifty-six patients who underwent laminectomy and posterior cervical fusions (PCFs) with instrumentation between January 2019 and January 2021 were included in a single institution. Patients were divided into the hardware failure group (n = 14) and no hardware failure group (n = 42). The sex, age, screw density, end vertebra (C7 or T1), cervical sagittal alignment parameters (C2-C7 lordosis, C2-C7 sagittal vertical axis, T1 slope, CL correction), and regional Hounsfield units (HU) of screw trajectory, comorbidity of osteoporosis were collected and compared between the two groups.

Results: There were no significant statistical differences in general information (age, gender, follow-up time) of patients between the two groups. The differences of fixation levels and screw density between the two groups were not statistically significant ($p > 0.05$). The failure rate of the fixation endpoint at T1 was lower than that at C7 (9% vs. 36.3%) ($p < 0.05$). The regional HU of pedicle screw(PS) and lateral mass screw(LMS) in failure group were lower than the ones of no failure group (PS: 267±45 vs. 368±43; LMS: 308±53 vs. 412±41) ($p<0.05$). The sagittal alignment parameters did not show significant differences between the two groups before surgery and at final follow-up ($p > 0.05$). The hardware failure rate in cases without osteoporosis was lower than that in cases with osteoporosis (14.3% vs. 57.1%) ($p < 0.05$).

Conclusion: Hardware failure was not uncommon after laminectomy and PCFs with instrumentation in patients with degenerative cervical myelopathy. Osteoporosis, fixation ended at C7, as well as low regional HU of screw trajectory were the independent risk factors.

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The clinical and radiological results of multi-level ACDF using zero-profile anchored cages in treating degenerative cervical spinal disorders: a minimal 5 year follow-up study

Background: Anterior cervical discectomy and fusion(ACDF) is increasingly used in multilevel degenerative cervical spinal disorders. However, the profile of the anterior cervical plate often lead to prolonged operation time and increased incidence of complications such as postoperative dysphagia, especially in multilevel diseases. Therefore, zero-profile implant was developed to overcome these setbacks and has been confirmed to be superior to the traditional cage-plate in their preliminary practice. However, there is a paucity of mid- to long-term results of these zero-profile cages in multilevel cases.

Objective: In this study, we retrospectively reviewed a series of cervical spondylotic disorders treated with 3- or 4-level ACDF using zero-profile anchored cages that were followed for at least 5 years to investigate the correlation between their clinical results and radiological outcomes.

Method: Thirty-four patients aged 54.1±8.8 years (range, 41–64 years) who underwent 3- or 4-level ACDF with zero-profile anchored cages for degenerative cervical spondylosis in a single institute between January 2014 and 2016 were included. Clinical outcomes were assessed using the visual analogue scale (VAS), modified

Japanese Orthopaedics Association (JOA) scores, and Neck Disability Index (NDI) preoperatively and post-operatively at the 1-, 2-, and 5-year. Radiological outcomes including fusion, disc height, subsidence, fused segment angle and cervical lordosis were also assessed at the same intervals.

Results: The mean follow-up time was 68 months. All patients had significant recovery of neurological function. Compared with the preoperative scores, the postoperative VAS, JOA and NDI scores were improved at each time point ($p<0.05$). The fused segment angle and cervical lordosis were improved at each follow up time point after the operation($p<0.05$). All surgical segments were fused and there were 32 cage subsidence (31.3%) was observed at the 5-year follow-up. The differences in VAS, JOA scores, NDI, fused segment angle and cervical lordosis between the 5-year and the 2-year follow-up were not statistically significant($p>0.05$). The loss of lordosis was not related to the postoperative symptoms.

Conclusion: ACDF using a zero-profile anchored cages for multilevel cervical spondylopathy achieved satisfactory midterm outcomes. Cage subsidence and the loss of cervical lordosis occurred in the first two years after surgery, but remained stable afterwards and were not related to post-operative symptoms.

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Causal Relationships between the Immune Cells and Cervical Disc Disorders: an Univariable and Multivariable Mendelian Randomization

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Introduction: Cervical disc disorders is an important contributor of cervicalgia which represents one of the most disabling symptoms within the adult population. Researches in recent years have suggested a possible connection between immune cells and cervical disc disorders. However, the potential causal relationship between them remains unclear.

Methods: We conducted a comprehensive Mendelian randomization (MR) analysis to assess the potential causal association between immune cells and cervical disc disorders. Sensitivity analysis was performed to test for heterogeneity and horizontal pleiotropy, including Cochran Q test, leave-one-out test, and MR-Egger intercept analysis. Multivariable MR was also conducted to adjust for the effect of immune cells on cervical disc disorders.

Results: We found 4 immune cells had potential causal relationship with cervical disc disorders by using univariable MR, including 1 risk factor and 3 protective factors. CD45RA- CD28- CD8+ T cell %CD8+ T cell increases the risk of cervical disc disorders (OR:1.002, 95%CI:1.000-1.004, P=0.045). CD28+ CD45RA+ CD8+ T cell %T cell reduces the risk of cervical disc disorders (OR:0.995, 95%CI:0.991-0.999, P=0.021). CD38 on IgD+ CD38+ B cell reduces the risk of cervical disc disorders (OR:0.895, 95%CI:0.808-0.992, P=0.035). CD62L on CD62L+ plasmacytoid Dendritic Cell reduces the risk of cervical disc disorders (OR:0.904, 95%CI:0.822-0.995, P=0.039). Heterogeneity and pleiotropy were not found, which means that our results are steady. The leave one test also indicates our result is robust. After adjusted by the multivariable MR, the relationship between immune cells and cervical disc herniation was still existence. CD38 on IgD+ CD38+ B cell reduces the risk of cervical disc disorders(OR:0.886, 95%CI:0.819-0.992, P=0.0027). CD62L on CD62L+ plasmacytoid Dendritic Cell also reduces the risk of cervical disc disorders (OR:0.885, 95%CI:0.824-0.950, P=0.0007).

Conclusions: MR discovered a possible link between cervical disc disorders and immune cells. Our findings shed light on the prevention and management of cervical disc disorders. But the exact mechanisms must be investigated further.

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Hounsfield units of the vertebral body predicts hardware-related complications in anterior cervical corpectomy and fusion (ACCF) : a propensity score-matched analysis

Background: There is insufficient quantifiable measure of bone mineral density(BMD） of the cervical spine, nor its effect on internal fixation.

Objective: To find out the correlation between Hounsfield units (HU) of the cervical vertebral body and the incidence of hardware-related complications in ACCF, so as to find out a threshold of HU that help in the selection of prosthesis in osteoporotic patients.

Method: A retrospective study was performed on patients who had ACCF from January 2014 to January 2019 in a single institute. Patients were divided into the 3DP (106) and TMC group (112). Demographic data including age, sex, body mass index, smoking habit, number of levels and disease duration were used to calculate a propensity score for comparison. HU of the cross-sectional cervical vertebral body on CT, and BMD of L1-L4 were obtained by dual-energy X-ray absorptiometry before surgery. Radiological data of fusion segment height, non-union, subsidence and displacement were measured on lateral radiograph on 1 day and 3 months post-operatively. Logistic regression model was used to test the correlations between the C2-C7 mean HU, the lumbar spinal T-value and hardware-related complications.

Results: The subsidence rate in 3DP and TMC group was 27.5% and 26.8%, respectively. Propensity score matching generated 35 pairs of patients. There was a significant positive correlation between C2-C7 mean HU and lumbar T-value. After adjusting sex and operation segment, the correlation between the subsidence, screw loosening or breakage and plate migration and C2-C7 mean HU was statistically significant; but the correlation between the hardware-related complications and the lumbar spinal T-value was not statistically significant. The thresholds of HUs to predict subsidence was 102.4 in 3DP group and 101.3 in TMC group.

Conclusion: Patients with higher preoperative HU of cervical vertebral had lower risk of hardware-related complications after ACCF using either 3DP or TMC prosthesis.

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Open-door cervical laminoplasty with skip-fixation can be cost-effective surgery comparing to that of standard fixation: a multicenter randomized controlled trial

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Background: In patients undergoing open-door laminoplasty, it is well-accepted that a multilevel laminar should be expanded to attain adequate decompression. However, whether all expanded lamina should be fixed or not have not been validated enough. We postulated that the surgical outcomes of open-door laminoplasty with every other expanded laminar fixation (skip-fixation) may not be inferior to those of surgery with an all-expanded laminar fixation (all-fixation).

Objective/Aim: This study aimed to compare the 1-year surgical outcomes between open-door laminoplasty with skip-fixation and that with all-fixation in patients with cervical spondylotic myelopathy (CSM).

Materials/Methods: This prospective, multicenter, non-blinded randomized controlled trial was performed in Japan. Patients at least 60 years old and who underwent C3-C6 open-door cervical laminoplasty for CSM were included. Totally, 213 were randomized to undergo laminoplasty with skip-fixation (n=112) or all-fixation (n=101). The primary outcome was the difference in the one-year JOA score between the groups. The non-inferiority margin was set as 2.0 (the MCID in the JOA score). Secondary outcomes included surgical data, surgical complications, one-year changes in the EQ5D score, and VAS score for neck pain, arm pain, arm numbness, and radiographic outcomes.
Results: Among the 213 patients, 178 completed the trial after one year (skip-fixation, n=92; all-fixation, n=86). The difference in the JOA score after one year was -0.101 ($p<0.0001$, non-inferior test). In the sub-analysis, laminoplasty with skip-fixation demonstrated a significantly shorter surgical time ($p=0.019$), better improvement in neck pain VAS ($p=0.007$), and EQ5D score ($p=0.048$) than laminoplasty with all-fixation.
Conclusion: Skip-fixation was not inferior to all-fixation in myelopathy improvement, and the procedure can improve QOL more than that with all-fixation. Additionally, laminoplasty with skip-fixation can reduce medical costs as it requires half number of implants. As the cost-effectiveness was evaluated by "medical cost / gained QOL", laminoplasty with skip-fixation can be considered a cost-effective procedure.

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The impact of sarcopenia in patients who underwent anterior cervical surgery.
Background: Previous study suggested that sarcopenia could be a risk factor of worse surgical outcome and sagittal malalignment in patients who underwent cervical laminoplasty. However, little has investigated the impact of sarcopenia in patients who underwent anterior cervical surgery.
Objective: To compare surgical result in anterior cervical surgery patients with or without sarcompenia.
Methods: We retrospectively reviewed 52 patients with cervical degenerative disease who underwent anterior cervical surgery. Appendicular skeletal muscle mass was obtained using dual-energy x-ray absorptiometry. Sarcopenia was defined using Sanada et al's reference value for the Japanese appendicular skeletal muscle index. We divided all patients into two groups: patients with sarcopenia (the S (+) group) and patients without sarcopenia (the S (-) group). Radiographic parameters were evaluated before and 3 months after surgery. The Japanese Orthopedic Association Score System for Cervical Myelopathy (JOA score) and Visual Analog Scale (VAS) were also evaluated.
Results: Of the 52 patients, fifteen (28.8%) had sarcopenia. The age at surgery was not significantly different in the two groups. The presence of cancer history was significantly higher in the S (+) group. Regarding radiographic parameters, pre and postoperative C2/7 angle in neutral and flexion position, pre and postoperative C7 slope were significantly higher in the S (+) group than in the S (-) group. Other parameters, such as C2-7 SVA. The recovery rate of JOA score and The change of VAS was not significantly different between the two groups.
Conclusions: Pre and postoperative C7 slope was higher in patients with sarcopenia in the present study, possibly due to the worse global alignment of the thoracolumbar lesion. C2/7 angle was also higher. However, sarcopenia patients who underwent anterior cervical surgery did not have the worse clinical outcomes or the higher C2-7 SVA. Anterior surgery can be a better option for sarcopenia patients with sagittal malalignment.

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Effect of K-line on posterior cervical surgery versus anterior cervical surgery in patients with multi-level ossification of posterior longitudinal ligament
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Background: It is difficult to choose posterior or anterior cervical in patients with multi-level ossification of posterior longitudinal ligament.
Purpose: To evaluate the influence of K-line on the outcome of open-door laminoplasty versus anterior cervical corpectomy decompression and fusion (ACCF) for patients with more than two levels of ossification of the posterior longitudinal ligament (OPLL).
Methods: 60 patients undergoing open-door laminoplasty and 62 patients undergoing ACCF from January 2013 to January 2020 with more than 2 years of follow-up were included. Eighty-four cases with the ossification mass not beyond the K-line were grouped as K-line (+), while thirty-eight cases were grouped as K-line (-). The operation time, intraoperative blood loss, hospital stay, preoperative, postoperative, and last follow-up JOA scores, and postoperative complications were investigated.
Results: The improvement rate of JOA scores after posterior approaches in cases of group K-line (+) and K-line (-) was 72.4% and 53.1%, respectively, which showed a significant difference ($P < 0.01$). In group K-line (+), the improvement of JOA scores for open-door laminoplasty was 73.4% and 71.8% for ACCF, which showed no significant difference ($P > 0.05$). In group K-line (-), the improvement of JOA scores for ACCF was 52.1% and 42.9% for open-door laminoplasty, which showed a significant difference ($P < 0.05$). The incidence of C5 palsy was significantly lower in cases with ACCF than in cases with open-door laminoplasty ($P < 0.05$).
Conclusion: For patients with more than two levels of OPLL, preoperative K-line (+) predicates a better outcome than K-line (-). For cases with K-line (-), ACCF provides better neurologic function recovery. For patients with K-line (+), open-door laminoplasty provides the same neurologic function recovery of ACCF.

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Imaging study on the safety of axial pedicle screw placement by the position of the screw trajectory tip on the anteroposterior and lateral radiographs
Background: Axial pedicle screw placement carries the risk of injuring spinal cord and vertebral artery due to its complex anatomy. Despite having reference points and angles for screw placement, there still lacks methods for accurately assessing the screw trajectory intraoperatively.
Objective: To propose a method to judge the safety of axial pedicle screw placement based on the position of the tip of the screw trajectory on the anteroposterior and lateral X-ray radiographs.
Methods: The position of the screw tip was divided into 5 regions (regions I-Ⅴ) from the inside to the outside on the anteroposterior radiographs and the upper and lower regions (regions a, b) on the lateral radiographs based on anatomical landmarks. The imaging simulation study reconstruct three-dimensional models and simulate axial pedicle screw placement in the cervical CT scans of 40 patients by Mimics. The direction of the screw was adjusted to position the tip within 10 regions on virtual anteroposterior and lateral radiographs (80 screws in each area) and subsquently determine if any screws penetrated the medial wall of the pedicle or vertebral artery foramen by CT. The retrospective imaging study examined the screw count and penetration rate in 10 regions using postoperative CT data and X-rays from 34 patients who had undergone axial pedicle screw placement, involving totally 67 screws.

Results: The imaging simulation study found that Regions Ⅱ and Ⅲ had relatively lower failure rates than Regions Ⅰ, Ⅳ and Ⅴ, and simulated screws in Region a performed better than those in Region b. The retrospective imaging study also revealed lower perforation rates in Regions Ⅱ and Ⅲ and no perforation events occurred in regions a-Ⅱ and a-Ⅲ.

Conclusion: Analysing the tips of pedicle screw trajectory on anteroposterior and lateral radiographs can guide the optimal placement of axial pedicle screws and regions a-II and a-III are considered as the "safe zones".

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Imaging study on determining the rationality of atlantoaxial fixation angle based on the ratio of line segments between anatomical markers on lateral X-ray films

Background: Previous studies have demonstrated the importance of the C1-C2 fixation angle in regulating postoperative subaxial alignment in posterior atlantoaxial fusion surgery. Therefore, it is crucial to accurately assess the reasonableness of the C1-C2 angle intraoperatively while direct measurements of the angle during surgery are susceptible to subjective experience, visual errors and obstruction. The upper and lower edges of the atlantoaxial lamina remain conspicuously defined during lateral fluoroscopy despite obstruction of screw-rod system.

Objective: To propose a method to determine the unreasonableness of the fixed angle in posterior atlantoaxial fusion surgery based on the ratio of line segments between anatomical landmarks of the atlantoaxial joint.

Methods: For the lateral X-ray film from asymptomatic volunteers, a line corresponded to the posterior edge of the lower articular surface of the axis was drawn parallel to the posterior margin of the odontoid process, intersecting the atlas at points b, c, and d. Line segments ab, bd, bc, and the C1-C2 angle were measured and the ratios of bd/ab and bc/ab were calculated subsequently.To assess the predictive ability of two ratios for the presence of an unreasonable atlantoaxial angle (≥22°), receiver operating characteristic (ROC) curve analysis was performed for the male and female groups and the performance was compared using Delong's test.

Results: In the male group, the AUC of bc/ab in predicting the unreasonable C1-C2 angle was 0.791 (sensitivity 97.3%, specificity 70.0%). This performance was significantly better than that of bd/ab (AUC=0.532, sensitivity 90.5%, specificity 44.8%). In the female group, the AUC of bc/ab for predicting the unreasonable C1-C2 angle was 0.804 (sensitivity 90.5%, specificity 58.6%). The performance was significantly better than that of bd/ab (AUC=0.687, sensitivity 90.5%, specificity 44.8%).

Conclusion: The bc/ab value can be used as an effective indicator to predict the unreasonable C1-C2 angle Intraoperatively with high diagnostic accuracy. The cutoff value for males is <0.449, and for females is <0.488.

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Posterior percutaneous endoscopy via vertical anchor technique combined with trench technique for single-segmental central cervical disc herniation

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Background: Central cervical disc herniation is considered the contraindication for posterior percutaneous endoscopic cervical discectomy

Objective: To investigate the clinical feasibility, safety, and effectiveness of posterior percutaneous endoscopy via vertical anchor technique combined with trench technique for single-segmental central cervical disc herniation. Methods: Between July 2017 and August 2019, 13 patients with the single-segmental central cervical disc herniation suffering from various neurologic deficits were treated with posterior percutaneous endoscopy via vertical anchor technique combined with trench technique. The general data of the patients and surgery-related complications, operation time, and intraoperative blood loss were recorded, and the results of clinical symptoms were measured by VAS scores and mJOA scores.

Results: All procedures were completed successfully, no severe complications such as dural tears or cerebrospinal fluid leakage occurred. The operation time ranged from 83 to 164 minutes (mean, 101.2 minutes). The intraoperative blood loss was 25-50 mL (mean, 33.1 mL). After operation, 12 of 13 cases were followed up 10-24 months (mean, 17.6 months). The VAS scores of patients with preoperative pain symptoms were 2.40±0.55 on the first day after operation and 1.80±0.45 at last follow-up, which were significantly lower than those before operation (P<0.05). Acute extremities weakness occurred for the postoperative hematoma formation in 1 case (disc herniation at C4, 5) presented with myelopathy preoperatively, and muscle strength was recovered after the clearance of hematoma and spinal cord decompression under percutaneous endoscopy.

Conclusion: Posterior percutaneous endoscopy via vertical anchor technique and trench technique for single-segmental central cervical disc herniation was clinical feasible, safe, and effective, and could be an alternative approach to the treatment of central cervical disc herniation.

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Enhanced Surgical Precision in Craniocervical Fusion: A Retrospective Review of Advanced Navigation Technologies

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Background: The craniocervical junction is a complex anatomical region where precision in surgical intervention is critical due to the proximity of vital structures such as the vertebral artery, the upper cervical spinal cord, and the medulla oblongata. Variation in this area poses a challenge to the safety and efficacy of craniocervical fusion procedures.

Objective/Aim: This study aims to retrospectively analyze the efficacy and precision of the Stealth Midas navigation system (Medtronic, Inc.) in the placement of screws and fixation of occipital bone plates in craniocervical fusion surgeries.

Methods: We conducted a retrospective review of patients who underwent craniocervical fusion at Nagoya University Hospital and Sakura General Hospital from January 2018 to June 2022. The focus was on the accuracy of C1 and C2 screw placements and the fixation of occipital bone plates, considering a significant deviation as more than 2 mm from the planned trajectory along the cortical bone.

Results: The cohort consisted of 20 patients, receiving 25 C1 lateral mass screws, 30 C2 pedicle screws, and 8 C2 laminar screws. The average posterior arch width of C1 was 4.07 ± 0.86 mm. Notably, three screws impinged on the ponticulus posticus, and two approached a caudally ectopic vertebral artery, yet only one C1 screw exhibited a deviation surpassing the 2 mm criterion. Eight occipital bone plates were placed; notably, three cases presented with anatomical aberrations (two post-occipital craniotomies and one with fibrous dysplasia) were successfully navigated and placed with O-arm guidance.

Conclusion: The use of the Stealth Midas navigation system has demonstrated a high level of precision in screw placement and occipital plate fixation in craniocervical fusion surgeries. Advanced navigation technologies like the Stealth Midas system can be crucial in minimizing complications associated with surgical variability, thereby enhancing patient outcomes in complex spinal procedures.

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A new classification of atlas fracture based on CT reconstruction and its clinical significance

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Backround: Adult atlas fractures account for 2% ~ 13% of cervical fractures. Atlas fracture classification systems are all based on the anatomical feature so far, which cannot reflect the severity of fracture, and its role in guiding clinical treatment is limited. Moreover, classification systems cannot cover all atlas fracture types.

Objective: To investigate the clinical significance of a new classification system for atlas fractures based on CT features, with a focus on diagnosis and treatment.

Methods Seventy-five patients with atlas fracture were included from January 2015 to December 2020. Based on the anatomy of fracture line, atlas fractures were divided into three types. Each type was divided into 2 subtypes according to the fracture displacement. Unweighted Cohen Kappa coefficients were applied to evaluate the reliability and reproducibility.

Results: The new atlas fracture classification method comprised three types (A,B,C)based on whether the fracture line involved the atlantoaxial facet joint. Additionally, based on the maximum displacement distance of the fracture, six subtypes were identified: subtype 1 (≤4 mm displacement) and subtype 2 (>4 mm displacement). Consequently, the subtypes were classified as A1, A2, B1, B2, C1, C2. The classification demonstrated excellent consistency, as assessed by the five doctors, with Kappa values of 0.85 and 0.91 for reliability and repeatability, respectively.

Conclusion: The new atlas fracture classification method, based on CT imaging features, comprehensively covers common clinical cases of atlas fractures and demonstrates excellent consistency. It provides valuable clinical guidance for the diagnosis and treatment of atlas fractures.

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Effect analysis of cervical posterior approach single open door surgery in patients with K-negative ossification of posterior longitudinal ligaments of the cervical spine

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Background: Ossification of the posterior longitudinal ligament (OPLL) of the cervical spine is a disease in which ossification of the posterior longitudinal ligament of the cervical spine compresses nerve roots or spinal cord, resulting in motor sensory disorders of limbs and autonomic nerve dysfunction of the visceral organs. The surgical approach for K-negative OPLL remains controversial. Objective: To explore the effect of posterior cervical enlarged spinal canal plasty on patients with K-negative OPLL of the cervical spine.

Methods: A total of 88 patients with K-negative OPLL of the cervical spine admitted to our hospital from February 2017 to February 2022 were selected and divided into two groups according to random number table method: 44 cases in the observation group and 44 cases in the control group. The control group was treated with traditional anterior approach surgery, and the observation group was treated with posterior cervical enlarged spinal canal plasty. Operation time and hospital stay, cervical spine dysfunction index (NDI) score, Japanese Orthopaedic Association (JOA) score, and complications 2 months after surgery were compared between the two groups. Results: Compared with the control group, the operation time and hospital stay in the observation group were shorter (P< 0.05).

Conclusions: Posterior cervical enlarged spinal canal plasty in the treatment of patients with K-negative OPLL of the cervical spine is beneficial to reduce the NDI score, improve the JOA score, and reduce the complications. Moreover, long-term follow-up results show that posterior cervical enlarged spinal canal plasty can achieve the same effect as anterior surgery in relieving symptoms of spinal cord compression. It should be used in patients with K negative OPLL of cervical spine

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A novel classification that define the normal cervical spine: an analysis based on 632 asymptomatic Chinese volunteers

Background: Numerous studies have described the “normal” shape of the cervical spine and defined the normal alignment as lordosis. However, some reversed curve on radiographs was emphasized in asymptomatic patients by historical studies. Hence, the “normal” cervical spine may be non-lordotic shapes and the cervical spine alignment targets are less well established.

Objective: The study was to propose novel classification for cervical spine morphologies with Chinese asymptomatic subjects, and to address cervical balance status based on the classification.

Method: An overall 632 asymptomatic individuals on cervical spine were selected from January 2020 to December 2022, with six age groups from 20-30 year to 70 plus group. Cervical alignment contained C2-7 cervical lordosis (C2-7 CL) and T1 slope (T1S), together with C1-2 CL, C2-4 CL, C5-7 CL, C2S, cervical sagittal vertical axis (CSVA), thoracic inlet angle (TIA) and neck tilt (NT). C2-7 cervical lordosis was regarded as primary outcomes. To identify groups with similar cervical alignment parameters, a 2-step cluster analysis was performed.

Results: C2-7 CL, T1S, CSVA, TIA and NT increased by age and mean value of them were larger in male than female group. Four unique clusters of female lordotic cluster (FLC), female kyphotic cluster (FKC), male lordotic cluster (MLC) and male kyphotic cluster (MKC) were classified mainly based on gender and C2-C7 CL. T1S was the independent influencing factor for C2-7 CL in all individuals and C2-7 CL=-28.65+0.57×TIA, which varied from clusters. Although interactions among cervical parameters, it showed the alignment was more coordinated in lordotic groups.

Conclusions: The cervical sagittal profile varied with age and gender. Four clusters were naturally classified based on C2-7 CL and gender. The cervical balance status was addressed by C2-7 CL=-28.65+0.57×TIA.

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Comparisons of Anterior and Posterior Approach in the Treatment of Odontoid Fractures: A Meta-analysis and Systematic Review

Background: Odontoid fracture has accounted for 15% to 20% of cervical injury. Although the operation methods various in different types, the superiority of overall outcomes of anterior approach (AA) and posterior approach (PA) in the treatment of odontoid fracture was still of controversy.

Objective: Based on previous studies, we aimed to perform a meta-analysis and systematic review to identify the overall efficacy of AA and PA.
Methods: The relevant studies were searched in PUBMED/Medline, Cochrane library, EMBASE, China Biological Medicine (CBM) and Wanfang database from the onset of conception to June 2022. Prospective or retrospective comparative study of AA and PA on odontoid fractures was screened, referring to fusion rates (primary outcomes), complications and postoperative mortality. Meta-analysis on the primary outcomes and systematic review for other outcomes were performed, the procedure was conducted with Review Manager 5.3.
Results: There were 12 articles with 452 patients included, all publications were retrospective cohort study. The average postoperative fusion rate was respectively (77.5 ± 17.9) % and (91.4 ± 13.5) % in AA and PA, with statistical significance (OR=0.42[0.22, 0.80], P=0.009). Subgroup analysis showed there was difference on fusion rate between AA and PA in the old group (OR=0.16[0.05, 0.49], P=0.001). There are five articles referred to postoperative mortality and the rate between AA (5.0%) and PA(2.3%) showed no statistical difference (P=0.148). There were 9 studies referred to complications with a rate of 9.7%. The incidence of complications in AA and PA group was comparable (P=0.338) and the incidence of non-fusion and complications was irrelevant. The most
cause of death was myocardial infarction. The time and segmental movement retention of AA were possibly superior to PA.
Conclusion: AA may be superior on the operation time and motion retention. There were no difference in complications and mortality between the two approaches. The posterior approach would be preferred on fusion rate.

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Adjacent segment degeneration after single- and double-level cervical total disc replacement: a cohort with an over 12-year follow up
BACKGROUND: The natural progression or irtrogenic interference for adjacent segment degeneration (ASD) after cervical spinal surgery remains controversial. In addition, there was few study focusing on ASD after cervical total disc replacement (CTDR) over one decade.
OBJECTIVE: Here, the study was to characterize the change of ASD after CTDR with more than 12-year follow up, and identified the risk factors for ASD.
METHODS: This process included 75 patients (42 male) underwent CTDR from February 2004 to December 2012, with the follow-up of 151.9±36.0 (m). The types of artificial disc was Prodisc-C, Prestige-LP and Mobi-C. ASD was followed up at 1 week, 6 months, 1 year, 2 years, 5 years, 10 years after CTDR and at the endpoint of June 2022. The radiographic measurements were cervical mobility; intervertebral disc height (IDH), cervical lordosis and balance status. The complications were implant migration, subsidence and heterotopic ossification (HO). The survival analysis on ASD based on operated levels and prosthesis types was performed, and the risk of ASD was evaluated with Cox regression. All time data to evaluate the impact of HO on ASD was performed by generalized estimating equations (GEE).
RESULTS: Cervical mobility in adjacent segments, IDH and lordosis showed no statistical differences between ASD and NASD group. Balance status, subsidence, migration showed no relationship with ASD. ASD began with 6m after CTDR (especially between 6m to 2y) and the proportion increased till to the endpoint (76.0%). There was no difference between the incidence of UASD and LASD all the time and few ASD-related reoperation. C4/5 (33.6%) and C6/7 (34.2%) was the majority of adjacent segments, and ASD of C5/6 held the highest incidence (61.5%). The Kaplan-Meier curve and Cox regression showed ASD was not related to the types of prosthesis or operated numbers. GEE analysis severe HO had a higher (2.68 times) probability to suffer from ASD.
CONCLUSIONS: After over 12-year follow up of CTDR, ASD began at 6m and significantly increased within 2 years. The occurrence of ASD and HO had temporal synchronization. So ASD was not a merely natural progression but with the pathological process such as HO.

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Cervical spine balance of multilevel total disc replacement, hybrid surgery and anterior cervical discectomy and fusion with a long-term follow-up
Background: There was few long-term comparisons on cervical alignment and cervical balance among 3-level total disc replacement (TDR), 2 prosthesis with one cage (2D1C), 1 prosthesis with 2 cages (1D2C) and anterior cervical discectomy and fusion (ACDF) for cervical spondylotic myelopathy (CSM).
Objective: To compare cervical alignment among 3-level TDR, 2D1C, 1D2C and ACDF, then identify the importance of cervical balance of CSM.
Methods: Twenty-eight patients with TDR, 15 with 2D1C, 36 with 1D2C and 32 cases with ACDF were included with a mean follow-up of 90.9±8.9(m). C2-C7 cervical lordosis (CL), C2-C7 sagittal vertical axis (SVA) , T1 slope (T1S) were measured on X-ray at preoperation, immediate postoperation and final follow-up, as well as range of motion (ROM), upper/lower adjacent ROM (UROM/LROM) and adjacent segment degeneration (ASD); Cervical balance was assessed by T1S minus CL (T1SCL; 20°). Clinical outcomes included neck disability index (NDI) and Japanese Orthopedic Association (JOA) score.
Results: NDI and JOA improved (P<0.01)at postoperation and final-visit with no difference among 4 groups. ROM decreased mostly in ACDF group while with a comparable inter-group UROM/LROM and ASD. All groups gained equal CL-improvement at final-visit. SVA and T1S together with their change were of no differences among groups (P>0.05). There was a correlation among alignment parameters and between CL and ROM. The inter-group capacity of balance maintaining and imbalance correction were comparable (P>0.05). The change of T1SCL was not correlated to NDI and JOA (P>0.05).
Conclusions: Adjacent segments were seldom effected. Cervical alignment was equivalently rebuilt among TDR, 2D1C, 1D2C and ACDF. It was not essential to pay excessive attention to balance.

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Radiological exploration on adjacent segments after total cervical disc replacement with Prodisc-C prosthesis
Background: The relationship between upper or lower adjacent segments (UAS/LAS) and the cervical spine parameters was not clear yet.
Purpose: So the purpose was to analyze range of motion (ROM), lordosis (LOR) and intervertebral disc height (IDH) of UAS and LAS pre- and post- operatively in total cervical disc replacement and to explore the influencing factors of cervical spine radiological parameters on adjacent segments.
Methods: A single-center retrospective study was performed in patients completing 10-year follow-up undergone total cervical disc replacement (TDR). Radiological parameters of UAS/LAS, as the primary outcome, include UAS-ROM/LAS-ROM, UAS-LOR/LAS-LOR and UAS-IDH/LAS-IDH. The secondary imaging outcomes were ROM and LOR of C2-C7 and surgical levels, IDH of surgical segments, prosthesis migration, subsidence, heterotopic ossification (HO) and adjacent segment degeneration (ASD) , which were obtained by X-ray.
Results: UAS-ROM and LAS-ROM remained stable in follow-up periods. There was no significance on UAS-LOR or LAS-LOR between pre- and post- operation, so was UAS-IDH or LAS-IDH. UAS-ROM was larger in the segments with ASD (P<0.001), the same to LAS-ROM (P<0.001) and UAS-LOR was larger in segments with ASD (P = 0.02). UAS-ROM was positively correlated with C2-C7 ROM and LOR (both P<0.001). UAS-LOR was correlated with surgical segments LOR while LAS-LOR were in

correlation with surgical segments ROM. The influencing factors of UAS-ROM were the surgical segment ROM and C2-C7 LOR. The influencing factors of UAS-LOR and LAS-LOR were respectively LAS-ROM and UAS-ROM. The influencing factors of UAS-IDH were LAS-IDH, surgical segment IDH and HO while that of LAS-IDH were UAS-IDH and surgical segment IDH.

Conclusions: TDR has not so much effect on the adjacent segments. There is an interaction on UAS and LAS. The maintenance on surgical segments ROM, reconstruction of IDH will benefit to adjacent segments.

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A minimum of ten years follow-up on radiological and clinical outcomes of total cervical disc replacement with Prodisc-C prosthesis

Background: There has still been unidentified long-term clinical and radio-graphic outcomes with comprehensive parameters of total cervical disc replacement with Prodisc-C.

Objective: This study was to evaluate radiographic and clinical efficacy of Prodisc-C at a minimum of 10-year follow-up (FU).

Methods: A single-center retrospective study was performed on total cervical disc replacement (TDR) with Prodisc-C. 118 patients (66 male and 52 female) completed ten-year FU from December 2005 to April 2008. The radiological parameters contained range of motion (ROM), sagittal alignment and intervertebral disc height (IDH). Radiological complications were implant migration and subsidence, implant loosening and locking, heterotopic ossification (HO) and adjacent segment degeneration (ASD). Clinical outcomes included visual analogue scale (VAS), Neck Disability Index (NDI), Japanese Orthopedic Association (JOA) score, Odom's criteria and reoperation. The follow-up time were from pre-operation to 10 years after post-operation.

Result: Both C2-C7 and index segments ROM recovered till to final follow-up and adjacent segments ROM maintained well. There was no significance of preoperative and final FU C2-C7 lordosis (P=0.22) but the index segment lordosis got correction (P=0.002). IDH of implanted segment increased ($P < 0.001$) while adjacent segment keep stable. There was no case with migration, subsidence or loosening. HO was in larger proportion (24.7%~72.8%) with 10-year FU ($P < 0.001$) and operated segment ROM with HO was less than non-HO ($P < 0.05$), so was ASD and ROM was slightly lower in patients with ASD. There were significant improvement in NDI, JOA, VAS and Odom's Criteria till to the final FU ($P < 0.001$) with no case of reoperation.

Conclusions: There is not so much impact on adjacent segments. TDR is considered to provide long-term and safe efficacy.

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Safety And Efficacy Of Anterior Cervical Discectomy And Fusion With Uncinate Process Resection: A systematic Review And Meta-analysis

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Background: In the case of severe foraminal stenosis, conducting uncinate process resection (UPR) during ACDF could achieve complete nerve root decompression and significant relief of neurological symptoms for CR. However, there is some controversy regarding its necessity and safety.

Objective/Aim: This study aims to compare the safety and efficacy of ACDF with UPR and ACDF.

Methods: The following electronic databases were searched: Medline, PubMed, EMBASE, the Cochrane Central Register of Controlled Trials, Evidence Based Medicine Reviews, VIP, and CNKI. And the following data items were considered: baseline demographics, efficacy evaluation indicators, radiographic outcome and surgical details.

Results: 10 studies were finally identified, including 746 patients who underwent ACDF with UPR compared to 729 patients who underwent ACDF. The group of ACDF with UPR had statistically longer intraoperative time (95%CI: 4.83, 19.77, P=0.001) and more intraoperative blood loss (95%CI: 12.23, 17.76, $P < 0.001$). ACDF with UPR obtained a significantly better improvement of Arm VAS at postoperative first follow-up (95%CI: -1.85, -0.14 P=0.02). There was no significant difference found in improvement of Neck VAS at postoperative latest follow-up (95%CI: -0.88, 0.27, P=0.30), improvement of Arm VAS at postoperative latest follow-up (95%CI: -0.59, -0.01, P=0.05), improvement of NDI (95%CI: -2.34, 0.33, P=0.14), JOA (95%CI: -0.24, 0.43, P=0.56), change of C2-C7 lordosis (95%CI: -0.87, 1.33, P=0.68), C2-C7 SVA (95%CI: -0.73, 5.08, P=0.14), T1 slope (95% CI: -2.25, 1.51, P=0.70) and fusion rate (95% CI: 0.83, 1.90P=0.29).

Conclusion: ACDF with UPR is an effective and necessary surgical method for CR patients with severe foraminal stenosis.

Keywords: Cervical radiculopathy, ACDF, Uncinate process resection, Foraminal stenosis, Meta-analysis

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Cage Alone vs. Plate Fixation Single-Level Anterior Cervical Fusion: Outcomes, Adjacent Segment Degeneration, and Cervical Alignment Parameters

Short Title: Cage-Alone vs. single-level ACDF with plate fixation

Background: For more than 50 years, anterior cervical discectomy and fusion (ACDF) surgery has been a common method for treating various cervical issues. However, the debate continues regarding whether additional plate fixation after ACDF is necessary.

Objective: To assess the radiographic outcomes of plate fixation and the incidence of radiographic adult spinal deformity (ASD) following anterior cervical discectomy and interbody fusion (ACDF).

Methods: Seventy patients (CAGE: 17 [24%], mean age: 55.35 years; PLATE: 30 [43%], mean age: 50.27 years) were included. Sagittal balance radiological and ASD-related parameters were analyzed. The neck disability index (NDI) and visual analog scale scores for neck and arm pain were used to assess clinical outcomes; fusion and subsidence rates were analyzed.

Results: There were no statistically significant between-group differences regarding demographic data. The pre-operative segmental angles were 0.78° (±5.55°) and 0.59° (±4.53°) in the CAGE and PLATE groups, respectively. Segmental kyphosis progressed in CAGE, with statistically significant between-group differences at 12-, 24-, and 48 months (P=0.00). The adjacent-level ROM increased in both upper and lower levels compared to preoperative values. Fusion was observed in 16 (94.1%) patients with CAGE-alone and in 25 of 30 patients (83.3%) in the PLATE group. CAGE exhibited a non-significant higher subsidence rate (12,5%) than PLATE (3.6 %). The CAGE group achieved statistically significant improvement in NDI scores compared to the PLATE group. Radiologic ASD was observed in 41.2% and 30.0% of patients in the CAGE and PLATE groups, respectively.

Conclusions: Cage-alone single-level fusion achieved favorable clinical outcomes. However, selective use is recommended in patients with lordotic cervical curvature without risk of subsidence. Plate augmentation may improve surgical outcomes for cases of severe cervical kyphosis or with high risk of subsidence.

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Development and Validation of a Predictive Model to Evaluate the Risk of Dysphagia Following occipitocervical fusion

Objective: To investigate the potential risk factors of dysphagia after occipitocervical fusion and to establish and validate a prediction model.

Methods: The clinical data of 134 patients who underwent occipitocervical fusion in our hospital from January 2010 to October 2022 were retrospectively analyzed and divided into the dysphagia group and the non-dysphagia group according to whether dysphagia occurred after surgery. Age, gender, body mass index, smoking and drinking history, hypertension history, diabetes history, rheumatic arthritis history, disease duration, number of segments involved in surgery, and changes in cervical curvature before and after surgery were recorded in both groups. Risk factors for postoperative dysphagia were identified and nomogram prediction models were developed.

Results: A total of 134 patients were included in the study, 27 of whom presented with dysphagia within 1 week after surgery. The results of multivariate logistic regression analysis indicated that female gender, rheumatic arthritis history, the occipital to C2 angle (O-C2a) and occipital and external acoustic meatus to axis angle (O-EAa) were independent risk factors associated with increased incidence of postoperative dysphagia.

Conclusion: The incidence of dysphagia symptoms after occipitocervical fusion gradually decreased with the improvement of O-C2a and O-EAa. And an adequate fixation angle is necessary to avoid airway obstruction after an occipitocervical fusion

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Cervical vertebral Hounsfeld units are a better predictor of Zero-P subsidence than the T-score of DXA in patients following single-level anterior cervical discectomy and fusion with zero-profile anchored spacer

Objectives: To determine the predictive effect of Hounsfeld unit (HU) values in the cervical vertebral body measured by computed tomography (CT) and T-scores measured by dual-energy X-ray absorptiometry (DXA) on Zero-P subsidence after anterior cervical discectomy and fusion (ACDF)with Zero-P. In addition, we evaluated the most reliable measurement of cervical HU values.

Methods: We reviewed 76 patients who underwent single-level Zero-P fusion for cervical spondylosis. HU values were measured on CT images according to previous studies. Univariate analysis was used to screen the influencing factors of ZeroP subsidence, and then, logistic regression was used to determine the independent risk factors. The area under the receiver operating characteristic curve (AUC) was used to evaluate the ability to predict Zero-P subsidence.

Results: Twelve patients (15.8%) developed Zero-P subsidence. There were significant differences between subsidence group and non-subsidence group in terms of age, axial HU value, and HU value of midsagittal, midcoronal, and midaxial (MSCD), but there were no signifcant diferences in lowest T-score and lowest BMD. The axial HU value (OR=0.925) and HU value of MSCD (OR=0.892) were independent risk factors for Zero-P subsidence, and the lowest T-score was not (OR=1.186). The AUC of predicting Zero-P subsidence was 0.798 for axial HU value, 0.861 for HU value of MSCD, and 0.656 for T-score.

Conclusions: Lower cervical HU value indicates a higher risk of subsidence in patients following Zero-P fusion for single level cervical spondylosis. HU values were better predictors of Zero-P subsidence than DXA T-scores. In addition, the measurement of HU value in the midsagittal, midcoronal, and midaxial planes of the cervical vertebral body provides an effective method for predicting Zero-P subsidence.

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Comparison of pain management and surgical outcomes for different four kinds of muscle-preservation Laminoplasty surgery for Patients with multilevel cervical spondylotic myelopathy----A designed retrospective cohort study

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Objective: The efficacy and advantages of expansive open-door laminoplasty (LP) has been proved by abundant investigations for treatment of multilevel cervical spondylotic myelopathy (MCSM). During clinical practice, we developed a set of variations of modified LP via paraspinal intermuscular approach to cervical spine at our spinal surgery center from 2010. All of these surgeries are aiming at sparing as much muscle and ligament as possible, and thus to reduce the risk of axial symptom, perioperative pain and long-term alignment preservation. Instead of cut the bilateral muscular attachment by the spinous process, the approach via natural space between the semispinalis cervicis (SSSe) and semispinalis capitis (SSSa) could minimize the dissection and preserve the attachment of multifidus and semispinalis cervicis on the spinous process. Via this approach, the ligamental-muscular complex on the hinge side was preserved, which was named unilateral intermuscular laminoplasty (UL). Based on this intramuscular approach and inspired by double-door laminoplasty, intermuscular sparing muscle-spared double-door (DD) laminoplasty and “raising roof” laminoplasty was developed, all of which variations of modified laminoplasty were conducted fairly successfully in the past decade. In clinical practice, we found all these modified surgeries could achieve good neurological outcome and alleviated perioperative pain, but no study has evaluated the efficacy and alleviation of perioperative and postoperative pain of four kinds of surgery. In this study, we aimed to find out whether these modified surgeries could achieve better neurological outcome or pain alleviation by sparing key cervical extensor muscles through intermuscular for MCSM patients.

Methods: From 2022.3 to 2022.5, a total of 154 MCSM patients who underwent four kinds of modified laminoplasty were enrolled and followed up for 12 months. Of these,37 patients received OD,39 received DD,41 receive UL and 36 received RL laminoplasty. Demographic data, medical characteristics, preoperative neurological conditions and imaging findings were collected. The assessment of clinical outcome was conducted using the cervical Japanese Orthopaedic Association score (JOA), Neck Disability Index (NDI), SF36-pf and visual analog scale scores (VAS).

Results: No significance was found in preoperative baseline variables between the groups. With more usage of enhanced analgesia, the RL group showed longer surgery duration (p=0.041) and more blood loss(p=0.000).At 6-month following surgery, satisfactory surgical outcome was observed in all four groups (JOARR: OD:73.46%±28.68%, DD:60.92%±32.94%, UL:65.45%±27.00%, RL:56.64%±31.30%, p=0.072; VAS alleviation: OD:1.8±2.7, DD:1.8±2.7, UL:1.6±2.4, RL:1.3±2.2, p=0.650). The were 28(77.78%) patients in the OD, 22 (59.5%) in the DD, 23 (59.0%) in the UL, 19(52.8%) in the RL reported axial symptoms (p=0.149) while 6 patients in the OD and 4 in the UL reported C5 Palsy (P=0.009). The overall complication rate did not differ significantly. After regression, patients in all four groups achieved

satisfactory neurological function recovery and pain alleviation at 6-month follow-up, while no significant difference were found among 4 groups in either VAS alleviation or JOARR. Patients in the UL group showed more transient VAS alleviation, though not significantly.
Conclusion: Almost comparable surgical outcomes were found between three kinds of modified laminoplasties and conventional laminoplasty at 6-month follow-up. We validated the efficacy of RL, UL, DD and found the possible potential of RL surgery in transient pain alleviation following surgery. Prospective cohort study with longer follow-up duration was planned for further investigation.

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Occurrence and course of postoperative nerve palsy in anterior cervical spine surgery: a multicenter study of 1434 cases -

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Background/Objectives: C5(6,7,8) palsy is a significant postoperative complication in cervical spine surgery, regardless of whether the surgical approach is anterior or posterior. However, the etiology and effective management of C5(6,7,8) palsy in anterior cervical spine surgery remain unclear. The purpose of this multicenter study was to investigate the risk factors and course of C5(6,7,8) palsy after anterior cervical spine surgery.
Methods: This retrospective observational study included 1,434 cases (1,050 males and 384 females) who underwent anterior cervical spine surgery in the Tokyo Medical and Dental University Group from January 2011 to March 2021. Postoperative C5(6,7,8) paralysis was defined as muscle weakness of 1 or more on MMT compared to the preoperative level. Risk factors for the development of paralysis were assessed through multivariate analysis, and the progression of muscle strength over a 2-year postoperative period in cases of paralysis was also examined.
Results: C5(6,7,8) palsy was observed in 99 cases, accounting for 6.9% of cases (80 males and 19 females). The affected nerve levels were C5: 81 cases, C6: 8 cases, C7: 9 cases, and C8: 1 case. Independent risk factors for nerve palsy were older age, male, intraoperative dural injury, and anterior cervical corpectomy and fusion (ACCF). Among the palsy cases, 81% showed improvement in muscle strength to preoperative levels. Muscle strength at worst was significantly lower in the palsy residual group compared to the palsy recovery group (MMT 1.63±0.2 vs. 2.46±0.1, $p<0.001$).
Conclusion: Postoperative C5(6,7,8) palsy occurred in 99 cases (6.9%), with 81% of cases showing improvement in muscle strength to the preoperative level. C5(6,7,8) palsy is an important complication that requires attention to the indications for ACCF and intraoperative dural injury.

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Lateral Deviation of the Hyoid Bone and Thyroid Cartilage Influences Prevertebral Soft Tissue Swelling and Dysphagia after Anterior Cervical Discectomy and Fusion

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Backgrounds: prevertebral soft tissue swelling (PSTS) after anterior cervical discectomy and fusion (ACDF) is known to be influenced by several factors. We considered the effect of lateral deviation on the traction force and attempted to find a relationship with the PSTS.
Objectives: To evaluate the preoperative lateral deviation of the hyoid bone and thyroid cartilage and its effect on PSTS, airway collapse, and clinical outcomes after ACDF.
Methods: Preoperative lateral deviations of the hyoid bone and thyroid cartilage at the superior cornu (SC) and inferior cornu (IC) were measured. To assess the effect of lateral deviation, patients who underwent 1 or 2 level ACDF with the left-side approach were divided into a deviation group (left side deviation > 5 mm or >10 mm) and a non-deviation group (left side deviation <5 mm or <10 mm). Difference of preoperative and postoperative PSTS (dPSTS), airway collapse, dysphagia score, and neck disability index (NDI) were compared between the two groups.
Results: Lateral deviation was measured in 290 patients, and 145 were enrolled to assess the effect of lateral deviation. Left-sided deviation was more common than right-sided deviation in all three structures (the hyoid bone, SC, and IC). The deviation group demonstrated a significantly larger dPSTS at the C3 and C4 levels, more airway collapse at the C4 level, and a higher dysphagia score. There was no significant difference in NDI between the two groups. Lateral deviation significantly correlated with dPSTS (C3, C4, C5, and C6 levels) and airway collapse (C4 level).
Conclusions: A left-sided deviation of more than 5 mm of the hyoid bone or thyroid cartilage discouraged the left-sided approach for ACDF due to the aggravation of dPSTS, airway collapse, and dysphagia postoperatively.

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Clinical study of MRI laminar line simulated decompression to predict the effect of cervical laminoplasty

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Objective: To investigate the clinical value of using MRI laminar line (LL) simulated decompression to predict the effect of cervical laminoplasty.
Methods: Data of 60 patients who underwent posterior cervical laminoplasty from January 2020 to October 2022 were retrospectively analyzed. There were 40 males and 20 females, aged 39-78 years, with an average age of 59.87±9.35 years. The diameter of the dural sac in the compression segment was measured on the medial sagittal T2-weighted image of the preoperative MRI. The line between the anterior-inferior margin of the superior lamina and the anterior-superior margin of the inferior lamina at the decompression segment was LL, and the anterior dural border to the midsagittal diameter of LL (simulated decompression midsagittal diameter) was measured. The diameter of the spinal canal measured in midsagittal plane of postoperative MRI was actual decompression diameter. To evaluate the correlation among the postoperatively actual decompression diameter, the improvement rate of JOA score and the preoperatively simulated decompression diameter.

Results: Developmental spinal stenosis ratio was 90.0% (54/60) in these cases. Postoperative MRI results showed that the spinal cord was significantly shifted backward and the spinal cord compression was relieved. Midsagittal diameter of actual decompression and LL simulated decompression were significantly increased compared with pre-operation, and the difference was statistically significant ($P < 0.05$). The accuracy of LL simulation decompression was 88.3% (53/60) compared with actual decompression effect. All 60 cases were followed up for at least 6 month, and JOA score was significantly higher at the last follow-up than before surgery ($P < 0.05$).
Conclusion: MRI LL simulated decompression can predict the effect of spinal cord decompression and guide the preoperative planning in cervical laminoplasty.
Key words: Cervical vertebra; Spinal cord; Laminoplasty; Decompression

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Anterior Vertebroplasty as Treatment for Aggressive and Symptomatic Cervical Hemangioma

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Background: At present, there is very few literature on the treatment of aggressive and symptomatic cervical hemangioma (ASCH).
Objective: The aim of this study is to evaluate the safety and effectiveness of anterior vertebroplasty for patients with ASCH.
Methods: Clinical data of patients of ASCH who underwent anterior cervical vertebroplasty in our hospital from January 2018 to January 2022 were retrospectively analyzed. A total of 20 patients (20 vertebrae) were included in this study, including 12 males and 8 females, with an average age of 48.2±5.3 years. In all patients, an open anterior cervical vertebroplasty was performed under general anesthesia. The VAS scores and NDI index of patients were compared before and 24 hours after surgery, 3 months, 6 months, 12 months after surgery and at the last follow-up, to evaluate the therapeutic effect. The amount of intraoperative bone cement injection, diffusion and leakage of bone cement were also recorded.
Results: All of the 20 patients underwent surgery successfully, including 4 cases of C3, 6 cases of C4, 7 cases of C5 and 3 cases of C6. The average injection volume of bone cement was 2.8±0.6ml, and the average follow-up was 42.5±5.6 months. The VAS score and NDI index were significantly improved after surgery and follow-up period compared with that before surgery ($P<0.05$). Intraoperative bone cement was observed to spread to both sides of the injured vertebra, and no bone cement leakage occurred.
Conclusion: Anterior vertebroplasty is a safe and effective surgical method for patients with ASCH.

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The reconstruction of anterior column after cervical corpectomy with 3D-printed "winged" artificial vertebral body——Preliminary clinical and radiological result

Background: The construction of anterior column after cervical corpectomy has not been resolved well. The titanium mesh has been used worldwide since late 20th century. But the sinking and subsidence of titanium mesh is an intrinsic weakness of this technique. The 3D printed artificial vertebral body with porous titanium alloy through EBM technology has been designed and used in China since 2014. But this original 3D printing artificial vertebral body must be used with plate and screws to achieve primary stability. Since 2020, a novel 3D printed "winged" vertebra body has been designed and used for the construction of anterior column after cervical corpectomy in our hospital. The 3D printed vertebral body has two screws fixed into vertebral body through endplate on both sides and a wing in the upper and lower end of vertebral body like a plate with screws fixed into vertebral body. The endplate of 3D printed vertebral body has different angle to achieve a good interface compactness with endplate of vertebral bodies. This study is a preliminary result of clinical and radiological outcome of surgical cases from August 2020 to August 2023.
Methods: 57 cases were included with minimal 3 months follow up. There were 32 males and 25 females with an average age of 57 years old. The median follow-up was 6 months (3-24)months. In the operative segments, single-stage ACCF was dominant (70.1%). In one level ACCF, C6ACCF was dominant, followed by C5ACCF (19 cases and 16 cases, accounting for 33.3% and 28.1%, respectively). In 2-level ACCF, the majority of C4-7ACCF were resected C5/C6 vertebrae (a total of 10 cases, accounting for 17.5%). Primary anterior operation in 54 cases, and it was used for anterior revision in 3 cases.
Results: The average preoperative JOA score was 13.07, and the average recovery rate of the last follow-up JOA score was 59.3%. The preoperative C2-7cobb angle was 7.27 degrees and the postoperative C2-7cobb angle was 9.49 degrees, with an average kyphosis correction of 2.22 degrees. The average local angle is 0.72 degrees before operation and 4.66 degrees after operation, which plays a more important role in correcting local angle. Postoperative screw loosening occurred in 5 cases, distal screw loosening in 4 cases, and 2 of these case, internal fixation was removed. There was one case of proximal internal fixation loosening, and with no further progress. All of the internal fixation loosening occurred before August 2020, and there is no possibility that such problems may be associated with improved locking mechanisms. Postoperative implant subsidence occurred in 5 cases, and the last case's operation was in March 2023. Because fusion is acceptable, conservative treatment was performed. The median occurrence of loosening and subsidence was 3 months after surgery. Cases
The first case was a 58-year-old male with cervical myelopathy, preoperative JOA score was 13, preoperative C2-7cobb angle was 3.4 degrees mild kyphosis, C4-6 local angle kyphosis 10 degrees. Because of the existence of opll, C5 ACCF was performed and winged artificial vertebrae were selected. The postoperative local angle was corrected to 4.1 degrees of lordosis and C2-7 overall angles of 9 degrees lordosis. After 3 months follow-up, 87.5%. recovery rate was achieved.

The second case was a 56-year-old female with cervical myelopathy and degenerative kyphosis. The preoperative JOA score was 15, the preoperative C2-7cobb angle was 9.3, the local kyphosis angle was 9.7, the postoperative C2-7 cobb angle was 6.7 degrees, the local kyphosis angle was 0.4, the local kyphosis correction was 9.3 degrees, after surgery. After 3-month follow-up, JOA score was 17, and kept for 3 years. the JOA recovery rate was 100%. This patient had severe osteoporosis and screw loosening occurred three months after operation. after close follow-up to 3 years, there was no progress in loosening screw and no sign of subsidence, therefore, conservative treatment was chosen for this patient.
Conclusion: A neotype 3D printed winged vertebra as a new internal fixation implant, by adjusting different endplate angles to provide better interface fitting than the previous artificial vertebral body, while ensuring clinical otcomes, a better cervical alignment. In addition, it also has a good application prospect in the complex reconstruction after multiply level ACCF and the revision of anterior surgery.

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The influence of the coexistence of ankylosing spine to the patient with cervical ossification of the posterior longitudinal ligament on the health-related quality of life

Background: In previous research, we identified the pain characteristics in patients with Cervical ossification of the posterior longitudinal ligament (C-OPLL). They significantly complained of pain in not only the neck but also the lower back. In C-OPLL patients, ankylosing spine (AS) such as diffuse idiopathic skeletal hyperosteosis (DISH) is coexisting at a high rate. We consider that the coexistence of C-OPLL and AS might be significantly involved in this wide regional pain.

Objective/Aim: This study aimed to identify the influence of the coexistence of AS to C-OPLL patients in terms of health-related quality of life (HR-QOL), such as SF-36.

Methods: We prospectively collected C-OPLL patients in 16 hospitals from September 2015 to December 2017. Propensity score matching was conducted for the group with AS (AS (+)) and the group without AS (AS (-)). After one-to-one matching, the Mann-Whitney U-test was used to identify the influence of the coexistence of AS on each domain of SF-36.

Results: We got 84 pairs after one-to-one propensity matching, using age, sex, and body mass index as covariates. There was no significant difference in the basic data between these groups. There was no significant difference in all items of SF-36.

Conclusion: There have been some reports that AS often exists with C-OPLL. However, the reports referring to the coexistence's influence on the symptoms were rare. We wondered if the pain of C-OPLL patients would be involved in the coexistence of AS, but there was no significant correlation. Other factors will be needed to investigate whether they strongly influence the pain of C-OPLL patients in future research.

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Optimizing Postoperative Sagittal Alignment: The effect of Pedicle Screw Fixation in 540° Combined Surgery for Degenerative Cervical Disease

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Background: The lateral mass screw (LMS) has traditionally been employed as a posterior fixation method for the subaxial cervical spine. However, with advancements in insertion techniques, the cervical pedicle screw (CPS) has gained popularity due to its superior pull-out strength. Despite this, limited studies have examined the correlation between CPS and sagittal alignment in posterior-anterior-posterior surgery.

Objective: To evaluate the relationship between utilization of CPS in the subaxial cervical spine and the sagittal alignment of the cervical spine in 540" complex surgery with posterior only instrumentation.

Method: Patients who underwent posterior laminectomy and fixation with anterior cervical discectomy and fusion between the years 2014 and 2022 were selected as subjects for this study. A total of 77 patients were included in the analysis. We divided the patients into three groups: all CPS group (Group 1), the upper LMS + lower CPS group (Group 2), and all LMS group (Group 3). Sagittal profile parameters including cervical lordosis (CL), sagittal vertical axis (SVA) from C7 to C2 and the center of gravity of the head (COG) were measured for each group. Statistical analysis was performed to investigate the difference of sagittal profile parameters between three groups.

Results: Immediate postoperative CL and C2/COG-C7 SVA showed no significant difference according to the number of CPS. However, last postoperative CL and C2/COG-C7 SVA significantly differed based on the number of CPS. (CL, Group 1, 27.00±2.61, Group 2, 20.30±6.09, Group 3, 16.90±10.60, p-value=0.023; C2-7 SVA, Group 1, 32.85±21.89, Group 2, 26.97±8.00, Group 3, 23.71±13.48, p-value=0.049) Additionally, C2-C7 SVA tended to revert to their preoperative values from the immediate postoperative period to the 1-year postoperative period when the number of CPS used was low. (Change of SVA from immediate to last follow-up, Group 1, 3.79±7.66, Group 2, 0.30±1.64, Group 3, -0.48±6.22, p-value = 0.045) Conclusion: The sagittal profile, including parameters such as CL and C2/COG-C7 SVA, was effectively corrected with the insertion of more CPS on 1 year-follow up. The reason of this correction was due to maintenance of sagittal profile from immediate period to one year postoperatively, as the use of more CPS helped to maintain the corrected sagittal status.

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Outcomes and Complications of Surgery for Symptomatic Spinal Metastases; a Comparison Between Patients Aged ≥ 70 and <70

Background: Advances in oncological treatment have resulted in increased life expectancies for cancer patients. This combined with an aging population has led to a consistent increase in elderly patients presenting with spinal metastases. Physicians may be deterred from operating on these patients due to fears of poorer outcomes and increased complications because of their comorbidities and operative risk. This concern about increased mortality and morbidity can potentially lead to suboptimal surgical treatment in elderly cancer patients.

Aim: To compare the outcomes of surgical treatment of spinal metastases in patients aged ≥ 70 years old and patients aged <70.

Methods: This is a retrospective study of patients who underwent surgical treatment for spinal metastases between January 2005 to December 2021, divided into two groups age <70-years and ≥ 70-years. Outcomes studied included post-operative neurological status, ambulatory status, medical and surgical complications, and the need for readmission after surgery.

Results: 383 patients met the inclusion criteria, of which 79 (20.6%) were ≥70 and they had significantly poorer comorbidity scores. There was no significant difference in modified Tokuhashi score and prognostic subgroup between patients aged ≥70-years and <70-years. There was no significant difference in the location of tumour operated, type of surgery, surgical approach, number of levels instrumented and decompressed between both groups. There was no significant difference in post-operative neurology, ambulatory status, and survival between both groups. Patients ≥70-years were more likely to have medical complications (53.2% vs 50.8%) (p=0.528) and require readmission within 1-month post discharge (33.3% vs 29.6%) (p=0.800).

Conclusion: ≥70-years patients have comparable improvement in neurological status, ambulatory status and survival compared to younger patients. However, there is a significant complication and readmission rate. Age should not be a contraindication to surgery in spinal metastases and patients should be treated on an individual basis in a multidisciplinary setting.

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Three-dimensional reduction method with a modified C2 isthmus screw in irreducible atlantoaxial dislocation

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Background: Three-dimensional reduction plays a vital role in surgical reduction of irreversible atlantoaxial dislocation (IAAD). However, the most commonly used combination of C1 pedicle screw (PS) or lateral mass screw (LMS) and C2 PS or isthmus screw often fails to achieve satisfactory reduction at one time. The difficulty is usually caused by short anteroposterior and vertical distance between heads of C1 and C2 screws, which lack enough space for reduction operation. The objective of this study is to describe a three-dimensional reduction method with a modified C2 isthmus screw and to illustrate its advantage and effectiveness for IAAD.

Methods: Twelve patients with IAAD underwent reduction and fixation with modified C2 isthmus screw combined with C1 PS or LMS, fusion with autologous bone graft. The insertion point was lateral to the intersection of caudal edge of C2 lamina and lateral mass, with a trajectory towards C2 isthmus, via lateral mass. The three-dimensional reduction was achieved through pulling and distracting. Radiographic evaluation included anteroposterior and direct distance between different insertion points, the occipitoaxial angle (O-C2A), clivus-canal angle (CCA) and cervicomedullary angle (CMA). Clinical outcomes evaluation included the Japanese Orthopaedic Association (JOA) score, Visual analog scale (VAS) and Neck
Disability Index (NDI).

Results: All the patients maintained effective reduction during the follow-up. The anteroposterior and direct distance was significantly higher in modified C2 isthmus screw than C2 PS whether combined with C1 PS or LMS ($P < 0.05$). The degree of O-C2A, CCA and CMA, JOA score, NDI, and VAS were significantly improved after the surgery ($P < 0.05$).

Conclusions: Three-dimensional reduction method with a modified C2 isthmus screw is effective and safe in managing IAAD. It can increase the anteroposterior and vertical distance between the heads of C1 and C2 screws, which is benefit for the three-dimensional reduction operation of IAAD.

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The clinical impact of 2-level anterior cervical corpectomy and fusion versus posterior open-door laminoplasty on the occipito-atlantoaxial complex

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Background: Both two-level anterior cervical corpectomy and fusion (t-ACCF) and posterior open-door laminoplasty (ODLP) are effective surgical procedures for the treatment of ossification of the posterior longitudinal ligament (OPLL). The cervical spine is divided into the upper and the subaxial cervical spine (UCS, SCS), and due to its different anatomical structure leads to considerable mechanical differences, previous studies have identified different effects of different surgical procedures on the UCS and SCS; however, there are no studies on the effects of t-ACCF and ODLP on the occipito-atlantoaxial complex.

Objective: The purpose of this study is to compare the changes in sagittal parameters and range of motion (ROM) of the occipito-atlantoaxial complex in OPLL patients treated with t-ACCF and ODLP.

Methods: A total of 74 patients with OPLL were treated with t-ACCF or ODLP. Preoperative, 3-month, and 1-year postoperative cervical neutral, flexion-extension, and lateral flexion radiographs were taken. Sagittal parameters including Cobb angle of C2-7, C0-2, C0-1, C1-2, C2 slope, and the ROM were measured.

Results: In the ODLP group, the SCS Cobb angle was significantly reduced, and the UCS Cobb angle was significantly compensated for at one year postoperatively compared with the t-ACCF group ($P<0.01$). The SCS ROM of the ODLP group was better maintained than t-ACCF ($P<0.01$), and the compensatory
increase in C0-2, C0-1, and C1-2 ROM was more pronounced.

Conclusion: The loss of SCS Cobb angle was more pronounced in ODLP relative to t-ACCF, resulting in a significant compensatory increase in UCS and atlantoaxial Cobb angle. The ROM of the UCS, atlantooccipital, and atlantoaxial joints was significantly increased. This may accelerate degenerative changes in the occipital-atlantoaxial complex, leading to poorer outcomes in the long term. In contrast, t-ACCF better maintains normal curvature of the SCS and occipito-atlantoaxial complex but loses more ROM.

Keywords Ossification of the posterior longitudinal ligament, Anterior cervical corpectomy and fusion, Open-door laminoplasty, Cervical atlas, Axis

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Classifying Hand Dexterity Impairment in Degenerative Cervical Myelopathy with 10-Second Grip and Release Test

Objective: This study aimed to establish optimal cutoff values for the 10-second Grip and Release (10s-G&R) Test to distinguish between mild, moderate, and severe levels of hand dexterity impairment in patients with Degenerative Cervical Myelopathy (DCM).

Background: The 10s-G&R test is widely utilized to assess hand function in DCM patients. However, whether this test can effectively distinguish between varying severities of hand dexterity impairment, along with the relevant cut-off values, remains unknown.

Methods: We analyzed hand motion data from 551 consecutively enrolled DCM patients using our AI system. Additionally, we conducted evaluations of functional status, quality of life, and various outcome measures. Receiver operating curve analysis was performed to determine cutoff values that differentiate mild, moderate, and severe hand dexterity impairments based on the ability to fasten front buttons, as assessed by the Japanese Orthopaedic Association Cervical Myelopathy Evaluation Questionnaire (JOACMEQ) Q2-1. The validity of these cutoffs was assessed by comparing G&R parameters, upper limb disability, overall disease severity, and quality of life among patients in different severity groups.

Results: We identified 16 G&R cycles as the cutoff for moderate hand dexterity impairment and 13 G&R cycles as the cutoff for severe impairment. Patients with severe impairment exhibited significantly worse G&R parameters, more severe upper limb symptoms, greater overall disease severity, and reduced quality of life. Patients completing fewer than 13 G&R cycles within 10 seconds were more likely to have moderate-to-severe DCM, indicating a need for surgical intervention.

Conclusion: We propose classifying mild hand dexterity impairment as 17-20 cycles on the 10s-G&R test, moderate as 14-16 cycles, and severe as 13 cycles or less. Our study underscores that the 10s-G&R test serves as a crucial supplementary tool with the current comprehensive evaluation systems.

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A novel MRI-based Cervical Endplate Bone Quality score independently predicts cage subsidence after Anterior Cervical Diskectomy and Fusion

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BACKGROUND CONTEXT: Postoperative cage subsidence after Anterior cervical discectomy and fusion (ACDF) often has adverse clinical consequences and is closely related to bone mineral density (BMD). Previous studies have shown that cage subsidence can be better predicted by measuring site-specific bone density. MRI-based Endplate Bone Quality (EBQ) scoring effectively predicts cage subsidence after lumbar interbody fusion. However, there is still a lack of studies on the practical application of EBQ scoring in the cervical spine.
PURPOSE: To create a similar MRI-based scoring system for Cervical Endplate Bone Quality (C-EBQ) and to assess the correlation of the C-EBQ with Endplate computed tomography (CT) Hounsfield units (HU) and the ability of this scoring system to independently predict cage subsidence after ACDF, comparing the predictive ability of the C-EBQ with the Cervical Vertebral Bone Quality (C-VBQ) score.
STUDY DESIGN/SETTING: A retrospective study.
PATIENT SAMPLE: A total of 82 patients who underwent single-level ACDF for degenerative cervical spondylosis at our institution from 2016 to 2022 who underwent preoperative MRI.
OUTCOME MEASURES: Cage subsidence, Cage height, Cervical endplate bone quality (C-EBQ) score, Cervical vertebral bone quality (C-VBQ), Endplate Hounsfield units (HU).
METHODS: Demographics, procedure-related data, and radiological data were collected, and Pearson's correlation test was used to determine the correlation between C-EBQ and endplate HU values. Cage subsidence was defined as fusion segment height loss of ≥3 mm. Receiver operating characteristic analysis and area-under-the-curve values were used to assess the predictive ability of C-EBQ and C-VBQ. A multivariate logistic regression model was developed to identify potential risk factors associated with subsidence.
RESULTS: Cage subsidence was present in 33 (40.24%) of 82 patients. The mean C-EBQ score was 1.81 ± 0.35 in the group without subsidence and 2.59 ± 0.58 in the group with subsidence (P < 0. 001). Multivariate analysis showed that a higher C-EBQ score was significantly associated with subsidence (OR=5.700; 95%CI=3.435-8.193; P<0.001), was the only independent predictor of cage subsidence after ACDF, had a predictive accuracy of 91.7%, which was superior to the C-VBQ score (89.2%), and was significantly negatively correlated with the end-plate HU value (r2 = -0.48, P <0.001).
CONCLUSIONS: Higher C-EBQ scores were significantly associated with postoperative cage subsidence after ACDF. There was a significant negative correlation between C-EBQ and endplate HU values. The C-EBQ score may be a promising tool for assessing preoperative bone quality and postoperative cage subsidence and is superior to the C-VBQ.
KEY WORDS: Anterior cervical discectomy and fusion, C-EBQ score, Cage subsidence. Cervical Endplate Bone Quality score, MRI

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Surgical Management of Atlantoaxial Dislocation with Extensive Bone Fusion

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Background: Atlantoaxial dislocation (AAD) represents a severe deformity in the upper cervical spine, often leading to spinal cord compression. In addition to reducible and irreducible types, AAD can present with a type characterized by extensive bone fusion, making reduction challenging. To date, surgical approaches for this specific type of AAD have not been well documented.
Objective/Aim: This study aims to present the clinical characteristics, surgical approaches, and outcomes of patients with AAD associated with extensive bone fusion.
Methods: We report on three cases (2 females, 1 male; age range 34-61 years) of AAD with extensive bone fusion at the lateral mass joints. Associated conditions included basilar invagination in one patient and ankylosing spondylitis with atlantoaxial rotatory dislocation, in another. Two patients presented with significant neurological symptoms.
Results: Surgical interventions varied: two patients underwent transoral atlantoaxial osteotomy and TARP plate fixation, while the third, at risk of vertebral artery injury during planned osteotomy, received posterior atlantoaxial osteotomy and screw-rod fixation. Postoperatively, all patients achieved satisfactory reduction with significant improvement in neurological symptoms (Figure 1-3).
Conclusion: Osteotomy is necessary for reduction in AAD with extensive bony fusion, presenting higher surgical difficulty and risk compared to other AAD types. Either transoral or posterior surgical approaches can be considered, but the relationship between the osteotomy site, vertebral artery, and spinal cord must be meticulously evaluated to avoid potential injuries. This emphasizes the need for meticulous preoperative planning and intraoperative vigilance to ensure patient safety and optimize outcomes in these complex cases.

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A Special type of Cervical Ossification of the Posterior Longitudinal Ligament

Objective: Cervical Ossification of the Posterior Longitudinal Ligament (OPLL) is a pathological process whereby lamellar bone is deposited on the posterior longitudinal ligament, leading to limited cervical motion and spinal cord compression. This study aimed to report and investigate a special type of OPLL while evaluating the operation scheme for this condition.
Methods: This retrospective study involved 335 consecutive patients with OPLL. We investigated the epidemiological characteristics of a special type of OPLL defined as a "seesaw"-like OPLL, which was observed on hyperextension and hyperflexion X-rays. The X-rays showed that OPLL was swinging in the spinal canal, reducing spinal canal volume. All patients underwent laminectomy and fusion.
Results: Out of 335 consecutive cases of cervical OPLL, 37 cases of "seesaw"-like OPLL (SOPLL) were included. SOPLL patients accounted for 11.04% of the total OPLL patients in this study. In all patients with SOPLL, the proportion of patients who had a cephalic type of ossification area was higher (34, 91.89%) than those with a caudal type of calcification area (3, 8.11%). There were no cases of epidural hematoma or internal fixation failure, but two cases of superficial infections were reported,

and both healed well after the application of antibiotics. At the final follow-up visit, all patients achieved significant improvement in neurological function compared to pre-operation.

Conclusions: Therefore, we believe that for long-segment non-fused continuous OPLL, careful evaluations of hyperextension and flexion radiographs are crucial, and simply evaluating the stability, curvature, and K-line of the cervical spine is not sufficient. In patients with "seesaw"-like OPLL, laminectomy and posterior fusion is appropriate surgical method.

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Immunoreceptor CD300a blockage promotes functional recovery after spinal cord injury in mice

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Background: Efficient clearance of apoptotic cells is crucial in preventing secondary injury expansion after spinal cord injury (SCI). The phosphatidylserine receptor CD300a is an immunoreceptor expressed on the dendritic cells and macrophages that regulate efferocytosis. A recent report indicated that CD300a deficiency enhanced efferocytosis by myeloid cells and treatment with an anti-CD300a neutralizing antibody ameliorated the neurological deficit in a rodent model of ischemic stroke.

Objective: This study investigates to evaluate the effect of CD300a blockade with an anti-CD300a neutralizing antibody in acute SCI.

Methods: Female C57BL/6J mice underwent laminectomy at T10 vertebral level and their spinal cords were injured with a 70 kdyn using an Infinite Horizon impactor. The antibody group (Group A) received 400 μg/200 μl of anti-CD300a neutralizing antibody immediately after SCI, and the control group (Group C) received normal saline. Hindlimb motor function was assessed up to 6 weeks after SCI using the Basso Mouse Scale (BMS). Histological analysis of the spinal cord utilized Hematoxylin-eosin（HE） and Luxol fast blue（LFB） staining for evaluating injury and residual myelinated areas.

Results: At 6 weeks after SCI, BMS was 4.3±0.3 in group A and 3.1±0.3 in group C. Group A demonstrated significant behavioral improvement compared to group C over 6 weeks after SCI (repeated major ANOVA, $p<0.05$). Histological examination revealed a smaller injured area in group A compared to group C in HE staining at 6 weeks after SCI. In addition, the percentage of residual myelinated area in LFB staining was higher in group A.

Conclusion: In a SCI mice model, anti-CD300a antibody administration enhanced hindlimb motor function for 6 weeks after SCI, reducing the injured area and preserving the myelin. The results suggest that CD300a blockade has neuroprotective effects in acute SCI and relieves the secondary injury to the spinal cord.

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Progressive syringomyelia in old age due to Chiari malformation type 1 and retro-odontoid pseudotumor

Introduction: Chiari malformation type I has a bimodal peak of incidence in childhood and middle age, but is rare in the elderly. We report a case of a 84-year-old woman with Chiari malformation and syringomyelia who developed foramen magnum stenosis due to a retro-odontoid pseudotumor(RPT) during follow-up for more than 20 years, worsened neurological symptoms, and whose symptoms improved by surgery.

Case report: The patient was an 84-year-old woman. She was diagnosed with Chiari malformation type I at the age of 61. The patient also had syringomyelia, which was symptomatic and indicated for surgery, but conservative treatment was performed at the patient's request. At the age of 83, her neurological symptoms worsened and she had difficulty walking. An MRI scan of the cervical spine at that time revealed a RPT. The appearance of a RPT due to age-related changes is thought to have caused progressive impairment of spinal fluid distribution in the subarachnoid space at the craniocervical transition, resulting in progressive syringomyelia and neurological symptoms. Compared to previous cervical spine MRIs, the finding of syringomyelia was enlarged cranial side, and a foramen magnum decompression was performed at age 84 years. DuraGen® was used for duraplasty. Postoperatively, the patient had no complications such as CSF leakage or meningitis. Cervical spine MRI showed improvement in the findings of syringomyelia. The patient was discharged home with improvement in gait disturbance.

Conclusion: We have experienced a case of an elderly patient with a Chiari malformation with syringomyelia who developed a RPT during conservative treatment and had worsening neurological symptoms, which was treated surgically and resulted in a good outcome. We believe that even in elderly patients, improvement may be achieved if the cause of symptoms is carefully investigated and the indications are carefully selected.

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Reverse translational research on Muse cells therapy for spinal cord injury from acute to chronic phase.

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Background: Multilineage-differentiating stress enduring (Muse) cells are endogenous pluripotent stem cells characterized by ease and safety of administration without pre-differentiation induction, and their clinical application is highly promising. Although animal studies have demonstrated the efficacy of Muse cells in acute spinal cord injury and clinical trials have affirmed their safety, the optimal timing of administration remains undetermined.

Objective: This study aims to elucidate the optimal timing for Muse cell administration through a reverse translational approach, providing foundational data for the development of clinical trial protocols.

Methods: A severe spinal cord injury model was created in 8- to 9-week-old female C57BL/6J mice by applying a 70-kdyne contusion injury with an IH impactor. Cells were administered to four different times: 2-, 8-, 14-, and 28-days post-injury. Intravenous administration was employed for three groups: control (PBS), mesenchymal stem cell (MSC:5.0x104 cells), and Muse cell (5.0x104 cells). Hindlimb paralysis was assessed using the Basso mouse scale (BMS).

Results: At 10 weeks, no significant difference in BMS was observed in the 14- and 28-day post-injury groups. In the 8-day post-injury group, the BMS at 6 weeks showed no significant difference among the three groups (control: 2.9±1.0, MSC: 3.1±1.0, Muse cell: 3.8±1.5; ANOVA: p 0.29). In the 2-day post-injury group, a significant difference was noted between the control (2.8±1.0), MSC (3.5±1.0), and Muse cell (4.6±1.3) groups (repeated major ANOVA: $p<0.01$). Behavioral improvement in the Muse cell group occurred after 2 weeks compared to the control group. No significant difference was observed between MSC and Muse cells.

Conclusion: The findings suggest that acute Muse cell administration may be more effective in a severe spinal cord injury mouse model. While a trend of improvement in the Muse cell-treated group, especially in the 2-day post-injury group, was noted compared to MSCs, it did not reach statistical significance.

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Halo traction combined with posterior-anterior approach correction for severe Cervicothoracic junctional kyphosis with Neurofibromatosis-1: minimum 2 years follow-up

Background: Surgical treatment of cervicothoracic junction kyphosis in patients with NF-1 is challenging.

For the surgical treatment of NF1 spinal deformity, low-level osteotomy and 360-degree fusion are the recommended treatment. However, the choice of surgical strategy and application of Halo traction used in cervicothoracic junctional kyphosis with NF-1 remain controversial.

Objective/Aim: The aim of this study is to evaluate the safety and the effectiveness of halo Traction combined with posterior and anterior approach correction for treatment of Cervicothoracic junctional kyphosis greater than 100 degree with NF-1.

Methods: 5 patients with severe Cervicothoracic junctional kyphosis more than 100 degree due to NF-1 were reviewed retrospectively between January 2016 and December 2020. All the cases underwent halo-pelvic or halo-Vest traction combined with posterior-anterior instrumentation and fusion surgery. Correction result, neurologic status and complications were analyzed.

Results: In our cohort， cervical kyphosis Cobb angle decreased from initial 101.3 ± 12.7 degrees to postoperative 20.6 ± 7.7 degrees (P<0.01).C2-C7 SVA decreased from 64± 11.7 mm to 21±5.4 mm from halo traction. JOA scores were improved from preoperative 15.4 ± 1.3 to postoperative 16.8 ± 0.3 (P<0.01). Neurological status was also improved. There was no correction loss and the neurological status was stable in mean 24 months follow-up.

Conclusion: Halo traction combined with Posterior-Anterior approach surgery is safe and effective method for severe Cervicothoracic junctional kyphosis in patients with NF-1. A satisfied correction result, and successful bone fusion can be achieved via circumference instrument fusion.

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Application of 3D printed personalized prosthesis in cervical tumor resection and reconstruction

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Objective: To investigate the feasibility and safety of application of 3D printed personalized prosthesis in cervical tumor resection and reconstruction.

Methods: Fourteen patients with tumors of the cervical spine underwent resection via a one-stage combined anteroposterior approach using 3D printed personalized prosthesis in our hospital from March 2015 June to June 2018 June. They comprised eight men and six women of mean age 56.2 years (range, 32–68 years)(8 primary bone tumors and 6 solitary metastases). A anteroposterior reconstruction was performed by 3D printed personalized prosthesis and spinal instrumentation in all cases. Surgical time, blood loss, visual analogue score (VAS), cervical spinal cord function score of Japanese orthopaedic association (JOA) and complications were recorded.

Results: All patients underwent tumor resection via a combined posterior and anterior approach in one stage. Mean operative time and estimated blood loss were 529 minutes and 1134 mL. Nerve root involved by tumor was sacrificed in two patients with preoperative upper extremity weakness. One vertebral artery was ligated. Two patients had respiratory difficulties and pneumonia after surgery postoperatively. Preoperative pain disappeared and function improved in all patients. The VAS score at 3 months after surgery was 2~ 4, with an average of (1.90±0.55), and the JOA score at 3 months after surgery was 12 ~ 17, with an average of (15.26±0.73). No complications such as loosening, displacement and fracture were observed.

Conclusion: Preliminary results suggest that 3D printed personalized cervical prostheses can be effectively used in cervical tumor removal and reconstruction surgery.

Key words: Cervical tumor; 3D Printing; Surgical procedures; personalized prosthesis

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Cervical deformity in metatropic dysplasia

Background: Metatropic dysplasia is a genetic disease related to mutations in the TPRV4 gene. It is a rare skeletal dysplasia characterized by rapid collapse of the thoracolumbar spine into kyphoscoliosis. It will also be accompanied by some characteristic cervical spine deformities.

Objective/Aim: By reviewing the imaging findings of these cases in our center, we want to summerize the characteristics of skeletal deformities and neurological deformities in the cervical region in patients with metatropic dysplasia

Methods: A retrospective review of 6 cases of metatropic dysplasia was performed. The X-Ray film， Computer Temography and Magnetic Resonance Imaging of these patients were reviewed. The preoperative and postoperative JOA scores and NDI scores of these patients were also reviewed

Results: 5 patients had odontoid hypoplasia and atlantoaxial instability leading to cervical myelopathy.6 patients had cervical stenosis. All these patients had more or less neurological insufficiency.

Conclusion: Despite the challenges provided by this patient population, the chance to halt or reverse neurological dysfunction and improve deformity necessitates prompt surgical intervention. Decompress the stenotic segments should be considered in conjunction with spinal fusion for treatment of odontoid hypoplasia or atlantoaxial instability.

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Impact of uniformly right-side opening laminoplasty on postoperative C5 palsy in patients with degenerative cervical myelopathy

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Introduction: C5 palsy is important complication after unilateral open door laminoplasty (UODL). Many studies had evaluated the risk factors for C5 palsy, but there were few studies about the relationship between lamina opening side and C5 palsy. The aim of this study is to evaluate the impact of uniformly right-side opening laminoplasty on C5 palsy according to preoperative dominant cord compression side and symptom side.
Materials/Methods: Degenerative cervical myeloradiculopathy underwent UODL and followed-up for more than two years were included. UOLD was uniformly performed on the right side and hinge was on the left side in all patients. Patients were sub-grouped based on preoperative dominant 3 characteristics: cord compression side, myelopathy symptom side and radiculopathy symptom side (right, symmetric and left). Occurrence of C5 palsy and C5 palsy side were analyzed for each sub-group.
Results: A total of 368 patients were included. C5 palsy incidence was 4.35% (16/368). Four (25%) occurred from the right side and 12 (75%) from the left side. All patients recovered from palsy. According to dominant preoperative cord compression side, C5 palsy rate was not differ in each sub-group. Right and left ratio was respectively 2:2, 2:6 and 0:4. According to dominant preoperative myelopathy symptom side, C5 palsy rate was not differ in each sub-group. Right and left ratio was respectively 1:3, 3:4 and 0:5. According to dominant preoperative radiculopathy symptom side, C5 palsy rate was not differ in each sub-group. Right and left ratio was respectively 1:3, 2:1 and 1:8.
Conclusion: In this study, the occurrence of C5 palsy after uniformly right-side opening laminoplasty was not affected by preoperative dominant cord compression or symptomatic side. Although there was no statistical significance, the patients with preoperatively dominant left-side radiculopathy tend to reveal postoperative left-side C5 palsy and overall occurrence of C5 palsy was higher in the left-side than in the right-side. Further large-scale research is needed in the future.
Keywords: C5 palsy, Unilateral open-door laminoplasty, Lamina opening side, Degenerative cervical myelopathy

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Biomechanics and outcome following contiguous anterior fusion for noncontiguous cervical spondylotic myelopathy: The whole is greater than the sum of its parts

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Background: Noncontiguous cervical spondylotic myelopathy (NCSM) is characterized by segments with significant degeneration at both ends and an intermediate segment showing no apparent degeneration.
Aim: To investigate the outcome and biomechanical analysis of anterior cervical decompression and fusion (ACDF) with or without contiguous fusion for treatment of NCSM.
Methods: The patients with NCSM in our department between January 2018 and October 2022 were divided into the contiguous fusion (CF) and noncontiguous fusion (NF) groups, and clinical outcomes and radiographic parameters were evaluated at routine postoperative intervals. The finite element models based on MRI data of two groups were established, enabling the analysis of biological stress in the cervical spine. Clinical outcomes were assessed using the average operative time, blood loss, Japanese Orthopaedic Association (JOA), neck disability index (NDI) and visual analogue scale (VAS), while radiographic outcomes included C2-C7 range of motion (ROM). Complications were also evaluated.
Results: 107 patients with MCSM were randomized to CF group (n = 52) and NF group (n = 55), and followed up for average 30.2 months. Average operative time and blood loss decreased significantly in the NF. For VAS and JOA score improved significantly in CF group than that in NF group. The ROMs of the CF group were markedly decreased at the operated levels, while the corresponding ROMs of the NF group were similar to those of the intact spine in all directions. However, longitudinal stress distribution of intervertebral disc and facet joints of intermediate segment in NF group was increased, especially for patients of NCSM involve C5 level.
Conclusion: The ACDF with contiguous fusion does not experience additive stress in the intervertebral disc or facet joints of NCSM patients, especially involve C5 level fusion, which has fewer biomechanical effects and better outcomes than does noncontiguous fusion.

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A comparative study of the effect of facet tropism on the index-level biomechanics after artificial cervical disc replacement with Prestige LP, Prodisc-C vivo, and Mobi-C

Backgound: Artificial cervical disc replacements (ACDR) have been found to potentially redistribute more load to the facet joints, which may lead to axial pain in some patients postoperatively. And some studies have indicated that facet tropism is prevalent in the lower cervical spine and can significantly increase facet joint pressure.
Objective: The present study aims to investigate the changes in the biomechanical environment of the cervical spine after ACDR using different prosthese when facet tropism is present.
Methods: A C2-C7 cervical spine finite element model was created. Symmetrical, moderate asymmetrical (7 degrees tropism), and severe asymmetrical (14 degrees tropism) models were created at the C5/C6 level. C5/C6 ACDR with Prestige LP, Prodisc-C vivo, and Mobi-C were simulated in all models. A 75 N follower load and 1 N·m moment was applied to initiate flexion, extension, lateral bending, and axial rotation, and the range of motions (ROMs), facet contact forces(FCFs), and facet capsule stress were recorded.
Results: In the presence of facet tropism, all ACDR models exhibited significantly higher FCFs and facet capsule stress compared to the intact model. All ACDR model in the presence of facet tropism, exhibited significantly higher facet capsule stresses at all positions compared to the symmetric model. The stress distribution on the facet surface and the capsule ligament in the asymmetrical models was different from that in the symmetrical model.
Conclusions: The existence of facet tropism could considerably increase FCFs and facet capsule stress after ACDR with Prestige-LP, Prodisc-C Vivo, and Mobi-C. None of the three different designs of implants were able to effectively protect the facet joints in the presence of facet tropism. Research into designing new implants may be needed to improve this situation. More attention should be paid to facet tropism when planning surgery and selecting implants.

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Effects of early hyperbaric oxygen therapy on neurological function recovery after ACDF

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Objective: To explore the therapeutic effects of hyperbaric oxygen on neurological function recovery in patients with cervical spinal cord injury after ACDF surgery.

Methods: We analyzed the clinical data of 30 patients admitted in out department with cervical spinal cord injury from March 2021 to March 2023. All the patients underwent anterior cervical decompression and fusion (ACDF) operation. Among them, patients were classified into early hyperbaric oxygen therapy group (14 cases) and non-hyperbaric oxygen therapy group (16 cases). Patients in early hyperbaric oxygen therapy group received hyperbaric oxygen treatment within 24 hours after ACDF and received physical therapy simultaneously. Patients in non-hyperbaric oxygen therapy group only received physical therapy. All patients were followed up for 6-12 months. We compared the basic clinical information of both groups. Neurological function recovery was assessed before surgery and 1 month and 6 months after ACDF surgery by American Spinal Injury Association (ASIA) Impairment Scale and Japanese Orthopaedic Association Scores (JOA).

Results: The results showed no significant differences in patients' gender, age, injury site, operative segment, operation time, and wound drainage after surgery. The results showed that ASIA sensory and motor function scores and JOA scores improved in both groups, but patients in early hyperbaric oxygen group bad a better neurological function recovery than non-hyperbaric oxygen group at the time points of 1 month and 6 months.

Conclusion: Early hyperbaric oxygen has promotive effects on neurological function recovery in patients with cervical spinal cord injury after ACDF surgery, and the earlier application, the better prognosis. Routine use of hyperbaric oxygen as soon as possible after surgical treatment of cervical spinal cord injury can help improve the quality of life.

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Are there differences in outcome after posterior cervical foraminotomy performed for cervical radiculopathy caused by soft disc and hard disc?

Background: Posterior cervical foraminotomy (PCF) is a procedure widely applied for the treatment of cervical radiculopathy.

Objective/Aim : The study was conducted to compare the clinical and radiographic results of PCF between radiculopathy caused by soft disc (SD) and hard disc (HD).

Methods: 53 patients who underwent PCF for the treatment of cervical radiculopathy and were followed-up for more than 2 years were retrospectively reviewed. Patients whose causative pathology is identified as disc herniation were classified as soft disc group (SD group), while patients who had symptoms due to foraminal stenosis by osteophytes were included in the hard disc group (HD group). Patient characteristics, cervical lordosis, C2-C7 sagittal vertical axis (SVA), T1 slope, and patient reported outcome measures such as neck pain visual analog scale (VAS), arm pain VAS, and neck disability index (NDI) were retrospectively reviewed.

Results: 17 patients (32.1%) were included in the SD group, and 36 patients (67.9%) were included in the HD group. There were no significant difference in patient characteristics, cervical lordosis, C2-C7 SVA, and T1 slope between the two groups. Neck pain VAS, arm pain VAS, and NDI significantly improved after the operation in both groups. Patient reported outcome measures at each follow-up time point did not demonstrate significant difference. However, the amount of neck pain VAS improvement was significantly greater in the SD group (4.2±1.6 vs 3.1±3.6; p=0.04), while the amount of arm pain VAS improvement was significantly greater in the HD group (3.6±3.8 vs 5.3±4.3, p=0.03).

Conclusion: Despite baseline disc space narrowing and narrower dimension of neural foramen in HD group, PCF still demonstrated favorable clinical outcome. Therefore, PCF can be resorted to cervical radiculopathy patients without much concern for poor clinical result caused by preoperative spondylosis.

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Comparison of mid-term effects of C3-6 and C3-7 open-door laminoplasty in patients without spinal cord compression at C7 segment

Background: The traditional single-door cervical spine surgery is performed from C3 to C7 segments, even in cases without spinal cord compression at C7 segment. However, the C7 spinous process is the origin and endpoint of many important neck and back muscles, so it is unclear whether retaining the C7 segment in cases without spinal cord compression will bring any benefit.

Objective: To compare the mid-term effects of open-door laminoplasty of C3-C6 and C3-C7 in patients with cervical spondylosis without obvious spinal cord compression at C7 segment.

Methods: Patients who underwent open-door laminoplasty of C3-6 and C3-7 and whose preoperative cervical spine MRI showed no compression of the spinal cord behind C6/7 and C7 vertebrae were included in the study, including 41 cases in the C3-C6 group and 48 cases in the C3-C7 group. The cervical curvature, neck pain VAS score, JOA and NDI scores, and the incidence of C5 nerve root palsy and axial pain were compared.

Results: The average follow-up time of the two groups was 38.4 months. There was no statistically significant difference between the two groups in terms of operation time, postoperative hospital-stay, intraoperative blood loss, and preoperative and postoperative cervical Cobb angle. There was no significant difference in VAS scores, JOA scores, NDI scores, between the two groups before, one year after surgery, and at the final follow-up. There were 6 patients with postoperative axial symptoms in the C3-6 group and 18 patients in the C3-7 group. The difference between the two groups was statistically significant. One patient in the C3-6 group and 2 patients in the C3-7 group suffered from C5 nerve root paralysis, and there was no statistically significant difference between the two groups.

Conclusion: Cervical open-door laminoplasty that preserves the C7 segment can ensure the spinal cord decompression effect while reducing the incidence of postoperative axial pain for patients without spinal cord compression at the C7 segment.

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Clinical outcomes of Unilateral Biportal Endoscopy decompression for degenerative lumbar canal stenosis in the elderly population - A single-center retrospective study

Background: Unilateral biportal endoscopic (UBE) decompression is a minimally invasive technique for treating degenerative lumbar canal stenosis (DLCS) in elderly patients allowing decompression with minimal spinal trauma and preserving motion. Elderly population is frail and standard open surgeries have increased risk of peri and post-operative complications/morbidities.

Aim: The current study aims to find clinical outcomes of UBE decompression for DLCS amongst the elderly frail population.

Methods: After obtaining Institutional Review Board (IRB) approval, we performed a single-center retrospective study and included patients who underwent UBE for DLCS from Jan 2022 to Oct 2023 with a minimum of six months of follow-up. Patient demographics, peri-operative data, frailty status using modified Frailty index (mFI), and length of hospital stay (LOS) were reviewed. Clinical outcomes were assessed using VAS scores for back and leg pain, ODI for back pre-operatively and at 1 and 6 months, and the modified Macnab criteria at the final follow-up. A repeated ANOVA test was performed to measure the difference between VAS and ODI scores.

Results: 20 patients (M: 8, F: 12) with a mean age of 81.4±3.2 were included. The mean follow-up period was 12.4±3.8 months. The mean mFI score was 0.27. The average surgical time was 69.6±16.8 mins. The average LOS was 1.6±0.5 days. At the final follow-up, the mean VAS for leg pain improved from 7.3±0.7 to 0.8±0.6 (89% improvement) and the mean VAS for back pain improved from 3.7±0.5 to 2.3±0.5 (39% improvement).ODI score improved from 22.9±2.5 to 6.7±0.3 at the final follow-up (71% improvement). The modified Macnab criteria reported 80% excellent and 20% good outcomes. There were 2 dural tears which were repaired primarily with no return to theatre.

Conclusion: The current study concludes that UBE is a safe and effective surgical treatment amongst the elderly frail population for DLCS with excellent clinical outcomes.

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Spontaneous resolution of syringomyelia after development of a cervical disc hernia

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INTRODUCTION: Syringomyelia is a disorder in which a fluid filled cyst develops within the spinal cord. It is assumed to be caused by disturbed flow of cerebrospinal fluid (CSF), with Chiari malformation type 1 as its leading cause. However, little is known about syringomyelia unrelated to Chiari malformation.

CASE SUMMARY: A healthy 27-year-old woman presented with a two-month history of numbness in her right upper arm. On physical examination, there was decreased sensation to touch in the right arm and leg, hyperalgesia the right arm, and hypalgia in the torso corresponding to levels C5-T3. Sense of temperature and deep sensibility were intact. Magnetic resonance imaging (MRI) of the spine revealed syringomyelia at C7-T1 but no signs of Chiari malformation or tethered cord syndrome. Neurological findings were inconsistent with the MRI findings, and the patient was scheduled for routine follow-up. MRI findings did not change until nine years after the primary visit, when a cervical disc herniation at C3/4 appeared along with a decrease in syrinx size. Meanwhile, the numbness in the right arm had improved. There was hyperreflexia at the left brachioradialis tendon, triceps tendon, patella tendon, and Achilles tendon implying the effect of C3/4-disc herniation rather than syringomyelia. Spinal cord compression was minimal and conservative treatment was continued. A year later, the cervical disc herniation had spontaneously resolved along with a slight enlargement of the syrinx. The patient is continued on annual follow-up, and no significant changes have appeared. DISCUSSION The pathophysiology of syringomyelia related to Chiari malformation are commonly described by the hydrodynamic theory represented by Gardner's "water-hammer theory" or William's pressure gradient theory. The transmedullary theory, which describes CSF permeation through the spinal cord surface as the cause of syringomyelia, also notes pressure dynamics in the spinal canal and may support the clinical course of this case

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PROGNOSIS OF POSTERATIVE C5 PALSY AFTER ANTERIOR CERVICAL DISCECTOMY AND FUSION

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Background: Postoperative C5 palsy is a relatively common complication after cervical spine surgery. Previous studies have attempted to identify pathogenesis of postoperative C5 palsy followed cervical surgery, and its prognosis is known as relatively good but the issue has not been clarified well and the number of studies analyzing C5 palsy after anterior cervical surgery is relative small. Objective and aim: Here, we report 3 cases of C5 palsy after anterior cervical discectomy and fusion (ACDF) with literature review. Two patients diagnosed with cervical spondylotic myelopathy, one patients diagnosed with cervical spondylotic radiculopathy.

Methods: Between January, 2018 and March, 2023, 53 patients of 166 patients was included and 3 patients experienced unilateral deltoid palsy immediately after ACDF of 2 or more levels. Results The C4-C5 level was involved in all of 3 cases, which is the most stenotic level at the posterior edge of excavated vertebra with OPLL or herniation of disc. It is possible that tethering of C5 nerve root caused the C5 palsy. One patient had pre-existing asymptomatic damage at the anterior horn cell at the gray matter of the spinal cord which is in combination with nerve root lesion caused by disc extrusion. It is possible that postoperative upper extremity paresis might be induced by segmental cord disorder and reperfusion injury of the spinal cord. All patients of C5 deltoid palsy were completely recovered within10.6 week without treatment. Two patients was completely improved within 12weeks and one patient was recovered within 8weeks.

Conclusion: To reduce the C5 palsy during ACDF, surgeon should be care about meticulous approach to surgical lesion not only check the preoperative risk factors, which is OPLL, excavated vertebra of C4-C5, and pre-existing anterior horn cell damage, but also elaborate on natural history of C5 palsy to patient and care giver, which most C5 palsy will be recovered spontaneously without treatment. Acknoledgement : All author have no conflict of interest to declare. 1. Key words : C5 nerve root, cervical spine disease, ACDF

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Fate of large CSF leakage due to unrecognized incidental durotomy in the cervical spine surgery.

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Back ground: The CSF (Cerebrospinal fluid) leakage due to incidental durotomy might not be recognized during the surgery and sometimes postoperatively large volume of CSF leakage was found.

Objective/Aim: We tried to find out the fate of leaked large volume of CSF after cervical spine surgery without primary repair of unrecognized incidental durotomy.

Methods: Large volume of CSF leakage was found postoperatively in 31 patients among 2849 patients who underwent cervical spina surgery. MRI was taken in the 31 patients immediate postoperatively and at 6 month follow up. The leaked CSF volume was measured on immediate postoperative MRI and 6 month follow up. Four types of cervical spine surgery, such as posterior and anterior combined (PAP) surgery, laminoplasty, posterior fusion, and ACDF, were performed. Risk factors for CSF

leakage were also analyzed. Inter-observer and intra-observer reliability was evaluated. Statistical analysis was performed using independent sample T-test. Chi-square test, ANOVA test.

Results: The total incidence of the CSF leakage after cervical spine surgery was 1.09%. PAP surgery had highest incidence of 7.25% followed by laminoplasty (1.41%), posterior fusion (0.59%), and ACDF (0.34%). Leaked CSF volume was decreased in all patients. The mean spontaneous absorption rate at 6 months follow up was 94.95±6.41%. According to risk factor analysis, incidence of CSF leakage in revision surgery (4.67%) was higher than in primary surgery (0.95%) (p=0.000). The patients with OPLL or OYL showed 5.57% of incidence, compared with the patients without OPLL (0.48%) (p=0.000).

Conclusion: The majority of leaked CSF was spontaneously absorbed within 6 months without any reoperation for dural repair. The water tight suture of fascia is necessary for spontaneous absorption. Revision surgery and OPLL were risk factors for CSF leakage.

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In vivo three-dimensional motion study of C0-C7 cervical facet joints in healthy human

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Objective: Functional cervical motion is achieved by the intervertebral cervical segments with each being composed of an intervertebral disc (IVD) and two facet joints (FJs)， The facet joints (FJs) are a set of synovial joints playing important roles in guiding the spinal movements and transmitting the axial loading. However, there is rare report that can truly simulate the in vivo three-dimensional motion of the upper and lower cervical facet joints. Therefore, systematic and accurate quantification of the in vivo three-dimensional motion of the facet joints can help reveal the physiological motion characteristics of the whole cervical spine, to evaluate the recovery of different surgical methods and adjacent segment degeneration after cervical spine fusion, and to provide theoretical guidance for rapid rehabilitation after cervical spine surgery and cervical spine manipulation.

Methods: 20 healthy volunteers underwent C0-C7 cervical spine CBCT scans at 7 functional positions. The range-of-motion (ROM) of each facet joints and the overall cervical spine were measured using a 3D-3D registration technique.

Result: During flexion and extension of the cervical spine. In the upper cervical , the range of motion (ROM) of C0-C1 was 24.5±5.9°, the ROM of C1-C2 was 9.4±2.6°, in the lower cervical facet joints , C4-C5 have the largest ROM which was 10.4±1.7°， the ROM of C2-C3 was 4.1±1.9° and C6-C7 was 5.0±1.8° which were smaller than the others. During axial twisting, the average axial rotation ROM of the C1-C2 was 51.4±5.1°, the ROM of C0-C1 was 3.8±2.5°. During lateral bending, in the upper cervical , the ROM of C0-C1 was 3.5±1.6°， the coupled flexion-extension rotation and axial rotation were 3.0±2.0° and 2.9±1.8°. The ROM of C1-C2 was 8.7±3.6°， the coupled flexion-extension rotation and axial rotation were 9.8±2.3° and 24.5±7.8°.

Conclusion: The study displayed that the upper cervical facet joints including the atlantooccipital joint and atlantoaxial lateral mass joint(C0-C2) have unique movement characteristics. in patients with multiple injuries caused by high-energy violence, it is necessary to pay attention to whether there is damage to the cervical facet joints, especially the upper cervical spine.

Keywords: Cervical facet joints; Three-dimensional kinematics; Cone beam computed tomography; 3D-3D Registration Technology; Six degrees of freedom

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Development of a Web Application for Predicting AIS at Discharge in Spinal Cord Injury Patients: A Machine Learning Approach

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Background: Precise ASIA Impairment Scale (AIS) prediction at discharge for spinal cord injury (SCI) patients is crucial for guiding treatments, indicating regenerative medicine, and rehabilitation. Machine learning (ML) models are a promising tool to improve such prognostic accuracy and aid clinical decisions.

Objective: We aimed to create an ML model that predicts discharge AIS, identify predictive factors, and integrate this model into a web application.

Methods: In a retrospective cohort study design, data from a nationwide database in Japan, the Japan Rehabilitation Database (JARD), consisting of records from 1991 to 2015, were employed. JARD contains both the SCI patients admitted to the SCI center right after the injury and the SCI patients referred to a rehabilitation hospital following acute phase treatment. 3,703 cases formed the study cohort. Patient demographics, SCI-specific characteristics, and neurological evaluations at admission were used for ML model training. Utilizing the PyCaret library for preprocessing and validating the models, the best-performing algorithm was selected based on R^2, accuracy, and the weighted Kappa coefficient. Shapley additive explanations (SHAP) were used to determine the contribution of individual variables to the model's predictions. Using the optimal ML model and Streamlit, a web application to predict AIS at discharge was deployed.

Results: The study divided the dataset into 2,592 training cases and 1,111 testing cases. The best-performing model exhibited an R^2 of 0.869, an accuracy of 0.814, and a weighted Kappa of 0.940. Eleven significant variables were identified with SHAP, including AIS at admission, days from injury to admission, and the motor score of L3. Using Streamlit library, this best-performing model was deployed as an open access web application. (http://3.138.174.54:8502/)

Conclusion: The developed ML model demonstrates high accuracy in predicting the AIS at discharge, using eleven essential variables. It has been integrated into a publicly accessible web application.

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The trans-muscular space approach for cervical open door laminoplasty enhance the recovery process after the surgery

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Objective: To investigate the difference between the trans-muscular space approach and the conventional approach in the post-operative recovery process of cervical open door laminoplasty.

Methods: 116 patients underwent cervical open door laminoplasty between March 2021 and September 2022 were enrolled. Patients with trans-muscular space approach were listed as the TM group and patients with conventional approach were listed as the CV group. The operation time, drainage indwelling time, ambulation time, hospital stay, intraoperative blood loss, postoperative day 1 and day 2 drainage volume, postoperative total drainage volume, decreased volume of albumin and hemoglobin after the surgery， the VAS score of postoperative neck and shoulder pain， Barthel index and improvement rate of spinal cord function were compared between the two groups.

Results: The operation time in the TM group was almost double of CV group. The indwelling drainage time, ambulation time, hospital stay, intraoperative blood loss,postoperative day 1 and day 2 drainage volume, and total postoperative drainage volume in TM group were significantly lower than the CV group ($P < 0.05$). The postoperative reduction of hemoglobin and albumin in TM group was less than the CV group. The spinal cord function and Barthel index were all inproved after the surgery in both group. The VAS score of postoperative neck and shoulder pain was significantly lower than that of the control group ($P < 0.05$).

Conclusion: The trans-muscular space approach for cervical open door laminoplasty can enhance the process of post-operative recovery.

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Far Lateral and Transdural Approach in the Lateral Position for the Resection of Retro-Odontoid Pseudotumors

Background : A retro-odontoid pseudo-tumor (RPT) usually presents as atlantoaxial instability and is treated with fixation. However, the optimal surgical procedure for an RPT without instability is controversial. Surgical options include the anterior transoral approach, endoscopic endonasal approach, far lateral approach in the prone position, posterior epidural approach, C1 laminectomy or laminoplasty, and C1/2 fixation. Direct decompression via the far lateral approach in the prone position avoids fusion; however, the approach is difficult, especially for an RPT that is not dorsally exposed.

Objective: To present a series of patients who underwent surgery for an RPT via the far lateral and transdural approach (FLTDA) in the lateral position.

Methods: This was a single-center, retrospective, observational study.

Results: The cohort comprised two patients (a man in his 60s and a woman in her 70s) with severe compression due to an RTP and progressive myelopathy. The RPT was completely ventral and covered by the spinal cord. Direct decompression of the RPT was performed via the FLTDA. With the patient in the lateral position, a C1 hemilaminectomy, small suboccipital craniotomy, and resection of the condylar fossa were performed. The dura mater was incised to enable direct observation of the ventral side of the dural sac, which allowed for minimal spinal traction. The ventral dura was re-incised and the RPT was resected. No intraoperative complications occurred, and the myelopathy was immediately improved. Postoperative MRI revealed complete regression of the RPT. In 2 years and 6 months of follow-up, respectively, there has been no instability or need for fusion surgery.

Conclusions: The FLTDA is safe and effective for a ventrally positioned RPT in patients with progressive myelopathy. This procedure provides immediate improvement and direct spinal cord decompression without increasing the instability; it also avoids fixation and avoids the risk of infection inherent to the anterior approach.

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Comparison of neck pain related disability and cervical degenerative changes on Magnetic Resonance Imaging among Nepalese professional porters and white-collar workers.

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Background: Despite weak scientific evidence, neck pain is often linked to physical strain and degenerative changes in the cervical spine. Nepalese professional porters, using the traditional head strap “Namlo” around the forehead face extreme cervical axial spinal loads potentially leading to increased neck pain-related disability (NPRD) and degeneration.

Objective: This cross-sectional, case-control study aimed to assess whether porters have (1) more NPRD and neck pain (2) more cervical degeneration on MRI as compared to white-collar workers and (3) whether the severity of cervical degeneration is associated with NPRD.

Methods: The study compared 50 male porters with 50 age-matched white-collar workers (mean age 40 years in both groups) for neck disability index (NDI) as the primary outcome and EuroQol five dimensions three levels (EQ-5D-3L), numeric rating scales for neck pain (NRS-NP) and arm pain (NRS-AP) as the secondary outcome. Two radiologists assessed MRI for cervical degeneration (Pfirrmann grade, anterior osteophytes, posterior disc-osteophyte complex, foraminal stenosis, uncovertebral arthrosis, Schmorl’s node, Modic changes, canal stenosis, scoliosis, and kyphosis). Multiple linear regression analysed the association between cervical degeneration and NPRD.

Results: Porters, carrying load of 83 kilograms (SD ± 14.3) average of 9.8 hours/day (SD ± 0.8), 6 days/week (SD ±0.44) for 15 years (SD ±7.1) reported NDI (mean 11, 95% CI 9.4 – 12.5) compared to controls (mean 5.6, 95% CI 3.6 – 7.7). EQ-5D-3L, NRS-NP and NRS-AP results were consistent with these findings. The prevalence of cervical degeneration was similar between groups. None of the degenerative findings were associated with increased NPRD.

Conclusion: Porters reported slightly more neck pain-related disability than white-collar workers but did not exhibit more cervical spine degenerative changes. Severe cervical degeneration was not associated with increased NPRD in either group. The finding challenges the conventional belief that physical strain contributes cervical spine degeneration and neck pain in Nepalese professional porters.

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Surgical outcomes and complications of reconstructive surgery for cervical myelopathy with kyphotic deformity

Introduction: Posterior decompression alone is considered to be insufficient for the cervical spondylotic myelopathy (CSM) with kyphotic deformity. In such cases, decompressive and fusion surgery (anterior, posterior and antero-posterior combined) are used. In this study, surgical outcomes and complications of those surgeries were investigated.

Materials and Methods: Fifty-three CSM patients with kyphotic deformity who underwent reconstructive surgery and was followed-up more than 1 year, were enrolled in this study. There were 26 men and 27 women and their mean age was 63.9. Anterior surgery was done in 15 patients, posterior fusion surgery in 15 and antero-posterior combined surgery in 23.

Results: Average 3.6 levels were fixed. Mean surgical time and blood loss were 285 minutes and 248 ml respectively. JOA score was 10.0 preoperatively and 12.8 postoperatively, and improvement rate was 44.5%. Local alignment was 24.2 degrees kyphotic preoperatively, 0.4 lordotic after surgery and 2.6 kyphotic at final follow-up. C5 palsy was seen in 9 patients (17%). Two cases were accompanied by vertebral injury. Dysphagia was seen in 4 cases postoperatively

Conclusion: Reconstructive surgery could provide moderately good surgical results for cervical myelopathy with kyphosis. However, the rate of severe complications and supplemental surgery were high. Preoperatively we should carefully choose surgical procedure and explain the patients in detail, including complications.

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Comparison of Clinical Outcomes between Unilateral Biportal Endoscopic and Percutaneous Posterior Endoscopic Cervical Keyhole Surgeries for treatment of Cervical Spondylotic Radiculopathy.

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Background: Unilateral biportal endoscopic discectomy (UBE) is a rapidly growing surgical method that uses arthroscopic system for treatment of cervical spondylotic radiculopathy (CSR), while percutaneous posterior endoscopic (PE) cervical discectomy using keyhole technique has been considered as a representative minimally invasive spine surgery for CSR.

Objective: The purpose of this study was to compare the clinical and radiological outcomes of unilateral biportal endoscopic (UBE) and percutaneous posterior endoscopic (PE) cervical discectomy using keyhole techniques for treatment of cervical spondylotic radiculopathy.

Methods: Patients diagnosed with cervical spondylotic radiculopathy (CSR) treated by UBE or PE keyhole surgery from Jan 2017 to Oct 2022 were retrospectively analyzed. The length of incision, fluoroscopic time, operation time, blood loss and postoperative hospital stay length were compared. The clinical efficacy was assessed using a visual analog scale (VAS), neck disability index (NDI), and modified MacNab criteria. Moreover, the C2-7 Cobb's angle, range of motion (ROM), intervertebral height, vertebral horizontal displacement, and angular displacement of the surgical segment were measured.

Results: A total of 57 patients were enrolled, including 23 patients in the UBE group and 34 patients in the PE group, with a follow-up period of 12-48 months. Compared with PE group, UBE group required shorter fluoroscopic times (7.32 ± 1.25 vs. 9.53 ± 1.51 s) and operation times (56.31 ± 13.29 vs. 78.35 ± 23.16min) but led to higher total hospitalization costs and longer incisions. No significant differences were observed in the postoperative hospital stay, bleeding volume, VAS score, NDI score, effective rate, or complication rate between the UBE and PE groups. Both the C2-7 Cobb's angle and ROM increased significantly after surgery, with no significant differences between groups. There were no significant differences between intervertebral height, vertebral horizontal displacement, and angular displacement of the surgical segment at different times

Conclusion: Both UBE and PE keyhole surgeries in the treatment of CSR were effective and similar after 24 months. The fluoroscopic and operation times of UBE were shorter than those of PE.

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Hounsfield Unit in the upper cervical spine: A comparison between patients with sandwich fusion and normal controls

Background: Research on the sub-axial cervical spine has shown a high correlation between Hounsfield Units (HU) and bone mineral density (BMD).

Objective/Aim: This study aims to compare HU of the upper cervical spine in patients with concomitant C1 occipitalization and C2/3 non-segmentation(sandwich fusion), and those with normal anatomy of the craniovvertebral junction, and to use HU to evaluate bone quality in the upper cervical region.

Methods: CT scans of 198 patients with sandwich fusion were analyzed for HU of six regions of interest (ROI) in C2: A and B (left and right lateral mass), C (spinous process), D and E (left and right laminae, and F (vertebral body). 60 patients were above 50 years and were 1:1 matched by a control group with normal anatomy of the atlantoaxial region according to age and gender for whom lumbar spine BMD was available. We calculated the HU threshold values for screening bone loss and osteoporosis.

Results: In sandwich fusion patients, except for region F, all regions had lower HU values in males than in females. There was no significant correlation between HU and age. HU in region A, B and F was significantly higher than the other regions. In the control group, HU were significantly correlated with age, and the correlation coefficients between HU in various regions and DXA ranged from 0.422 to 0.702. The AUC for screening bone loss and osteoporosis was highest in region F in both cases (HU 336.2 and 257.3, respectively). The average HU of region F was 298.1 in the sandwich fusion group, compared to 325.1 in the control group.

Conclusion: The HU threshold values of the axial plane C2 vertebral body was 336.2 for predicting bone loss and 257.3 for predicting osteoporosis. Sandwich fusion patients had lower HU values compared to normal controls.

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How Does Cervical Sagittal Balance Change After Hangman Fracture Treated with Anterior or Posterior Approach Surgery?

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Background: Traumatic spondylolisthesis of the axis, also known as hangman fracture, is characterized by a bilateral arch fracture. The choice between anterior and posterior approaches in treating unstable hangman fracture should not be random. Although ACDF and posterior C2-C3 short-segment fixation and fusion have been proved to achieve health-related outcomes, controversy remains regarding their ability to correct deformity and sagittal imbalance.

Objective: To assess and compare clinical outcomes and sagittal balance after unstable hangman fracture between C2-C3 anterior discectomy and fusion (ACDF) and posterior C2-C3 short-segment fixation and fusion.
Methods: A total of 45 patients underwent ACDF (20 patients) and posterior C2-C3 short-segment fixation and fusion (25 patients). Visual analog scale, Neck Disability Index, Odom grading system, American Spinal Injury Association Impairment Scale (AIS), C2-C3 angle, displacement of C2-C3 (DC2-C3), occiput-C2 angle (O-C2 angle), cervical lordosis (CL), and C2-C7 sagittal vertical axis (cSVA) were assessed preoperatively and at final follow-up.
Results: The follow-up duration was 20.0 months in the anterior group and 19.0 months in the posterior group. The VAS score and NDI score were significantly lower than their respective preoperative score in each group ($P < 0.001$), whereas there was no difference between 2 groups ($P = 0.78$; $P = 0.85$). A statistically significant decrease of O-C2 angle and cSVA between preoperative and postoperative data was found in each group ($P < 0.001$), and CL increased statistically ($P < 0.001$). For O-C2 angle, CL, and cSVA, the changes of parameters after the posterior approach were more significant than after the anterior approach ($P < 0.05$).
Conclusion: Both anterior and posterior surgical techniques are effective for unstable hangman fracture and both can restore the sagittal balance of the cervical spine. Furthermore, the posterior approach has an advantage over the anterior approach in promoting recovery of cervical sagittal balance.

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Traumatic cervical spinal cord injury: relationship of MRI findings to initial neurological impairment

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Background: Traumatic cervical spinal cord injury (TCSCI) represents a significant health challenge in medicine. To date, several investigators have examined some objective parameters related to length, such as maximum spinal cord compression, for assessing cervical spinal cord compression, and demonstrated the relationship between the MRI measurements and the neurologic outcome. However, more detailed assessments of compression, using axial images and area calculations are still scant.
Objective: To quantify the degree of available space for the cord and cord swelling in patients following TCSCI, and to assess the relationship among the available space for the cord, cord swelling, and the severity of neurologic impairment.
Methods: This study included 91 patients. Maximum cord available area (CAAmax) and maximum cord swelling area (CSAmax) were measured by two blinded observers. The American Spinal Injury Association Impairment Scale (AIS) grades were used to evaluate the extent of neurological injury. Relationship among CAAmax, CSAmax, and initial AIS grades were assessed via univariate and multivariate analyses.
Results: Patients who were AIS grade A demonstrated significantly greater median CAAmax and CSAmax than AIS grade C or D ($P < 0.01$). Multivariate analysis identified only CAAmax (OR, 20.88 [95% CI, 1.50-291.21]; $P = 0.024$) and CSAmax (OR, 17.84 [95% CI, 1.15-276.56]; $P = 0.039$) were identified as independently influencing the likelihood of complete injury at the initial assessment. The classification accuracy were best for CAAmax and CSAmax; areas under the curve were 0.8998 (95% CI 0.7881-1.0000) and 0.9167 (95% CI 0.8293-1.0000), respectively.
Conclusion: The present study provides a novel radiologic method for identifying the severity of TCSCI with MRI findings. Greater available space for the cord (CAAmax > 38%) and cord swelling (CSAmax > 29%) can be used to identify patients at risk for TCSCI and both imaging characteristics are associated with an increased likelihood of severe neurological deficits.

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Cervical myelopathy caused by motor tics in a patient with Tourette's Syndrome A Case Report

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Background: Tourette's syndrome is a neurological disorder characterized by involuntary motor and vocal tics. Recent reports have highlighted a potential link between severe motor tics in Tourette's syndrome and the development of cervical myelopathy.
Case Presentation: A patient diagnosed with Tourette's Syndrome at the age of 10 exhibited violent cervical motor tics involving neck extension, rotation, jerking, and extremity posturing. Initially managed medically and with symptoms regressing over time, medications were discontinued at age 22. However, a gradual neurological decline ensued over six months marked by gait instability, neck pain, and motor skill deterioration. Neurological examination revealed spastic extremities and asymmetric motor strength. Cervical MRI showed a significant C2-C3 disc protrusion with resultant myelomalacia. Posterior decompression with spinal fusion was then performed.
Conclusion: The intricate relationship between severe motor tics in Tourette's syndrome and their potential progression to cervical myelopathy underscores the need for vigilance and multidisciplinary collaboration. While a direct causal link remains uncertain, the presented cases highlight the role of repetitive and forceful neck movements in potentially contributing to spinal instability and myelopathy. Timely diagnosis and intervention are crucial to address the evolving neurological deficits. This complex interplay emphasizes the importance of addressing both motor tic symptoms and their potential consequences on spinal health.

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The clinical effect analysis of minimally invasive Cervical Key-Hole Decompression on cervical spondylotic radiculopathy

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Aim and Scope: Cervical spondylotic radiculopathy（CSR） is the most common spine disease, and its incidence rate accounts for more than 60% of the cervical spondylosis. As a classic posterior operation, the Cervical Key-Hole Decompression（CKHD) has always been the standard surgical treatment for CRS. However, the problems such as nape muscular disorders and axial pain which were induced by CKHD affect patient satisfaction frequently. Recently, the development of UBE technique enable the application of minimally invasive non-fusion operation on CSR via spinal endoscopy solution. However, the standard UBE CKHD incisions often faces problems such as excessive nerve root traction and pedicle occlusion, which affect the safety and comfort of the endoscopic operation. Therefore, we attempt to improve the UBE CKHD procedure details such as the incision design, decompression range. Accordingly, we performed 8 surgeries using the improved UBE CKHD and achieved good results from January 2023 to August 2023.

Methods and result: Among the 8 patients admitted, there were 6 males and 2 females, aged 39 to 65 years old (average age 49.5 ± 9.2). We include single segment CSR patients who have not been effectively relieved by 3-6 weeks conservative treatment, and the clinical manifestation consistent with imaging examinations. Patients with cervical instability and inability to tolerate general anesthesia surgery before surgery will be excluded. Regarding to UBE CKHD surgical segments, there were 1 case of C4-5, 5 cases of C5-6, and 2 cases of C6-7. In addition, there were 3 cases of right compression and 5 cases of left compression. The UBE CKHD were performed under intravenous general anesthesia. The patients were in a prone position head high and feet low and a head rest keeps the cervical surgical area segment parallel to the ground. In terms of incision, two incisions (1cm operation portal and 0.5cm observation portal) centered around the intersection of the horizontal mid-line and the outer edge of adjacent lateral masses. During procedures, 5 cases underwent partial pedicle resection by (2 cases of C5-6, 3 cases of C6-7), and 4 cases underwent partial posterior edge resection (2 cases C5-6, 2 cases C6-7) post the Key-Hole decompression. The average surgical time was 85 to 240 min (average time 148.5±18.6 min），Regarding to the clinical effect, the improvement rate of NDI score was 65.6 to 70.3%, and the improvement rate of VAS was 44.4 to 88.9% on one week post operation. The NDI improvement rate was 65.2 to 75.5% , and the VAS improvement rate was 66.7 to 88.9% on one month post operation. The NDI improvement rate was 68.4 to 80.2%, and the VAS improvement rate was 77.8. to 88.9% on three months post operation. All these improvement comparison has statistically significance ($p<0.005$).

Conclusion: In summary, the improved UBE CKHD achieved good short-term efficacy in the treatment of CSR. It conforms to the cervical ERAS concept in terms of minimally invasive surgical incision, muscular protection and postoperative outcomes, and has great promotion and development value. Regarding to limitations, including a small sample size, short follow-up time, and the lack of control groups such as conventional open surgery and single portal endoscopic operation should be considered. These aspects require comprehensive studies to be validated in the future.

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The predictive value of the cervical nuchal ligament ossification in intra-spinal lesions and the surgery approach selection

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Objective ：To explore the correlation between the morphological characteristics of the cervical nuchal ligament ossification and cervical intraspinal lesions, as well as its suggestive role in surgery approach selection.

Methods ：Retrospective analysis of 138 patients with cervical spondylosis admitted to our department from 2022.09 to 2023.09. Cervical X-ray and CT examinations were examined to demonstrate the presence or absence of ossification of the nuchal ligament and the intraspinal lesions. The nuchal ligament ossification was classified into 4 types based on the morphological characteristics, and Kappa analysis was applied to test the classification reliability. Summarize the correlation between various types of ligament ossification and intraspinal lesions through regression analysis, and evaluate the value of the ligament ossification classification system in predicting intraspinal lesions and selecting surgical procedures.

Results ：Among all 1056 patients admitted, there were 730 males and 326 females, with an average age of 58 years. Among them, 619 cases had ossification of the cervical nuchal ligament (incidence rate 58.7%). Among 1056 patients, 85.6% had cervical spinal stenosis, of which 67.3% had ossification of the nuchal ligament and 32.7% had the nuchal ligament ossification. Regarding to the causes of cervical spinal stenosis, with 61.5% having ossification of posterior longitudinal ligament and 93.1% having discogenic lesions, and 39.6% of patients with ossification of the nuchal ligament have ossification of the posterior longitudinal ligament, and 82.7% have discogenic lesions. According to the morphological characteristics of ossification, cervical nuchal ligament ossification can be classified into four types (Focal, Continuous, Intermittent, and Mixed), cervical posterior longitudinal ligament ossification can be divided into four types (Focal, Continuous:, Segmental, and Mixed), and cervical discogenic lesions were divided into four types (Single segment, Two segment, Multi-stage, and Discontinuous segments). In cases of Continuous the cervical nuchal ligament ossification, the incidence of ossification of the posterior longitudinal ligament accounting for 61.6%. In cases of Focal cervical nuchal ligament ossification, the incidence of discogenic lesions around 97.5%. Importantly, regarding to the situation of nuchal ligament ossification, there are 69.4% of anterior operation patients present Focal cervical nuchal ligament ossification lesion, and 95.9% of posterior operation patients present Continuous cervical nuchal ligament ossification lesion.

Conclusion ：Cervical nuchal ligament ossification is related to the type and severity of cervical spinal stenosis, and the specific type of cervical nuchal ligament ossification played suggestive roles in surgery approach selection, and has guiding significance for clinical practice and surgical selection. Importantly, base on the cervical nuchal ligament ossification classification, it is possible to quickly and conveniently predict three-dimensional compression within the spinal canal using two-dimensional data such as X-rays.

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A CT-based analysis on occipito-atlantal (C0-1) compensation in children with atlanto-axial rotatory fixation and dislocation (AARFD)

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Background: Atlanto-axial rotatory fixation and dislocation (AARFD), representing the end-stage status of chronic atlanto-axial rotatory fixation, frequently causes C0-1 joints to rotate abnormally to compensate for C1-2 separation. The C0-1/C1-2 relationship is poorly understood.

Objective/Aim: To explore the C0-1/C1-2 relationship in AARFD and to evaluate the effect of C1-2 correction on C0-1 compensation.

Methods: We reviewed the pre-operative CT scans of 54 AARFD patients (symptom duration 2-132 months). 30 patients had post-operative CT scans at 1-year follow-up. We measured the C0, C1 and C2 angles and calculated the C1-2 and C0-1 rotational separation angles. We classified patients into physiological ($|C0-1|\leq 3°$, n=15) and compensation ($|C0-1|>3°$, n=39) groups. We used piecewise linear regression and multivariate regression to analyze the data.

Results: The mean C1-2 angle differed significantly between the physiological (13.89 ± 7.50°) and the compensation (36.58 ± 12.12°) groups ($P<0.001$). The ROC curve showed that the optimal C1-2 separation threshold for C0-1 compensation was 19.23°. C0-1 compensation occurred when C1-2 separation exceeded 12.91°, with a linear correlation ($R=0.816$). After C1-2 reduction surgery, the C0-1 angle decreased significantly ($P<0.001$). However, the residual C0-1 angle differed significantly between the patients with residual C1-2 angle less (2.62±4.93°) than 8.5° and those greater (11.55±9.55°) than 8.5° ($P=0.007$). The multivariate regression model for residual C0-1 was residual C0-1 = 0.298 + 0.178 * pre-operative C0-1 -0.537 * residual C1-2 ($P<0.001$, adjusted $R2=0.544$).

Conclusion: In AARFD, C0-1 compensation (|C0-1|>3°) started when C1-2 separation was >12.9°, with a significant correlation (R=0.816). A C1-2 separation of 19.2° was a good indicator of C0-1 compensation. The residual C0-1 angle was determined by the pre-operative C0-1 and the residual C1-2 angles. C1-2 reduction surgery reduced C0-1 compensation, and we recommended a residual C1-2 angle of <8.5° for a physiological C0-1 rotation.

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Preoperative frailty is potential risk factor for postoperative kyphotic change after posterior decompression of cervical spine

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INTRODUCTION: At last year's CSRS-AP meeting, we reported frailty was associated with poor neurological outcomes after posterior decompression for cervical spondylotic myelopathy (CSM). This study aimed to investigate whether frailty is associated with kyphotic change of the cervical spine after posterior decompression.

METHODS: Fifty-six patients with CSM who underwent posterior decompression with minimum 1 year follow-up were reviewed. Patients' demographics (age, sex, BMI, frailty [mFI-11≧3]), number of decompressed segments, and radiological parameters (C2-7 SVA, C2-7 Cobb, C2-7 ROM, C2-7 Extension ROM [extension Cobb - neutral Cobb], C2-7 Flexion ROM [neutral Cobb - flexion Cobb]) were recorded. Preop, postop, and Δ(postop-preop) values of each radiological parameter were measured. (1) All parameters were compared between frail (the F group, n=15) and non-frail patients (the NF group, n=41). (2) Multiple regression analysis was performed to identify the parameters associated with postop decrease in C2-7 Cobb.

RESULTS: (1) Patients in the F group were significantly older than those in the NF group (75.2 vs 63.9, p=0.01). There were no significant differences in the other demographics and the number of decompressed segments. Each ROM decreased postoperatively in both groups without significant intergroup differences. Preop (37.6 vs 25.5, p=0.01) and postop C2-7 SVA (43.7 vs 29.1, p<0.01) was significantly larger in the F group, butΔSVA was similar (6.1 vs 4.1, p=0.46). Although there were no significant differences in preop (10.7 vs 8.1, p=0.47) and postop C2-7 cobb (5.4 vs 10.5, p=0.23), C2-7 cobb decreased in the F group but increased in the NF group postoperatively (ΔC2-7 Cobb, -5.3 vs 2.5, p<0.01). (2) Preop C2-7 Extension ROM (p=0.02) and frailty (p=0.04) were associated with postop decrease in C2-7 Cobb.

CONCLUSION: Frailty can be one of the preop parameters to flag patients who have a risk for kyphotic change after posterior decompression.

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Comparing CSM and OPLL for complications after anterior cervical spine surgery

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Background: The anterior cervical spine surgery causes local complications as well as systemic complications. Surgeries for ossification of the posterior longitudinal ligament of the cervical spine (OPLL) is generally challenging compared to cervical spondylotic myelopathy (CSM). However, there have been few reports comparing the two diseases, especially in the anterior procedure.

Objective: We conducted a large-scale cohort study comparing complications in anterior cervical surgery for OPLL and CSM

Methods: Of the 1434 patients who underwent anterior cervical spine surgery at 3 spine centers in the same spine research group from January 2011 to March 2021, 333 OPLL patients and 488 CSM patients were retrospectively complications examined for patient background, surgical procedure, JOA score (cases followed for more than 1 year), complications during hospitalization and after discharge. The outcomes were statistically compared between OPLL and CSM.

Outcomes: The rate of diabetic comorbidity was significantly higher in the OPLL group (p<0.001). There were significantly more anterior cervical corpectomy and fusion (244 cases, 73.3%) in the OPLL group and more anterior cervical decompression and fusion (387 cases, 79.3%) in the CSM group (p<0.001). Regarding the perioperative complications during hospitalization, reoperation (p<0.001), cerebrospinal fluid leak (p<0.001), C5palsy (p<0.001), graft dislocation (p=0.020), hoarseness (p<0.001), and upper airway complications (p<0.001) were more common in the OPLL group. Dislocation of graft bone and cage (p=0.031) and hoarseness (p=0.043) were more common in the OPLL group among complications after discharge. The JOA score recovery rate at 1 year postoperatively was similar in the OPLL and CSM groups.

Conclusion: The present study demonstrated that the OPLL group had significantly more complications during hospitalization and after discharge than the CSM group in the anterior approach. Extensive care should be taken when performing anterior surgery for OPLL because of the high frequency of complications.

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The CASINO Trial: Surgical versus conservative management in patients with cervical radiculopathy due to intervertebral Disc Herniation: A Prospective Cohort Study

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Keywords: Cervical Radiculopathy, Cervical Radicular Syndrome, ACDF, anterior discectomy

Background: Cervical Radicular Syndrome (CRS) is predominantly treated conservatively, but surgical treatment can be an option after shared decision making. Knowledge on the difference in outcome is scarce. Aim: The CASINO trial aims to enhance this knowledge in order to assist patients and physicians in optimizing treatment choices.

Methods: A multi-centre observational cohort study was conducted in patients visiting the neurosurgeon with CRS and disc-herniation. Conservative and surgical treatment were discussed and in agreement a decision was made. Visual Analogue Scale for arm pain (VAS arm) and Neck Disability Index (NDI) served as primary outcome parameters. Secondary outcome measures involved VAS neck pain, Illness Perceptions Questionnaire (IPQ-K) and the EuroQol VAS (EQ-VAS). Data were collected at baseline, 6, 12, 26, 38, 52 and 104 weeks after inclusion, and analysed using linear mixed-effects models, while adjusting for age, gender, smoking behaviour, weight, length and Type D Scale-14 (DS-14). Results: 140 patients were included, 88 were treated surgically and 53 were conservatively treated. At baseline, patients in the surgical group had more arm pain (VAS Arm Pain, p=0.017) and worse functionality (NDI, p=0.082). However, during the two year follow up period all outcome data were comparable in evaluating conservative versus surgical treatment: VAS arm pain (22.8 ± 31.0 versus 19.0 ± 27.2), NDI (20.4 ± 23.4 versus 16.8 ± 14.9), EQ-VAS (66.3 ± 26.0 versus 70.5 ± 23.5) and VAS Neck Pain (31.5 ± 34.3 versus 18.2 ± 20.3).

Conclusion: During two years follow up no difference could be substantiated between the two treatment arms, although variations between patients were considerable. The current results illustrate that treatment choices made in shared decision making lead to satisfactory decline in symptoms in both treatment arms. In order to distinguish which treatment suits what patient best predictive modelling studies are needed.

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Anterior spinal reconstruction with structural femoral allograft post enbloc spinal tumour resection in the thoracolumbar spine

Background: Structural femoral allografts may be an effective and less costly alternative to synthetic implants.

Objective/Aim: We wish to report the outcomes of using femoral allograft to reconstruct the spinal column post spinal tumour resection. We also wish to report our technique of stabilisation of the allograft by preinserting a pedicle screw which is connected to the posterior construct.

Material and Methods: This is a retrospective review of patients who underwent enbloc vertebrectomy for primary spinal tumours or solitary spinal metastases of the thoracolumbar spine followed by anterior column reconstruction with fresh frozen femoral structural allograft and posterior instrumentation with pedicle screws between 1994 to 2022. Primary outcomes were fusion and time to fusion, local recurrence and duration of local recurrence free survival, and death and duration of survival.

Results: 14 patients were treated, with a mean age of 36 (range 11-63). 9/14 of the patients had primary tumours of the spine and 5/14 had solitary spinal metastases. Median follow up was 66 months (range 12-324 months). An all-posterior approach was utilized for 13/14 of the patients with only one requiring an anterior approach. The mean time to fusion was 11 months (range 6-14). There were 2 cases of local recurrence. The mean local recurrence free survival was 106 months (range 12-324). The mean survival in the primary tumour group was 160 months (range 12-324) and 47 months (range 24-84) in the spinal metastases group.

Conclusion: Structural Femoral Allografts are a biomechanically suitable alternative for spinal reconstruction post vertebrectomy and are ideal for post-operative surveillance and radiotherapy. Our technique of posterior stabilisation of the allograft ensures mechanical stability and removes the need for an anterior approach and stabilisation.

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The Oxford Spinal Sarcoma Service: Excellent oncological outcomes with a centralised multidisciplinary approach to primary spinal tumour care

Background: The Oxford Spinal Sarcoma Service is one of 4 designated primary spinal tumor referral centers in the United Kingdom serving over 10 million residents.

Objective/aim: We wish to report the outcomes of this centralized approach.

Methods: A retrospective review of surgically treated primary spinal tumor patients between 2008 to 2022. Patients were divided into Enneking Appropriate (EA) and Enneking Inappropriate (EI). Outcomes studied included local recurrence, metastases and overall survival.

Results: 119 patients were included of which 75 (63.0%) were male. The mean age at time of surgery was 46 (8-86) years. Most tumors involved the mobile spine (86/119(72.3%)) compared to sacral tumors (33/119 (27.7%)). 96/119(80.7%) patients were virgin cases and we managed to achieve EA margins in 81(68.1%) of our patients. There were 38 (31.9%) EI patients of this group 23/38(60.5%) were non-virgin cases which precluded EA resection. We achieved EA margins 81/90 (90.0%) of the time. In EA patients with mobile spine tumors the local recurrence rate was 1/51(2.0%) compared to 5/28(17.9%) in EA patients with sacral tumors and 7/35(20%) in EI patients with mobile spine tumors and 4/5(80%) in EI patients with sacral tumors. Mean local recurrence free (LRF) survival was 5.2(1-13.5) years and local recurrence rate was 14.3%. Mortality rate was 21.0% with a mean survival of 5.63 (1-13.5) years post-surgery. On multivariate analysis EI (p=0.019) and post-operative systemic treatment (p=0.004) were significant risk factors for local recurrence while the presence of metastases (p=0.012) and pre-operative systemic therapy (p=0.025) were significant risk factors for mortality

Conclusion: Centralization of primary spinal tumor care has led to excellent oncological results with a local recurrence rate comparable to most large spinal tumor centers. In primary tumors of the mobile spine our local recurrence rate (2.0%) is one of the lowest reported in the literature.

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Is intraoperative cell salvage and autogenic transfusion a risk factor for postoperative metastases in spinal chordoma surgery ?

Background: There remains controversy regarding the use of Intraoperative Cell Salvage- Leukocyte Depletion Filter (IOCS-LDF) in sarcoma surgery due to concern about dissemination of chordoma cells potentially leading to distant metastases.

Objectives/Aim: To assess if IOCS-LDF leads to increased risk of distant metastases in spinal chordoma surgery.

Material and Methods: This is a retrospective review of surgically treated spinal chordoma patients treated between 2012-2021. Follow up was till time of death with a minimum of 1 year follow up. Data on demographics, histology, tumour location, history of previous local or systemic treatment, presence of local recurrence and metastases was collected. Patient outcomes were local recurrence, recurrence free survival in years, metastases, metastases free survival in years and overall survival was also recorded.

Results: A total of 31 patients were identified of which 1 patient was excluded due to intraoperative mortality. 20 (66.7%) patients had chordomas of the mobile spine, 10(33.3%) of the sacrum. 17/30 (56.7%) patients had EA resections and 13/30(43.3%) had EI resections. Overall local recurrence rate was 7/30(23.3%) and Metastases rate was 6/30 (20.0%).5/6 of patients with metastases were EI patients of whom 4/5(80%) had received autogenic blood. On univariate analysis EI status (p=0.037)(4.75(1.10-20.50)) was a significant risk factor for local recurrence. EI+ Autogenic blood transfusion was a significant risk factor for metastases (p=0.034) (11.06(1.20-101.78)) as was non-virgin (previous surgical treatment) status (p=0.002)(6.70 (2.70-22.44) and history of previous radiotherapy (p=0.004)(3.97 (1.57-10.04)).

Conclusion: This has led to a change in practice in our centre, IOCS-LDF is no longer used for non-virgin procedures; in virgin cases it is stopped prior to any manipulation of the tumour where there may be the potential for capsular breach. We advocate further study into the use of IOC-LDF in spinal sarcoma surgery

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The Oxford Experience excellent outcomes with centralisation of primary spinal sarcoma care

The Oxford Spinal Sarcoma Service is one of 4 designated primary spinal tumor referral centers in the United Kingdom serving over 10 million residents.

Objective/aim: We wish to report the outcomes of this centralized approach.

Methods: A retrospective review of surgically treated primary spinal tumor patients between 2008 to 2022. Patients were divided into Enneking Appropriate (EA) and Enneking Inappropriate (EI). Outcomes studied included local recurrence, metastases and overall survival.
Results: 119 patients were included of which 75 (63.0%) were male. The mean age at time of surgery was 46 (8-86) years. Most tumors involved the mobile spine (86/119(72.3%)) compared to sacral tumors (33/119 (27.7%)). 96/119(80.7%) patients were virgin cases and we managed to achieve EA margins in 81(68.1%) of our patients. There were 38 (31.9%) EI patients of this group 23/38(60.5%) were non-virgin cases which precluded EA resection. We achieved EA margins 81/90 (90.0%) of the time. In EA patients with mobile spine tumors the local recurrence rate was 1/51(2.0%) compared to 5/28(17.9%) in EA patients with sacral tumors and 7/35(20%) in EI patients with mobile spine tumors and 4/5(80%) in EI patients with sacral tumors. Mean local recurrence free (LRF) survival was 5.2(1-13.5) years and local recurrence rate was 14.3%. Mortality rate was 21.0% with a mean survival of 5.63 (1-13.5) years post-surgery. On multivariate analysis EI (p=0.019) and post-operative systemic treatment (p=0.004) were significant risk factors for local recurrence while the presence of metastases (p=0.012) and pre-operative systemic therapy (p=0.025) were significant risk factors for mortality
Conclusion: Centralization of primary spinal tumor care has led to excellent oncological results with a local recurrence rate comparable to most large spinal tumor centers. In primary tumors of the mobile spine our local recurrence rate (2.0%) is one of the lowest reported in the literature.

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Bone resorption phenomenon after combined anterior-posterior cervical fusion surgery
Background: Wolff's law, in which bone formation occurs at the compressive side and bone resorption occurs at the tensile side, is well known.
Objective/Aim: To see the anterior vertebral bone resorption after cervical anterior-posterior (AP) fusion and the factors affecting bone resorption.
Methods: 253 patients who underwent cervical AP fusion were included in this study. All patients had cervical radiographs and CT before and 1 year after the surgery. The ratio of anterior-posterior length to vertebral height (RAPH) was measured on postoperative and 1-year follow radiographs. Bone resorption was measured by the anterior-posterior length of the vertebral body (APL) on preoperative and 1-year follow CT. The spine where the greatest amount of resorption occurred was investigated. Sagittal vertical axis (SVA) and cervical lordosis (CL) were measured after surgery to determine whether they affected bone resorption.
Results: At immediate post-operatively, the mean RAPH was 1.42, 1.34 at C3, 1.44 at C4, 1.47 at C5, 1.48 at C6, 1.34 at C7. At 1 year postoperatively, the mean RAPH was 1.28, and it was 1.29 at C3, 1.34 at C4 1.25 at C5, 1.24 at C6, 1.27 at C7($p<0.001$). At pre-operatively, the mean APL was 18.3 mm, 17.5 mm at C3, 17.7 mm at C4, 18.3 mm at C5, 18.9 mm at C6, 19.3 mm at C7. At 1 year postoperatively, the mean APL was 17.0mm, 17.3mm at C3, 17.0mm at C4, 16.2mm at C5, 16.7mm at C6, 17.9mm at C7($p<0.001$). The greatest amount of resorption occurred at C6. Postoperatively, the mean SVA was 12.8mm and CL was 17.5°. There was no correlation between SVA and bone resorption($p=0.810$). However, there was significant correlation between CL and bone resorption ($p<0.001$).
Conclusion: Bone resorption occurred in the vertebral body after anterior-posterior cervical fusion surgery. The bone resorption was significantly correlated with cervical lordosis but not with sagittal vertical axis.

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Dichotomous indicator on lateral X-ray to predict spinal cord compression in patients with cervical spondylotic myelopathy
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INTRODUCTION: This study aimed to investigate whether the presence or absence of the Spinous process base to Lateral mass Distance (SLD [Fig. A, B]) on lateral X-ray of the cervical spine can predict spinal cord compression in patients with cervical spondylotic myelopathy (CSM).
METHODS: Consecutive sixty-three patients with CSM who underwent posterior decompression surgery were reviewed. SLD (presence [+] or absence [-], distance [mm]) on the true lateral X-ray, and Antero-Posterior Diameter of the spinal canal (APD) and lateral mass-to-Posterior Canal Distance (PCD) on axial CT images at the pedicle level (Fig.C) were measured for each vertebra from C3 to C6. (1) The correlations of SLD (mm) with APD and PCD were investigated using Pearson's correlation coefficient. (2) The percentages of spinal cord compression at the rostrally adjacent segment of each vertebra were compared between vertebrae with SLD (+) and those with SLD (-). Spinal cord compression was defined as the complete absence of cerebrospinal fluid anteriorly and posteriorly to the spinal cord on sagittal T2 MRI.
RESULTS: (1) SLD was more strongly correlated with PCD (C3, [n=47] r=0.52; C4 [n=44], r=0.62; C5 [n=42], r=0.48; C6 [n=46], r=0.66) than APD (C3, r=0.24; C4, r=0.35; C5, r=0.40; C6, r=0.32). (2) Vertebrae with SLD (-) had higher percentages of spinal cord compression than those with SLD (+) (C3, 3.6% [SLD +] vs 29.4% [SLD -], p=0.01; C4, 40.6 vs 100%, p<0.01; C5, 54.6 vs 87.5%, p=0.07, C6, 50 vs 93.8%, p<0.01).
CONCLUSIONS: SLD that can be simply assessed dichotomously (+/-) on the lateral X-ray reflects the shape of the posterior dome in the spinal canal, and SLD (-) at C4, C5, and C6 can predict the spinal cord compression at C3/4, C4/5, and C5/6, respectively, with high positive predictive value, but not at C2/3 where degenerative changes are less likely to occur.

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Keyhole Foraminotomy via a Percutaneous Posterior Full-endoscopic Approach for Cervical Radiculopathy: An Advanced Procedure and Clinical Study
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Background: Endoscopic cervical foraminotomy is increasingly used for cervical spondylotic radiculopathy (CSR), but there is great concern about radiation exposure because of the heavy dependence of this surgical method on fluoroscopy.
Objective: The objective of this study was to introduce in detail an advanced surgical technique of keyhole foraminotomy via a percutaneous posterior full-endoscopic approach as a treatment for CSR and investigate its clinical outcomes.
Methods: We retrospectively reviewed 33 consecutive patients with CSR who underwent keyhole foraminotomy via a percutaneous posterior full-endoscopic approach from October 2015 to April 2017. The patients' general characteristics, including operative time, blood loss, hospital stay, complications, and recurrence, were obtained. Clinical outcomes were evaluated using the visual analogue scale (VAS) for radicular pain, the neck disability index (NDI) for functional assessment, and the modified MacNab criteria for patient satisfaction.

Results: All operations were successfully performed (mean operation time, 62 min), with no measurable blood loss or severe related complications. The mean follow-up was 25 months. The VAS and NDI scores were significantly improved as compared with those in the preoperative period (preoperative vs. final follow-up: 7.6±1.6 vs. 3.83±7.34 for VAS, P<0.01; 69.5%±10.5% vs. 17.54%±13.40% for NDI, P<0.01). Of the 33 patients, 32 (97.0%) had good-to-excellent global outcomes and all patients obtained symptomatic improvement.
Conclusion: In conclusion, keyhole foraminotomy via a percutaneous posterior full-endoscopic approach is an efficient, safe, and feasible procedure for the treatment of CSR. Its simplified single-step blunt incision for localization appears to decrease radiation exposure risks.

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Management strategy for an overweight patient with "chin-on-chest" cervicothoracic kyphoscoliosis due to Ankylosing Spondylitis in lateral position : a Case Report and Literature Review

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Background: Management of correction of sagittal "Chin-on-Chest" deformity due to Ankylosing Spondylitis in cervical spine remains strategically and technically challenging. The surgical strategy regarding surgical approach and which level of osteotomy to choose (i.e., cervical or thoracic) has barely been discussed. Here, we present a case report of an overweight man who diagnosed with "chin-on-chest" cervicothoracic kyphoscoliosis due to Ankylosing Spondylitis.
Objective: The objective of this study was to report a rare overweight man who diagnosed with "chin-on-chest" cervicothoracic kyphoscoliosis due to Ankylosing Spondylitis and discussed the related literature.
Methods: The patient was 24 years old, weighed more than 140 Kg, and underwent posterior T1 PSO (Pedicle subtraction osteotomy) and pedicle screw fixation (free hand technique) and fusion (C4-T4). During the surgical procedure, there were some obvious kyphosis-related technical difficulties: endotracheal intubation, installation, and the surgical approach are demanding. After carefully treatment, the patient finally successfully completed the operation in lateral position.
Results: Postoperative radiography of the entire spine and appearance revealed satisfactory correction (Chin Brow Vertical Angle: 90° pre -op, 25° post -op). At the 2 years follow-up, no obvious loss of correction and neurological dysfunction was observed. Osteotomy site fusion (T1) was achieved solid, and the Japanese Orthopedic Association (JOA) score and neck disability index (NDI) improved significantly.
Conclusion: For "Chin-on-Chest" deformity due to Ankylosing Spondylitis, posterior T1 PSO and pedicle screw fixation and fusion can be preferred and achieved by lateral position. During the treatment, Kyphosis-related technical difficulties such as endotracheal intubation, installation, and the surgical approach need to be considered carefully and respectively.

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Biomechanical Evaluation of Different Surgical Approaches for the Treatment of Adjacent Segment Diseases After Primary Anterior Cervical Discectomy and Fusion: A Finite Element Analysis

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Background: Symptomatic adjacent segment disease (ASD) is a common challenge after anterior cervical discectomy and fusion (ACDF).
Objective: The objective of this study was to compare the biomechanical effects of a second ACDF and laminoplasty for the treatment of ASD after primary ACDF.
Methods: We developed a finite element (FE) model of the C2-T1 based on computed tomography images. The FE models of revision surgeries of ACDF and laminoplasty were simulated to treat one-level and two-level ASD after primary ACDF. The range of motion (ROM) and intradiscal pressure (IDP) of the adjacent segments, and stress in the cord were analyzed to investigate the biomechanical effects of the second ACDF and laminoplasty.
Results: The results indicated that revision surgery of one-level ACDF increased the ROM and IDP at the C2-C3 segment, whereas two-level ACDF significantly increased the ROMand IDP at the C2-C3 and C7-T1 segments. Furthermore, no significant changes in the ROM and IDP of the laminoplasty models were observed. The stress in the cord of the re-laminoplasty model decreased to some extent, which was higher than that of the re-ACDF model.
Conclusion: Both ACDF and laminoplasty can relieve the high level of stress in the spinal cord caused by ASD after primary ACDF, whereas ACDF can achieve better decompression effect. Revision surgery of the superior ACDF or the superior and inferior ACDF after the primary ACDF increased the ROM and IDP at the adjacent segments, which may be the reason for the high incidence of recurrent ASD after second ACDF.

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Comparison of the effectiveness of zero-profile device and plate cage construct in the treatment of one-level cervical disc degenerative disease combined with moderate to severe paraspinal muscle degeneration

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Background: Recent evidence indicates that cervical paraspinal muscle degeneration (PMD) is a prevalent and age-related condition in patients with cervical disc degenerative disease (CDDD). However, the relationship between surgery selection and post-operative outcomes in this population remains unclear.
Objective: To investigate the disparities in various outcomes between two frequently utilized anterior cervical surgical procedures.
Methods: 140 patients who underwent single-level ACDF were included. The patients were divided into three groups based on the severity of PMD: mild (n=40), moderate (n=54), and severe (n=46), as determined by Goutalier fat infiltration grade. The subjects of interest were those with moderate-severe PMD, and their clinical outcomes, radiological parameters, and complications were compared between those who received a stand-alone zero-profile anchored cage (PREVAIL) and those who received a plate-cage construct (PCC).
Results: While the PCC group demonstrated more pronounced enhancements and maintenance of several sagittal alignment parameters, such as the C2-7 angle, FSU angle, C2-7 SVA, and T1 slope, there were no statistically significant differences between the two groups. The incidence of dysphagia in the zero-profile group was 22.41% at one week, which subsequently decreased to 13.79% at three months and 3.45% at the final follow-up. In contrast, the plate cage group exhibited a higher incidence of dysphagia, with rates of 47.62% at one week, 33.33% at three months, and 11.90% at the final follow-up. Notably, there were significant differences in the

incidence of dysphagia between the two groups within the first three months. However, the fusion rate, occurrence of implant subsidence, and adjacent segment degeneration (ASD) were comparable at the final follow-up.
Conclusions: Although no significant disparities were observed between these two technologies in terms of complications such as ASD and subsidence, the zero-profile technique exhibited superior performance over PCC in relation to dysphagia during the early stages of postoperative recovery.

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Preoperative MRI-based Endplate Quality: A Novel Tool for Predicting Cage Subsidence after Anterior Cervical Spine Surgery

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Background: Recently, MRI-based endplate bone quality (EBQ) was introduced. However, there have been few studies that investigate the association between site-specific MRI bone assessment and osteoporosis-related complications in patients undergoing anterior cervical discectomy and fusion (ACDF).
Objective: To assess the predictive value of EBQ for cage subsidence following ACDF.
Methods: Patients undergoing ACDF for degenerative cervical diseases between January 2017 and June 2022 were included. Correlation between EBQ scores and segmental height loss was analyzed using Pearson's correlation. ROC analyses were employed to ascertain the EBQ cut-off values that predict the occurrence of cage subsidence. Multivariate logistic regression analyses were conducted to identify the risk factors associated with postoperative cage subsidence.
Results: 23 individuals (14.56%) exhibited the cage subsidence after ACDF. In the nonsubsidence group, the average EBQ and lowest T-score were determined to be 4.13 ± 1.14 and -0.84 ± 1.38 g/cm2 respectively. In contrast, the subsidence group exhibited a mean EBQ and lowest T-score of 5.38 ± 0.47 ($p<0.001$) and -1.62 ± 1.34 g/cm2 ($p=0.014$), respectively. There was a significant positive correlation ($r=0.798^{**}$) between EBQ and the segmental height loss. The EBQ threshold of 4.70 yielded optimal sensitivity (73.9%) and specificity (93.3%) with AUC of 0.806. Furthermore, the lowest T-score ($p = 0.045$, OR 0.667) and an elevated cervical EBQ score ($p<0.001$, OR 8.385) were identified as significant risk factors for cage subsidence after ACDF. The EBQ method presents itself as a promising and efficient tool for surgeons to assess patients at risk of cage subsidence and osteoporosis prior to cervical spine surgery, utilizing readily accessible patient data.
Conclusions: The EBQ method presents itself as a promising and efficient tool for surgeons to assess patients at risk of cage subsidence and osteoporosis prior to cervical spine surgery, utilizing readily accessible patient data.

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Comparison of the Postoperative Motion Stabilization Between Anterior Cervical Decompression and Fusion with a Zero-Profile Implant System and a Plate-Cage Construct

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Background: Due to the lack of an additional anterior plate, the motion stability of a zero-profile device with an anchored cage (AC) may be inferior to that of a traditional plate-cage construct (PCC).
Objective: To compare the motion stabilization features of an AC and a PCC and analyze their impact on postoperative outcomes and complications.
Methods: Patients treated with single-level ACDF were included. First, clinical and radiological outcomes, postoperative complications and time to achieve motion stabilization were compared. Then, based on the time to achieve motion stabilization, all patients were divided into group A (time to achieve motion stabilization <3 months), group B (time to achieve motion stabilization from 3-6 months), and group C (time to achieve motion stabilization >6 months). The early postoperative complications were compared across the 3 groups.
Results: A total of 160 patients met the inclusion criteria, including 90 patients in the AC group and 70 patients in the PCC group. The disc height loss was 2.26 ± 1.00 mm in the AC group and 1.76 ± 1.13 mm in the PCC group ($P = 0.004$), and the incidence of implant subsidence was 24.44% in the AC group and 11.43% in the PCC group ($P = 0.036$). In addition, the PCC was more dynamically stable than the AC at 3 months post-surgery ($P < 0.001$), and at this time, the disc height loss and implant subsidence in motion-stable patients were significantly lower than those in motion-unstable patients ($P < 0.05$). Furthermore, when the arrival time of motion stabilization was prolonged, the loss of disc height and occurrence of subsidence gradually increased.
Conclusion: More attention should be given to minimizing the adverse impact of poor motion stability in the design and development of future zero-profile cervical implants, although this has little impact on clinical efficacy.

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Conservative treatment for dropped head syndrome

Background: Previous reports about efficacy of conservative treatment for dropped head syndrome (DHS) are scarce. To elucidate the efficacy of the conservative treatments for DHS, and to clarify the possible predictive factors relating to the outcome of the conservative treatment.
Methods: Among 76 DHS patients, conservative treatment (2-3 months collar application, active neck range of motion exercise, and occasional prescription of pain killer) succeeded in 17 patients (22.4%, group S, four male, 13 female, a mean of 75.9 years old). Remaining 59 patients failed (group F). The clinical and radiological parameters were compared between the groups. In group S, radiological factors were also compared between at pre-operation and at the follow-up.
Results: Duration of disease were: 6.3 ± 10.4 months in group S and 20.0 ± 27.6 months in group F respectively. C2-7 angle (degree), the incidence of anterior slippage of the vertebra (%), and upper thoracic kyphosis angle (degree) in group S/F were; -19.3 ± 18.7/-34.6 ± 26.6, 23.5/62.7, 6.7 ± 9.2/17.9 ± 13.7, and 47.3 ± 11.5/32.5 ± 18.3 respectively. C2-7 angle were; -19.3 ± 18.7degrees at pre-operation and 10.2 ± 24.9 degrees at follow-up respectively. These differences reached to statistical significance.
Conclusions: The present study has indicated that twenty-two percentage of the DHS patients succeeded with the conservative treatment, and cervical kyphotic alignment improved. DHS patients accompanying with shorter duration of disease, relatively smaller cervical kyphosis without anterior slippage of the vertebra, and abundant compensation at the upper thoracic region were good indication of conservative treatment.

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Intra- and post-operative management of cerebrospinal fluid leakage (CSFL) in anterior surgery for cervical ossification of the posterior longitudinal ligament (OPLL)

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Background: Cerebrospinal fluid leakage (CSFL) is one of the most common complications after anterior surgery patient with cervical ossification of the posterior longitudinal ligament (OPLL), especially for the presence of dural ossification (DO).
Objective: To present our experience on intra- and post-operative management of CSFL after anterior surgery for cervical OPLL patients, and to provide a reference for this issue.
Methods: Between April 2010 to May 2020, 148 patients diagnosed as cervical OPLL who underwent anterior cervical ossified posterior longitudinal ligament en bloc resection (ACOE) were enrolled in this retrospective study. Among them, 12 patients occurred CSFL. Diagnosis of DO was confirmed during the surgery. Based on the whether the OPLL could be separated with DO, OPLL-DO was divided into fused type and separated type. Besides, a Dura-Guard patch was used if there was a CSFL. Postoperatively, the wound was continuously pressed by a sandbag or elastic bandage until the CSFL disappeared.
Results: Among the 12 patients with CSFL, 10 cases (83.3%) were combined with DO. The presence of DO significantly increase the risk of CSFL ($P < 0.005$). For fused type and separated type with tubercular DO compressed on spinal cord, DO should be resected under direct vision, and DO could be preserved for platelike DO without compression on spinal cord. The integrity of arachnoid was maintained as much as possible. All the patients with CSFL got an excellent recovery and lumbar cistern drainage was not performed in any one. The presence of platelike DO shows no compression on spinal cord in the one-year follow-up.
Conclusion: Cervical OPLL combined with DO has a high probability of CSFL in anterior approach. However, delicate intraoperative manipulation and appropriate postoperative management, such as preserving arachnoid integrity, repairing dura defect and moderate pressure dressing can effectively accelerate the recovery of CSFL.

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Biomechanical Risk Factors for Heterotopic Ossification after Cervical Disc Replacement: the Role of Endplate Coverage and Intervertebral Height Change
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Background: Heterotopic ossification (HO) is a common complication after cervical disc replacement (CDR). Biomechanical factors including endplate coverage and intervertebral disc height change may be related to HO formation. However, there is a dearth of quantitative analysis for endplate coverage, intervertebral height change and their combined effects on HO.
Objective: To investigate the effects of endplate coverage and intervertebral disc height change postoperatively and the combination of these two factors on HO formation following CDR through quantitative analysis.
Methods: Patients who underwent single-level or two-level CDR with Prestige-LP were retrospectively reviewed. Clinical outcomes were evaluated through Japanese Orthopaedic Association (JOA) score, Neck Disability Index (NDI) score, and visual analog scale (VAS) score. Radiological data, including the prosthesis-endplate depth ratio, intervertebral height change, posterior heterotopic ossification (PHO) and angular parameters, were collected. Logistic regression analysis was used to identify the potential risk factors. Receiver operating characteristic curves were plotted and the cutoff values of each potential factors were calculated.
Results: A total of 138 patients with 174 surgical segments were evaluated. Both the prosthesis-endplate depth ratio ($P<0.001$) and postoperative disc height change ($P<0.001$) were predictive factors for PHO formation. The area under the curve (AUC) of the prosthesis-endplate depth ratio, disc height change and their combined effects represented by the combined parameter (CP) were 0.728, 0.712 and 0.793, respectively. The risk of PHO significantly increased when the prosthesis-endplate depth ratio < 93.77% ($P<0.001$, OR=6.909, 95% CI 3.521-13.557), the intervertebral height change ≥ 1.8 mm ($P<0.001$, OR=5.303, 95% CI 2.592-10.849), or the CP representing the combined effect < 84.88 ($P<0.001$, OR=10.879, 95% CI 5.142-23.019).
Conclusion: Inadequate endplate coverage and excessive change of intervertebral height are both potential risk factors for the PHO after CDR. Endplate coverage less than 93.8% or intervertebral height change more than 1.8 mm would increase the risk of PHO. The combination of these two factors may exacerbate the non-uniform distribution of stress in the bone-implant interface and promote HO development.

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Cervical disc arthroplasty for patients with osteopenia: A matched cohort study
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Background: The presence of low bone mineral density (BMD) presents significant challenges to spine surgeons. Osteoporosis was unanimously listed as an exclusion criterion in the published trials for cervical disc arthroplasty (CDA). However, there was a paucity of data on CDA patients with osteopenia. The extent to which BMD influences the postoperative outcomes of CDA patients remains uncertain.
Objective: This study aimed to evaluate postoperative outcomes of single-level CDA in patients with osteopenia and compare these results with a matched cohort of normal BMD.
Methods: This study included 38 patients with osteopenia who underwent single-level CDA. A 1:1 match was utilized based on gender, follow-up time, and arthroplasty level. BMD was assessed with dual-energy x-ray absorptiometry. Clinical, radiographic data, and BMD-related complications were recorded.
Results: In total, 76 patients were ultimately enrolled for analysis in the study. The osteopenia group achieved satisfactory improvements in clinical outcomes, with no significant intergroup differences. Additionally, there were no significant differences between groups in any of the radiological parameters, either in cervical alignment or segmental height, or range of motion. In terms of BMD-related complications, the radiological incidence rate of adjacent segmental degeneration and heterotopic ossification (HO) was comparable in both groups, respectively, with a similar composition of ROM-limiting HO. However, the osteopenia group had a tendency of more implant subsidence (2.7% vs. 15.2%). According to the logistic regression analysis, the osteopenia group had a significantly higher incidence rate of anterior bone loss (ABL) than the normal group (OR=5.37, 95% CI: 1.50 - 19.22).
Conclusion: Single-level CDA for patients with osteopenia achieved similar improvements in clinical outcomes compared with the normal BMD group and maintained satisfactory sagittal balance and segmental height. However, the occurrence of postoperative ABL and implant subsidence remains a source of concern.

Keywords. Osteopenia; bone mineral density; cervical disc arthroplasty

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Is there a relationship between bony fusion after anterior cervical discectomy and fusion and heterotopic ossification after cervical disc arthroplasty in hybrid surgery?

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Background: Bone formation is considered a risk factor in cervical disc arthroplasty (CDA) but is essential for a solid union in anterior cervical discectomy and fusion (ACDF). However, there are no reports of any connections between them. Hybrid surgery (HS) provides an irreplaceable advantage in directly studying the mechanism and relationship of different forms of postoperative bone formation.
Objective: This study aimed to investigate the relationship between bony fusion after ACDF, and heterotopic ossification (HO) after CDA in HS.
Methods: Clinical data of ninety-one patients who had undergone consecutive 2-level HS between 2011 and 2018 and with a minimum of 2-years follow-up was analyzed. HO was assessed based on McAfee's classifications while fusion success was evaluated according the US-FDA approved IDE criteria. Clinical outcomes and radiographic parameters were collected and used for the relevant comparisons.
Results: HO was identified in 48.4% of patients (44/91). As such, the patients were divided into HO group and non-HO group. The fusion rates of patients in the HO group and the non-HO group at 3, 6, and 12 months postoperatively, and the final follow-up were 81.8% and 19.1%, 95.4% and 74.5%, 95.4% and 85.1%, and 97.7% and 93.6% respectively. The fusion rates were significantly higher at 3 and 6 months after operation in the HO group than in the non-HO group ($P<0.05$). Patients in both groups had significant improvements across all clinical outcomes at final follow-up.
Conclusion: There was a significant positive correlation between bony fusion and occurrence of postoperative HO. As such, it was inferred that both bony fusion and postoperative HO are a reflection of individual osteogenic capacity. However, a reliable predictor of postoperative bone formation is needed in the future to guarantee a solid bony fusion after ACDF and to further take full advantage of the motion-preserving from CDA.
Keywords. Bony fusion; Heterotopic ossification; Anterior cervical discectomy and fusion; Cervical disc arthroplasty; Hybrid surgery

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Anterior bone loss after single-level anterior cervical surgery and its relationship with cervical sagittal alignment

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Background: Anterior bone loss (ABL) is a common phenomenon after cervical disc replacement (CDR). Interestingly, ABL was also observed in patients who underwent ACDF using zero-profile (Zero-P) cage. Biomechanical factors play an important role in the occurrence of ABL.
Objective: To investigate the incidence and severity of ABL in single-level CDR and ACDF and explore the relationship between cervical sagittal alignment and ABL.
Methods: This is a single-center retrospective cohort study of 212 patients. 113 patients treated with CDR and 99 patients treated with ACDF were retrospectively reviewed from January 2014 to January 2019 in West China Hospital. Cervical sagittal alignment parameters, including C0-C2 angle, cervical lordosis (CL), C2-C7 sagittal vertical axis (cSVA), T1 slope, functional spinal unit angle, disc angle, and surgical level slope, were evaluated.
Results: ABL was identified in 75 (66.4%) patients in the CDR group and 57 (57.6%) patients in the ACDF group. There were no significant differences in the incidence, severity, and location of ABL between the ACDF and CDR groups. For patients who underwent ACDF, the proportion of females was significantly higher in ABL group ($P=0.002$), while the BMI was significantly lower in the ABL group compared to non-ABL group (22.72 ± 3.09 vs. 24.60 ± 3.04, $P=0.002$). The effect of ABL on the clinical outcomes of ACDF and CDR was not observed. In the ACDF group, patients with ABL had significantly smaller postoperative CL, T1 slope, cSVA, and surgical level slope. ABL after CDR was less correlated to the cervical sagittal alignment.
Conclusion: ABL is common after both CDR and ACDF. The incidence, severity, and location of ABL were all comparable between CDR and ACDF. Cervical sagittal alignment was closely related to ABL after ACDF while had less influence on ABL after CDR. Smaller postoperative cervical lordosis, T1 slope, sagittal vertical axis, and surgical level slope were observed in patients with the occurrence of ABL after ACDF.

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Cost Effectiveness of Navigated Robot-assisted Minimally Invasive Transforaminal Interbody Fusion (MIS-TLIF)

Background: Minimal invasive Transforaminal Lumbar Interbody Fusion (TLIF) is an increasingly common procedure used in treating degenerative lumbar spine conditions. Advancement of robotic-assisted technology has improved accuracy of instrumentation with smaller incisions, resulting in better surgical outcomes and shorter hospital stay.
Objective: This study aims to assess cost -effectiveness of robotic-assisted TLIF (RA-TLIF) using the Mazor™ X Stealth Edition in our institution; and compare patient outcomes with conventional O-arm navigated minimally invasive TLIF (ON-TLIF).
Methods: Single-centre, retrospective case cohort series of 27 patients who underwent elective RA-TLIF performed against 50 elective conventional ON-TLIF. Patient demographics (age, gender, BMI, Charlson Co-morbidity Index), and post-operative outcomes were used in comparative analysis.
Results: No significant differences were found in patient demographics, baseline CCI, operative duration, length of inpatient stay, post-operative ambulation. Rates of intra-operative and post-operative complications were similar between the 2 groups (OR 0.93, $p = 0.112$).
Conclusion: The Mazor™ X Stealth RA-TLIF has shown no added advantage in surgical outcomes against conventional ON-TLIF. However, it is associated with a longer operative duration due to increased set-up time and possible software issues which might pre-dispose it to errors. This will require a steep learning curve for the operating staff to overcome to achieve optimal results to justify its high operating and maintenance costs.

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Two-step distraction and reduction (TSDR) for basilar invagination with atlantoaxial dislocation: A novel technique without traction

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Background: The pathological changes of basilar invagination (BI) and atlantoaxial dislocation (AAD) include vertical and horizontal dislocations. Current surgical techniques have difficulty accurately controlling the degree of reduction in these two directions and often require preoperative traction, which increases patients' pain, hospital stay, and medical cost.
Objective: This study aimed to introduce a novel technique for accurately reducing horizontal and vertical dislocation without preoperative traction and report the radiological and clinical outcomes.
Methods: From 2010 to 2022, patients with BI and AAD underwent posterior two-step distraction and reduction (TSDR) (Figure 1) and occipitocervical fixation. Radiological examination was used to evaluate the reduction degree (RD) and compression. Japanese Orthopedic Association (JOA) score was used to evaluate clinical outcome.
Results: A total of 62 patients with BI and AAD underwent TSDR and occipitocervical fusion. The clinical symptoms of 96.8% of them improved. JOA score increased significantly after the operation. Appropriate (50%≤RD< 80%) or satisfactory (RD≥80%) horizontal reduction was achieved in 93.5% of patients, and 91.9% obtained appropriate or satisfactory vertical reduction. Thirty-one patients did not undergo preoperative skull traction. There was no significant difference in radiological outcomes or JOA scores between the traction- and non-traction groups. However, the length of hospital stay in the traction group was longer than that in the non-traction group.
Conclusion: TSDR enables horizontal and vertical reduction. It is a safe, simple, and effective technique for patients with BI and AAD. Despite the absence of preoperative skull traction, the degree of reduction and clinical outcomes were satisfactory.

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Segmental slope is a predictor of fusion rate in anterior cervical discectomy and fusion

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Background: Fusion status is one of the standard to evaluate the success of anterior cervical discectomy and fusion (ACDF). Its predictive factors have not been thoroughly studied.
Objective: This study aimed to explore preoperative segmental slope as a predictor of fusion rate after single-level ACDF.
Methods: Data of consecutive patients with single-level cervical spondylosis who underwent ACDF between 2014 and January 2022 were retrospectively reviewed. Preoperative parameters including baseline characteristics, segment slope, T1 slope, range of motion, intervertebral disk height, and bone density were evaluated. Data were analyzed using Student's t-test, Mann–Whitney U test, $\chi 2$ test, Fisher's exact test, multivariate logistic regression analysis, and receiver operating characteristic curve.
Results: In total, 248 patients were selected. The mean follow-up was 32.3 months. Male sex, body mass index, preoperative segment slope, T1 slope, operative levels, and osteoporosis or osteopenia were associated with non-fusion at an early stage after surgery. However, no statistically significant difference was observed at the last follow-up. Multivariate logistic regression analysis revealed that the preoperative segment slope was an independent predictor for non-fusion at 3, 6, and 12 months postoperatively. Osteoporosis or osteopenia was an independent predictor of non-fusion at 6 and 12 months postoperatively. The area under the curve was 0.869 at 3 months ($p<0.001$, cutoff value 10.23°), 0.867 at 6 months ($p<0.001$, cutoff value 14.32°), and 0.823 at 12 months ($p<0.001$, cutoff value 21.16°).
Conclusion: Preoperative segment slope can be used as a predictor of early fusion rate after single-level ACDF. We determined detailed cutoff values . This study may help surgeons take measures to promote early fusion in advance.

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Luschka Joint Fusion Versus End Plate Space Fusion in Anterior Cervical Spine Surgery ： A Prospective Randomized Controlled Trial

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Background: The Luschka joint, also known as the uncovertebral joint, is a potential region for anterior cervical fusion. The effect of the Luschka joint fusion (LJF) has been confirmed in goat model. However, there are no clinical trials on human Luschka joint fusion.
Objective: This study aimed to compare the fusion speed and clinical efficacy of LJF and traditional endplate space fusion (ESF) in anterior cervical surgery.
Methods: Patients with single-level cervical spondylosis were recruited and admitted between February 2021 and October 2022 and randomly divided into the LJF and ESF groups (Figure 1). The primary outcome was the early fusion rate 3 months postoperatively. Secondary outcomes included the incidence of complications and patient-reported outcome measures (PROMs).
Results: A total of 74 (92.5%) patients completed the trial and were included in the analysis, with an average age of 54.8 (26-65) years. The operation duration (131.3 ± 29.4 min vs. 123.6 ± 26.0 min, p=0.237) and intraoperative blood loss (70.6 ± 50.0 ml vs. 79.2 ± 49.0 ml, p=0.454) were comparable between the two groups. The fusion rate in the LJF group was significantly higher than that in the ESF group at 3 and 6 months after operation (3 months after operation: 66.7% vs. 13.2%, $p<0.0001$; 6 months after operation: 94.1% vs. 66.7%, p=0.006). No significant difference was found in the fusion rate between the two groups 12 months postoperatively. The JOA, NDI, and VAS scores for the arm and neck significantly improved after surgery in both groups.
Conclusions: In anterior cervical fusion surgery, the early fusion rate in LJF is significantly higher than that in ESF.

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Is the fusion order of the upper and lower levels different in two-level anterior cervical discectomy and fusion for cervical spondylopathy?

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Background: Fusion is the standard used to judge the success of ACDF. However, the fusion order in two-level ACDF remains uncertain. The mechanical environment of different levels is different, which may affect the fusion rate or fusion order.

Objective: This study aimed to compare the fusion order between the upper and lower levels in two-level anterior cervical discectomy and fusion (ACDF) with a zero-profile device in the treatment of cervical spondylopathy.

Methods: From 2017 to January 2022, data of consecutive patients with two-level cervical disc degenerative disease who underwent ACDF were retrospectively reviewed. Radiological assessments were based on the range of motion of the fusion level, segment slope, and disc height, and complications were assessed. Data were analyzed using the paired t, Mann-Whitney U, c2, Fisher exact, and rank-sum tests and logistic regression analysis.

Results: In total, 129 patients were ultimately enrolled for analysis in the study. The respective fusion rates of the upper and lower levels were 26.13% and 10.97% ($p<0.05$) at 3 months, 58.23% and 42.41% ($p<0.05$) at 6 months, 86.19% and 82.08% ($p>0.05$) at 1 year, and 92.12% and 89.76% ($p>0.05$) at the last follow-up. Multivariate logistic regression analysis indicated that the preoperative segmental slope and upper level were independent risk factors for non-fusion. The adjacent segment degeneration (ASD) and subsidence rates were comparable between the two levels.

Conclusion: The lower level had a slower fusion process than the upper level. A higher preoperative segment slope was a risk factor for fusion. However, the subsidence and ASD rate were comparable between the lower and upper levels in the two-level ACDF.

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Posterior percutaneous endoscopic cervical discectomy for residual disc fragments after anterior cervical discectomy and fusion: a technical note

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Background: A residual disc fragment after anterior cervical decompression and interbody fusion (ACDF) is clinically challenging. Literature about the discussion of the revision strategy is scarce.

Objective: To first present a case series with residual disc fragments after ACDF, who underwent percutaneous endoscopic cervical decompression.

Methods: 11 patients with insufficient ventral decompression and unsatisfactory symptom relief were transferred to our hospitals between January 2015 and March 2018. These patients were diagnosed with single-level cervical spondylotic myelopathy and treated with ACDF. A residual disc fragment was observed at the postoperative follow-up magnetic resonance imaging (MRI), which was subsequently removed by percutaneous endoscopic surgery. Preoperative, immediately after the operation and at every follow-up interval, the American Spinal Injury Association (ASIA) scale and Japanese Orthopaedic Association (JOA) scores were recorded for each patient. At postoperative 1 week and 3 months, a cervical MRI was recommended to verify whether the decompression was performed thoroughly.

Results: The residual disc fragment was successfully removed and no patients required conversion to an open procedure. The ASIA scale score was improved from C degree to D degree after the operation. The JOA score is increased from 8.7+0.2 initially and 9.6+0.2 pre-revision surgery to 15.3+0.1 at the final follow-up ($P < 0.001$). Interbody fusion was observed in all patients on cervical radiography performed at 12 months postoperatively.

Conclusion: As an alternative treatment for residual disc fragments after ACDF, percutaneous endoscopic cervical discectomy via a posterior approach can provide direct decompression and satisfactory clinical outcome with minimization of surgery-related trauma.

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Association of Craniocervical Sagittal Alignment With the Outcomes of Cervical Disc Replacement

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Background: Cervical disc replacement (CDR) is an effective procedure for the treatment of cervical degenerative disc disease. Cervical sagittal alignment plays a crucial role in maintaining the physiological function of the cervical spine and could affect patient surgical outcomes and health-related quality of life. However, the effect of craniocervical sagittal balance on the patient-reported outcomes and radiological results of CDR has been poorly studied.

Objective: To explore the association between craniocervical sagittal balance and clinical and radiological outcomes of cervical disc replacement (CDR).

Methods: Patients who underwent 1-level and 2-level CDR were retrospectively analyzed. Clinical outcomes were evaluated using scores on the Japanese Orthopaedic Association (JOA), Visual Analogue Scale (VAS), and Neck Disability Index (NDI). The craniocervical sagittal alignment parameters, including the C0-C2 Cobb angle, C2-C7 Cobb angle, C2 slope, T1 slope, C2- C7 sagittal vertical axis (SVA), C1-C7 SVA, the center of gravity of the head (CGH)-C7 SVA, and range of motion (ROM) at the surgical segments were measured.

Results: A total of 169 patients were involved. Both the pre- and postoperative C2 slope were significantly higher in the less mobile group than in the more mobile group. Analogously, the CGH- C7 SVA before and after surgery was significantly larger in the less mobile group. Patients with a higher preoperative C2 slope and CGH-C7 SVA had lower cervical lordosis and ROM after surgery. There were no significant differences in the clinical outcomes between patients with different sagittal balance statuses. Patients with radiographic adjacent segment pathology (rASP) had significantly higher preoperative CGH-C7 SVA (19.57 ± 14.16 mm vs. 13.77 ± 13.83 mm, $P = 0.014$) and C2- C7 SVA (20.83 ± 9.62 mm vs. 17.06 ± 9.91 mm, $P = 0.041$).

Conclusion: Craniocervical sagittal balance is associated with cervical lordosis and ROM at the index level after CDR. A higher preoperative SVA is related to the presence and progression of rASP. A relationship between sagittal alignment and clinical outcomes was not observed.

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A COMPARISON OF ANTERIOR CERVICAL DISCECTOMY AND FUSION USING AUTOGRAFT VERSUS ALLOGRAFT: CLINICAL AND RADIOLOGICAL OUTCOMES

Objective: The primary aim of this retrospective study was to assess and contrast the clinical and radiological outcomes subsequent to anterior cervical discectomy and fusion (ACDF) with autograft versus allograft.

Background: The cervical X-ray is the most frequently utilized method for evaluating cervical fusion. Currently, there is limited research on measuring CT imaging parameters to evaluate the impact of graft selection on surgical outcomes.
Methods: A retrospective cohort analysis was performed on patients who underwent one or two-level ACDF was conducted. Radiographic assessments were conducted preoperatively, immediately postoperatively, and during the follow-up. These assessments included measurements of changes in C2-7 lordosis, sagittal vertical axis (SVA), segmental height and lordosis, subsidence, and interbody bone graft fusion status. The clinical efficacy of the procedure was evaluated using the visual analog scale (VAS), the Neck Disability Index (NDI), and the Modified Japanese Orthopedic Association score (mJOA).
Results: A total of 60 patients were evaluated, with 40 receiving autograft and 20 receiving allograft. There were no notable disparities in demographic characteristics between the two patient cohorts. Autografts demonstrated a significantly higher fusion rate within a 6-month period (43% vs. 27%, P<0.05). However, there was no significant distinction in long-term fusion rates between the two groups (89% vs. 76%, P>0.05). The subsidence rate was 38.5% for the autograft group and 34.3% for the allograft group (P>0.05). No significant differences existed between preoperative, postoperative, or change in mJOA, NDI, VAS between the two groups.
Conclusion: The maintenance of sagittal alignment is observed regardless of whether autografts or allografts are utilized in the context of ACDF. The autograft group demonstrates a superior early fusion rate in comparison to the allograft group, while long-term fusion rates do not exhibit any notable disparities. Both groups have similar clinical outcomes.

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SURGICAL PLANNING AND MORPHOLOGICAL CHARACTERISTICS OF IN-SITU BONE GRAFTS IN ANTERIOR CERVICAL DISCECTOMY AND FUSION: A 3D SIMULATION STUDY

Objective: To investigate the morphological characteristics of cervical vertebrae in three dimensions, quantify the volume of bone obtained during in-situ harvesting, and evaluate the clinical outcomes of grafting in anterior cervical discectomy and fusion (ACDF).
Background: For cervical spine surgeries involve precise procedures and high surgical risks, 3D CT reconstruction greatly improve the accuracy and safety of the surgery. However, there is a dearth of literature reporting the utilization of 3D preoperative planning for calculating and designing bone harvest in ACDF.
Methods: Sixty-one patients undergoing single-level ACDF were included in this study. Prior to surgery, a 3D surgical planning simulation was conducted, and constructed a simulated cutting plane in ACDF. Harvested in-situ bone graft volumes were measured during simulated surgery, including anterior lip, posterior osteophytes, Luschka joints. Postoperative CT scans were performed to evaluate the efficacy of preoperative planning. Subsequently, the radiological fusion rate and clinical outcomes were monitored during the follow-up period.
Results: The mean duration of follow-up was 18.02 ± 4.9 months. Upon final follow-up, it was observed that the mJOA, VAS, and NDI scores exhibited significant improvement following surgery (P < 0.05). Five cases experienced subsidence. The average graft groove volume of the cage measuring 373.2 ± 74.4 mm3, which was found to be lower than the surgical plan (494.4 ± 209.5 mm3, P <0.001). In 88.5% (54/61) of the cases involving simulated operation, it was observed that the volume of cage's bone graft groove met the stipulated requirements, aligning with the intraoperative scenario. Male, elderly patients, lower surgical segments, and higher-grade facet joint degeneration exhibited a greater availability of in-situ autologous bone.
Conclusions: The comprehensive analysis of the in-situ bone harvest in ACDF, offers valuable guidance for the decision-making process regarding bone grafting and potential cost reduction through eliminating allografts.

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Comparison of surgical outcomes of posterior decompression in patients with single-level cervical spondylotic myelopathy with and without instability

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Background: Cervical intervertebral instability has been reported to negatively affect the outcome of decompression surgery alone for cervical spondylotic myelopathy (CSM). However, in those studies, the level of the responsible lesion for symptoms and the level of intervertebral instability were not always the same.
Objective: To ensure the correspondence between the responsible lesion and the instability level, we compared the surgical outcomes of posterior decompression for CSM with single-level stenosis with or without intervertebral instability.
Methods: Patients who underwent laminoplasty or selective laminectomy for CSM with single-level intervertebral stenosis were included. We defined the length of anteroposterior translation at the stenosis level on preoperative flexion/extension radiographs as Translation. Patients with Translation of 3 mm or more at the stenosis level were classified as instability group, and those with less Translation than 3 mm as stable group. Propensity score matching was performed. C2-7 angle, C2-7 range of motion, Translation, and the Japanese Orthopaedic Association scoring system (JOA score) for cervical myelopathy were compared preoperatively and at 1 year postoperatively.
Results: 34 patients were included in this study. 10 cases from each group were matched. There were no significant differences in patient backgrounds. The radiographic parameters and JOA score were shown in Table1. Both groups demonstrated a decrease at 1 year postoperatively in the C2-7 range of motion ($p < 0.05$). Translations decreased postoperatively in instability group ($p < 0.05$). Four of the instability group patients kept intervertebral instability postoperatively. Both groups had a significant improvement in JOA score after surgery ($p < 0.05$). Instability group indicated a similar JOA score recovery rate as stable group.
Conclusion: When treating CSM patients with single-level stenosis by posterior decompression alone, short-term results with intervertebral instability were comparable to those of patients without instability. In instability group, preoperative intervertebral instability significantly decreased postoperatively.

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Effects of Decompression Surgery and Erythropoietin Combination on a Rat Model of Compressive Myelopathy

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Background: Treatment for severe myelopathy primarily involves surgical interventions, with varying recovery outcomes. Erythropoietin (EPO) is a medication known for its hematopoietic effects; however, it has also attracted attention for its neuroprotective and remyelination properties.
Objective: To investigate the effects of combining EPO administration with decompression surgery in a rat model of compressive myelopathy.

Methods: 8-week-old female SD rats were used. After removing the C6 lamina, a hydroexpansive sheet (3×5×0.7mm) was inserted under the C4/5 lamina to create a chronic spinal cord compression model. Following sheet insertion, weekly behavioral evaluations (Basso, Beattie and Bresnahan score: BBB score, Grid runway test) were conducted, and rats with BBB scores of 13 or lower between weeks 5 and 8 were considered to have developed myelopathy. The BBB score serves as an assessment scale for evaluating the function of a rat's hindlimbs. Rats with myelopathy were divided into three groups: control group (sham surgery and subcutaneous saline injection), decompression group (laminectomy, sheet removal, and subcutaneous saline injection), and decompression-EPO group (laminectomy, sheet removal, and subcutaneous EPO injection). Behavioral evaluations were conducted for 8 weeks after the onset of myelopathy. After 8 weeks, spinal cords were harvested for Luxol fast blue (LFB) staining and immunohistochemical staining (Myeline Basic Protein: MBP, Growth Associated Protein 43: GAP-43). (figure 1).
Results: At 8 weeks post-intervention, BBB scores were 12.1(±0.8), 13.4(±1.0), and 14.1(±1.4) for the control, decompression, and decompression-EPO groups, respectively, with a significant difference observed between the decompression-EPO and control groups ($p<0.05$). Histologically, significant differences were observed between the decompression-EPO and control groups in LFB staining, MBP and GAP-43 positive area ratios ($p<0.05$).
Conclusion: EPO combined with decompression surgery shows potential in promoting axonal remyelination and improving outcomes in myelopathy, although its superiority over surgery alone is unclear.

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Three-dimensional printing motion-preserving cervical joint system implantation for treatment of cervical myelopathy

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BACKGROUND: At present, fusion surgery must be performed to reconstruct the stability of the cervical spine after anterior cervical corpectomy. However, fusion sacrifices the mobility of the surgical segment of the cervical spine. We have done some research and exploration on the preservation of cervical segmental motor function after anterior cervical corpectomy.
OBJECTIVE: To explore the short-term clinical effect of three-dimensional printing motion-preserving cervical joint system implantation in the treatment of patients with cervical spondylotic myelopathy.
METHODS: In December 2020, a self-developed three-dimensional printing motion-preserving cervical joint system implantation technology was used to treat two patients with cervical spondylotic myelopathy. Visual analogue scale score and JOA score were used to evaluate the patient's pain and neurological recovery at 1, 6, 12, and 16 weeks after the operation. Imaging techniques such as dynamic position X-rays and three-dimensional CT were used.
RESULTS: The pain and numbness of the two patients were significantly reduced the next day after the operation, and the muscle strength of the limbs was partially restored. At 1, 6, 12, and 16 weeks postoperative follow-up, the patient's limb muscle strength, visual analogue scale score, and JOA score were significantly improved compared with preoperatively, and the head and neck movement function was good. X-ray examination showed that the cervical spine physiological curvature was well restored, and the intervertebral height was maintained well. 3D-CT showed that the prosthesis components and the cervical spine bones were in good fit. The dynamic position X-ray showed that the prosthesis endplate component had a certain angle of opening and closing changes during flexion, extension and lateral flexion, and there was no cervical spine instability.
CONCLUSION: It is concluded that motion-preserving cervical joint system can retain the function of intervertebral movement on the basis of reconstructing the stability of the cervical spine.

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Cervical sagittal balance after consecutive three-level hybrid surgery versus anterior cervical discectomy and fusion: radiological results from a single-center experience

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Background: According to the different numbers and relative locations of cervical disc replacement (CDR) and anterior cervical discectomy and fusion (ACDF), three-level hybrid surgery (HS) has many constructs.
Objective: The purpose of this retrospective study was to compare the sagittal alignment parameters of HS and ACDF for cervical degenerative disc disease (CDDD) and the association of the respective parameters.
Methods: This study involved patients with three-level CDDD who underwent ACDF or HS. This follow-up included one-level CDR and two-level ACDF (type I group), two-level CDR and one-level ACDF (type II group) and three-level ACDF. Cervical sagittal alignment parameters included cervical lordosis (CL), segment alignment (SA), T1 slope (T1S), C2-C7 sagittal vertical axis (SVA), T1S-CL, C2 slope (C2S), occipital to C2 angle (O-C2A) and segment range of motion (ROM).
Results: The three groups with a total of 106 patients were better matched in terms of demographics. Patients who underwent HS had significantly higher CL than those who underwent ACDF at 1 week, 6 months, 12 months and the final follow-up after surgery, as well as significantly better SA at 12 months and the final follow-up.
Conclusion: Most improvements in cervical sagittal alignment were observed in all three groups postoperatively. HS was more advantageous than ACDF in the maintenance of postoperative CL and SA. Thus, three-level HS may be better for maintaining cervical curvature.

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A Comparison of Self-Locking-Cage and Cage-With-Plate Systems For Three-Level ACDF: Minimum 2 Year Assessment of Clinical And Radiological Outcome

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Background: Multilevel anterior cervical discectomy and fusion (ACDF), although being considered as the gold standard for cervical spondylotic myelopathy, possesses potential complications including non-union, adjacent segment degeneration and dysphagia. Self-locking-cage and cage-with-plate systems are reasonable options but specific indications for each technique remain controversial.
Objective: The aim of our study is to compare clinical and radiological outcomes of three-level ACDF using self-locking cages and cage-with-plate configuration.

Material and Methods: We retrospectively study patients who underwent three-level ACDF for cervical spondylotic myelopathy. There were 46 patients in self-locking cage group and 50 in cage-with-plate group. Clinical parameters included JOA score for neurological status and NDI for axial neck pain. Fusion rate, global and segmental lordotic angles, disc height, and adjacent segment degeneration rate were assessed by radiographs.
Results: Both groups showed excellent improvement in neurological status and axial neck pain at final follow-up with no statistical differences. Dysphagia at final follow-up was more common in cage-with-plate patients than in self-locking-cage group (18% and 5%, respectively; $p<0.05$). In terms of radiological outcome, both global and segmental lordotic angles were well maintained in all groups, with minimal correction loss over time. The fusion rate was 86% in self-locking cage group and 100% in cage-with-plate group ($p<0.05$). There were 15 cases (30%) with adjacent segment degeneration (ASD) in cage-and-plate group and none has been detected in self-locking cage patients ($p<0.05$), however ASD did not have any negative effect on final clinical outcome. No cases needed to have revision surgery due to implant-related complications.
Conclusion: Both self-locking-cage and cage-with-plate configurations provide similar satisfactory clinical and radiological outcomes. Cage-and-plate system is better in terms of fusion rate but accompanied by higher dysphagia rate and therefore should be carefully indicated in patients with preexisting swallowing difficulties.

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Long-Term Follow-Up of the First Case of Multidimensional Atlanto-Odontoid Joint Arthroplasty

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Background: Instability of the cervical joint may occur due to various factors, such as common traumas, congenital deformities, and tumors, and can cause compression of the spinal cord or nerve roots, with severe cases leading to atlanto-odontoid dislocation. Surgical intervention is often required for atlanto-odontoid joint instability. Both anterior and posterior approaches often involve fusion or fixation procedures. However, these fixation or fusion surgeries often result in a loss of atlanto-odontoid joint mobility.
Objective: To circumvent the above issues, we designed a several kinds of artificial atlanto-odontoid joints since 2008. Following considerable biomechanical testing on fresh cadavers and animal models, we performed the first multidimensional artificial atlanto-odontoid joint replacement surgery in the world on a 42-year-old patient to test the feasibility, safety and Effectiveness.
Methods: The patient, a 42-year-old man, was admitted to the hospital in November 2016. He complained of 1-year-long unexplained posterior neck pain, exacerbated with activity and relieved at rest, and accompanied by numbness in all four limbs. After approved by the Medical Ethics Committee, we adopted atlanto-odontoid replacement surgery on this patient with an artificial multidimensional atlanto-odontoid joint that we constructed (China patient No.: ZL 201410082867.6). And conduct a 6-year follow-up.
Results: His cervical appearance was as healthy, and he exhibited reasonable mobility as follows: flexion (32°), extension (29°), lateral bending (left, 35°; right, 38°), and rotation (left, 75°; right, 80°). Throughout the 6-year follow-up period, he occasionally experienced neck pain, but his mobility mainly remained preserved, and he did not experience any symptoms of bilateral lower limb weakness. Radiography images showed slight loosening of some screws in C2, but no evidence of dislocation.
Conclusion: As an effective treatment approach, this artificial multidimensional atlanto-odontoid joint maintains the stability of the atlanto-odontoid joint and preserves its mobility.

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Usefulness of paravertebral foramen screw insertion in posterior cervical fixation surgery

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Background: Paravertebral foramen screw (PVFS) applied in posterior cervical fixation surgery has been reported to be safer than the cervical pedicle screw. PVFS strengthens the fixation force by grasping the cortical bone around spinal canal with the screw threads. In this study, we evaluated the accuracy of the screw insertion, the presence of medial and craniocaudal cortical bone grasping, and the postoperative complications related to the screw malposition.
Methods: Thirty patients (22 males, 8 females, mean age 67.0 years old) who underwent posterior cervical fixation surgery using PVFS were enrolled. (Mean follow-up period was 18.6 months.) It is recommended that the screw insertion point is 1mm medial from the middle of the lateral mass at the pedicle height, and the trajectory is 20° medially. Postoperative CT was used to evaluate the position of the PVFS (perforation, insertion point, trajectory, and whether the cortical bone grasped or not). Complications were also investigated.
Results: Total of 134 PVFS were inserted. There were 17(12.7%) screw perforations, (8.2% medial and 4.5% craniocaudal). There was no vertebral artery injury. One case had medial perforation resulting in postoperative C5 palsy, and the screw removal was needed. The average insertion angle was 14.8°(3-31°). Eleven screws with medial perforation were inserted at an average insertion angle of 23.4°, significantly higher than those without medial perforation. They were also significantly inserted more medial from the intended point. Of 117 PVFS without perforation, 55(47.0%) screws grasped medial cortical bone, and 87(74.5%) screws grasped craniocaudal cortical bone. That is, 94(80.3%) screws grasped either medial or craniocaudal cortical bone. Screw loosening was observed in 19(14.2%) screws at the follow-up, but no backout was observed.
Conclusion: In this study, less than half of PVFS grasped medial cortical bone. The insertion angle was smaller than 20° in those cases, probably due to the doctors speculation to avoid medial perforation. However, 80% of PVFS grasped either medial or craniocaudal cortical bone, and good fixation strength are expected.

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Partial uncinatectomy combined with anterior cervical discectomy and fusion for the treatment of one-level cervical radiculopathy: analysis of clinical efficacy and sagittal alignment

Background: Partial uncinatectomy (UT) may be required for some patients with cervical spondylotic radiculopathy (CSR).
Objective: To investigate effect of the clinical efficacy and sagittal alignment of partial UT during anterior cervical discectomy and fusion (ACDF).

Methods: A total of 87 patients who had undergone single level ACDF using a zero-profile device from July 2014 to December 2018 were included. Based on whether the foraminal part of the uncovertebral joint was resected or preserved, the patients were divided into the ACDF with UT group (n = 37) and the ACDF without UT group (n = 50). Perioperative data, radiographic parameters, clinical outcomes, and complications were compared between the two groups.
Results: The average preoperative VAS arm score was 5.89 ± 1.00 in the ACDF with UT group and 5.18 ± 1.21 in the ACDF without UT group (p = 0.038). However, the average VAS arm score was 4.22 ± 0.64, 4.06 ± 1.13 and 1.68 ± 0.71, 1.60 ± 0.70 at 1 week post operation and at final follow up, respectively, (p >0.05). We also found that the C2-7 SVA and St-SVA at the last follow-up and their change (last follow-up value − preoperative value) in the ACDF with UT group were significantly higher than ACDF without UT group (p < 0.05). No marked differences in the other cervical sagittal parameters, fusion rate or complications, including dysphagia, ASD, and subsidence, were observed.
Conclusion: ACDF using a zero-p implant with or without partial UT both provide satisfactory clinical efficacy and acceptable safety. However, additional partial UT may have a negative effect on cervical sagittal alignment.

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The Influence of Cervical Range of Motion on Postoperative Kyphotic Change after Laminoplasty

Background: The influence of cervical range of motion on postoperative kyphotic change after laminoplasty (LAMP) has received attention. We have previously focused on the proportion of extension to total cervical range of motion (defined as % cervical position; %CP) and its influence on postoperative alignment. However, it is still unclear how it directly impacts postoperative outcomes.
Methods: Forty-four patients who underwent cervical spine surgery for cervical spondylotic myelopathy (CSM) or posterior longitudinal ligament ossification (OPLL) at our institution between April 2018 and March 2019, and were followed up for at least 1 year, were included in the study (7 OPLL and 37 CSM). We assessed preoperative cervical spine parameters, including T1 slope, cervical lordosis angle (∠CL), CGH-C7SVA, and %CP, and identified risk factors for 1-year postoperative ∠CL reduction using univariate and multivariate analyses. ROC curves were used to determine thresholds. Additionally, we analyzed the correlation between cervical spine parameters and neck pain VAS and recovery rate of JOA scores one year after surgery.
Results: The amount of ∠CL changes demonstrated the highest correlation with %CP (r=0.559). In a multivariable analysis using a decrease of 5 degrees or more in the lordosis angle as the dependent variable, %CP was found to be the sole risk factor (OR 0.931) with a threshold of 22.0% (47.6% sensitivity, 87.0% specificity). There was no correlation between postoperative neck pain VAS and any cervical parameters, while only %CP (correlation coefficient=0.602, p<0.01) correlated with JOA improvement rate.
Conclusion: It has been suggested that %CP is not only a predictor of lordosis reduction following LAMP, but also of postoperative outcomes.

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The predictive value of Hounsfield units for titanium mesh cage subsidence after anterior cervical corpectomy and fusion

Background: There are few reports on the relationship between titanium mesh cage (TMC) subsidence and Hounsfield units (HU) in anterior cervical corpectomy and fusion (ACCF).
Objective: To investigate whether bone mineral density measured in HU correlates with TMC subsidence after ACCF.
Methods: A total of 64 patients who underwent ACCF with TMC with a mean follow-up of 19.34 ± 7.86 months were analyzed. HU values were measured according to published methods. Receiver operating characteristic (ROC) curve analysis and multivariate logistic regression analysis were performed.
Results: Twenty-two patients (34.38%) had evidence of postoperative TMC subsidence. The mean HU values in the subsidence group (317.34 ± 32.32) were significantly lower than those in the nonsubsidence group (363.07 ± 25.23, p < 0.001). At last follow-up, mean disc height loss was 4.80 ± 1.16 mm in the subsidence group and 1.85 ± 1.14 mm in the nonsubsidence group (p< 0.001). There was a negative correlation between HU values and disc height loss (Pearson's coefficient −0.494). HU values decreased gradually from the C3 to the C7, and the HU values of the C5, C6, and C7 vertebrae in the nonsubsidence group were significantly higher than those in the subsidence group (p<0.05). The area under the ROC curve was 0.859, and the most appropriate threshold of the HU value was 330.5. The older age, lower LIV HU value and a greater segmental angle change were significantly associated with a higher incidence of TMC subsidence after ACCF.
Conclusion: There are strong correlations between a lower HU value and TMC subsidence after ACCF. More accurate assessment of bone quality may be obtained if HU measurement can be used as a routine preoperative screening method together with DXA.

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Luschka Joint Fusion Versus End Plate Space Fusion in Anterior Cervical Spine Surgery : A Prospective Randomized Controlled Trial

Background: The Luschka joint, also known as the uncovertebral joint, is a potential region for anterior cervical fusion. The effect of the Luschka joint fusion (LJF) has been confirmed in goat model. However, there are no clinical trials on human Luschka joint fusion.
Objective: This study aimed to compare the fusion speed and clinical efficacy of LJF and traditional endplate space fusion (ESF) in anterior cervical surgery.
Methods: Patients with single-level cervical spondylosis were recruited and admitted between February 2021 and October 2022 and randomly divided into the LJF and ESF groups (Figure 1). The primary outcome was the early fusion rate 3 months postoperatively. Secondary outcomes included the incidence of complications and patient-reported outcome measures (PROMs).
Results: A total of 74 (92.5%) patients completed the trial and were included in the analysis, with an average age of 54.8 (26-65) years. The operation duration (131.3 ± 29.4 min vs. 123.6 ± 26.0 min, p=0.237) and intraoperative blood loss (70.6 ± 50.0 ml vs. 79.2 ± 49.0 ml, p=0.454) were comparable between the two groups. The fusion rate in the LJF group was significantly higher than that in the ESF group at 3 and 6 months after operation (3 months after operation: 66.7% vs. 13.2%, p<0.0001; 6 months after operation: 94.1% vs. 66.7%, p=0.006). No significant difference was found in the fusion rate between the two groups 12 months postoperatively. The JOA, NDI, and VAS scores for the arm and neck significantly improved after surgery in both groups.
Conclusions: In anterior cervical fusion surgery, the early fusion rate in LJF is significantly higher than that in ESF.

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Radiation exposure of operators during Spine surgery

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Background: Intraoperative X-ray is essential for anterior or posterior cervical spine fixation. The safety and reliability of surgical operations can be increased by using X-ray. On the other hand, radiation exposure to the surgeon poses a major problem.

Objective: The expected radiation exposure for one year was calculated and quantified for one operator.

Methods: Generally, cervical spine diseases are less common than those of the lumbar spine. It is impossible to measure the radiation exposure from cervical spine surgery alone. We decided to measure the X-ray irradiation time in conjunction with lumbar spine surgery to indirectly predict radiation exposure. For fusion surgery, the fluoroscopy time was measured using one C-arm, and when two C-arms were used, such as in percutaneous vertebroplasty, the A-P fluoroscopy and lateral fluoroscopy times were measured separately. Film badges were attached to the inside of the left chest protector, the left front neck, and the inside of the X-ray protection glasses.

Results: Total irradiation time for the cervical and lumbar was 14,896 seconds/year. The annual actual measured values were 1.7 mSV for the left eye, 25.5 mSV for the neck, 6.1 mSV for the chest, and the effective dose was 8.2 mSv/year. The average irradiation time for each in the anterior cervical spine fixation was 44 seconds, and the average time for each in the posterior cervical fixation was 106 seconds.

Conclusion: Don't forget that the cervical fixation are almost directly exposed to X-ray, as little patient's body to shield. By actually quantifying the operator's exposure to radiation, I was able to reaffirm the importance of always being conscious of defense.

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SURGICAL OUTCOME OF MINGSHENG TAN TECHNIQUE FOR C2 ODONTOID FRACTURE

Background: Regarded as the gold standard of surgery for C2 odontoid fracture, Goel-Harms technique had several drawbacks including but not limited to the necessity of dealing with the venous plexus and C2 nerve roots. To overcome those obstacles, several modifications have been proposed and Mingsheng Tan technique was one of alternative solutions that we used since 2014 for C1-2 fixation.

Objective: Evaluating the surgical outcome of Mingsheng Tan technique for C2 odontoid fracture

Methods: Mingsheng Tan technique differed from conventional Goel-Harms technique only on the entry points of C1, which located at the posterior arch of C1 rather than C1 lateral mass only. We retrospectively assessed C2 odontoid fracture patients surgically treated with Mingsheng Tan technique from January 2014 to June 2022. Clinical parameters (including neck pain, range of motion and neurological complications if any) and radiographic findings (including sign of implant failure and fusion rate) were assessed.

Results: There were forty-four recruited patients with mean age of 34.67 years. The mean operation time and blood loss were 126,67 ± 25,34 minutes and 125 ± 3,12 milliliters, respectively. No intraoperative neurovascular complications were documented in our group. In terms of postop clinical findings, restriction of cervical rotation was the most common chief complain, with minimal to moderate impact on the patient's quality of life. The mean rate of odontoid union and posterior fusion were 87.93% and 100%, respectively.

Conclusion: Given the preliminary results of our study, Mingsheng Tan technique could be considered as a safe and reliable alternative option apart from Goel-Harms procedure for C2 odontoid fracture. The avoidance of dealing with the C1-2 venous plexus might help to minimize the blood loss as well as surgical duration. Further studies with larger sample size and longer duration are required in order to make more definitive conclusions.

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Postoperative Intervertebral Height Loss in OLIF patients –True Subsidence or "Artificial Settling"? A CT-based analysis

Background: Post-operative intervertebral height loss following Spinal fusion is an undesired effect of surgery. This is particularly concerning in lateral surgery, as it negates the positive effects of indirect decompression, leading to symptom recurrence. Traditionally, disc height loss was attributed to subsidence caused by a violation or breach of the endplate. However, we believe that over-distraction resulting in "artificial settling" may be a more common cause, rather than subsidence alone.

Objective/Aim: The aim was to determine if post-OLIF intervertebral height loss was predominantly due to true subsidence or artificial settling.

Methods: 154 levels in 79 patients aged 67±7.8 years who underwent single or multilevel OLIF for degenerative spinal conditions were selected. Immediate postoperative and 1-year postoperative imaging were used to measure the anterior disc height (ADH), posterior disc height (PDH), and mean disc height (MDH). Post-operative Subsidence was measured at all four corners of the cage, using the 1-year postoperative CT. Mean disc height loss and mean subsidence were calculated. Height loss not due to subsidence was attributed to settling. The degree of settling and subsidence in our patient population was determined.

Results: 109 of 154 levels demonstrated 1-year postoperative disc height loss. Of these, 27.5% (30 levels) exhibited true subsidence, suggesting that artificial settling was more common (72.5%). However, subsidence resulted in greater disc height loss (1.893±1.284mm vs 1.408±1.084mm, P= 0.0522). BMI and weight were risk factors for disc height loss, concurring with current literature. There was a positive correlation (R2 = 0.182) between intraoperative height gain and postoperative height loss.

Conclusion: Postoperative intervertebral height loss may result from both true subsidence and artificial settling. Although previously believed that subsidence was more common, artificial settling is actually more prevalent. However, subsidence still results in greater disc height loss. It is important to note that both phenomena can coexist.

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Where to stop lateral exposure to reduce surgical invasiveness in posterior decompression surgery of cervical spine? ―Cadaveric study―

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OBJECTIVE: Deep extensor muscles (Semispinalis, Multifidus, Rotators Cervicis) and capsules of the facet joints work as stabilizers of the cervical spine. This study aimed to investigate anatomical characteristics of these stabilizers to assist surgeons to reduce surgical invasiveness in posterior decompression surgeries.

METHODS: Four cadavers were observed microscopically. (1) The dorsal aspect of Multifidus was exposed by removing Semispinalis from the spinous processes. Multifidus was detached from its insertion at the spinous processes and flipped caudally / laterally, and then its ventral aspect was observed to determine its origin. (2) Next, Rotators which runs in the deepest layer among the three muscles was identified, and its origin and insertion were determined. The space between the medial border of facet joint and the lateral border of tendinous insertion of Rotators to the lamina (LTR) were carefully observed to identify the facet capsule.
RESULTS: (1) Multifidus originates from the dorsal aspect of the lateral mass of C5 and C6 and the transverse processes of C7 and T1. (2) Rotators also originate from the dorsal aspect of the lateral mass from C3 downwards, together with Multifidus from C5 downwards, and insert to the adjacent laminae by one (brevis) or two (longus) levels rostrally. LTR was always found slightly medial to the medial border of the facet joint. The space between LTR and the facet joint was filled with membranous tissue, instead of a capsule-like fibrous structure.
CONCLUSIONS: Unprepared lateral exposure can violate the origins of Multifidus and Rotators on the lateral mass. Additionally, the fibrous capsule at the medial border of the facet joint is hardly visible even using a microscope. LTR may serve as an anatomical landmark to avoid unintentional damages to the facet joint and to preserve the muscle origins on the lateral mass.

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Pathological and Molecular Regulation Characteristics of Ossified Nuchal Ligament with Different Sections

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Background: Both ONL and Ossification of the Posterior Longitudinal Ligament (OPLL) are forms of heterotopic ossification (HO). Research conducted on HO and OPLL have identified that distinct pathological and molecules features, however, there is a dearth of studies focusing on ONL.
Objective: To examine the pathological characteristics of ONL and explore its molecular regulators through different cross sections.
Methods: 35 ONL specimens were collected during laminoplasty conducted in our department between 2018 and 2023. Transverse incisions were made at three distinct cross sections, encompassing both ends and the middle portion of the specimen's vertical long axis. The middle portion was defined as the midsection of the ossified substance. Hematoxylin-eosin and Safranin O-Fast Green staining techniques were employed for detection. Three distinct regions of cell distribution were chosen from stained sections of various parts of the specimen for tissue chip scanning. BMP-2, FGFR-1, CTGF, GDF-5, and IGF-1 were used as markers for possible mechanism exploration.
Results: In most specimens, the central region exhibits a higher degree of bone maturation in comparison to both ends, characterized by more prominent mature bone trabeculae, lower chondrocyte content, and reduced presence of inflammatory cells. The expression levels of BMP-2, FGFR1, CTGF, GDF-5, and IGF-1 in the sections located at both ends of the ossified nuchal ligament were elevated. Conversely, the middle sections of the ossified nuchal ligament higher expression levels of TGF-β.
Conclusion: The middle portion of the ossified nuchal ligament exhibits greater maturation compared to its ends, accompanied by a less inflammatory response. The expression levels of BMP-2, FGFR1, CTGF, GDF-5, and IGF-1 were found to be elevated in the terminal regions, suggesting their prominent involvement in the initial phase of ossification. The expression levels of TGF-β were higher in the middle segment, indicating they might prone to influence the maturation of ONL.

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What Impact does Segmental Motion with Non-union after Anterior Cervical Discectomy and Fusion on Adjacent Segmental Degeneration?

Backgrounds: Adjacent segment degeneration (ASDeg) is one of the complications that occurs after anterior cervical discectomy and fusion (ACDF) and may require regular follow-up or treatment. Some clinical and radiologic risk factors was revealed for ASDeg. But There are still less understood about on ASDeg in relation to this decrease of segmental motion by solid fusion.
Objectives: To elucidate the effect of decreased segmental motion on ASD in solid union after ACDF.
Methods: This retrospective cohort study was evaluated 104 patients who underwent ACDF to treat degenerative cervical myelopathy or radiculopathy and were followed 2 years. The dynamic fusion group was defined as the difference of interspinous motion less than 1mm between lateral flexion and extension simple radiographs. The ASD incidence rate, clinical outcomes, radiologic factors were compared between 65 dynamic fusion patients and 39 non-fusion patients. Logistic regression analysis was performed to identify the risk factors of ASD at postoperative 2 years.
Results: This study included 104 patients with 208 adjacent segments. There are no difference at clinical outcomes such as neck pain visual analogue scale (VAS), arm pain VAS, neck disability index. At dynamic fusion group, ASDeg ans ASDi ratio at 2-year follow-up was higher than non-fusion group (ASDeg ratio: 36.9% vs 7.7%, $p<0.001$; ASDi ratio: 20.0% vs 5.1%, $p=0.037$). Multicariate logistic regression analysis demonstrated the dynamic fusion, decreased bone mineral density (BMD), increased C2-C7 sagittal vertical axis (SVA) were factors associated with ASDeg.
Conclusions: The dynamic fusion can be not only the shield to prevent the recurrence of surgical level but also a risk factor of ASDeg after ACDF. ASDeg is also related low BMD and imbalanced C2-C7 SVA. In terms of ASDeg occurrence, non-union is by no means a bad thing, and in order to reduce both ASDeg and recurrence of surgical level, focus should be placed on BMD treatment and C2-C7 SVA recovery before and after surgery.

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The relationship between neck pain and cervical sagittal parameters：A real world study.

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Objective: To analyze the relationship between neck pain and cervical sagittal parameters from a real world data.
Methods: We reviewed all outpatient in our clinic from January 2023 to September 2023 and collected 126 cases, whose main complaint was neck pain. The VAS of neck pain for each patient was recorded. We measured cervical sagittal parameters, including C2–C7 angle (CL), C2–C7 SVA (cSVA), T1 slope (TS) and the value of T1 slope minus cervical lordosis (TS-CL) by lateral X-ray. Patients with ossification of the nuchal ligament (ONL) or not was also recorded.
Results: Eighty-four female and 42 male patients with a mean age of 40.21 years were enrolled in this study. The mean VAS of neck pain was 4.00+-1.52. There was a positive relationship between neck pain VAS and cSVA ($p=0.04$), and TS-CL ($p=0.05$). There was no correlation between VAS and CL ($p=0.32$), TS ($p=0.37$), or with ONL

or not (p=0.18). According to the duration of neck pain, patients were divided into acute group (less than 1 month) and chronic group (more than 1 month,). There was a significant difference in cSVA (1.62+-1.03cm VS 1.27+-1.01cm, p=0.05) and TS-CL (11.80+-8.38 degree VS 8.77+-7.61 degree, p=0.03) between these two groups. But CL, TS and the incidence of ONL and cervical kyphosis were similar in these two groups. Once again patients were divided into mild neck pain group (VAS less than 4) and moderate and severe neck pain group (VAS more than 5). There was a significant difference in cSVA (1.16+-0.94cm VS 1.80+-1.04cm, p=0.00) , CL (12.25+-10.76 degree VS 8.27+-9.08 degree, p=0.03) and TS-CL (8.11+-7.54 degree VS 12.84+-8.04 degree, p=0.00) between these two groups. Patients in severe neck pain group had a high ratio to combine with ONL and cervical kyphosis significantly.

Conclusion: The severity of neck pain was correlated with cSVA and TS and CL mismatch. There was a large value of cSVA and T1 slope minus cervical lordosis in acute and severe neck pain groups. Patients with severe neck pain tended to combine with ONL and cervical kyphosis.

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In Vivo Three-Dimensional Kinematics Analysis of Cervical Spine After Posterior Atlantoaxial Fusion Under Physiological Load

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Summary of Background Data: Posterior atlantoaxial fusion (PAAF) is the main and effective surgical method for atlantoaxial instability, but the study of its effect on cervical biomechanics mainly focuses on the optimal atlantoaxial fusion angle and the variation of lower cervical curvature. There are few studies on the three-dimensional movement of the cervical spine after PAAF, particularly the changes of in vivo biomechanical characteristics of adjacent segments and lower cervical segments are not clear.

Objective: The aim of this study was to analyze in vivo three-dimensional (3D) cervical motion characteristics of patients who had undergone posterior atlantoaxial fusion (PAAF) surgeries using cone beam computed tomography (CBCT) combined with three dimensions (3D-3D) registration technology.

Methods: The study selected 20 patients who underwent PAAF surgery and 20 healthy people as the control group. All subjects underwent CBCT scans of the occipital and cervical spine in 7 different functional positions, then 3D-3D registration of Occiput (Oc)-C7 was performed at each functional position to calculate the motion characteristics of each segment. The ranges of motion (ROMs) of the entire cervical spine (C1-C7) and each segment in each functional position were obtained.

Results: In the PAAF group, the primary ROMs of C1-C7 in flexion-extension and twisting were significantly reduced compared with the control group (41.9°±13.8°vs.56.6°±11.6°, 29.3°±9.6°vs. 91.2°±13.7°, respectively, $P < 0.05$). For Oc-C1, the ROM of the PAAF group was significantly smaller than the control group in flexion-extension (10.7°±3.2°vs.19.4°±4.2°, $P<0.001$), but there is a compensatory increase of the ROM in twisting (5.3°±4.2° vs. 2.1°±1.8°, $P<0.05$). The twisting ROM of C2-C3 was 4.7°±2.0° in the PAAF group and 3.1°±1.6° in the control group ($P < 0.05$).

Conclusion: The PAAF surgery would result in biomechanical changes to the cervical spine. After PAAF, the movement of the overall cervical spine (C1-C7) in flexion-extension and rotation were significantly decreased, and the kinematics of adjacent segments and lower cervical segments were also impacted to varying degrees. Furthermore, the operation had a greater impact on cervical extension compared to cervical flexion.

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An in vivo, three-dimensional, functional centers of rotation of the healthy cervical spine

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Objective: The position of the center of rotation (COR) under functional postures for each cervical segment remains controversial. Therefore, this study investigated in vivo cervical COR positions at seven postures in healthy volunteers using validated cone beam computed tomography (CBCT) combined with the 3D-3D registration technique.

Methods: Twenty healthy volunteers underwent CBCT scans of the cervical vertebra at seven functional positions, and a three-dimensional model was constructed. The images for each position for the cervical vertebrae were superimposed over the neutral position using 3D-3D registration technology. The kinematic difference was recorded, and the rotational axis was analyzed. From C2/3 to C6/7, each segment's COR was measured for each functional position.

Results: In the flexion and extension positions, the position of the CORs of C2/3 to C6/7 was located posterior (-5.3±3.8 ~-0.6±1.2mm) and superior (16.5±6.0 ~23.6±3.2 mm) to the geometric center (GC) of the intervertebral disc in the anterior-posterior and superior-inferior directions. However, the COR of the C4/5 segment was located anterior to the GC (2.0±9.8 mm) in the flexion position and close to the GC in the right-left direction. During left-right twisting, the CORs of C2/3-C6/7 were posterior (-21.8±10.5 ~-0.9±0.8 mm) and superior (3.1±7.5 ~23.2±3.6 mm) to the GCs in the anterior-posterior and superior-inferior directions, but there was no constant directivity in the right-left direction. During left-right bending, the COR of each segment was located posterior (-25.2±13.1 ~-6.5±9.9 mm) and superior (0.3±12.5 ~12.1±5.1 mm) to the GC in the anterior-posterior and superior-inferior directions, except for the COR of the C2/3 segment, which was located inferior to the GC (-5.9 ±4.1 mm) in the left bending position. The position of the COR in each segment was not fixed in the right-left direction.

Conclusions: Our results indicate that the COR changes with different segments and functional postures. This suggests that the CORs of C3/4, C4/5, and C5/6 are located near the GCs of the intervertebral discs at different functional positions and are maintained in intervertebral cross-sections. These results probably support the suitability of total disc replacement surgery for the C3/4 to C5/6 segments.

Keywords: cervical spine, center of rotation, 3D-3D registration technology, in vivo kinematics

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Effect of different cervical curvatures on three-dimensional kinematics under physiological load

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Objective: The aim of this study was to measure the 3D motion of cervical vertebra with different curvatures under seven functional postures and investigate the relationship between cervical spine curvatures and the kinematics of each functional motion unit.
Methods: Seventy-five volunteers were classified into 5 curvature groups based on the C1-C7 Cobb angle of sagittal alignment. These were: a normal group, straight group, kyphosis group and hyper and hypolordosis groups. All volunteers underwent cervical spine CBCT scans at 7 functional positions. The range-of-motion (ROM) of each vertebra and the overall cervical spine were measured using a 3D-3D registration technique.
Results: In comparison to the normal group, the ROM of C3-C4 during left-right twisting in the kyphotic group was significantly higher, while the ROM of C1-C2 during left-right bending was also significantly greater. In addition, the ROM of C5-C6 in the straight group was higher during left-right bending in comparison to the normal group. During flexion-extension, the ROM of C4-C5 in kyphotic subjects was significantly lower than in the normal group, while in the C5-C6 segment, the ROM of the straight and the kyphotic groups was significantly greater compared to the normal group. During left-right bending, the global ROM of kyphotic subjects was higher than in the normal group.
Conclusions: 3D kinematics was used to accurately quantify the ROM of cervical spine
under different curvatures under physiological load. The data implied that cervical kyphosis may have a greater impact on ROM. Our findings may contribute to prevent cervical spondylosis by early intervention in curvature changes.
Keywords: Cervical curvature; Three-dimensional kinematics; Cone beam computed tomography; 3D-3D Registration Technology; Six degrees of freedom

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Silicate Nanoplatelets Promotes Neuronal Differentiation of Neural Stem Cells and Restoration of Spinal Cord Injury

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Background: Neural stem cell (NSC) transplantation has been suggested as a promising therapeutic strategy to replace lost neurons after spinal cord injury (SCI). However, the low survival rate and neuronal differentiation efficiency of implanted NSCs within the lesion cavity limit the application. Furthermore, it is difficult for transplanted cells to form connections with host cells.
Objective: Effective and feasible methods to enhance the efficacy of NSCs transplantation are needed.
Methods: The effects of Laponite nanoplatelets, a type of silicate nanoplatelets, on Neural stem cell therapy is explored by RNA sequencing, western blot, immunofluorescence staining and axon tracing.
Results: Laponite nanoplatelets can induce the neuronal differentiation of NSCs in vitro within five days, and RNA sequencing and protein expression analysis demonstrated that the NF-κB pathway is involved in this process. Moreover, histological results revealed that Laponite nanoplatelets can increase the survival rate of transplanted NSCs and promote NSCs to differentiate into mature neurons. The formation of connections between transplanted cells and host cells is confirmed by axon tracing.
Conclusion: Laponite nanoplatelets, which drove neuronal differentiation and the maturation of NSCs, can be considered a convenient and practical biomaterial to promote repair of the injured spinal cord by enhancing the efficacy of NSC transplantation.

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Reoperation rates after anterior surgeries for cervical radiculopathy related with injection therapy: Korean national population-based cohort study

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Background: There is a low incidence of reoperation after surgery for cervical degenerative disease. Therefore, it is difficult to sufficiently power studies to find risk factors for reoperation rates. National population-based databases provide large, longitudinally followed cohorts that may help overcome this challenge. Patients undergoing anterior surgeries for cervical radiculopathy receive injection therapy due to their severe pain before operation. However, there has been no study to evaluate the preoperative injection therapy as a risk factor for reoperation.
Objective: To determine whether injection therapy is a risk factor for reoperation in the anterior surgeries for cervical radiculopathy in a national population of patients with long-term follow-up.
Methods: We used the Korean Health Insurance Review & Assessment Service national database to select our study population. We included 5,997 patients with diagnosis of cervical spondylotic radiculopathy who underwent anterior cervical surgeries from January 2009 to December 2009. The follow up period was 8.4 ± 0.9 years (3,070.4 ± 319.0 days). Seventeen percent of patients received an injection therapy in the preoperative period of three months. Age, gender, presence of diabetes, associated comorbidities, surgical levels, hospital types, and preoperative injection therapy were considered potential confounding factors.
Results: The reoperation rate over the entire follow-up period was 2.10%. The risk factors for reoperation were female gender (OR 0.716, 95% CI 0.531, 0.964), hospital of hospital types (OR 0.629, 95% CI 0.452, 0.875), and the presence of the injection therapy before operation (OR 2.645, 95% CI 1.491, 4.693).
Conclusions: Patients undergoing anterior surgeries for cervical radiculopathy receive injection therapy due to their severe pain before operation, and preoperative injection therapy increase the risk for reoperations following anterior cervical surgeries. The information is essential to discuss the operations with the patients with these factors.
Key words : Cervical spine, Radiculopathy, Reoperation, Injection therapy, Nationwide database, Long-term follow-up

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Return to work of patients after cervical OPLL surgery based on a multicenter survey

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Background: Ossification of the posterior longitudinal ligament of the cervical spine (c-OPLL) is an intractable disease that impairs ADL and QOL. There are few reports on the status of patients returning to work after surgery.
Objective/Aim: The purpose of this study was to examine the return to work status of c-OPLL patients after surgery.
Methods: At a facility affiliated with the Japanese Multicenter Research Organization for Ossification of the Spinal Ligament, we conducted a mail-based questionnaire survey regarding return to work for patients after surgery for c-OPLL.
Results: We were able to study 220 patients (152 men, 68 women, mean age at surgery: 65 years old) from 11 facilities. We analyzed return to work in 156 cases, excluding 64 cases who were unemployed before surgery. One hundred and twelve patients (72%) were able to return to work, and they returned to work an average of 6 months after surgery. The group who returned to work after surgery was significantly younger, had a lower BMI, had a higher preoperative JOA score, and had a higher preoperative workload. No significant differences were observed in the spinal canal occupancy rate of OPLL, the presence or absence of diabetes, intramedullary intensity changes on MRI, or K-line status. To the best of our knowledge, there are 4 reports on return to work after surgery for c-OPLL, and the return to work is affected by the severity of myelopathy, with the return to work rate ranging from 53% to 75%.
Conclusion: When considering returning to work after surgery for c-OPLL, the results of the present study suggested that surgical treatment should be considered before neurological symptoms become severe.

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The application of self-stabilizing screw in prosthesis in the reconstruction of the lateral atlantoaxial joint

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Background: The lateral atlantoaxial joint was usually expanded after posterior release and occipitocervical instrumentation. Cage reconstruction of the lateral atlantoaxial joint obstruct the reduction and was not easy to implant after instrumentation.
Objective: To evaluate the clinical effect of self-stabilizing screw in prosthesis in reconstructing the lateral atlantoaxial joint
Methods: A total of 18 patients with atlantoaxial dislocation admitted to our department were retrospectively analyzed. The patients were treated with posterior release and reconstruction with 3D printing self-stabilizing screw in prosthesis followed by occipitocervical fusion. The operative time and blood loss of the operation were recorded. The anterior atlantodental interval (ADI), clivus-canal angle (CCA), cervical medullary angle (CMA), and Japanese Orthopedic Association (JOA) score before the operation and at the latest follow-up were measured and compared. The fusion time and the complications were observed.
Results: All patients were followed up for 12-40 months. The intraoperative blood loss was (230.2 ± 50.1) ml and the operation time was (165.1 ± 62.3) min. The differences of ADI, CCA, CMA and JOA scores before operation and at the last follow-up were statistically significant ($P<0.05$). The fusion rate was 88.9% at 3 months after operation and 100% at 6 months after operation. There was no hardware failure or reduction loss. Three cases were complicated with pain of occipitocervical region and 3 cases with numbness of occiput. No other serious complications occurred.
Conclusion: The self-stabilizing screw in prosthesis can reconstruct the lateral atlantoaxial joint after posterior release, reduce the stress of internal fixation, and enhance the stability of atlantoaxial joint after reduction. The clinical effect is satisfactory

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Innovative Minimally Invasive Surgery for Atlantoaxial Dislocation: Posterior Atlantoaxial Lateral Mass Joint Fusion Through Muscle Interspace "

Background: Traditional surgical approaches for atlantoaxial dislocation (AAD), exemplified by the Goel-Harms technique, present inherent challenges including disruption of posterior neck musculature, a heightened incidence of postoperative occipito-cervical pain, and substantial perioperative blood loss. In response, our team introduces a pioneering approach termed "Minimal Invasive Surgery - Posterior Atlantoaxial Lateral Mass Joint Fusion (Mis-PALF)." This method entails the meticulous exposure and fixation of the atlantoaxial lateral mass joint through a minimally invasive route along the posterior midline, adjacent to the muscle interspace, incorporating the semispinalis capitis, multifidus, and obliquus capitis inferior muscles.

Objective: This study seeks to juxtapose the clinical efficacy of the Mis-PALF approach with the traditional atlantoaxial fusion and fixation surgery (Goel-Harms technique) for AAD treatment. Additionally, we aim to scrutinize the reliability and safety of the Mis-PALF procedure.
Methods: A retrospective analysis encompassed AAD patients undergoing surgery at Peking University Third Hospital's Department of Orthopedics between April 2021 and August 2022. The Mis-PALF group (43 cases) was compared with a control group (120 cases, the Goel-Harms technique). Parameters included surgical duration, perioperative blood loss, postoperative hospital stay, temperature, pain scores (evaluated with the Visual Analog Scale), additional analgesic requirements, preoperative and follow-up spinal cord function (assessed using the Japanese Orthopaedic Association (JOA) scores), JOA improvement rates, and complications.
Results: The Mis-PALF group exhibited significantly superior outcomes compared to the control group in perioperative blood loss, postoperative hospital stay, postoperative temperature, postoperative pain scores, and additional analgesic requirements (all $P<0.01$). No significant differences were noted between the groups regarding gender composition, surgical duration, preoperative and follow-up JOA scores, JOA improvement rates, and
complication rates (all $P>0.05$).
Conclusion: The Mis-PALF approach demonstrates notable advantages in minimizing perioperative blood loss, reducing hospital stay, and ameliorating postoperative pain and fever compared to the traditional open atlantoaxial fusion and fixation. Crucially, it maintains treatment efficacy without increasing complication rates. This technique showcases clinical reliability and safety, warranting further exploration and widespread adoption.
Keywords: atlantoaxial dislocation, minimal invasive surgery, atlantoaxial lateral mass fusion, surgical innovation, enhanced recovery after surgery.

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Biomechanical Evaluation of an Artificial Cervical Vertebra and Intervertebral Complex in a Goat Model

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Background: Cervical degenerative disease is one of the most common spinal disorders worldwide, especially in older people. However, surgical methods such as anterior cervical corpectomy and fusion (ACCF) and anterior cervical disc replacement (ACDR) both have drawbacks, particularly the neck motion decrease observed after arthrodesis, and the limited condition arthroplasty should be performed.
Objective: We designed a non-fusion cervical joint system, namely an artificial cervical vertebra and intervertebral complex (ACVC), to provide a novel treatment for multi-level cervical degenerative disease. In addition, we applied a hydroxyapatite (HA) biocoating on the surface of the artificial joint to enhance the long-term stability of ACVC.
Methods: Thirty-two goats were randomly divided into four groups: sham control group, ACVC group, ACVC-HA group, and ACCF group. We compared the clinical, radiological, biomechanical, and histological outcomes among these four different groups for 24 weeks after the prosthesis implantation in our previously established goat model.
Results: The range of motion (ROM) in adjacent level increased after ACCF but was not altered after ACVC or ACVC-HA implantation. Compared with the control group, no significant difference was found in ROM and neutral zone (NZ) in flexion-extension or lateral bending for the ACVC and ACVC-HA groups, whereas the ROM and NZ in rotation were significantly greater. Compared with the ACCF group, the ROM and NZ significantly increased in all directions. Overall, stiffness was significantly decreased in the ACVC and ACVC-HA groups compared with the control group and the ACCF group. The histological results showed more new bone formation and better bone implant contact in the ACVC-HA group than the ACVC group.
Conclusion: Compared with the intact state and the ACCF group, ACVC could provide immediate stability and preserve segmental movement after discectomy and corpectomy. Besides, HA biocoating provide a better bone ingrowth, which is essential for long-term stability.

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CLINICAL OUTCOMES EVALUATION OF PERCUTANEOUS ENDOSCOPIC CERVICAL DISCECTOMY WITH LAMINA-HOLE APPROACH FOR CERVICAL SPONDYLOTIC RADICULOPATHY

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Background: Cervical spondylotic radiculopathy is a clinical disease characterized by sensory and motor disorders in the corresponding area of the upper extremity. Percutaneous endoscopic cervical discectomy is an efficient surgical treatment for cervical spondylotic radiculopathy. Here, we applied percutaneous endoscopic cervical discectomy with lamina-hole approach for cervical spondylotic radiculopathy and retrospectively analyzed its clinical efficacy.
Objectives: To investigate the clinical outcomes of percutaneous endoscopic cervical discectomy with lamina-hole approach for treating cervical spondylotic radiculopathy.
Methods: A retrospective case series study was conducted to analyze clinical data of 30 patients with cervical spondylotic radiculopathy from May 2018 to December 2019. All patients underwent percutaneous endoscopic cervical discectomy with lamina-hole approach. The operative time, intraoperative blood loss, intraoperative complications were collected. The Neck Disability Index(NDI) scores, the visual analogue scales(VAS) of neck and arm were compared preoperatively, postoperatively and finally.
Results: All patients completed the operation successfully. Mean operation time was 84.5±36.5 min(30 min~200 min). Mean intraoperative blood loss was 20.5±11.8 ml(5 ml~50 ml). No neurovascular injury was observed intraoperatively and postoperatively. The mean follow-up time was 14.3±4.0 months(9 months~23 months).The NDI scores decreased from 61.3±13.2 points preoperatively to 26.6±7.4 points postoperatively($P=0.000$), and further decreased to 9.8±3.5 points at the last follow-up($P=0.000$).The VAS scores of the neck and arm were 5.2±0.7 and 6.5±1.1 before operation, and decreased to 3.1±0.7($P=0.000$) and 2.8±0.7($P=0.000$) after operation, respectively. At the last follow-up, the values were further reduced to 0.6±0.8($P=0.000$) and 0.5±0.6($P=0.000$), respectively.
Conclusion: For cervical spondylotic radiculopathy, percutaneous endoscopic cervical discectomy with lamina-hole approach can achieve the decompression of nerve root with preserving facet joint integrally, and the early clinical outcomes were satisfying. And the long-term efficacy still needs to be further explored.

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CLINICAL EFFICACY OF FULL-ENDOSCOPIC CERVICAL FORAMINOPLASTY FOR CERVICAL RADICULOPATHY WITH UNCOVERTEBRAL OSTEOPHYTES

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Background: The cervical radiculopathy with uncovertebral osteophytes often need surgical treatment. Posterior cervical foraminotomy with endoscope had satisfactory clinical outcomes for cervical foraminal stenosis. We first used full-endoscopic cervical foraminoplasty (PECP) to treat cervical radiculopathy with uncovertebral osteophytes and compared the clinical outcomes with full-endoscopic cervical foraminotomy (PECF).

Objectives: To investigate the clinical outcomes of PECP for treating cervical spondylotic radiculopathy with uncovertebral osteophytes.

Methods: Forty-five patients who suffered from cervical radiculopathy with uncovertebral osteophytes were included in a single-center case-control study from March 2018 to July 2020. Twenty-three patients were treated with PECP, and the others were treated with PECF. All patients were followed up for 12 months. Intraoperative data of surgical duration, intraoperative blood loss volume, perioperative complications, intraoperative visual analog scale (VAS) and VAS of the neck and arm were recorded.

Results: All patients successfully finished the operation under local anesthesia with proper sedation management. The mean surgical duration and mean intraoperative blood loss volume were not different between the two groups ($p \geq 0.05$) . PECP group had significant lower intraoperative VAS scores than PECF group ($p < 0.05$). Both groups had continuous improvements in VAS of the arm and neck postoperatively ($p < 0.05$). After the operation, the VAS score of the arm in the PECP group was significantly lower than that in the PECF group ($p < 0.05$). For VAS of the neck, a significant lower scores was observed in the PECP group 3 months after the operation ($p < 0.05$), and the difference still existed at the final follow-up ($p < 0.05$).

Conclusion: PECP has a reduction in damage to the physiological structure and better clinical outcomes than PECF. The short-term treatment effect of cervical radiculopathy caused by uncovertebral osteophytes treated with PECP was satisfactory, and its long-term clinical outcomes still require further study.

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Association Between Negative Sagittal Vertical Axis and Neck Pain among Cervical Spondylotic Myelopathy Patients

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Background: In cervical spine disorders such as cervical spondylotic myelopathy (CSM), while there is a plethora of reports on alignment utilizing cervical spine X-ray, there is a paucity of assessments employing standing whole-spine X-ray.

Objective: This study is sought the characteristics of standing whole-spine X-ray in patients with CSM experiencing neck pain and to explore postoperative changes in spinal alignment.

Methods： Thirty-six patients who underwent cervical posterior spine surgery for CSM were recruited in this study. The cases with a Neck Disability Index (NDI) scores of less than 18% was defined as the group without neck pain (NP group), while those with a score of 18% or more were categorized as having neck pain (P group). Alignment assessment was conducted preoperatively and at one year postoperatively.

Results: The NP group comprised 12 cases (average age 71 years), while the P group included 24 cases (68 years). Preoperative Sagittal Vertical Axis (SVA, NP:P=65:41mm), Cervical Lordosis (CL, 17:14°), C2-7 SVA (21:26mm), Lumbar Lordosis (LL, 35:39°), and Pelvic Tilt (PT, 21:20°) did not show significant differences between the two groups. Even at one year postoperatively, there were no significant differences in SVA (45:43mm), CL (14:10°), C2-7 SVA (28:32mm), LL (32:41°), and PT (21:21°) between the two groups. However, focusing on cases with negative SVA at one year postoperatively, 9 out of 36 cases exhibited Negative SVA (average -35 mm), and, 8 cases (89%) had an NDI of 18% or higher. On the other hand, for cases with Positive SVA, 44% (12/27 cases) had an NDI of 18% or higher ($P<0.05$).

Conclusions：

This study has elucidated a strong association between negative SVA and neck pain. There is little potential for significant changes in spinal alignment, and it should be pre-emptively explained that postoperative neck pain persist in cases with preoperative negative SVA.

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Epidural Platelet-rich Plasma (PRP) versus Steroid on Low Back Pain in Patients with Prolapsed Intervertebral Discs: A Meta-analysis

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Background: Conservative management is used to treat herniated lumbar discs. Epidural steroid injection has been an option. However, the efficacy of PRP compared to steroids remains controversial between studies.

Objective: This meta-analysis aims to compare the efficacy of epidural platelet-rich plasma (PRP) and epidural steroids in patients with low-back pain due to prolapsed intervertebral discs.

Methods: Scopus, Science Direct, PubMed, and Cochrane Central Register of Controlled Trials (CCTR) databases were searched. Four prospective randomized controlled studies (RCT), one prospective non-randomized study, and one retrospective study were included. A total of 378 patients with prolapsed discs, including 187 and 191 patients treated with PRP and steroids, respectively. The meta-analysis was performed using STATA/MP 17.0 software. A standard mean difference (SMD) with 95% confidence intervals (CI) was calculated and a random-effect model was employed.

Results: Our meta-analysis showed that there is no overall significant statistical difference between PRP and steroid groups in 6 months of follow-up. ODI 1-month follow-up (SMD=0.37, 95% CI=0.07~0.67, p=0.11), ODI 3-month follow-up (SMD=-0.04, 95% CI=-0.33~0.26, p=0.32), ODI 6-month follow-up (SMD=-0.55, 95% CI=-1.18~0.09, p<0.001), Pain score (1-10) 1-month follow-up (SMD=0.31, 95% CI=-0.22~0.84, p<0.001), Pain score (1-10) 3-month follow-up (SMD=-0.91, 95% CI=-2.25~0.42, p<0.001), Pain score (1-10) 6-month follow-up (SMD=-1.08, 95% CI=-3.13~0.98, p<0.001).

Conclusion: There is no difference in efficacy between administering epidural PRP or epidural steroids for patients experiencing low back pain due to prolapsed intervertebral discs.

Keywords: Platelet-rich plasma, Steroid, Epidural, Prolapsed intervertebral disc, Low-back pain, Meta-analysis.

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Anterior Cervical Discectomy and Fusion (ACDF) versus Anterior Cervical Corpectomy and Fusion (ACCF) in Cervical Spondylotic Myelopathy Patients: An Updated Meta-analysis

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Background: Anterior cervical discectomy and fusion (ACDF) is considered the gold standard for treating cervical spondylotic myelopathy (CSM). However, the clinical outcomes between ACDF and anterior cervical corpectomy and fusion (ACCF) for treating CSM were controversial.
Objective: This meta-analysis aims to compare the efficacy and safety of ACDF and ACCF for treating CSM patients.
Methods: Scopus, Science Direct, and Pubmed databases were searched. Seventeen retrospective studies were included with 1667 CSM patients, including 908 and 759 patients treated with ACDF and ACCF, respectively. The meta-analysis was performed using STATA/MP 17.0 software. SMD or OR with 95%CI were calculated.
Results: Our meta-analysis showed no overall difference in postoperative clinical outcomes between ACDF and ACCF (SMD= -0.06, 95% CI= -0.19~0.07, p<0.001). ACDF group showed favorable radiological results compared to the ACCF group (SMD= -0.52, 95% CI= -0.64~-0.39, p<0.001). The ACDF group showed less blood loss (SMD= -1.58, 95% CI= -2.15~-1.00, p<0.001). ACDF is more favorable in overall perioperative parameters, including blood loss (SMD= -0.99, 95% CI= -1.50~-0.47, p<0.001) (Figure 1A). However, the ACDF group showed no significant difference in overall complications (OR= 0.28, 95% CI= -0.02~0.59, p=1.00). Furthermore, no significant differences were found in fusion rate (OR= 0.46, 95% CI= -0.08~0.99, p=0.29) and Odom's criteria (excellent/good) (OR= 0.21, 95% CI= -0.56~0.98, p=0.77) in both groups (Figure 1B).
Conclusion: ACDF is associated with better results compared to ACCF for the treatment of CSM. There is no statistically significant difference in complications, fusion rate, and Odom's criteria (excellent/good) between the two groups.
Keywords: Anterior cervical discectomy and fusion, Anterior cervical corpectomy and fusion, Cervical spondylotic myelopathy, Meta-analysis.

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Slow expansion and degradation swelling-stengthening hydrogel: design, regulate, and establish a modified cervical spinal cord compression animal model

Simulating the ligament compression caused by osteophytes and ossification in cervical spondylotic myelopathy (CSM), establishing a reliable and controllable chronic rat model of cervical spinal cord compression, is of significant clinical importance. Through meticulous molecular design, we have developed a functionalized polyurethane hydrogel for constructing an animal model. This hydrogel exhibits water-triggered microphase separation, resulting in an increase in modulus after water absorption, thus enabling effective compression. The presence of dynamic disulfide bonds in the hydrogel imparts two additional crucial functionalities. Firstly, it allows precise control of the hydrogel thickness through thermal pressing. Secondly, under the action of reducible substances within the animal body, the disulfide bonds can undergo cleavage, leading to gradual expansion and subsequent degradation of the hydrogel. By adjusting the content of disulfide bonds, the expansion and degradation rate can be further regulated. Dry hydrogels were implanted into the sublaminal space at the C5 level of rats, and the animal model was comprehensively evaluated using magnetic resonance imaging, macro-morphology, behavioral analysis, and gait analysis. Significant cervical spinal cord compression and spinal canal invasion were shown in the MRI and macro-morphology. In terms of behavioral analysis and catwalk gait analysis, the experimental group showed a gradual progression of spinal cord dysfunction, followed by a gradual recovery from spinal cord dysfunction. The first phase corresponds to the slow expansion of the hydrogel, similar to the clinical course of CSM, and the second phase corresponds to the degradation of the hydrogel, mimicking the decompression of CSM. Therefore, we conclude that our optimized animal model can effectively reproduce the pathophysiology of CSM and provide essential support for the basic study of CSM.

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Correlation Between Intervertebral Disc Degeneration Degree and Heterotopic Ossification after Artificial Cervical Disc Replacement

Introduction: There were kinds of factors influencing the incidence of heterotopic ossification (HO) after artificial cervical disc replacement (ACDR), while not including reports about the effects of intervertebral disc degeneration on the occurrence of HO. In view of this, the current research retrospectively analyzed the data of 120 patients having accepted ACDR, to investigate the correlation between the degeneration degree of cervical intervertebral disc and the HO after ACDR.
Material and Methods: From January 2009 to June 2016, 120 patients who had undergone ACDR were included into this study. There were 87 males and 33 females with an average age of 43.83±8.76 years old (range, 27-67 years old). There were 100 patients who had undergone single level implant, and 20 patients double level implant. Cervical spine flexion-extension X-rays were taken to assess the range of motion (ROM) of the surgical level. HO situation was evaluated by McAfee classification through cervical lateral X-rays. Degeneration degree of patients' cervical intervertebral discs were evaluated by Pfirrmann grading standards with the preoperative cervical magnetic resonance imagings (MRIs). The occurrence and McAfee classification of HO in the replacement segment at the last follow-up were concerned. According to whether HO occurred, the patients were divided into HO group and non-HO group. ROM and preoperative Pfirrmann score were compared between the two groups of patients.
Results: All 120 patients were followed up. The average follow-up time was 52.29 months (13 to 102 months). The VAS score, JOA score, and NDI index all improved at the last follow-up. At the last follow-up, a total of 27 patients developed HO, and the incidence of HO was 22.5%. ROM of the HO group (7.40±1.75)° was significantly lower than that of the non-HO group (9.79±1.40)°. Pfirrmann score of preoperative disc degeneration (3.31±1.11) was significantly higher in HO group than which in non-HO group (2.40±0.96). The correlation analysis showed that the Pfirrmann degeneration score of the preoperative replacement segment of the HO group was positively correlated with the postoperative HO McAfee classification (R=0.765, p<0.01), and negative correlated with ROM of the replacement segment (R=-0.866, p<0.01).
Conclusion: The occurrence of HO after ACDR was correlated with the degree of preoperative degeneration of intervertebral disc. The degree of degeneration of cervical disc in HO group was significantly higher than that of non-HO group. In the HO group, the higher the degree of Pfirrmann degeneration of the intervertebral disc preoperatively was, the higher the McAfee grade at the last follow-up was and the lower ROM of the replacement segment was.

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Complications and risk factors of ACAF for the treatment of cervical OPLL

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Background: Ossification of the posterior longitudinal ligament (OPLL) has been known as one of the main causes of myelopathy which is a pathologic process of lamellar bone deposition at the site of the posterior longitudinal ligament. The most common location is at the cervical spine region. The treatment of choice for patients with symptomatic OPLL is surgery to relieve spinal cord compression. However, there is a relatively high incidence of surgical complications for cervical OPLL compared with other cervical degeneration diseases. We have designed a novel surgery technique - anterior controllable antidisplacement and fusion (ACAF) strategy in a hope to achieve anterior direct decompression without removing the OPLL. The preliminary results in the recent exploratory studies suggested that the novel technique is an effective and safe option for the treatment of severe cervical OPLL. However, as a new technology, ACAF still has some surgical related complications. So far, there was few reports focused on this regard.

Objective: The aims of the procedure are to analyze the complications and risk factors of ACAF following treatment for cervical OPLL .

M**ethods:** This is a single-center retrospective case review study. Between Oct. 2018 and Dec. 2022, a total of fifty-nine consecutive patients who underwent ACAF surgery for OPLL at our department were conducted. Surgical indications were symptomatic cervical myelopathy with or without radiculopathy and imaging evidence of spinal cord compression due to OPLL correlating with clinical symptoms. All the surgeries were completed by the same team. Before surgery, a detailed radiologic examination including x-ray and computed tomography was performed to investigate the extent and type of OPLL. Magnetic resonance imaging showed the condition of spinal cord compression and presence of high intensity zones. Patient demographics, medical comorbidities, operative details and outcomes were collected and analyzed. Condition severity was evaluated using the JOA scoring system.

Results: There were 38 (64.4%) males and 21 (35.6%) females, with a mean age of 55.8 ± 7.2 years. The mean preoperative JOA score was 10.6±2.9, which improved to 14.1±2.6 at 6 months and 14.5± 2.0 at 1 year postoperatively. Ten (16.9%) surgical complications were recorded in the cohort. C5 palsy occurred in four cases (6.8%). Transient minor neurological deterioration, manifesting with the weakness of limbs occurred in 2 cases (3.4%) after operation and the muscle strength was improved to 4+ at the 6 months follow-up. The CSF leak occurred in 3 cases (5.1%) and lumbar drainage was performed at the second postoperative day for one case. Vertebral fracture occurred in one case (1.7%) when tightening the screw to displace the bodies anteriorly during the operation. There was no occurrence of postoperative hematoma. No instrumented failure was observed during follow-up.

Conclusion: ACAF technology can reduce the incidence of surgical complications following the treatment for cervical OPLL. OPLL extends over 3 levels, ossifcation mass on the very lateral, and osteoporosis are risk factors for complications.

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Is anterior subarachnoid space related with postoperative outcome in patients with the cervical myelopathy?

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Background: Mechanical compression of the spinal cord results in decreased blood flow to the anterior spinal artery (ASA), which leads to ischemia, neuronal damage, and consequential neurological deficits. Surgical decompression relieves mechanical compression and improves blood flow due to reduced compression of the ASA, which may improve neurological function.

Objective/Aim: Purpose of this study was to see whether the restored anterior subarachnoid space (ASAS) was related with postoperative clinical outcome.

Methods: Radiological assessments included measurements of the ASAS and space available for the cord (SAC) using postoperative cervical MRI. Clinical outcomes were measured by visual analog scale (VAS) for neck and arm pain, the Neck Disability Index (NDI), Japanese Orthopedic Association (JOA) score and its recovery rate. Comparisons between the ASAS (+) and ASAS (-) groups were performed using an independent sample t-test. Pearson's correlation analysis was conducted to determine the correlation between ASAS, ASAS/SAC (%), and postoperative clinical outcomes. In addition, the cut-off value and diagnostic performance were calculated using the Youden index to determine the cut-off point for the clinical outcome of ASAS and ASAS/SAC.

Results: Results demonstrated a significant correlation between restored ASAS and improved clinical outcomes, particularly in JOA scores and JOA recovery rates.

Conclusion: Cervical myelopathy was improved by restoration of the anterior subarachnoid space (ASAS) after decompression surgery.

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The Incidence and Treatment of CSF Leak in OPLL Patients After ACCF

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Background: Cerebrospinal fluid(CSF) leak, which is a difficult-to-handle complication, is not uncommon after Anterior Cervical Corpectomy and Fusion(ACCF), especially with OPLL.

Objective ： We design the study to explore the incidence and treatment of CSF after ACCF in OPLL patients.

Methods: We retrospectively included 492 patients who were diagnosed as symptomatic OPLL(n=96) or cervical spinal myelopathy(n=396). All patient had underwent ACCF between Oct 2011 and Sept 2017. The intraoperative dural defect was repaired with an onlay graft of collagen dura substitute. Bed rest and a cervical elastic bandage(Fig.1) were used for 7 days after surgery.

Results: The incidence of CSF leak in OPLL patients was 6.25%(6/96), which in CSM patients was 2.02%(10/496). And 4 out of 6 CSF leak in OPLL patients were found dural ossification. Patients with CSF leak were treated for 7 days on average. Only in 1 case, the needle is used for puncture and suction. All CSF leak patients were finally cured without reoperation for CSF leak.

Conclusion: The incidence of cerebrospinal fluid leakage in ACCF surgery for OPLL was 6.3%. The incidence of cerebrospinal fluid leakage during OPLL combined with dural capsular ossification was 66.7%. The dural is covered with collagen dura substitute, local compression dressing and bed rest, which can effectively treat cerebrospinal fluid leakage.

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Minimally invasive keyhole surgery for cervical radiculopathy, percutaneous endoscopy (PE) of different working channel/UBE, how to choose?

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Background: Patients with cervical radiculopathy might need surgery after failed conservative treatment. Minimally invasive keyhole surgery is an effective and desirable method.
Objective: This study aims to compare three surgical techniques—percutaneous posterior endoscopy (PE), PE with a big working channel (Delta), and Unilateral Biportal Endoscopy (UBE)—to assess their advantages and disadvantages in performing keyhole procedures.
Methods: A retrospective study was conducted on keyhole surgeries performed in our department from January 2017 to August 2023. Patients were categorized into three groups: PE group, Delta group, and UBE group. Preoperative, postoperative (at six months), and final follow-up assessments included Visual Analogue Scale (VAS) for pain and Oswestry Disability Index (ODI) for functional impairment. General clinical data, such as surgical time, fluoroscopy frequency, estimated blood loss, and perioperative complications, were collected.
Results: Fifty-five cases were included after accounting for lost-to-follow-up cases: PE group (11 cases), Delta group (17 cases), and UBE group (27 cases). The follow-up period ranged from 6 to 12 months, with an average of 9±3.2 months. Significant improvement in pain symptoms was observed in all patients postoperatively, with statistical differences. No significant differences were found in VAS scores between the three groups preoperatively and postoperatively. The average fluoroscopy frequency was 2, 2, and 3 times for PE group, Delta group, and UBE group, respectively. UBE had the shortest surgical time, followed by Delta group, and PE group had the longest duration. The estimated blood loss in the UBE group was significantly higher than the other groups. UBE also required a larger exposure area compared to the other two groups.
Conclusion: All three techniques are feasible for performing keyhole procedures. UBE demonstrates superior efficiency, making it a recommended choice for keyhole surgeries. PE and Delta are highly instrument-dependent, requiring efficient endoscopic burr and Kerrison Rongeur for optimal performance.
Keywords: Keyhole surgery; UBE ; percutaneous posterior endoscopy.

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The comparison of clinical and radiological results of oblique keyhole foraminotomy for the better decompression of cervical spondylotic radiculopathy

Sung Hoon Choi, Jong Hyun Ko, Min Woo Kim, and Kyoung-Chung Kang

Introduction: Posterior cervical keyhole foraminotomy is a motion preservation surgery that can perform foraminal decompression by removing part of the posterior facet in patients who complain of persistent upper extremity radiating pain despite conservative treatment.
Objective: The hypothesis of this study is that oblique keyhole foraminotomy (OKF) will allow more superior articular processes (SAP) and show better clinical results than conventional keyhole foraminotomy (CKF).
Methods: Clinical and radiographic parameters were compared before and 1 year after surgery in 38 patients who underwent CKF and 31 patients who underwent OKF. Patients with cervical myelopathy, patients with C2-C7 SVA > 40mm, CBVA > 10°, and TS-CL > 15°, and trauma patients were excluded. Preoperative and postoperative clinical parameters of VAS NP, AP, and NDI and preoperative and postoperative radiographic parameters of IAP, SAP diameter, IAP, SAP resection rate, and inclination angle were compared.
Results: There were no differences in preoperative neck pain, arm pain, and NDI among clinical parameters, but postoperative arm pain was significantly lower in the OKF group (3.2 ± 1.4 vs. 2.5 ± 0.8, <0.05). There was no difference in preoperative IAP, SAP diameter, and post-op IAP diameter among radiographic parameters, but postoperative SAP diameter was significantly smaller in the OKF group (7.35 ± 2.8 vs. 6.61 ± 2.3, <0.05). In addition, there was no difference in the postoperative IAP resection rate, but the postoperative SAP resection rate and resection inclination angle were significantly higher in the OKF group (SAP resection rate: 46.7 ± 5.8 vs. 52.3 ± 4.7, <0.01, resection inclination angle 3.7 ± 1.4 vs. 14.5±2.7, <0.01).
Conclusion: Oblique keyhole foraminotomy through the medial to lateral route is an effective procedure that can reduce radiating arm pain by enabling more superior facetectomy compared to similar inferior facetectomy than conventional keyhole foraminotomy in cervical spondylotic radiculopathy.

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Artificial neural networks detection and classification for cervical disc degeneration

Background: Cervical disc degeneration is a common cause of symptomatic axial neck pain. Magnetic resonance imaging (MRI) is the standard for investigating and diagnosing disc degeneration disease. Deep learning models of artificial intelligence are tools for detecting visuals with significant speed and automatic tools.
Objective: This study proposed artificial neural networks (ANN) for detecting, classifying and grading intervertebral disc degeneration (IDD).
Methods: The sagittal images of IDD T2-weighted MRI of 500 levels from 100 adult patients with symptomatic neck pain were included and separated 400 MRI images for the training dataset (80%) and 100 MRI images of the test dataset (20%). Training datasets were labelled and annotated by the radiologist. All cervical disc images were classified as disc degeneration based on the Pfirrmann grading system. The deep learning method used the deep ANN model to train, detect and grade the IDD. The ANN model was verified by testing the dataset for grading under an automatic model.
Results: The sagittal intervertebral disc cervical MRI images train dataset found 500 Grade I, Grade II, Grade III, Grade IV, and Grade V discs. The ANN model detected cervical IDD and classified it with an accuracy of more than 95%. The training ANN model verified the test dataset by finding automatic classification and detection of IDD with an accuracy of more than 95%.
Conclusion: The ANN model can be automatically graded reliably on routine T2-weighted MRI using the Pfirrmann grading system with an efficient method for cervical disc degeneration * Corresponding Author – Presenter: Wongthawat Liawrungrueang, M.D. (mint11871@hotmail.com) Department of Orthopaedics, School of Medicine, University of Phayao, Phayao 56000, Thailand (Tel +66-89-1483458)

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Artificial Intelligence Detection of Cervical Spine Fractures Using Convolutional Neural Network Models

Background: The convolutional neural network (CNN) is a class of deep neural networks particularly efficient in analyzing visual imagery. These networks consist of convolutional layers that can automatically learn features from images.
Objective: CNN with the KNIME analytics platform is used in this study to offer a technique for computer-assisted diagnosis of cervical spine fractures from radiographic x-ray imaging.

Methods: This study obtained five hundred lateral radiographic cervical spine x-ray images from standard open-source dataset repositories to develop a classification model using CNN. All the images contained diagnostic information, including normal cervical radiographic images (n = 250) and fracture images of the cervical spine fracture (n = 250). The model would classify whether the patient was with or without cervical spine fracture. Eighty per cent of the images were training data sets used for model training and twenty per cent for testing. KNIME's graphic user interface-based programming enabled class label annotation, data preprocessing, CNN model training, and performance evaluation.

Results: All radiographic X-ray imaging was reported using the KNIME graphic user interface program. The CNN model has performed ten epochs of training. Performance model evaluation by the sensitivity (recall), specificity (predictive value), and f-measure were all 87%, 82.4%, 90.9%, and 88.9%, respectively. The model's accuracy was equal to 92% of the area under the receiver operating characteristic (ROC)curve for detecting and diagnosing cervical spine fractures.

Conclusion: Deep learning models were successfully utilized for computer-assisted diagnosis of cervical spine fractures using radiographic x-ray images. This approach can assist the radiologist in screening or detecting and diagnosing cervical spine fractures.

Keywords: Cervical spine fracture, Computer-assisted diagnosis, Machine learning, KNIME

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Novel risk factors for cervical facet joint degeneration in cervical spondylotic myelopathy: correlation with cervical sagittal alignment and bone mineral density

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Background: The cervical facet joints play a crucial role in function of cervical spine, and its degeneration is one of the main causes of cervical spondylosis. The potential mechanisms of CFD, however, remain unclear.

Purpose: The impact of cervical sagittal alignment on cervical facet joint degeneration (CFD) and risk factors for CFD in patients with cervical spondylosis (CS) were investigated in the current study.

Methods: A total of 250 surgical patients with CS were recruited. Clinical data and radiographical characteristics including CFD, cervical sagittal balance parameters, Hounsfield unit(Hu) value, disc degeneration, modic change were collected. The detailed correlation between these characteristics and CFD were analyzed. Characteristics including CFD were compared among various cervical alignment types and different CFD group. Finally, risk factors for CFD were revealed via logistic regression.

Results: CFD were prevalent in CS patients. Age, cSVA, ROM, T1S, TIA, DD, Hu value and modic change were correlated with CFD segmentally and globally($p<0.05$). In different cervical sagittal alignment types, severe CFD had different prevalence, and lordosis&sigmoid had significantly higher prevalence ($p<0.05$). Further, the threshold of average CFD for severe CFD group was determined to be 1.625 (AUC,0.958). One-hundred and sixty seven patients with average CFD (<1.625) and 83 patients with FD≥1.625 were classified into the mild CFD group and severe CFD group respectively. Finally, multivariate analysis was performed and the results demonstrated that CFD (OR, 1.058; $p=0.020$), cSVA (OR, 1.041; $p=0.036$), Hu value (OR, 0.993; $p=0.030$), modic change (OR, 2.782; $p=0.005$) and DD (OR, 3.739; $p<0.001$) were the independent risk factors for CFD.

Conclusions: The load distribution tends to shift to a more shear-like pattern in sigmoid&kyphosis types or individuals with a higher cSVA, thereby promoting the CFD. Aging, cervical malalignment, low bone mineral density, disc degeneration and modic change were revealed to have high risks for CFD.

Keywords: zygapophyseal joint, sagittal alignment, bone mineral density, disc degeneration, modic change

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Cervical facet joint degeneration, facet joint angle and paraspinal muscle degeneration are correlated with degenerative cervical spondylolisthesis: a propensity-score matched study

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BACKGROUND: Prior studies have hypothesized that degenerative cervical spondylolisthesis (DCS) may influenced by loss of stability. Meanwhile, it is commonly believed facet joint and paraspinal muscle participate in maintaining cervical spine stability. However, the impact of aforementioned characteristics on DCS requires further investigation.

PURPOSE: To compare facet joint characteristics, disc degeneration and muscle morphology between patients with DCS and those without DCS.

METHODS: Demographic data, clinical data, disc degeneration, muscle degeneration and facet joint characteristics including Facet angle, facet tropism as well as cervical facet joint degeneration(CFD) were compared between DCS patients and those without DCS. Further, CFD were compared with adjacent segments in both groups. Additionally, logistic regression was performed to determined independent risk factors for DCS. Finally, receiver operator characteristic curve (ROC), area under the curve (AUC) and the cutoff value of risks factors were calculated.

RESULTS: A total of 431 surgical patients were performed by propensity-scores match, considering age, sex, BMI, and 146 patients were included for final analysis, with 73 patients were grouped in C4/5 DCS and 73 patients in non-DCS group. Patients with DCS was generally associated with severe CFD, more horizontal FA-S, more FT and worse paraspinal muscles health, but similar disc degeneration compared with patients without DCS. Besides, anterior spondylolisthesis were related to severe CFD and decreased functional aCSA of flexor and extensor. Finally, CFD, horizontal FA-S and high FI% of deep extensor were revealed to be risk factors for DCS, which cutoff values were 1.5, 44.5° and 37.1%, respectively.

CONCLUSIONS: This study demonstrated that CFD, facet joint angle and tropism as well as parasipnal muscles degeneration were associated with DCS. If an average CFD ≥ 1.5, FA-S < 44.5° and FI of DE ≥ 37.1% is detected on CT or MRI, a high alert should be raised for DSC.
Keywords: degenerative cervical spondylolisthesis, zygapophyseal joint, facet joint angle, facet tropism, disc degeneration, muscle morphology

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Exosomal miR-140-5p inhibits osteogenesis by targeting IGF1R and regulating the mTOR pathway in ossification of the posterior longitudinal ligament

Background: The pathogenesis of OPLL is still unclear. Exosomal miRNA plays an important role. We focused on the downregulation of miR-140-5p in OPLL cell-derived exosomes to explore the mechanism by which exosomal miR-140-5p inhibits osteogenesis in OPLL.
Methods: Exosomes were isolated by differential centrifugation and identified by transmission electron microscopy, nanoparticle tracking analysis, and exosomal markers. Exosomal RNA was extracted to perform miRNA sequencing and disclose the differentially expressed miRNAs. The confocal microscopy was used to trace the exosomal miR-140-5p. The effect of exosomal miR-140-5p on osteoblast differentiation of hMSCs was assessed by alkaline phosphatase and Alizarin Red staining. Also, osteogenesis-related genes were analyzed. Luciferase reporter assay was utilized to identify the binding area between miR-140-5p and IGF1R. IGF1R/IRS1/PI3K/Akt/mTOR pathway was analyzed. Besides, micro-CT and immunohistochemistry of ectopic bone were performed to demonstrate the effect of exosomal miR-140-5p in vivo.
Results: Exosomes were isolated by differential centrifugation and identified by transmission electron microscopy, nanoparticle tracking analysis, and exosomal markers. Exosomal RNA was extracted to perform miRNA sequencing and disclose the differentially expressed miRNAs, among which miR-140-5p was significantly downregulated. Confocal microscopy was used to trace the exosomal miR-140-5p delivered from OPLL cells to human mesenchymal stem cells (hMSCs). In vitro, we verified that exosomal miR-140-5p inhibited the osteoblast differentiation of hMSCs by targeting IGF1R and suppressing the phosphorylation of the IRS1/PI3K/Akt/mTOR pathway. In vivo, we verified that exosomal miR-140-5p inhibited ectopic bone formation in mice as assessed by micro-CT and immunohistochemistry.
Conclusions: We found that exosomal miR-140-5p could inhibit the osteogenic differentiation of hMSCs by targeting IGF1R and regulating the mTOR pathway, prompting a further potential means of drug treatment and a possible target for molecular therapy of OPLL.
Keywords: OPLL, miR-140-5p, MSC, Exosome

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How to choose the open side for unilateral open-door laminoplasty in the treatment of cervical ossification of the posterior longitudinal ligament?

Objective: To provide a more optimized strategy for choosing the open side for unilateral open-door laminoplasty in the treatment of cervical ossification of the posterior longitudinal ligament (OPLL).
Methods: We retrospectively analyzed the data of patients with cervical OPLL who underwent unilateral open-door laminoplasty in our department from January 2015 to December 2019. All patients had myelopathy preoperatively, with symmetrical symptoms on left and right limbs, and CT or MRI showed ossification leaning toward one side. The data of patients who completed a 3-year follow-up period were analyzed. According to the direction of the open side, all patients were divided into two groups: the contralateral group and the ipsilateral group. JOA score, JOA recovery rate, cervical spine range of motion, and spinal cord cross-sectional area were measured. The independent sample t-test was used for intergroup comparisons. P<0.05 was considered statistically significant.
Results: 148 patients were included in this study, with 85 in the contralateral group and 63 in the ipsilateral group. There were no statistically significant differences in the baseline data between the two groups. The incidence of postoperative complications in the two groups was not significantly different. The JOA score and JOA recovery rate of the contralateral group were significantly higher than those of the ipsilateral group after surgery. There were no significant differences in cervical spine range of motion between the two groups during the 3-year follow-up period. However, the cross-sectional area of the spinal cord after surgery showed that the degree of increase in the cross-sectional area was significantly higher in the contralateral group than in the ipsilateral group (P<0.05).
Conclusion: When performing unilateral open-door laminoplasty in patients with cervical OPLL who present with myelopathy, choosing the contralateral side of the ossified mass as the open side can achieve better clinical outcomes.

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Correlation between changes of cervical longus and cervical extensor muscles and clinical efficacy after anterior cervical discectomy and fusion

Objective: To evaluate the volume changes of cervical longus and cervical extensor after anterior cervical discectomy and fusion (ACDF), and the correlation with the clinical efficacy of patients.
Methods: All of 57 patients with cervical spondylotic myelopathy who underwent single-segment ACDF surgery from January 2013 to December 2018 were analyzed. The follow-up time was 23.0±4.8 months (range 16-34 months). All included subjects underwent MR examination within 1 week before operation and 3rd, 12th months after operation and at the last follow-up. The axial section cross section area (AxCSA) of the cervical longus and the ratio of length to short diameter line (RLS) at the level of each disc of C2-C7 were measured on the axial T2WI. Calculate the volume of the cervical longus based on the layer thickness. At the same time, measure the cervical extensor cross-sectional area (CESA) of the same level including the multifidus, cervical semispinous muscle, semispinous head, splinter head, and cervical splinter muscles, and compare CESA with the corresponding vertebral cross-sectional area (VBA). The ratio is analyzed as the volume of the neck extensor muscle, namely CESA/VBA. At the 3rd and 12th months after operation and at the last follow-up, the axial pain was assessed by visual analogue scale (VAS) for assessing pain, and the modified Japanese Orthopedic Association score (mJOA) and the neck dysfunction index (NDI) were used to assess the functional status of the cervical spine. Analyze the morphological changes of the cervical longus and extensor cervical muscles before and after the operation and during the follow-up period, and analyze the correlation with VAS, mJOA, and NDI.
Results: Compared with the preoperative period, the average AxCSA of the surgical segment decreased at the 3rd and 12th months after the operation and at the last follow-up. The average RLS of surgical segments increased slightly, and the difference was statistically significant (F=22.612, P<0.05). The volume of thecervical longus of the patients decreased after the operation, and the difference was statistically significant (F=64.511, P<0.05). There were no statistically significant differences in the non-surgical segment AxCSA, RLS and the volume of thecervical longus at the 3rd and 12th months after surgery and the last follow-up (P>0.05). There was no statistically significant difference of CESA and CESA/VBA compared to preoperative in the surgical segment and non-surgical segment (P>0.05). Pearson correlation analysis showed that the volume of cervical longus and VAS at the 3rd month (r=-0.308, P<0.05), the 12th month (r=-0.210, P<0.05) and the last follow-up (r=-0.404,

P<0.05) were negatively correlated; Among the volume of cervical longus and NDI in the 3rd month (r=-0.511, P<0.05), 12th month (r=-0.518, P<0.05) and the last follow-up (r=-0.352, P<0.05), there was a negative correlation; However, there was no statistically significant correlation between the cervical longus muscle volume and mJOA at each follow-up time point (P>0.05); There was no significant correlation between CESA/VBA and VAS, NDI, and mJOA at the 3rd, 12th and last follow-up (P>0.05).
Conclusion: The volume and morphology of cervical longus after ACDF was significantly reduced compared with that before the operation, but the volume and morphology of the cervical extensor muscle did not change significantly. ACDF surgery mainly affects the cervical longus corresponding to the surgical segment, and the volume is negatively correlated with the VAS and NDI during follow-up.

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ACDF Using Zero-P System for Treatment of Cervical Spondylosis: A Meta-Analysis

Background: Previous study evaluated the efficacy of Zero profile intervertebral fusion system (Zero-P) and traditional anterior plate cage system (PC) in the treatment of CSM.
Objective: This study aimed to evaluate the difference between two fixation methods on medical security, height of intervertebral disc, adjacent-level ossification development (ALOD), and adjacent segmentation disease (ASD) through a systematic retrospective analysis.
Methods: Studies on Zero-P system and traditional anterior plate cage system for ACDF in the treatment of CSM were searched in PubMed, Web of Science, Ovid, Embase, and Cochrane Library databases. Two independent researchers screened articles, extracted data, and evaluated the quality of the articles based on the inclusion and exclusion criteria of the current study. RevMan5.3 software was used for meta-analysis following the guidelines of Cochrane collaboration network. Cervical curvature, interbody fusion rate, preoperative and postoperative disc height index (DHI), fusion cage sinking rate, postoperative dysphagia, ASD, ALOD, and loosening of screw were compared between the two groups.
Results: A total of 17 literatures were included in the present study, including 6 randomized controlled trials and 11 observational studies. The studies comprised a total of 1204 patients with CSM, including 605 patients in the Zero-P system group (Zero-P group) and 599 patients in the traditional animal plate cage group (PC group). Results of this meta-analysis showed that postoperative dysphagia, ALOD, ASD, and screw loosening of the Zero-P group were significantly lower compared with the PC group. On the other hand, preoperative cervical curvature, postoperative cervical curvature, cage sinking rate, intervertebral fusion rate, preoperative DHI, and postoperative DHI were not significantly different between the two groups.
Conclusion: It was evident that the Zero-P system used in ACDF is superior compared with the traditional anterior plate cage system in postoperative dysphagia, avoiding ALOD, ASD, and screw loosening.

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Is a Lamina Spacer Necessary in Cervical Laminoplasty for Compressive Myelopathy with Non-kyphotic Alignment? -Comparison between Kirita-Miyazaki Method and Metal Spacer Method-

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Background: In cervical laminoplasty, the use of inter-lamina spacers stabilizes the opened laminae and prevents lamina closure (LC), but has risks of the spacer-related problems (dislocation, pseudarthrosis, e.g.). For many years, we have performed double-door spacerless laminoplasty (Kirita-Miyazaki method) for non-kyphotic cases, but we started to use metal spacers in 2021.
Objective: To compare the surgical outcomes between the spacer non-use group (Kirita-Miyazaki method) and the spacer use group in double-door cervical laminoplasty.
Methods: In cervical compressive myelopathy patients with non-kyphotic and well-balanced alignment, twenty patients who underwent Kirita-Miyazaki method (Spacer (-) group; average 3.5 operative segments) in 2020 and twenty-one patients who underwent metal spacer method (Spacer (+) group; average 3.6 operative segments) in 2021 were completed 1-year follow-up and included in this study. We investigated C-JOA score, neck pain (VAS), NDI, and C2-7 angle, lamina angle (LA: the angle between the posterior line of the vertebral body and the lamina on CT) at preoperative and 1-year after surgery, and LC (LA at 1 year/immediately after surgery <80%), bony fusion at the hinge of the opened lamina on CT at 1 year follow-up.
Results: The patient backgrounds were not different between the two groups. The recovery rate of C-JOA score, neck pain, NDI, and C2-7 angle at 1 year were not different between the two groups. The postoperative LA at the immediate and 1-year period were both larger in the spacer (-) group. The LC was not observed in either group. The hinge pseudarthrosis rate was higher in the (+) group.
Conclusion: There was no difference in clinical outcomes between the spacer and non-spacer groups, but radiological results showed large opened lamia angle in the non-spacers group and more hinge pseudoarthrosis in the spacer group.

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Preservative treatment results for dropped head syndrome(DHS) using Halo vest

Objective: This study aims to report the results of conservative treatment of dropped head syndrome (DHS) using a halo vest.
Method: Of the 36 cases of DHS treated using the halo vest at our hospital from 2013 to 2023, 15 were treated conservatively. Cases with cervical spondylotic myelopathy, halo vest immobilization for less than one week and follow-up for less than three months were excluded. Patient background (age, gender, BM, period of halo vest usage), comorbidities (Parkinson's disease, DM, autoimmune disease, thyroid disease, kidney disease, history of cervical spine surgery), X-ray parameters, treatment results (avoidance of surgery), horizontal visibility, complications) were investigated. Halo vests were generally used for at least two weeks to assess their effectiveness, and if DHS persisted, they were continued. Surgery was considered for cases with no improvement in DHS at four weeks.
Result: The average age was 76.5 years, and the average duration of halo vest usage was 16.3 days. There were 2 cases of Parkinson's disease, 2 cases of DM, 2 cases of autoimmune disease, and 2 cases of previous cervical spine surgery, and 46.7% had background diseases that could lead to DHS. X-ray parameters improved in the head and cervical spine regions and were maintained at three months. Surgery was avoided in 9 cases (60%), and horizontal vision could be held in 6 cases (40%) with halo vest treatment alone at the time of final observation. Dysphagia during halo vest fixation occurred in 0 cases, delirium in 1, and pin loosening in 2 cases.

Conclusion: Background diseases were present in approximately half of the DHS cases. Conservative treatment with Halo vest fixation avoided surgery in 60% of cases, and horizontal vision was maintained in 40%. It is also possible to evaluate dysphagia, which is useful when proceeding to surgery.

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Selective modified K-line Interval can predict residual anterior compression of spinal cord after posterior decompression of cervical spine

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INTRODUCTION: Modified K-line interval (mK-line-INT [Fig. A]), which is based on C2-7 alignment predicts residual anterior compression of spinal cord (rACS) after posterior decompression in cervical spondylotic myelopathy (CSM) patients. At last year's CSRS-AP meeting, we proposed "selective" mK-line (SmK-line [Fig. B], the line connecting the midpoints of the spinal cord at the rostral endplate-level of the uppermost vertebra and at the caudal endplate-level of the lowermost vertebra of the selected decompression levels). SmK-line-INT (the minimum distance between the ACS and SmK-line [Fig. B]) predicted JOA score recovery rate (JOA-RR) more accurately than mK-line-INT and its cut-off value to predict JOA-RR<40% was 3.4mm (sensitivity 77.3%, specificity 70.0%). This study aimed to investigate whether SmK-line-INT≤3.4mm can also predict postop rACS.

METHODS: We reviewed 34 patients whose postop MRIs were available out of consecutive 62 CSM patients who underwent posterior decompression. rACS was defined as the effacement of the anterior cerebrospinal fluid buffer on sagittal and axial T2 MRI (Fig. C). ①The percentage of rACS was compared between patients with SmK-line-INT>3.4mm (INT>3.4mm group, n=19) and those with SmK-line-INT≤3.4mm (INT≤3.4mm group, n=15). ②Preop C2-7 Cobb, local Cobb of decompressed levels, C2-7 SVA, and SmK-line-INT were compared between patients with rACS (rACS group, n=10) and those without rACS (No rACS group, n=24).

RESULTS: ①INT≤3.4mm group had significantly higher rate of rACS than INT>3.4mm group (9/15 [60%] vs 1/19 [5.3%], p<0.001). The sensitivity and specificity of SmK-line-INT≤3.4mm to predict rACS was 90.0% and 75.0%, respectively. ②Preop C2-7 Cobb (p=0.005), local Cobb (p=0.008), and SmK-line-INT (p<0.001) were significantly smaller in rACS group than No rACS group, and the odds ratios of these variables for rACS by univariate logistic regression analysis were 1.12 (95%CI 1.03-1.23, p=0.006), 1.15 (1.04-1.33, p=0.005), and 4.28 (1.75-17.69, p<0.001), respectively.

CONCLUSIONS: SmK-line INT≤3.4mm can predict rACS after posterior decompression.

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Frequency and associated factors of venous thromboembolism in cervical spine surgery

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Background: Venous thromboembolism (VTE) is a well-known complication after spine surgery. As many cases of cervical spine disease result in severe gait disturbance due to myelopathy, it may harbor a higher risk of VTE than other spinal disorders. However, few studies have focused primarily on cervical spine surgery to date.

Objective: This investigation sought to determine the prevalence of VTE after cervical spine surgery and identify patient-based risk factors.

Methods: The medical data of 341 consecutive patients (240 male and 101 female; mean age: 68.1 years) who underwent cervical spine surgery were retrospectively examined. Logistic regression models were employed to examine the prevalence, characteristics, and risk factors of post-operative VTE.

Results: We observed that 2.6% of cervical spine surgery patients experienced post-operative VTE. In comparisons of VTE and non-VTE groups, significant differences were found for age (79.6 years vs. 67.7 years, p<0.01), 1-week post-operative D-dimer level (10.6 μg/mL vs. 2.7 μg/mL, p<0.01), and cardiovascular disease (44.4% vs. 11.1%, p=0.011). Multivariate analysis identified elevated post-operative D-dimer level and cardiovascular disease as significantly associated with post-surgical VTE, with respective odds ratios of 1.54 and 9.52.

Conclusion: Post-operative VTE in cervical spine surgery was seen in 2.6% of cases. Patients with elevated post-operative D-dimer level and cardiovascular disease may be at increased risk of VTE and require additional observation.

Key Words: venous thromboembolism; cervical spine; surgery; cardiovascular disease, D-dimer

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Biomechanical Properties of Bicortical Laminar Screw Compared with Different Screw Fixation Methods on the Subaxial Cervical Spine

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Background: There are numerous methods of fixating the subaxial cervical spine. Those methods include lateral mass screw (LMS), pedicle screw (PS), and translaminar screw (TLS). Recently, we have reported the anatomical feasibility of bicortical laminar screw (BLS). Although it is technically feasible, the biomechanical properties of bicortical laminar screw compared to other techniques are yet unknown.

Objective/Aim: To analyze the biomechanical properties of the bicortical laminar screw (BLS) and compare them with other different screw fixation methods LMS, PS, and TLS, we have performed a biomechanical study using a synthetic bone model.

Materials and methods: We prepared polyurethane bone models to analyze the mechanical properties of screw fixation. We inserted LMS, PS, TLS, or BLS using 3.5mm diameter polyaxial screws. The length of the screws was determined by using a depth gauge. Biomechanical properties, including pullout strength (POS) and torsional stiffness (TSti), were measured for each method.

Results: POS were 100.44±4.94N, 95.77±9.20N, 63.30±9.80N, and 61.08±9.01 in LMS, PS, TLS, and BLS, respectively. PS and LMS showed significantly higher POS than TLS and BLS. TSi were 50.34±1.44Nmm/rad, 71.35±2.65Nmm/rad, 98.53±3.95Nmm/rad, and 50.34±1.44Nmm/rad in LMS, PS, TLS, and BLS, respectively. PS showed the highest TSi, followed by TLS. LMS and BLS had the lowest TSi. POS and TSi did not show a positive correlation.

Conclusions: BLS showed similar POS to TLS, but lower than LMS and PS. Since BLS showed similar POS and a lower potential risk of canal breach, BLS is considered an alternative option to TLS in the subaxial spine.

Keywords: Cervical Spine, Subaxial, Screw, Biomechanics

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True continuous segment of ossification of posterior longitudinal ligament is protective against postoperative early kyphosis progression following laminoplasty

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Background: Ossification of the posterior longitudinal ligament (OPLL) is a potentially catastrophic disease. Laminoplasty (LP) is a common surgical intervention, but postoperative kyphosis progression is a major complication, for which various risk factors have been identified and utilized in surgical decision-making.
Objective/Aim: Our focus is to validate the ability of OPLL with specific morphological traits, designated as the true continuous segment (TCS), to stabilize alignment and prevent postoperative kyphosis following LP.
Methods: This retrospective case-control study included patients who underwent cervical LP for OPLL treatment with a minimum 1-year follow-up. Demographic, operative, and radiographic parameters were analyzed. TCS is defined as a continuous segment of OPLL that spans the disc space more than half of the adjacent vertebral body height without crack, or OPLL segment attached to both upper and lower adjacent vertebral bodies by bridging, or obvious interbody autofusion, and is identified from preoperative CT. A subgroup analysis for preoperatively lordotic patients, divided into two groups based on cervical alignment at the final follow-up, was conducted to identify risk factors for kyphosis progression. Difference analysis, linear regression analysis for loss of lordosis, and logistic regression analysis for kyphosis progression were employed.
Results: A total of 84 patients were identified. Among them, 78 patients with preoperatively lordotic alignment were divided into two groups: those who maintained lordotic alignment (n=60), and those who progressed to kyphosis (n=18). Regression analyses revealed a significant protective effect of TCS count against loss of lordosis and postoperative kyphosis, with a TCS count of 3 or more conclusively preventing kyphosis (sensitivity 1.000, specificity 0.283, AUC 0.629).
Conclusion: For patients with OPLL, TCS was shown to protect against the loss of lordosis following LP. Therefore, TCS should be identified and considered when planning surgical treatment for OPLL.

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Prognostic factors for neurological outcome after anterior decompression and fusion for proximal-type cervical spondylotic amyotrophy

Background: Decompression through an anterior approach is theoretically effective for the surgical treatment of cervical spondylotic amyotrophy (CSA), because the pathology usually locates at the anterior side. However, most previous studies investigated posterior surgery or mixed anterior surgery and posterior surgery in their investigation. Only a few small case series exist that have investigated the surgical outcomes of anterior decompression and fusion (ADF).
Objective: We conducted a multicenter retrospective study that included patients who underwent ADF for proximal-type CSA.
Methods: We analyzed the outcomes of 77 consecutive spinal surgeries performed on proximal-type CSA patients who underwent ADF. Preoperative and postoperative manual muscle tests (MMT) and the patients' backgrounds, radiological findings, and complications were reviewed. We divided patient cases into two groups, good outcomes (MMT improvement ≥ 2 or improved to MMT 5) and poor outcomes (others) and evaluated the prognostic factors for outcomes.
Results: Of the 77 patients, 48 (62%) showed a good neurological outcome. Multiple compressive lesions at anterior horn (AH) and/or ventral nerve roots (VNR) were recognized in 66 patients (85.7%) on the magnetic resonance images. The patients with a single compressive lesion at VNR or AH tended to show good neurological recovery when compare to those with multiple lesions. Age and duration of symptoms were related to the poor outcome in univariate analysis. Duration of symptoms was an independent factor associated with postoperative neurological outcomes. The cut-off value for poor outcome was 7.0 months for symptom duration (sensitivity: 79%, specificity: 54%, area under the curve: 0.69).
Conclusions: Patients with proximal-CSA were more likely to have multiple compressive lesions at AH and/or VNR. The prognostic factor for poor neurological outcome were duration of symptoms ≥ 7 months.

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Comparison between the bone union rates using auto-iliac bone and bone morphogenetic protein without auto bone in a posterior atlantoaxial fusion procedure: Results from a minimum 1-year follow-up

Introduction: Atlantoaxial bone fusions are challenging due to the biomechanical stress. Therefore, some concerns have been raised regarding bone fusion using recombinant human bone morphogenetic protein-2 (rhBMP-2) without auto bone in a posterior atlantoaxial fusion procedure. This study was conduct to compare the bone union rates achieved with an auto-iliac bone graft and rhBMP-2 without auto bone.
Methods: The study included 103 patients who underwent a posterior atlantoaxial fusion due to a C1-2 pathology. As bone graft material, using an auto-iliac bone graft were assigned to the iliac bone graft group (group I, n=68), while cases involving rhBMP-2 without auto bone were assigned to a rhBMP-2 group (group B, n=35). To check atlantoaxial bone fusion, we analyzed pseudomotion in postoperative dynamic radiographs and bone bridge formation, facet joint fusion, and metal loosening in postoperative CT, respectively.
Results: No significant differences were evident between the bone union rates using 1-year dynamic radiographs in group I and B (66/68, 97.0%, vs 34/35, 97.1%, respectively; P=1.000). However, the bone union rates using 1-year CT in group I is higher than group B (86.7% vs 51.4%, p<0.001). The operation time and hospital stay is longer in group I than group B (189.4±39.0 min vs 102.6±20.9 min, 9.8±4.1 vs 7.7±4.8, p<0.001, 0.048). Additionally, persistent pain at the graft site during at 1 year was reported in 20.6% (14/68) of patients in group I.
Conclusions: Considering the advantages including decreased operative times, shorter hospital stay and donor site morbidity, rhBMP-2 has advantages as grafting choice for posterior atlantoaxial fusion procedure. But, this study also demonstrated that definite bone bridge formation and facet joint fusion on postoperative CT were

lessly checked in the rhBMP-2 without auto bone group. Therefore, a long term follow-up is also required in posterior atalntoaxial bone fusion using rhBMP-2 without auto bone.

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Spinal Intramedullary Schwannomas – Rare-cases report and review of the literature.

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Introduction: Intramedullary schwannomas (IMS) are exceptionally rare pathologies, typically presenting as solitary lesions. Only five cases of "subpial schwannoma" have been documented. We report two rare-case of a intramedullary schwannoma surgically treated and discuss clinical, radiological and pathologic findings related to these types of tumors.

Materials and Methods: This report presents two cases of IMS in the cervical and thoracic spine, affecting a 66-year-old and a 55-year-old male patient, respectively. Underwent surgery to remove the tumor and follow up on postoperative imaging and pathology. A systematic literature review for all cases reporting subpial schwannoma was performed. The review encompassed PubMed, EMBASE, and the Cochrane Central Register of Controlled Trials (CENTRAL) to identify relevant studies concerning symptomatic presentations, MRI characteristics, histopathological findings, and recurrent factors.

Purpose: To discuss clinical, radiological findings and surgical treatments related to these types of tumors.

Conclusions: The intraoperative finding supports the pathogenesis theory of IMS, a tumoral growth of the Schwann cells at a critical site in which the dorsal nerve transit into the pia mater. GTR has many benefits for treating this type of tumor

Keywords: Subpial schwannoma, Intramedullary tumour, Cervical cord tumor, Ki-67, Pathogenesis

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C2 Anatomical Pedicle Screw: A Novel Alternative Technique for C2 Fixation under the Concept of Atlantoaxial Joint Distraction and Fusion with Intra-articular Cages

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Object: To describe a novel alternative technique for C2 fixation under the concept of atlantoaxial joint distraction and fusion with intra-articular Cages, and to report its preliminary clinical outcomes with a minimum 8-month follow-up.

Methods Eighteen patients with basilar invagination and atlantoaxial dislocation underwent atlantoaxial joint distraction and fusion with intra-articular Cages. All patients had hypoplasia of the C2 isthmus prohibiting insertion of the pedicle screw. A new method, the C2 anatomical pedicle screw (C2APS) was used as an alternative. In this technique, we directly inserted screw into the C2 anatomical pedicle after facet joint distraction and Cage implementation. The trajectory mostly went through the anatomical pedicle, which completely bypasses the variated VA and eliminates the risk of VA harm. The dense anatomical pedicle could provide robust and secure screw purchase.

Results: Satisfactory C2APS placement and reduction were achieved in all 18 patients. No instance of vertebral artery injury was observed. There were no cases of implant failure, and all patients demonstrated solid fusion.

Conclusion: This novel technique can provide rigid fixation of the axis while eliminating VA injury. Favorable clinical outcomes with low complication rates were achieved with this technique. When placement of a C2 pedicle screw is not possible due to anatomical constraints, C2APS can be considered as a simple, safe and efficient alternative when the technique of atlantoaxial joint distraction and fusion with intra-articular Cages was used.

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Clinical Study of Anterior Controllable Antedisplacement Fusion for Cervical Ossification of the Posterior Longitudinal Ligament

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Key words: Ossification of the posterior longitudinal ligament, Anterior controllable antedisplacement and fusion, Anterior cervical approach

Objective: Clinical and radiographic assessment of Anterior Controllable Antedisplacement Fusion(ACAF) in treating Cervical Ossification of the Posterior Longitudinal Ligament(OPLL).

Background: Cervical OPLL usually occult in onset, existing surgical techniques were far from ideal. ACAF is a novel technique for cervical OPLL.

Methods: Patients with cervical OPLL from July 2019 to November 2021 were retrospectively enrolled. The neurological function was evaluated by the Japanese Orthopedic Association (JOA) scoring system preoperatively and at follow-ups. The cervical curvature (Cobb angle) was measured on the preoperative and postoperative X-ray; the maximum occupying rate of spinal canal was measured on the axial CT scan, and the compression of spinal cord was evaluated on cervical MRI.

Results: 32 patients were analyzed, in whom 1 case involving 1 vertebral body, 18 cases involving 2 vertebral bodies, 11 cases involving 3 vertebral bodies, 1 case involving 4 vertebral body and 1 case involving 5 vertebral bodies. Mean followed up was 20.0±7.59 months(range: 8 to 35months). JOA score of 31 patients were improved, and 1 patient was slightly decreased after surgery(5 vertebral bodies involved, no applicable plate available). The JOA score improved from 12.43±2.88

preoperatively to 15.91±1.61 at the last follow-up, with an average improvement rate of 79.6±29.0%. The Cobb angle improved from 11.50±9.31° to 20.21±7.64°, the stenosis rate of spinal canal decreased from 50.8%±15.3% to 16.5% ± 10.7%, and MRI showed sufficient spinal cord decompression (subarachnoid cerebrospinal fluid filling in both front and rear spinal cord) in 23 cases (71.88%). No spinal cord injury occurred during the operation.
Conclusion: ACAF technique is effective treatment for cervical OPLL. It can effectively expand the volume of spinal canal, relieve spinal cord compression, preserve cervical lordosis and balance, and effectively improve neurological function,. This is an ideal surgical technique of cervical OPLL.
Disclosure of conflict of interest: The authors declare that they have no conflicts of interest.

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Biomechanics of a Novel Artificial Cervical Vertebra from an in vivo Caprine Cervical Spine Non-Fusion Model

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Objective: Anterior cervical corpectomy and fusion (ACCF) has been widely used in the treatment of cervical spondylotic myelopathy (CSM) but is accompanied by unavoidable motion loss and destruction of vertebra. We aim to evaluate the range of motion (ROM) of caprine cervical spine constructs implanted with cervical artificial disc and vertebra system (ADVS). The purpose of this study was to investigate the biomechanical properties of the ADVS from an in vivo caprine cervical spine non fusion model.
Methods: Twelve goats were randomly divided into ADVS or control group, with 6 animals in each group. The animals in the ADVS group were implanted with ADVS at the C4 level. The cervical spine constructs were harvested 6 months after the operation. The ROM of cervical spine specimens in the ADVS group was recorded. Biomechanical testing of the specimens in the control group were conducted to evaluate the ROM of the cervical spine specimens under intact and fixed condition (C3-C5) by an anterior plate, respectively.
Results: The biomechanical outcomes showed that the ROM of the levels (C3-C5) implanted with ADVS was maintained. The ROM in the adjacent level (C2-3) did not increase significantly comparing with intact group.
Conclusions: In general, ADVS could preserve the ROM of operative levels and could reconstruct the height of the vertebra. ADVS did not increase the ROM of upper adjacent level. This device provides a non-fusion method for the treatment of patients suffering from CSM. However, improvements on the design of ADVS are still needed.

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3D-printed titanium vertebra and titanium mesh cage in the treatment of cervical spondylotic myelopathy: a comparison of perioperative parameters, radiographic and clinical outcomes

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Purpose: Anterior cervical corpectomy and fusion (ACCF) using titanium mesh cage (TMC) is a conventional approach for treating cervical spondylotic myelopathy (CSM). However, the incidence of TMC subsidence remains a concern. This study aims to explore the potential benefits of using 3D-printed vertebra comparing with TMC in ACCF surgery.
Methods: A retrospective study was conducted on patients who underwent ACCF at our hospital from March 2017 to June 2023. Patient demographics, including gender, age, body weight, smoking history, medical history, operation details such as duration and blood loss, functional assessments (Barthel score, Morse Fall Scale (MFS), anterior cervical corpectomy index (aCCI)), hospitalization duration, costs, postoperative adverse events, major and minor complications, unscheduled reoperations, postoperative ICU admissions, as well as patient-reported outcomes (Japanese Orthopedic Association (JOA) score, Visual Analog Scale (VAS) score, Neck Disability Index (NDI) score), were collected. Radiographic outcomes, including C2-C7 Cobb angles, segmental lordosis, and subsidence, were measured using lateral cervical spine X-rays. Data analysis was performed using the Chi-square test and Mann-Whitney test.
Results: A total of 92 patients were included in this study, with 48 patients in the 3Dvertebra group and 44 patients in the TMC group. The demographic characteristics of the two groups were comparable. 3D-vertebra group had shorter operation time, lower blood loss, and better functional scores compared to the TMC group ($p < 0.05$). Hospital length, costs, and ICU admissions did not differ significantly between the groups. The 3D-vertebra group had lower JOA and VAS scores at one-week postoperative and follow-up. NDI scores were comparable at one-week postoperative but higher in the TMC group at follow-up. Segmental lordosis did not differ significantly, but C2-C7 Cobb angles showed significant differences at follow-up. The TMC group experienced subsidence of 2.5mm on average, while the 3D-vertebra group had minimal subsidence.
Conclusions: 3D-printed titanium vertebra in ACCF surgery offers advantages in perioperative parameters, radiographic outcomes, and clinical scores compared to TMC implants. Further long-term follow-up studies are needed to evaluate the long-term benefits of 3D-printed vertebra.
Key words: Cervical spondylotic myelopathy; ACCF; 3D-printed titanium vertebra; Titanium mesh cage; Subsidence

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Anterior Vertebroplasty as Treatment for Aggressive and Symptomatic Cervical Hemangioma

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Background: At present, there is very few literature on the treatment of aggressive and symptomatic cervical hemangioma (ASCH).
Objective: The aim of this study is to evaluate the safety and effectiveness of anterior vertebroplasty for patients with ASCH.
Methods: Clinical data of patients of ASCH who underwent anterior cervical vertebroplasty in our hospital from January 2018 to January 2022 were retrospectively analyzed. A total of 20 patients (20 vertebrae) were included in this study, including 12 males and 8 females, with an average age of 48.2±5.3 years. In all patients, an open anterior cervical biopsy and vertebroplasty at the diseased vertebrae was performed under general anesthesia. The VAS scores and NDI index of patients were

compared before and 24 hours after surgery, 3 months, 6 months, 12 months after surgery and at the last follow-up, to evaluate the therapeutic effect. The amount of intraoperative bone cement injection, diffusion and leakage of bone cement were also recorded.
Results: All of the 20 patients underwent surgery successfully, including 4 cases of C3, 6 cases of C4, 7 cases of C5 and 3 cases of C6. The pathological results of the tissues taken during the operation were all hemangioma. The average injection volume of bone cement was 2.8±0.6ml, and the average follow-up was 42.5±5.6 months. The VAS score and NDI index were significantly improved after surgery and follow-up period compared with that before surgery (P<0.05). Intraoperative bone cement was observed to spread to both sides of the injured vertebra, and no bone cement leakage occurred.
Conclusion: Anterior vertebroplasty is a safe and effective surgical method for patients with ASCH.

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Diaphragmatic Paralysis after Cervical Spine Surgery: A Case Report

Background: Diaphragmatic paralysis has been reported to occur subsequent to different diseases. However, there are few reports focus on cervical spine surgery.
Objective: To describe an rare complication of diaphragmatic paralysis following cervical spine surgery
Methods: The study describes clinical presentation and management of a case of diaphragmatic paralysis subsequent to operation for cervical ossification of posterior longitudinal ligament (OPLL).
Results: The patient was a 65-year-old farmer complaining of progressive numbness and weakness on limbs. Physical examination detected signs of cervical myelopathy. Imaging examination revealed OPLL and spinal canal stenosis from C3-6 with maximum occupation ratio of 64% at C3/4. Preoperative chest radiographs revealed normal diaphragm location. Then single-stage laminoplasty and ACDF at C3/4 was performed. Numbness and weakness significantly released with JOA score increased from 8 to 14. However, the patient suffered dyspnea even supine on bed. If without oxygen inhalation, oxygen saturation decreased from 98% to 90% and arterial blood gas analysis revealed hypercapnia. This condition aggravated without sputum or fever. One week later, acidosis (pH 7.313), pneumonia and pleural effusion was detected. Although anti-infection strengthened, dyspnea still progressed with severer acidosis (pH 7.289). Firstly, diaphragmatic paralysis was a suspected diagnosis with special characteristics, such as elevated diaphragm, weak abdominal respiration, no fever or sputum. Then respiratory function test was performed with restrictive ventilatory dysfunction. Meanwhile, MRI also showed incomplete decompression and obvious high signal change at C3/4. Thus, diaphragmatic paralysis was confirmed. Ventilation support of noninvasive ventilator and BIPAP was performed sequentially with successful outcome. One year later, the patient did not suffered dyspnea in daily life and working. However, restrictive ventilatory dysfunction still can be detected.
Conclusion: Diaphragmatic paralysis may occur as rare complication after cervical spinal surgery, especially operated at C3/4. If occurred, ventilatory support may be an effective treatment.

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Full Title: Strategizing Simultaneous Spinal Osteotomy and Total Hip Replacement in Ankylosing Spondylitis

Objective: Ankylosing spondylitis (AS) is a debilitating rheumatic condition that significantly impairs mobility and quality of life through chronic inflammation and spinal fusion. The aim of this study is to investigate the optimal sequencing of spinal osteotomy and total hip replacement (THR) as treatment options, a topic that remains a subject of debate among medical professionals.
Methods: In a retrospective cohort study spanning from 2017 to 2021, we assessed adult patients with AS who underwent both spinal osteotomy and THR, outcome measures involved radiographic assessments like Global Cobb angle, Thoracolumbar Kyphosis (TLK), Lumbar Lordosis (LL), Pelvic Incidence (PI), Pelvic Tilt (PT), and Sacral Slope (SS), as well as clinical metrics such as the Harris hip score. For the same surgical group, paired t-tests were performed for pre- and post-operative data, while independent sample t-tests were used for comparing different surgical groups. The study aims to elucidate the optimal sequencing of these surgical procedures based on these comprehensive metrics.
Results: Among the 14 patients included, demographic and clinical variables were comparable between the two procedural groups.At the 3-month follow-up, all major metrics showed significant post-operative improvements. Specifically, the Global Cobb angle reduced from 98.88±38.54 to 54.48±18.14 (p=0.018), and the Harris hip scores, evaluated at the 3-month follow-up, dramatically increased from 15.14±10.12 to 72.57±14.12 (p=0.001). Furthermore, the Spine First Group exhibited more pronounced changes in pelvic parameters (p=0.009), albeit at the expense of longer operation times and increased blood loss. No major complications were encountered.
Conclusions: Contrary to the prevalent belief that spinal osteotomy should precede THR, our study argues that under certain conditions, opting for hip surgery first can be both viable and advantageous. This approach may mitigate the risk of complications and even facilitate subsequent spinal surgery. Surgical decisions must be highly tailored, focusing on patient-specific needs and anatomical considerations. The ultimate goal remains consistent: to improve patients' functional abilities in daily activities and thereby enhance their overall quality of life.
Key words: Deformity, Ankylosing Spondylitis, Spinal Osteotomy, Total Hip Replacement, Surgical Sequencing

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The mechanism of traumatic posterior atlantoaxial dislocation without fracture ： A radiological study of 17 cases based on literature review

Introduction: It has been proposed that hyperextension with variable amounts of distraction may be the probable mechanism of posterior atlantoaxial dislocation without odontoid fracture. However, the assumption is not proved by any clinical or experimental studies, and whether the retroversion angle of the dens associated with injury mechanism is not known. So the purpose of this study is to investigate the injury mechanism by literature review and radiological measurement.
Materials/Methods: A total of 17 posterior atlantoaxial dislocation without odontoid fracture cases with detailed information were collected through literature review. There were 15 male patients and 2 female patients. The age of patients was from 20 to 65. There were 6 patients from China, 5 patients from The USA, 3 patients from India ,and the other 3 patients from Iran, Korea and Germany. The facial lacerations, neurological condition and reduction method were recorded. The angle of dens in sagittal plane(DASA) were measured by cervical X-ray radiographs or CT scans. Besides, 22 consecutive adult subjects who performed cervical X-rays were randomly recruited from Synapse System of our hospital. And the DASA were measured by cervical lateral X-ray.
Results: Twelve patients(70.1%, 12/17) had facial lacerations, and the other 5 patients wasn't mentioned in the literature. There were 7 patients with neurological deficit. The DASA of healthy subjects was （13.9±3.6）°, which similar with the west countries reported by literature(13.0±9)°. And the DASA of posterior atlantoaxial dislocation without fracture patients was （21.2±3.5）°. There was a significant difference statistically between the two group(P<0． 05).

Conclusion: Posterior atlantoaxial dislocation without fracture is extremely rare. Patients with posterior atlantoaxial dislocation without fracture usually have facial lacerations and larger retroversion angle of the dens. So the larger retroversion angle of the dens, be the anatomical basis, as well as hyperextension with variable amounts of distraction should be the mechanism of such kind of injury.

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Lasso Analysis of gait characteristics and correlation with spinopelvic parameters in patients with degenerative lumbar scoliosis

Purpose: This study quantifies the gait characteristics of patients with degenerative lumbar scoliosis (DLS) and patients with simple lumbar spinal stenosis (LSS) by means of a three-dimensional gait analysis system, aiming to determine the image of spinal deformity on gait and the correlation between spinal–pelvic parameters and gait characteristics in patients with DLS to assist clinical work.

Methods: From June 2020 to December 2021, a total of 50 subjects were enrolled in this study, of whom 20 patients with DLS served as the case group and 30 middle-aged and elderly patients with LSS were selected as the control group according to the general conditions (sex, age, and BMI) of the case group. Spinal–pelvic parameters were measured by full-length frontal and lateral spine films one week before surgery, and kinematics were recorded on the same day using a gait analysis system.

Results: Compared to the control group, DLS patients exhibited significantly reduced velocity and cadence; gait variability and symmetry of both lower limbs were notably better in the LSS group than in the DLS group; joint ROM (range of motion) across multiple dimensions was also lower in the DLS group; and correlation analysis revealed that patients with a larger Cobb angle, T1PA, and higher CSVA tended to walk more slowly, and those with a larger PI, PT, and LL usually had smaller stride lengths. The greater the PI-SS mismatch, the longer the patient stayed in the support phase. Furthermore, a larger Cobb angle correlated with worse coronal hip mobility.

Conclusion: DLS patients demonstrate distinctive gait abnormalities and reduced hip mobility compared to LSS patients. Significant correlations between crucial spinopelvic parameters and these gait changes underline their potential influence on gait disturbances in DLS. Our study identifies a Cobb angle cut-off of 16.1 as a key predictor for gait abnormalities. These insights can guide personalized treatment and intervention strategies, ultimately improving the quality of life for DLS patients.

Key words: degenerative lumbar scoliosis; lumbar stenosis syndrome; cobb angle, balance, gait

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T1 slope minus cervical lordosis in multilevel anterior cervical discectomy and fusion with or without plate: a mean 6-year follow up

Purpose: Cervical alignment between self-locked cage (SLC) and anterior cage-with-plate (ACP) system was debatable, especially in multilevel anterior cervical discectomy and fusion (ACDF). T1 slope minus C2-C7 cervical lordosis (T1S-CL) was critical for cervical-balance while without identified threshold. Thus the study was to compare sagittal alignment between SLC and ACP on 3-level ACDF and to identify the threshold of T1S-CL in 3-level ACDF.

Methods: 45 patients of 3-level SLC and 28 cases of 3-level ACP with well-matched demographics were retrospectively enrolled with 6.1-year follow-up. Cervical alignment paramters were CL, C2-C7 sagittal vertical axis (C2-C7 SVA), T1S and T1S-CL, as well as adjacent segment degeneration (ASD), obtained on X-ray. Neck disability index (NDI) and Japanese Orthopedic Association (JOA) score were recorded for evaluating quality of life (QOL). NDI of 20 was difined as the cutoff of QOL. Threshold of T1S-CL was determined by both linear and logistic regression model.

Result: CL, C2-C7 SVA and T1S were insignificant at baseline and all parameters were indifferent at last ($P > 0.05$). CL and T1S improved at last in both groups ($P < 0.05$). The incidence of ASD was comparable between groups ($P > 0.05$). Both groups acquired inprovement on NDI and JOA ($P < 0.001$). There were close correlation among alignment paramters and between parameters and NDI at final follow-up. C2-C7 SVA was independent risk factor for NDI and two regression models predicted C2-C7 SVA with a cutoff of 29.2 mm, corresponded to the threshold on T1S-CL of 20.7°.

Conclusions: It is comparable on alignment reconstruction between SLC and ACP system. The cutoff on C2-C7 SVA with 29.2 mm corresponds to a thershold of T1S-CL with 20.7° in multilevel ACDF.

Key words: cervical spondylotic myelopathy; multilevel self-locked cage; anterior cage-with-plate; T1 slope minus cervical lorsosis; clinical outcomes

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A cadaveric study on the origin and distribution of blood vessel of longus colli

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Background: Cervical hematomas are a common complication in anterior cervical spine surgery. The Longus colli(LCo) is a common site of bleeding.

Objectives: To explore the potential clinical significance of longus collithrough analyzing the origin and distribution of the vessels of LCo.

Methods: An anatomical study was performed on 12 embalmed adult cadaveric specimens. The origin of blood vessles of LCo, and the entry point, distribution and end point of the blood vessels of each branch at LCo were recorded.

Results: According to anatomical position, the relationship between the vessels and LCo was divided into: (1) The vessels passing over LCo(upper, middle, and lower branches). The upper branch was distributed at C6-C7 vertebrae. The middle branch was distributed at C6-T1 vertebrae. The lower branch was distributed at C6-T3 vertebrae; (2) The intramuscular vessels of LCo were the continuation of the upper surface vessels after entering the muscle; (3) The blood vessels on the lower surface of LCo were distributed between the lower surface of the muscle and the vertebral body.

Conclusions: The blood vessels of LCo is regular in distribution, which branches into upper, middle, and lower branches at the surface of LCo and mostly end at the nutrient foramina on both sides at the upper 1/3 of the vertebral body under the lower surface of LCo. In anterior cervical spine surgery, avoiding dissecting LCo above the vertebral body or below the upper endplate can reduce the probability of bleeding and postoperative cervical hematoma formation.

[Key words] Longus colli; Anterior cervical spine surgery; Origin of blood vessels

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The range of motion of atlantoaxial joints with the “sandwich” deformity: a human cadaveric biomechanical study

Background: Patients with “sandwich” deformity(concomitant atlas occipitalization and C2-3 fusion, a subtype of Klippel-Feil syndrome) are at particular risk of developing atlantoaxial dislocation(AAD). Those patients were characterized with earlier onset age, more severe dislocation, higher incidence of Chiari deformity and syringomyelia, and greater difficulty in surgery. But it is unknown if there is special biomechanical characteristics between atlantoaxial joints.
Aim: To explore if the biomechanical characteristics between atlantoaxial joints in “sandwich” deformity patients is particular and if there is a relationship between the AAD and the malformations (Chiari malformation and the formation of syringomyelia).
Study Design: A human cadaveric biomechanical study
Methods: We conducted a biomechanical study on the atlantoaxial joint by simulating “sandwich” deformity in cadaveric specimens. Five fresh frozen cadaver spinal specimens (from the occiput to C7) were selected from human donors with no history of spinal trauma and congenital malformations. The C0-1 and C2-3 (C1 pedicle screws combined with occipital titanium, C2 pedicle screws and C3 lateral mass screws) were fixed to develop congenital atlas occipitalization and C23 fusion deformities (“sandwich” deformity). Each specimen was tested two times, firstly under the normal condition and secondly under the “sandwich” condition. Then the range of motion(ROM) between C1 and C2 was measured under different conditions.
Results: The results showed that the relative range of flexion-extension motion between C1-2 in the “Sandwich” specimens was significantly greater than that in the normal specimens ($P<0.05$). No significant difference in the relative range of other two motion modes (lateral bending and axial rotation) between C1-2 was observed for the normal and “Sandwich” specimens.
Conclusions: The ROM between C1-2 in “sandwich” deformity increased during flexion and extension compared with normal atlantoaxial joints. The “clamp” mechanism of “sandwich” deformity might be involved in the pathogenesis of AAD and secondary nervous system damage.

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Finite Element Analysis of a New Preoperative Traction for Cervical Kyphosis: Suspensory Traction
Background: Preoperative traction plays an important role in the treatment of cervical kyphosis. Suspensory traction, a new method of preoperative traction, has a good clinical effect, but its biomechanical mechanism has not been studied.
Objective: A finite element model of cervical kyphosis was established to analyze the stress of cervical spine under suspensory traction, and to explore the mechanism and effect of it.
Methods: A patient with typical cervical kyphosis (C2-C5) underwent CT scan imaging, and 3D slicer was used to reconstruct the C2 to T2 vertebral bodies. the reconstructed data was imported into Hypermesh 2020 and Abaqus 2017 for meshing and finite element analysis. The changes of the kyphotic angle and the von Mises stress on the annulus fibrosus of each intervertebral disc and ligaments were analyzed were analyzed under suspensory traction conditions.
Results: With the increase of suspensory traction weight, the overall kyphosis of cervical spine showed a decreasing trend. The correction of kyphosis was mainly contributed by the change of kyphotic segments. The kyphotic angle of C2-C5 was corrected from 45° to 13° degrees finally. In cervical intervertebral discs, the stress was concentrated to anterior and posterior part, except for C4-5. The stress of the anterior longitudinal ligament (ALL) decreased from the rostral to the caudal, and the high level von Mises stress of the kyphotic segments appeared at C2-C3, C3-C4 and C4-C5. The roles of the other ligaments were not obvious.
Conclusion: The kyphotic angle of the kyphotic segment was significantly reduced by the suspensory traction. The high von Mises stress and shear force in front of the annulus fibrosus and the tension on the anterior longitudinal ligament play a role in the correction of cervical kyphosis.

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Dynamic CT imaging of the cervical spine in patients with atlantoaxial instability
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Background: Dynamic imaging examinations, such as radiography and MRI of the cervical spine was performed with the patient’s head and neck in flexion and extension, were commonly used to evaluate and diagnosis cervical spine degenerative disease or trauma. However, about the reports of dynamic computerized tomography to assess the instability of the atlantoaxial joint, were relative scarce. It is necessary that more details of the facetal alignment is appropriately evaluated, and the implications of mal-alignment of facets are understood.
Objective: We proposed to evaluate more details of the facetal alignment and the implications of mal-alignment of facets by dynamic CT imaging of the cervical spine in patients with atlantoaxial instability.
Methods: This retrospective study included 16 patients (9 males, 7 females) with or without atlantoaxial instability. Radiography and CT were performed with the neck in the neutral position, flexed and extended position. MR imaging was performed in the neutral position in all patients. Atlanto-dental interval (ADI), dynamic change of the facet joints congruence were taken.
Results: In this study, dynamic CT was performed for 16 patients. Of 7 patients were diagnosed atlantoaxial instability, 8 cases combined with Os Odontoideum , 5 cases associated with basilar invagination. Posterior instrumentation and fusion at only the C1–2 level was performed in 9 patients. Whereas C1–2-level fixation and fusion using Margel’s technique was performed in 2 patients with anomalous VA, and occipitocervical fusion combined with transoral anterior decompression was performed in 5 patients with basilar invagination. Another one patient with bilateral partial bony avulsion fracture of transverse atlantal ligament, without atlantoaxial instability, received conservative treatment. All these patients have good and excellent improvement after treatment at the following-up.
Conclusions: The alignment of the upper cervical spine may change significantly according to the neck position. Dynamic computerized tomography scan can provide usefully more detailed information to the diagnosis and the management of atlantoaxial instability.

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ACDF with cervical uncinectomy for cervical radiculopathy with foraminal stenosis
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Background: Cervical radiculopathy is among the most common adult spinal disorders. There are several surgical treatment options available.

Objective: This study aims to describe the technique for ACDF with incomplete or complete uncinectomy for the management of cervical radiculopathy due to foraminal stenosis.
Methods: We retrospectively collected clinical and radiological data from June 2018 to June 2020. A total of 10 patients (16 segments) were included. In total, 16 disc levels (C3/4, 2; C4/5, 4; C5/6, 7; C6/7, 3) were investigated. The mean follow-up duration was 6.1 months(range: 4.5-19.2 months). The neck disability index (NDI) and Visual Analog Scale scores(VAS) for neck pain before surgery and at final follow-up were used to evaluate the clinical results. The occurrence of surgical complications, surgical time, and blood loss volume were also investigated.
Results: The mean VAS scores before surgery and at final follow-up were 6.6, 1.5, respectively. The mean NDI before surgery was 0.38 and 0.08 at the final follow-up. The scores decreased significantly at the final follow-up ($p<0.01$). The mean surgical time and the mean blood loss volume were 125 mins and 10 ml, respectively. There were significant improvements at final follow-up. There were no vertebral artery injuries, cerebrospinal fluid (CSF) leaks, or wound infections. One patient with 3 level discectomy suffered dysphagia after surgery, while improved at final follow-up. All of patients were decompressed completely, and had a good to excellent outcome.
Conclusion: The results in the present study were consistent with previous reports of ACDF with uncinectomy for cervical foraminotomy, especially when severe osseous foraminal stenosis accompanies other pathologies that require an anterior approach to the cervical spine. Use of the microscope and ultrasonic bone dissector during ACDF with uncinectomy was a safe and effective procedure, that can relieve pain and lead to a resolution of neurologic symptoms for patients with cervical radiculopathy.

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Case report: A rear neck tumor-malignant triton tumor

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Basic Information of the Case : Mr Zhao, male, 56 years old. Chief Complaint and Present Illness: He found neck mass on the left side and felt left upper extremity pain and numbness for 6 months. The mass grew rapidly and he felt left upper extremity pain and numbness worse and worse, even he could not sleep throughout the night and needed to eat some opioids to kill the pain. His left-hand dexterity was decreased but the gait and balance were normal. He had no dizzy, head pain, amaurosis, or even syncope. The bladder and fecal function were not influenced.
Clinical Findings: A 5 x 3 cm mass was palpated at the left side of neck (Picture 1). The mass was hard and fixation, without tenderness. His muscle power of left deltoid, biceps and extensor carpi was IV level, other key muscle power was normal. The left C5 and C6 innervational area was hypoesthesia. Bilateral Hoffmann signs and Babinski signs were negative. The ultrasound found there was a mix-echoic paraspinal mass between the anterior and middle scalene muscle and posterior scalene muscle. The contrast-enhanced MRI showed the mass rooted in the left C5-6 intervertebral foramen and wrapped the left brachial plexus, while C5 and C6 vertebral body was not invasion (Picture 2). We did a needle biopsy of the mass and the pathology report was malignant neurilemmoma.
Treatment performed: The surgery was preformed to cut the tumor totally. Patient was placed in supine position under general anesthesia. The longitudinal incision was used from left sternocleidomastoid to supraclavicular. The left sternocleidomastoid was exposed and paid attention to protect left accessory nerve. After cutting left omohyoid and left sternocleidomastoid, we could find left carotid sheath and pulled it to the middle. The tumor and C5 and C6 vertebral body was exposed. Because left brachial plexus and subclavian vein was wrapped by the tumor, we try to separate the tumor along the capsule very carefully and avoid to injury the nerve root and vessel. In another side of the tumor, left C5-6 partial foraminotomy was performed and we found the tumor originated from left C6 nerve root (Picture 3). After separating the tumor and C6 nerve root, tumor was removed finally. The final pathology report was: TLE1(-), INT1(+), CD99(+), BCL-2(+), Vimentin(+), Ki-67(30-40%), malignant triton tumor, striated muscle differentiation.

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Factors affecting being discharged home of patients with cervical spinal cord injury without major bone injuries

Background: Patients with cervical spinal cord injury (CSCI) without major bone injuries have been increasing in recent years owing to an increase in the aging population in Japan. Although several studies have been published on treatment and functional prognostic factors for CSCI, existing studies on patient outcomes are scarce.
Objective: We aimed to investigate the proportion of patients with CSCI who were discharged home and identify factors that influence this outcome.
Methods: We retrospectively reviewed 58 patients with CSCI (43 men and 15 women; mean age at time of injury: 65.7 years [range: 16–95]) who visited our hospital between April 2014 and November 2022. The patients were graded based on the American Spinal Injury Association Impairment Scale (AIS): Grade B: 1 patient, Grade C: 25 patients, and Grade D: 32 patients. One patient with AIS Grade B impairment was excluded from the study because the patient died during hospitalization. Four patients who originally experienced neurological symptoms, including numbness in the upper limbs, and had strongly requested surgery were treated surgically, whereas the remaining patients were treated conservatively.
Results: Of the 57 patients, 12 were discharged home directly and 35 were discharged home after rehabilitation transfer, totaling 47 patients (81%). Seven others were institutionalized, and outcomes are unknown for two patients. Univariate analysis showed that age, walking ability before injury, and AIS at the time of injury and after hospitalization were factors that influenced patient discharge from the hospital. The large number of multifamily dwellings, in conjunction with these factors, were thought to be responsible for the higher percentage of patients being discharged home than that observed in previous studies.
Conclusions: In patients with CSCI, young age, degree of preserved physical function before and after injury, and availability of adequate care at home increased the possibility of being discharged home.

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Preliminary Clinical and Radiological Outcomes of Single Position Prone Lumbar Interbody Fusion

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Background: Lateral Lumbar Interbody Fusion (LLIF) is an increasingly adopted approach for correction of adult lumbar spinal deformities. This approach traditionally requires the patient to be repositioned intra-operatively from lateral to prone, increasing operative and general anaesthesia time. Single position prone LLIF (P-LLIF)

reduces operative and general anaesthesia time while allowing for more complex posterior procedures. It is a relatively new approach to the LLIF and the learning curve, clinical and radiological outcomes have yet to be described.

Methods: A retrospective case series with preliminary data of eighteen patients who underwent single or double level P-LLIF with a single surgeon in a single centre. Six patients underwent primary single level P-LLIF for lumbar spinal stenosis, two patients underwent primary double level P-LLIF for lumbar spinal stenosis, two patients underwent primary single level P-LLIF with concurrent single level TLIF for lumbar spinal stenosis, six patients underwent revision surgery with single level P-LLIF for adjacent segment disease from prior posterior lumbar spinal fusion and two patients underwent revision surgery with double level P-LLIF for adjacent segment disease from prior posterior lumbar spinal fusion. Primary radiological and clinical outcomes at 3 months were heterogeneously compared to published 2 year follow up data of 2 level MIS traditional dual position LLIF from the same centre.

Results: Our patients had an average operative time of 220 +/- 69 minutes, average length of stay of 6.44 +/- 6.20 days and an average blood loss of 194 +/-24mls. Left thigh weakness was reported in 9 patients. 8 of the 9 patients had resolution of their thigh symptoms by 9 months. The one patient with persistent thigh numbness was worked up to have early adjacent segment disease of L2/3. In terms of patient reported outcomes, 10 of 18 patients had at least 3 months of patient reported outcomes. Similar to traditional LLIF, P-LLIF patients showed improvements in all measured patient reported outcomes. VAS back pain improved by 5.7 +/- 4.0 points, VAS leg pain improved 7.10 +/- 2.51, ODI improved by 43.5 +/- 15.9% and RAND-36 Physical Function improved by 47 +/- 29.5 points. P-LLIF demonstrated similar radiological outcomes to traditional LLIF in restoration of disc height (4.3 +/- 1.9 vs 4.4 +/- 2.4), foraminal height (3.7 +/-5.8 vs 3.3 +/- 3.6) and lumbar lordosis (3.8 +/- 2.8 vs 4.1 +/- 7.0).

Conclusion: Three month preliminary clinical and radiological outcomes suggests that single position prone trans-psoas LLIF is a reasonable approach in degeneration lumbar spinal stenosis and may be a useful tool to tackle adjacent segment disease in patients with prior posterior lumbar fusions.

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Structural Allograft and PEEK Cages have similar outcomes after 1 year in Multilevel Anterior Cervical Fusion

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Background: Structural Allograft cages and PEEK cages are commonly used substitutes for autologous bone graft as interbody spacers. They circumvent harvest-site complications in traditional gold-standard autologous bone graft cervical fusion. Structural Allograft are harvested from donor or cadavers under aseptic technique while PEEK cages are manufactured from synthetic medical grade material with a elastic modulus similar to that of native bone. Both structures lack osteogenic properties due to their acellular make up but are highly osteoconductive, having hollow cores within to allow for autograft, allograft or other synthetic osteogenic products to provide osteoinductive properties. This study aims to compare the post-operative rates of fusion, subsidence, restoration of lordosis at 1 year between structural allograft cages and PEEK cages.

Methods: A single-centre retrospective review of patients undergoing primary double level (DL) or triple level (TL) anterior cervical fusions was conducted for the diagnosis of cervical myelopathy, radiculopathy, myeloradiculopathy, from 2019-2022, with a minimum of 1 year follow up. Data was collected for age, gender, indication for surgery, pre-operative, immediate post-operative and 1 year post-operative cervical lordosis, presence of fusion at 1 year, subsidence and implant migration. Fusion was defined as the presence of complete bridging trabecular bone and radiological stability compared to the prior radiography. Subsidence was defined as a reduction in Total Intervertebral Height (TIH) or ≥ 2mm.

Results: A total of 93 cases were selected in our institution. 60 cases using Structural Allografts and 33 cases using PEEK cages were identified. Between the Allograft and PEK groups, there were no statistically significant differences in age (63.3 +/- 10.8, 65.7 +/- 10.3), gender (30F,30M), (15F, 18M), number of levels fused (36 DL, 24 TL) (16 DL, 17TL), fusion rates (96.7%(58/60), 97.0%(32/33)), subsidence rates (28.3% (17), 27.3% (9)) implant migration (6.7%(4), 9.1%(3)), pre-operative lordotic angle (1.7º, -2.9º), immediate post-operative lordotic angle (10.2º, 8.7º), loss of restored cervical lordosis at 1 year (-3.2º, -4.7º), p>0.05.

Conclusion: Structural allografts and PEEK Cages are both good options for anterior cervical fusion with similar outcomes in terms of fusion rates, restoration of cervical lordosis and subsidence rates at 1 year. Further studies with longer follow up duration and larger sample sizes are recommended for further validation of our study.

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Post-operative Horner's Syndrome (HS): A case report on a rare complication after Anterior Cervical Discectomy and Fusion (ACDF) surgery

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Background: Cervical degenerative disc disease (CDDD) is common in older individuals and typically presents with pain and neurological symptoms. The gold standard for correcting CDDD is Anterior Cervical Discectomy and Fusion (ACDF), a safe and effective procedure. Horner's Syndrome (HS) is an extremely rare complication, with an incidence of approximately 0.06%, occurring post-ACDF due to impairment of the sympathetic trunk, resulting in unilateral ptosis, miosis, and anhidrosis on the affected side. We aim to present the first case, to our knowledge, of delayed-onset HS occurring 48-hours post-ACDF.

Methods: The patient, a 48-year-old woman with neck pain and radiculopathy, likely CDDD-related, was counselled, and consented for C5/6 and C6/7 ACDF. ACDF was performed by standard anterior left-sided incision, involving careful division of the platysma, deep cervical fascia, with medial and lateral retraction of the strap muscles, and sternocleidomastoid and carotid sheath respectively. Subsequently, the longus colli was retracted subperiosteally. Contrasting with our usual practice, retractors with deeper teeth were employed for better exposure (Image below). Two cages were inserted at C5/6 and C6/7. ACDF proceeded without intra-operative complications.

Results: Post-ACDF, the patient experienced significant relief from CDDD symptoms. However, approximately 48-hours post-ACDF conclusion, she developed sudden onset left-sided HS, with ptosis and anhidrosis. A prednisolone course was initiated, and she was followed-up at 2, 6, 12, and 16 weeks postoperatively. By 2-weeks, she exhibited clinical improvement, and by 12-weeks, her HS had completely resolved, with no residual effects.

Conclusion: This case study represents, to the best of our knowledge, the first documented instance of delayed-onset HS post-ACDF. It may possibly be associated with the type of retractors used during ACDF, resulting in neuropraxia or strain on the sympathetic chain ganglia. We strongly recommend other spine surgeons ensure adequate exposure while minimizing excessive retraction of the longus colli muscle to reduce irritation to the sympathetic trunk.

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Outcomes of posterior fixation surgery for cervical destructive spondyloarthropathy (DSA) in hemodialysis patients (HD)

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Background: Surgery for cervical destructive spondyloarthropathy (DSA) is challenging because the patients undergoing hemodialysis (HD) have medical complications such as renal failure and osteopenia, difficulty of perioperative management such as circulation, and loss of bone stock, malalignment, and instability of the spine. The purpose of this study was to investigate the surgical outcome for DSA who suffered cervical myelopathy.
Methods: 28 patients (12 males, 16 females, a mean age of 66.2 years old) who underwent cervical posterior fixation using screw-rod system for DSA were included. The mean duration of HD for the patients was 280.4 months. The mean follow-up period was 34.3 months. As clinical evaluations, operation time, blood loss, the recovery rate of the JOA score, postoperative complications and mortality were investigated. As radiologic evaluations, the cervical lordosis angle and the local kyphosis angle were measured and compared between at pre-operation and at the follow-up.
Results: The mean operative time was 222 minutes, the blood loss was 237 g, and the extent of fixation was 4.2 vertevra. The recovery rate of the JOA score was 47.25%. Clinical complications included transient C5 palsy in 4 patients and surgical site infection in 2 patients. There was no vertebral artery injury, epidural hematoma, spinal cord injury, reoperation, or perioperative mortality. Cervical lordosis angle stayed from5.74° preoperatively to 5.85° at the follow-up, however, the local kyphosis angle improved from -14.8° preoperatively to -3.1° postoperatively ($p<0.01$). Distal junctional kyphosis was observed in 2 cases, but no revisions required.
Conclusion: In this study, the outcomes of surgeries for DSA were acceptable without any catastrophic complications. Therefore, we thought that the surgical intervention could be a choice of the treatments for DSA.

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The utility of a patient-specific screw guide templating system for posterior cervical instrumented fusion as a revision surgery following anterior instrumentation; a two-case report

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Background: For adjacent segment disease following anterior cervical fusion (ACF) surgery, posterior decompression and instrumented fusion (PDF) surgery are occasionally performed. However, there is a concern for potential interference between anterior instrumentation and the posterior pedicle screw trajectories.
Objective: Here we report two cases of PDF as revision surgery following ACF, utilizing a patient-specific screw guide templating system.
Methods: Case 1: A 75-year-old man with a history of thrice ACF surgeries presented with myelopathy. X-ray showed anterior fusion from C2 to C7, with anterior screws in C5 and C7 vertebrae. Case 2: A 69-year-old man, 20 years post-ACF, exhibited myelopathy 1 month ago. X-ray showed anterior fusion from C5 to C7 with an anterior cage inserted in C6 and anterior screws in C5 and C7 vertebrae.
Results: In both cases, MRI showed spinal cord compression at C7/T1 level due to hypertrophy of ligamentum flavum. We planned a PDF surgery for these patients from C6 to T2 using MySpine Cervical○R, a patient-specific screw guide templating system. While planning pedicle screw insertion on the workstation based on CT, we adjusted the trajectory of the C6 and C7 pedicle screws to avoid interference with the previously inserted anterior screws or cage. Using the patient-specific 3D guide based on the preoperative workstation, we inserted bilateral pedicle screws from C6 to T2 and completed a PDF surgery. No perioperative adverse events were observed. Postoperative CT showed all the pedicle screws were inserted adequately (Neo classification: within grade 1).
Conclusion: The use of a patient-specific screw guide templating system enabled the safe and accurate insertion of cervical pedicle screws even in vertebrae with prior anterior screws or cages by adjusting the trajectory of pedicle screws while planning on the workstation.

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Unexpected Deterioration of Myelopathy Following Occipitocervical Posterior Decompression and Fusion Surgery; A Case Report

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Background: Occipitocervical posterior decompression and fusion (O-C fusion) surgery is occasionally required for treating high cervical myelopathy due to atlantoaxial subluxation. The advance of the instrumentation systems has led to favorable clinical outcomes following O-C fusion surgery.
Objective: We encountered a rare case involving an unexpected deterioration of myelopathy following O-C fusion surgery.
Methods and Results (Case presentation): A 49-year-old male was transported to our hospital by ambulance with left-sided upper and lower limb paralysis. At the initial visit, a neurological examination revealed left upper limb weakness (MMT grade 2). X-ray and CT revealed severe atlantoaxial subluxation due to Os Odontoideum, while MRI revealed significant spinal cord compression at the C2 level. On the diagnosis of acute exacerbation of high cervical myelopathy, an O-C2 posterior decompression and fusion surgery including C1 laminectomy was performed. Postoperatively, the patient exhibited a deterioration in right-sided upper limb paralysis (MMT grade 2), despite proper implant placement confirmed by CT. During two weeks postoperatively, there was no improvement in the right-sided upper limb paralysis, and bilateral deep sensory impairment worsened. Follow-up X-rays revealed a progressive decrease in the O-C2 angle and dynamic X-ray imaging demonstrated a recurrence of instability at the O-C2 level. On the diagnosis of the instrumentation failure, a revision surgery was performed 3 weeks after the primary surgery. Intraoperative findings revealed instability at the C2 screw head and loosening of the set screw on the C2 screw head. To achieve a more secure fixation, we extended the fusion to C4 with a triple rod connection. Following the revision surgery, his myelopathy and paralysis gradually improved. At the final follow-up 6 months after surgery, X-rays showed that O-C2 was firmly stabilized.
Conclusion: In O-C fusion surgery, screw head fixation at the O-C rod bending site may result in unexpected implant failure.

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To fill or not to fill? Fusion Behavior of Cervical PEEK Cages implanted empty compared to Fillings with autologous Bone Graft – a prospective Study.

Objective: The implantation of a Polyether-Ether-Ether-Ketone (PEEK) cage is a common practice after anterior discectomy in cervical spine. The aim of the study was to evaluate whether filling with autologous bone graft can enhance the fusion rate of PEEK cages.
Methods: We evaluated prospectively 99 consecutive patients with single level cervical radiculopathy or mild myelopathy treated with anterior discectomy and fusion by a PEEK cage filled with autologous bone graft obtained locally. They were compared with the 100 patients treated earlier for the by the same type of PEEK Cage implanted empty. The study was completed by 89 patients and 97 in the comparison group.

Results: Six month after surgery 21 patients of the PEEK/Bone group (24%) compared to only one in the PEKK group were fused already ($p<0.001$). After one year the fusion rate was 66 (74%) compared to 56 (58%) still significantly better ($p<0.02$). At the final follow up after two years the fusion rate was equal with 77 cases fused in both groups (86% PEEK/Bone versus 80% plain PEEK, $p=0.2$).
Conclusions: Autologous bone filling of PEEK Cages can speed up fusion at the 6 month follow up, after one year the effect is minimal and after two year the fusion rate is equal. Filling of cervical cages seems not to have an effect in the long run and can be considered superfluous.

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Cage obliquity in OLIF – how common is it and what are the effects on fusion rates, subsidence and sagittal alignment? A CT based analysis.
Background: The OLIF procedure is an evolution of the lateral approach to circumvent complications associated with the transpsoas approach. However, the oblique trajectory has raised some questions with regards to its effects on cage placement, particularly its obliquity. There is paucity of literature regarding the OLIF Cage placement on subsidence, fusion rates and sagittal alignment.
Objective: To assess the effects of cage obliquity and position on fusion rates, subsidence and sagittal alignment in patients who underwent OLIF.
Materials and Methods: 55 patients (104 levels) underwent OLIF from L1 to S1 with a minimum of 12-months follow-up. Post operative radiological outcomes were measured using radiographs and computed tomography. We measured cage positioning and assessed its correlation with fusion, subsidence and sagittal alignment correction. We assessed fusion and subsidence using the Bridwell Criteria and Marchi Criteria respectively.
Results: The mean cage obliquity was 4.00° ± 4.33. 103 (99.0%) levels were considered to have achieved fusion with a Bridwell score of 1 or 2. 88 (84.6%), 14 (13.5%) and 2 (1.9%) levels had a Marchi score of 0, 1 and 2 respectively. We considered a Marchi grade of 1 and above to have significant subsidence (16 levels; 15.4%). There was good improvement in both the segmental lordosis angle (4.12° ± 5.96; $p<0.0001$) and disc height (4.57mm ± 3.76; $p<0.0001$). There was no statistical correlation between cage placement and post operative radiological outcomes.
Discussion and Conclusion: We demonstrated a small degree of cage obliquity of below 20°. Significant subsidence was seen in 15.4% of cases but majority resulted in fusion. OLIF remains a powerful tool for lumbar interbody fusion and the small degree of cage obliquity does not result in poorer radiological outcomes.

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Investigation of risk factors of C5 palsy after anterior cervical spine surgery
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Objectives: C5 palsy after cervical spine surgery is one of the most common complications. In this study, we analyzed cases of C5 palsy in anterior cervical spine surgery and investigated risk factors.
Methods: From 800 cervical spine surgeries performed at our hospital between April 2011 and March 2023, we included anterior decompression fusion surgeries for degenerative diseases, including C4/5 fusion. A total of 161 cases (mean age 61.9 years, 120 males and 41 females) were included in the study, excluding cases of surgery for deformity correction, scheduled two-stage surgery, and revision surgery. Patients were defined as having C5 palsy if their deltoid MMT decreased by at least one level compared to the preoperative MMT without lower limb dysfunction within 2 weeks after surgery. Patient background, including age and gender and so on, and C4/5 decompression procedure (C4/5 intervertebral decompression, C4 only corpectomy, C5 only corpectomy, C4,5 both corpectomy) were investigated and compared in the group with C5 palsy and the group without C5 palsy.
Results: C5 palsy occurred in 17 patients (10.6%). No significant differences were found in age, gender, preoperative deltoid muscle weakness, or JOA score between groups with and without C5 palsy. However, the proportion of OPLL was significantly higher in the group with C5 palsy. There were significantly more fixed vertebral in the group with C5 palsy. The incidence of C5 palsy was the highest in C4,5 both corpectomy, and was significantly higher than that in only C4/5 intervertebral decompression. Logistic regression analysis revealed the corpectomy for both C4 and C5 was independent risk factor, with an odds ratio of 4.64.
Conclusions: In anterior surgery for cervical degenerative disease, the risk factor of C5 palsy was the use of both C4,5 corpectomy for C4/5 decompression.

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Enhanced Surgical Precision in Craniocervical Fusion: A Retrospective Review of Advanced Navigation Technologies
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Background: The craniocervical junction is a complex anatomical region where precision in surgical intervention is critical due to the proximity of vital structures such as the vertebral artery, the upper cervical spinal cord, and the medulla oblongata. Variation in this area poses a challenge to the safety and efficacy of craniocervical fusion procedures.
Objective/Aim: This study aims to retrospectively analyze the efficacy and precision of the Stealth Midas navigation system (Medtronic, Inc.) in the placement of screws and fixation of occipital bone plates in craniocervical fusion surgeries.
Methods: We conducted a retrospective review of patients who underwent craniocervical fusion at Nagoya University Hospital and Sakura General Hospital from January 2018 to June 2022. The focus was on the accuracy of C1 and C2 screw placements and the fixation of occipital bone plates, considering a significant deviation as more than 2 mm from the planned trajectory along the cortical bone.
Results: The cohort consisted of 20 patients, receiving 25 C1 lateral mass screws, 30 C2 pedicle screws, and 8 C2 laminar screws. The average posterior arch width of C1 was 4.07 ± 0.86 mm. Notably, three screws impinged on the ponticulus posticus, and two approached a caudally ectopic vertebral artery, yet only one C1 screw exhibited a deviation surpassing the 2 mm criterion. Eight occipital bone plates were placed; notably, three cases presented with anatomical aberrations (two post-occipital craniotomies and one with fibrous dysplasia) were successfully navigated and placed with O-arm guidance.
Conclusion: The use of the Stealth Midas navigation system has demonstrated a high level of precision in screw placement and occipital plate fixation in craniocervical fusion surgeries. Advanced navigation technologies like the Stealth Midas system can be crucial in minimizing complications associated with surgical variability, thereby enhancing patient outcomes in complex spinal procedures.

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Carbon Fiber Scews in Oncological Spine Surgery, a case series.

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Introduction: The use of carbon fiber implants in orthopaedic oncology has been increasing in the recent years. Its radiolucency allows for better post-op visualisation for targeted radiotherapy and relatively artifact-free tumor surveillance while still promising structural support with its high strength-to-weight ratio, similar elastic modulus to bone and high biocompatibility.

Methods: A retrospective series of spinal tumor patients managed by two spine surgeons from 2021-2023 in a single institution. Patients who under went surgery for primary or metastatic spine tumors with isolated carbon fiber screws with carbon fiber or titanium rods were selected. Demographic data (age, sex, ethnicity), tumor histology, levels of surgery, type of implants, estimated blood loss (EBL), complications, length of follow up and patient survival data were collected. Intra-operative, immediate post-operative and latest follow up radiographs were reviewed to look for implants related complicates such as loosening, pull out or fractures.

Results: A total of 112 carbon screws (84 open pedicle, 28 MIS percutaneous pedicle) across 14 patients were selected across our study period. The average age of our patients were 58.9 +/- 12.8, consisting of 8 males, 5 females, with ethnicity of Chinese (7), Malay (4), Indian (2) and Indonesian (1). Tumor histology consisted of Breast (2), Hepatocellular (2), Melanoma (2), Thyroid (2), Schwannoma (2), Lung (1), Colon (1), Prostate (1) and gastric neuroendocrine (1). There were 3 thoracic, 6 thoracolumbar, 4 lumbar and 1 lumbo-iliac surgery. 11 patients decompression surgery with instrumented stabilization with no interbody fusion, 2 patients had instrumented stabilization alone and 1 patient had decompression surgery, instrumented stabilization with interbody fusion. 11 patients had open pedicle screws instrumentation while 3 patients had minimally invasive (MIS) percutaneous screw insertion. 8 patients had carbon fiber only construct while 6 patients had a hybrid construct with carbon fiber screws paired with titanium rods. The average blood loss was 389 +/- 210 mls, with no significant difference in blood loss between the open vs MIS screw insertion groups (391mls vs 383mls). 5 patients had pre-operative (<48hrs) angioembolization of tumor prior to spinal surgery and more intra-operative blood loss was noted with this group compared to patients who did not undergo pre-operative angioembolization but this was not statistically significant in our study (500mls vs 328ml, p= 0.13). There were no implant-related complications encountered. One patient developed post-operative epidural hematoma resulting in lower limb paralysis. The patient was offered but declined both open and computed tomography guided drainage of the hematoma. At latest follow up, 7 patients had demised and 7 patients were alive with a follow up spanning 2 – 26 months.

Conclusion: Carbon fiber screws are safe and viable in managing metastatic epidural spinal canal compression. In our series there were not patients with implants related complications requiring revision surgery across 112 carbon fiber screws. Multi-center studies are needed to evaluate the long term effective of these implants.

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Dynamic Cervical Spinal Canal Stenosis: Identifying Imaging Risk Factors in Extended Positions

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Keywords: MRI, canal stenosis, cervical, dynamic MRI

Background: Neck extension can significantly induce spinal cord compression in patients with cervical disorders, leading to neurological deficits. Diagnosing such dynamic factors is vital for effective decompression. Still, it is often limited by static, neutral-position MRI scans, which may not reveal the full scope of cervical stenosis.

Objective: To identify imaging-based risk factors for cervical stenosis that are undetectable in neutral MRI scans but become apparent in extended neck positions, thereby refining surgical intervention strategies.

Methods: The study retrospectively analyzed 143 patients who underwent cervical decompression surgery over a three-year period. Eligible participants had symptomatic cervical spine disorders with MRI evidence of spinal compression and no prior cervical surgery. Data containing demographics, disease characteristics, and outcomes were gathered. Radiological evaluations by surgeons included assessments of stenosis at multiple spinal levels in neutral and extended positions, measuring adjacent disc levels, dural tube and spinal cord diameters, and the space available for the spinal cord (SAC). Cervical alignment and motion range were also quantified using various radiographic measurements.

Results: Extension-position imaging revealed new stenosis sites predominantly below pre-existing neutral-position stenosis, with the most frequently affected C5/C6 and C6/C7 levels. A reduced SAC significantly predisposed patients to new stenosis at the upper and lower adjacent disc levels. SAC cutoff values were established, with 1.0mm being a practical threshold for new stenosis development in both upper and lower adjacent intervertebral disc levels.

Conclusion: The study underscores the clinical significance of dynamic imaging, demonstrating that a decreased SAC, with a clinically relevant cutoff value of 1 mm, is a significant risk factor for developing new cervical stenosis in extension.

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Three Different Etiologies of Sudden Respiratory Arrest due to Upper Cervical Lesion of Rheumatoid Arthritis

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Background: Upper-cervical lesions in rheumatoid arthritis acknowledged for their potential to induce sudden death, yet the understanding of progressive pathways to fatality is limited. We present three cases of rheumatoid cervical myelopathy whose lives were swiftly endangered by respiratory failure resulting from their upper-cervical lesions.

Case presentations: Case 1: An 81-year-old male presented severe flaccid quadriplegia due to destructive atlantoaxial subluxation. Odontoid fragments induced significant medullary compression, resulting in sudden respiratory arrest. A diagnosis of central nervous system respiratory failure prompted endotracheal intubation and

mechanical ventilation. Subsequent occipitocervical fusion alleviated medullary compression, restoring spontaneous respiration, enhancing limb strength, and facilitating wheelchair transfer with assistance.

Case 2: A 78-year-old female with Ranawat class IIIB quadriplegia was hospitalized with respiratory distress resulted from diaphragmatic paralysis due to spinal cord compression at C1. CO2 narcosis induced altered consciousness, leading to mechanical ventilation initiation. Occipitospinal fusion ensued, yielding diaphragmatic function recovery, successful mechanical ventilation weaning with auxiliary respiratory support, and eventual discharge with assisted living.

Case 3: An 80-year-old female, hesitated surgery for rheumatoid cervical myelopathy, experienced a fall due to difficulty standing resulting in ankle fracture, followed by surgery of the ankle. During rehabilitation, she suddenly developed bradycardia, loss of consciousness and respiratory arrest, and was diagnosed with rapid onset ball palsy syndrome due to medullary impairment. Emergency pacemaker implantation stabilized cardiac function. Despite stable heart function, progressive limb paralysis, urinary dysfunction, and recurrent infections ensued, leading to her demise 4.5 months after pacemaker placement.

Conclusion: These cases highlight the urgency of timely intervention in rheumatoid upper-cervical lesions. Patients opting for cervical spine surgery demonstrated prolonged survival compared to those refraining from it. Given the potential for sudden respiratory failure to lead to fatal outcomes in these cases, surgical intervention stands out as the primary and foremost therapeutic approach in managing this condition.

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An evaluation of prognostic scoring systems for survival in a surgically treated cohort of 245 patients

Introduction: Survival prognostication is crucial in the decision-making process for management of patients with spinal metastases. Traditional scoring systems including modified Tokuhashi and Tomita scoring systems were previously used extensively but their accuracy has recently been disputed. This has led to the development of machine learning algorithms to predict survival. In this study we aim to compare the accuracy of prognostic scoring systems in a surgically treated cohort of patients.

Materials and Methods: This is a retrospective review of 245 surgically treated spinal metastases patients between 2009 to 2021. The outcome measured was survival from time of diagnosis. Predicted survival at 3, 6 and 12 months derived from the prognostic scoring systems was compared to actual survival, then plotted against area under receiver operating characteristic curves (AUROC). The following scoring systems were compared: Modified Tokuhashi (MT), Tomita (T), Modified Bauer (MB), Van Den Linden (VDL), Oswestry Spinal Index (O), New England Spinal Metastases score (NESMS), GSTSG and SORG scoring systems.

Results: For predicting 3 months survival, GSTSG 0.980(0.949-1.0) and NESM 0.980(0.949-1.0) had outstanding predictive value, while SORG 0.837(0.751-0.923) and O 0.837 (0.775-0.900) had excellent predictive value. For 6 months survival, only O 0.819(0.758-0.880) had excellent predictive value and GSTSG 0.719(0.725-0.880) had acceptable predictive value. For 1 year survival, NESM 0.871(0.822-0.919) had excellent predictive value and O 0.722(0.657-0.786) had acceptable predictive value. The MT, T and MB had an AUC of <0.5 at all timepoints

Discussion: Traditional scoring systems such as MT, T and MB have become less predictive. Although newer scoring systems such as the GSTSG, NESM and SORG have outstanding to excellent predictive value, there is no single scoring system that can accurately prognosticate survival at all 3 time points. A multidisciplinary, personalised approach to survival prognostication is needed.

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Anatomical Study of Transverse Foramen and Vertebral Artery in Subaxial Cervical Spine for Safe Pedicle Screw Insertion

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Background: Cervical pedicle screw (CPS) is technically-demanding procedure, it should pass cervical pedicle, between spinal canal (SC) and transverse foramen (TF). During surgery with lateral X-ray, probe tip passes lateral to SC first, then medial to TF. TF usually exists anterior to the posterior wall of vertebral body (PW). So, the knowledge, how deep TF exists from PW, is important. This study clarifies the distance from PW to TF and vertebral artery(VA) for safe insertion of CPS.

Methods: Consecutive 96 cases' cervical CT angiograms (CTA) were evaluated retrospectively. The age was 72.6±6.2(range 61-85) yrs, and they were 85 male and 11 females. The distance from PW to posterior margin of TF (PW-TF), to posterior margin of contrast medium, equivalent to VA lumen, (PW-VA) were measured with axial section of CTA. The heights for evaluation were subaxial spine, from C3 to C6.

Results: PW-TF was 2.7±1.2mm at C3, 3.3±1.3mm at C4, 3.2±1.3mm at C5 and 2.8±1.4 mm at C6. The PW-TF of C4 and C5 were higher than of C3 and C6 with significance. PW-VA were 3.6±1.2mm at C3, 4.2±1.3mm at C4, 4.5±1.6mm at C5, 4.2±1.3mm at C6. From C3 to C5, that increased with significance.

Conclusions: The distance from PW to TF was 3mm and to VA lumen was 4mm, approximately. When screw proceeds over the distance, there is risk of VA injury. It is necessary to confirm that there is no perforation before proceeding more. If not certain, stopping at posterior wall is safe. It is enough strong if the screw bites the cortex of spinal canal. There are individual differences, so preoperative evaluation is mandatory.

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Clinical Features and Outcomes of Basilar Invagination

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Background: Currently, there is inadequate reporting the symptomatology and progression of basilar invagination. Objective: This study endeavors to investigate the symptom progression and prognosis in two types of basilar invagination.

Methods: A retrospective analysis was conducted on 141 patients diagnosed with basilar invagination who underwent surgical treatment at Xuanwu Hospital from January 2016 to December 2020. The patient's neurological function was assessed by the JOA scale and SF-12. Logistic analyses were performed to predict prognostic risk factors.

Results: The average age of the 141 cases with basilar invagination was 45.4±13.1 years. Type A (21/101, 20.8%) had a higher likelihood of experiencing dizziness compared to type B (2/40, 5%) (P=0.022). Preoperative JOA and SF-12 PCS scores indicated a more severe neurological impairment in type A as compared to type B (JOA, 13.0 vs 13.9, P=0.042; SF-12 PCS, 37.48 vs 38.42, P=0.034). The ventral cervical triangle area was larger in type A than in type B (P=0.001). Type B (22/40, 55%)

had a higher likelihood of associated ataxia than type A (35/101, 34.7%) (P=0.026). Patients with type B demonstrated a significantly higher improvement rate in SF-12 PCS than type A (P=0.018). Further logistic regression revealed that onset age ≥ 45 years (OR 4.654, 95% CI 1.645-13.165; p=0.004) and basal angle ≥ 125° (OR 28.139, 95% CI 1.090-726.239; p=0.044) were independent risk factors for type A and type B, respectively. Additionally, a preoperative atlantodental interval ≥ 6 mm (OR 5.358, 95% CI 1.146-20.278; p=0.013) was an independent risk factor for type A.

Conclusion: Patients with basilar invagination type A present more severe ventral compression, resulting in specific dizziness, who need early treatments. On the other hand, type B patients with more cases of ataxia, who can achieve better long-term prognosis following clinical intervention based on the degree of actual symptoms and radiological characteristics.

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The Impact of Nucleus Pulposus Cell Exosomes under Cyclic Mechanical Tension on Nucleus Pulposus Cells

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Background: Nucleus pulposus cells (NPCs) are regulated by various factors in the complex microenvironment of the cervical intervertebral disc, and the impact of abnormal cervical stress on NPCs needs further exploration. Objective: To observe the secretion of extracellular vesicles (NPCs-exo) from NPCs under cyclic mechanical tension (CMT) conditions, and to investigate the effects and mechanisms of the interaction between NPCs-exo and NPCs.

Methods: Rabbit nucleus pulposus cells were isolated and cultured. The FX-5000T system from the Flexcell brand was used to apply CMT to NPCs. NPCs-exo were extracted from NPCs under CMT and non-loaded conditions. Characterization of NPCs-exo was performed using electron microscopy, NTA, and Western-blot techniques. NPCs-exo were labeled with PKH67 fluorescent dye, co-cultured with NPCs, and the uptake of NPCs-exo by NPCs, as well as the apoptosis and activity of NPCs, were observed. MiRNA sequencing was performed on NPCs-exo, followed by bioinformatics analysis. Differential expression miRNAs were validated in ex vivo-loaded rabbit cervical disc specimens, and PCR validation was performed on extracted exosomes. Validation of miR-8485 and the Wnt/β-catenin pathway mechanism was also conducted.

Results: ① CMT promoted the secretion of NPCs-exo; ② NPCs-exo were taken up by recipient NPCs; ③ The activity of CMT-NPCs was lower than the control group ($P < 0.05$), and the apoptosis rate was higher than the control group ($P < 0.05$); ④ MiRNA sequencing and PCR validation confirmed significant differential expression of miR-8485; ⑤ Experimental results demonstrated that miR-8485 can regulate NPCs through GSK-3β to modulate the Wnt/β-catenin pathway.

Conclusion: NPCs-exo can increase secretion under CTM conditions and enter NPCs to regulate the degeneration of NPCs, thereby participating in the regulation of intervertebral disc degeneration

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Deep learning model for automated detection and classification of degenerative cord signal abnormality, spinal canal and neural foraminal stenosis on cervical spine MRI

Background: Deep learning (DL) model for degenerative cervical spondylosis on MRI could make reporting more consistent and efficient.

Objective/Aim: Create a DL model to detect and classify cervical cord signal abnormalities, spinal canal and neural foraminal stenosis.

Materials and Methods: In this retrospective study, cervical spine MRI performed from January 2013 to July 2021 were included. Studies with instrumentation, suboptimal image quality, post-contrast studies and scoliosis were excluded. Axial T2-weighted gradient echo and sagittal T2-weighted images were utilized. The internal training/test set split was 90%/10%, respectively. Training data were labelled by a musculoskeletal radiologist(12-years-of-experience) using pre-defined gradings. A transformer-based deep learning model was developed for automated detection and classification of the regions on interest on axial and sagittal images. An internal test set was labelled by the musculoskeletal radiologist (reference standard), two subspecialist radiologists (Rad1/Rad2), and two in-training radiologists (Res1/Res2). DL model performance on an external test set was evaluated. Detection recall(%), inter-rater agreement(Gwet's kappa) and sensitivity/specificity were calculated.

Results: Overall, 504 MRI cervical spines were analyzed(504 patients, mean age=58 years±13.7[SD]; 202 women) with 454 for training(90%) and 50(10%) for internal testing. On internal testing, the DL model showed high agreement(κ=0.95,$p<0.001$) for binary spinal canal classification (normal/mild versus moderate/severe), which was superior to all readers(κ range=0.85-0.91,$p<0.001$). For binary neural foraminal stenosis the DL model agreement(κ=0.91, $p<0.001$) was also superior to all readers(κ range=0.78-0.83, $p<0.001$). DL model recall of 84.8% for altered cord signal was higher compared to all readers(range 51.5-69.7%)($p<0.001$). External testing of the model demonstrated high agreement for binary grading of the spinal canal(κ=0.92, $p<0.001$) and neural foramina(κ=0.82, $p<0.001$), with high recall for altered cord signal(80.1%).

Conclusion: A DL model for degenerative cervical spondylosis on MRI showed superior agreement to specialist and in-training radiologists for detection and classification of spinal canal and neural foraminal stenosis, and cord signal abnormality.

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Carbon fibre rods in the treatment of cervical spine tumours: A case series and description of a novel surgical technique.

Introduction: Carbon fibre rods are not used in cervical spinal tumour surgery due to the absence of suitable rod calibers for cervical instrumentation. We propose a technique that allows the use of carbon fibre rods in cervical spinal tumour surgery.

Material and Methods: This is a retrospective case series of patients who underwent cervical spinal tumour surgery between November 2020 to September 2022. A customized titanium connector was used to allow connection of a carbon rod to the cervical/occipital instrumentation. Clinical, perioperative, postoperative and radiological data was collected.

Results: There were 11 patients, 8 males and 3 female, with a mean age of 59.4 (range 21-80) years. 5 patients had primary spinal tumours and 6 spinal metastases. In 2/11 cases en-bloc resection was performed, in 4/11 cases intralesional debulking, and in 5/11 cases separation surgery. Mean length of construct was 9 (range 7-13) levels and mean number of un-instrumented levels was 4 (range 2-6) levels. 9/11 patients did not require anterior reconstruction. 3 patients underwent postoperative

radiotherapy alone, 1 preoperative radiotherapy, 1 pre and postoperative radiotherapy and 1 patient underwent postoperative hadron therapy. At 1 year follow up there was no evidence of loss of spinal alignment, implant pullout or breakage for all patients.
Conclusion: In view of the decreased need for anterior reconstruction secondary to improved mechanical stability and ease of radiological surveillance and radiotherapy, we believe that our technique is a valid method to utilise the biomechanical advantages of carbon rods. Further prospective studies are needed.

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Can a deep learning artificial intelligence model lead to earlier diagnosis of high grade metastatic epidural spinal cord compression and reduction in treatment delay?

Background: Delay in diagnosis and treatment is associated with poorer outcomes in patients with symptomatic metastatic epidural spinal cord compression (MESCC). Staging CT scans are performed routinely but high grade MESCC is often underdiagnosed. We had previously developed and validated a deep learning model (DLM) to automate the detection of high grade (Bilsky 2/Bilsky 3) MESCC.
Objective/Aim: We aim to assess the utility of a DLM in detecting high grade MESCC and potential reduction in diagnostic delays.
Materials and Methods: This is a retrospective review of 140 patients with high grade MESCC between C7 to L2 who underwent surgical decompression and stabilization for MESCC between Jan 2015 to Jan 2022. Prior staging CT up to 4 months before diagnostic MRI was reviewed by a consultant musculoskeletal radiologist (JH) and consultant spinal surgeon (JT) and classified based on grade of MESCC. The deep learning model (DLM)was then used to classify these scans. The above findings were compared to original radiologist (OR) reports. Potential decrease in diagnostic delay was calculated in days from screening CT to MRI scan diagnosing high grade MESCC.
Results: 95/140 (67.8%) of patients had available pre-operative CT scans. High grade MESCC was identified in 84/95 (88.4%) of the pre-operative CT scans by both JH and JT. High grade MESCC was reported in only 32/95 (33.7%) of pre-operative scans by the OR. There was almost perfect agreement between JH vs JT kappa=0.947 (CI 0.893-1.000)($p<0.001$) , JH vs DLM kappa=0.891 (0.816-0.967)($p<0.001$) and JT vs DLM kappa = 0.891(0.816-0.067) ($p<0.001$). There was poor interobserver agreement between the OR and all other readers . There was a mean potential reduction in diagnostic delay of 19 days.
Conclusion: The DLM had an almost perfect interobserver agreement with both reviewers. This is the first clinical study to demonstrate its potential for reducing diagnostic delays.

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Good safety and early efficacy of day anterior cervical discectomy and fusion to treat cervical degenerative diseases

Background: Neck and shoulder pain is a common clinical symptom, mostly caused by cervical degenerative diseases (CDD). The main symptoms are radicular pain in the neck, shoulders and arms. In severe cases, it may even be accompanied by limb weakness and unsteady walking, and other spinal cord dysfunction. Anterior cervical discectomy and interbody fusion (ACDF) has been regarded as a classic surgical procedure for the treatment of CDD. Conventional ACDF surgery generally requires 3-7 days of hospitalization. However, some developed countries or regions in Europe and the United States have incorporated ACDF into daytime surgery (DS) mode, and even into outpatient surgery management, allowing patients to save medical expenses and return home quickly. In China, there are few literature reports on daytime ACDF or outpatient surgery.
Objective: Our research team has incorporated ACDF in the treatment of CDD into the daytime management to explore its safety and early efficacy.
Methods: A retrospective analysis was performed on 12 patients with CDD who underwent the day ACDF from September 2022 to March 2023. Among them, 10 were females, 2 were males, the age range is from 36 to 67 years, 8 underwent single-segment surgery, and 4 underwent double-segment surgery. Visual analogue scale (VAS), cervical disability index (Neck disability index, NDI), Japanese orthopedic association (JOA) score, JOA recovery rate (RR), incidence rate of dysphagia-related symptoms, 30-day readmission rate, patient satisfaction with medical care, and complication rate were used to assess surgical safety and early clinical outcomes. Cervical X-rays, CT, and MRI were taken to assess the location of implant, nerve decompression, and cervical curvature.
Results: All 12 patients were successfully operated, and the follow-up time was 1-6 months. The postoperative pain symptoms and nerve function were significantly improved. The operation time was (71.3±20.5) min, the intraoperative blood loss was (14.6±8.4) ml, and the postoperative drainage volume was (8.8±7.3) ml. Postoperative VAS(2.1±0.9), NDI(22.4±3.5), and JOA(14.3±1.1) scores were significantly improved compared with those before operation[VAS(6.6±1.7), NDI(66.3±4.7), and JOA(8.3±1.3)] ($P<0.05$), and the RR is 100%. One patient had mild dysphagia after operation (8.3%), however, the symptom disappeared without special treatment. During the follow-up period, there was no case of re-admission within 30 days after discharge, but 1 patient developed incision hematoma on the 6th day after discharge, fortunately, with no difficulty in breathing or swallowing. After specialist examination and evaluation, pressure bandaging was performed, and healed up 4 days later. Postoperative imaging examination showed that the position of the implant was ideal, the nerve decompression was sufficient, and the physiological curvature of the cervical spine was good. All patients were satisfied with the daytime surgery mode of ACDF.
Conclusion: The safety and early efficacy of daytime ACDF are relatively satisfied, which can provide a new surgical mode option for suitable patients with CDD.

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The Relationship Between Increased Intervertebral Disc Height (IDH) and Development of Postoperative Dysphagia After Single-level Anterior Cervical Discectomy and Fusion (ACDF) — A retrospective Study of 217 Cases.

Background: One goal of the ACDF is to restore the loss of intervertebral disc height (IDH) results from the degenerative process. However, the effect of IDH on postoperative dysphagia after ACDF remain unclear.
Methods: 217 consecutive patients after single-level ACDF were enrolled. Based on the results of a one-year telephone follow-up, the patients were divided into dysphagia group and non-dysphagia group. Radiologically, IDH, spinous process distance (SP) of the operated segment and C2-7 angle (C2-7A) were measured preoperatively and postoperatively. The relationship between changes of above radiological parameters and the development of dysphagia was analyzed.
Results: 63 cases exhibited postoperative dysphagia. The mean changes in IDH, SP and C2-7A were 2.84 mm, -1.54 mm, and 4.82 degrees, respectively. Change of IDH ($P=0.001$) and change of C2-7A ($P=0.000$) showed significant differences between dysphagia and non-dysphagia patients. Increased IDH and increased C2-7A ($P=0.037$ and 0.003, respectively) significantly and independently influenced the incidence of postoperative dysphagia. When change of IDH ≥ 3 mm, the chance of

developing postoperative dysphagia of this patient is significantly greater. No significant relationship was observed between change of spinous process distance (SP) and the incidence of dysphagia.
Conclusion: The change of IDH could be regarded as a predictive factor for postoperative dysphagia after single-level ACDF.
Keywords: dysphagia, ACDF, intervertebral disc height, C2-7 angle, spinous process distance

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Comparative Analysis of Anterior Cervical Discectomy and Fusion with Cage-Only Fixation versus Cage and Plate Fixation in Relation to Clinical Outcomes.
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Introduction: Anterior cervical discectomy and fusion (ACDF) is one of the most common surgical procedures used to treat degenerative cervical spine diseases. In recent years, several variations of the ACDF procedure have been proposed to improve clinical outcomes. One such variation is the use of a plate in addition to the cage for additional intervertebral segment fixation. This study aims to conduct a detailed comparative analysis of ACDF with cage-only fixation and ACDF with cage and plate fixation in terms of clinical outcomes.
Objective: To prospectively analyze the effect of single-level or two-level anterior cervical discectomy and fusion (ACDF) and compare the clinical outcomes between ACDF with cage-only fixation and ACDF with cage and plate fixation.
Methods: The study included 102 patients, of which 31 patients underwent ACDF with cage-only fixation and 71 patients underwent ACDF with cage and plate fixation. Among them, 59 patients underwent single-level ACDF, 40 patients underwent two-level ACDF, and 3 patients underwent three-level ACDF. The patients were divided into two main groups: Group A - ACDF with cage-only fixation (ACDF-Cage only) and Group B - ACDF with cage and plate fixation (ACDF-Cage with plate). Clinical outcomes were evaluated using the Neck Disability Index (NDI) and visual analog scale (VAS) scores for arm pain.
Results: When comparing the single-level groups with ACDF using only the cage and the ACDF-Cage with plate group, the NDI score was better in the group receiving cage and plate fixation at 1.6 months of follow-up, but no significant difference in clinical outcomes was observed at 12 months. Similarly, when comparing the two-level groups with ACDF using only the cage and the ACDF-Cage with plate group, the NDI score was better in the group receiving cage and plate fixation at 1.6 months of follow-up, but no significant difference in clinical outcomes was observed at 12 months.
Conclusion: Our clinical results demonstrated that in terms of clinical outcomes, both single-level and two-level cage and plate fixation did not provide additional advantages compared to cage-only fixation.

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'Radiographic Characteristics of Caudal Segment in Multi-level Anterior Cervical Discectomy and Fusion: 'The Bony Buttress Formation'
Background: Anterior cervical discectomy and fusion (ACDF) with anterior plating is a widely utilized procedure for cervical disc diseases. Despite generally positive outcomes in multilevel ACDF cases, the challenge of symptomatic pseudarthrosis persists, particularly in the caudal segments, often necessitating revision surgeries.
Objective: This study aims to underscore the significance of managing the caudal construct in multilevel ACDFs by assessing radiographic characteristics influenced by intraoperative techniques.
Methods: A retrospective cohort study included patients undergoing three or four-level ACDF with anterior plating between June 2010 and August 2022. Patients underwent regular follow-ups at 4 months, 12 months, and subsequently annually post-operation. Fusion rates were examined, and the grading of bony spurs beneath the anterior plate, termed bony buttress, was performed. Pseudarthrosis cases were categorized based on bony buttress grades at the 4-month follow-up to assess delayed fusion outcomes.
Results: Of the 163 patients studied, overall fusion rates were 31.29% at 4 months (37.29% for 3 levels, 15.56% for 4 levels), 64.62% at 1 year (69.70% for 3 levels, 48.39% for 4 levels), and 83.48% at the final follow-up (83.70% for 3 levels, 82.61% for 4 levels). Pseudarthrosis exclusively occurred in the caudal-most segments. Pseudarthrosis cases lacking bony buttress at the 4-month follow-up exhibited a higher likelihood of remaining unfused, while those with higher bony buttress grades demonstrated a significantly elevated delayed fusion rate.
Conclusions: Pseudarthrosis predominantly manifests in the caudal-most segment, emphasizing the critical role of caudal construct management. Cases with inadequate engagement of the anterior plate in the caudal segment and milder bony buttress formation at the 4-month postoperative follow-up are more prone to persist as pseudarthrosis in later phases. Ensuring a tight engagement of the anterior plate and addressing osteophytes during intraoperative procedures may contribute to enhanced fusion rates.

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Association of Infliximab use with cervical spine deformity in patients with Rheumatoid Arthritis
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Objective: To study the correlation between infliximab use in patients with early onset RA and the prevalence of cervical spine deformity after 10 years of FU.
Methods: This is a sub-analysis of the BeSt Study, where patients were treated to target Disease Activity Score (DAS44) below 2.4. Infliximab was administered as starting therapy in one of four randomized treatment strategies and could be administered in the other regimens upon failure to decrease DAS.
Results: Of the 272 patients, 144 patients (53%) used infliximab at least once during the 10 years FU. At the end of follow up, 108 of 272 patients had mild deformity: atlantoaxial subluxation (AAS) > 2 mm and/or subaxial subluxation (SAS) > 2mm in neutral position; 41 of 123 patients had AAS ≥ 3 mm in flexion and/or neutral position (moderate); 8 of 107 patients had AAS ≥ 5 mm in flexion and/or neutral position (severe). Binomial logistic regression showed an OR for mild cervical spine deformity of

0.89 (95% CI: 0.81-0.98; p=0.02) for an increase in duration of infliximab use of one year. (corrected for age at baseline, sex, anti-CCP positivity and Rheumatoid Factor positivity). For patients with moderate cervical spine deformity OR was 0.97 (95% CI: 0.84-1.11; p=0.63) and for patients with severe cervical spine deformity OR was 0.91 (95% CI: 0.66-1.25; p=0.56).

Conclusions: In conclusion, longer duration of use of infliximab is associated with a lower OR for cervical deformity after 10 years. It is important to balance the positive effects of infliximab use for the joints and cervical spine with the possible side effects of this medication in the long term.

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Correlation between Longer duration of glucocorticoid use and cervical spine deformity in patients with Rheumatoid Arthritis

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Objective: To evaluate the influence of corticosteroid use on the prevalence of cervical spine deformity in patients with Rheumatoid Arthritis (RA).

Background: Patients with RA are often prescribed glucocorticoids although it is known that long-term use of glucocorticoids increases the risk of osteoporosis and fractures. The influence of corticosteroid use on the prevalence of cervical spine deformity is yet to be determined.

Methods: Duration and dose of corticosteroid use during 10 years was evaluated for patients with new onset RA (BeSt Trial). Missing values were imputed using last observation carried forward. Lateral X-rays at 5 and 10 years FU were assessed for Atlantoaxial Subluxation (AAS) and Subaxial Subluxation (SAS). Odds Ratios (OR) were corrected for age at baseline, gender, ACPA-positivity and RF-positivity.

Results: 272 patients were included and mild cervical deformity (AAS and/or SAS >2 mm) was observed in 108 patients (40%). 147 patients (54%) used glucocorticoids during 10 years FU, with a median duration of 15 months (IQR 3-11 months). For a one year increase in total duration of prednisone-use, the corrected OR for cervical spine deformity was 1.20 (95% CI: 1.03-1.38; p=0.02), and for an increase in total cumulative dose of 1 gram of prednisone, OR was 1.063 (95% CI: 1.011-1.118; p=0.018).

Conclusions: The use of glucocorticoids in RA patients leads to an increased odds of cervical spine deformity after 10 years. So, while glucocorticoids are known to have a beneficial effect on overall disease activity, caution should be used in prescribing glucocorticoids for long time periods.

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Experience in reconstructive surgery of the cranivertebral and subaxial spine

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Introduction: Reconstructive surgery of the cervical spine in relation to the lumbar and thoracic spine has its own characteristics and difficulties, since the biomechanics and anatomy of the cervical spine requires a more subtle and thorough approach due to the increased risk of intraoperative and postoperative complications that impair the quality of life of patients as a result of an increase in neurological deficit . To date, the concept of "instability" in relation to the craniovertebral junction and subaxial spine has a large coverage of the disease. With the improvement of instrumental methods of fixation of the spine, today the fixation of the cervical spine has become a more accessible method for solving the problem of the cervical spine associated with instability. Our team performs surgical treatment of patients with unstable injuries, congenital and acquired deformities, as well as oncological lesions of the cervical spine in our clinic. We practice the most commonmethods of screw fixation of the cervical spine - the insertion of screws into the interfacial part of the vertebral arches (lateral mass screws) and the transpedicular insertion of screws (pedicle screws), (pars screw), translaminar methods of fixation of the cervical spine.

Objective: Analysis of the results of surgical treatment of patients with unstable injuries, congenital and acquired deformities, as well as with oncological lesions of the cervical spine using all available methods of fixation of the cervical spine and cranio-vertebral junction.

Material and methods. 40 patients with diseases of the cervical spine leading to instability in the segments of the cervical spine were examined. In the majority of patients, the studies included in the study group assessed the stability and reliability of the fixation system in the long-term period, analyzed the errors and complications that arose during treatment.

Results: Positive results were obtained in 85% of cases, signs of fixation instability were absent in all patients. In 10% of patients, revision surgeries were performed to strengthen and lengthen the fixation system. A low number of complications was noted, including no damage to the vertebral artery. Pain syndrome in patients decreased.

Conclusion: The results obtained during the study showed high efficiency and reliability of reconstructive surgery of the cervical spine in pathologies associated with instability. This requires careful preoperative preparation and examination of patients, thorough knowledge of the surgical anatomy of the operated area, experience and qualifications of the surgeon.

Key Words: reconstructive surgery, transpedicular fixation, interfacet (inter-ancillary) fixation, translaminar fixation, cervical spine, spinal instability.

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Intraoperative Positioning Technique for Cervical Posterior Approaches Independent of Patient Body Type: Consideration of Camera Placement Using Navigation

Background: Surgeons often face challenges in performing posterior cervical spine surgeries due to variations in patient body types, and impacting the depth of the surgical field. When the head or trunk is posterior to the surgical field, it not only complicates the surgery but may also hinder the navigation camera.

Purpose: This study aimed to evaluate the efficacy of our intraoperative positioning during posterior cervical spine surgeries, ensuring independence from variations in patient body types.

Subjects: We analyzed 218 cases of cervical posterior surgeries performed under general anesthesia for conditions such as CSM and OPLL. The average age was 69 years, with 133 male and 85 female patients. Positioning and Deployment Technique:
1. Secure the cranial fixation device (GSS head grip arc system) and position the cervical spine in military tuck.
2. Deploy the mid-lower cervical spine posteriorly from C3 to C7 in the midline.
3. When approaching the cranio-cervical transition, deploy C2 and the occiput, followed by expanding C1 posterior arch beneath the periosteum to avoid damage to the vertebral artery (VA) and the epidural venous plexus.
Methods: Patients were divided into two groups based on BMI (Body Mass Index) ≥25 and BMI <25. Various parameters, including (A) surgical duration, (B) blood loss, (C) GSS angle adjustment scale, and (D) decompression force, were measured.
Results: For groups with BMI ≥25 and BMI <25, there were no significant differences in (A), (B), (C), and (D). The ability to perform surgery was generally similar across both BMI groups.
Discussion and Conclusion: Factors such as posterior shift of the cranial bone, significant thoracic kyphosis, and narrow interlaminar spaces make posterior approaches challenging, especially when using navigation. Adjustments during device placement, surgical table inclination, and adopting the military tuck position quantitatively addressed these challenges, making posterior cervical spine surgery feasible irrespective of patient body type.

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Factors associated with non-contiguous spine fracture in patients with traumatic cervical spine fracture: a 10-year retrospective study

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Background: Multilevel non-contiguous spine fractures are defined as a lesion separated by at least one normal vertebra. Multilevel non-contiguous spinal fractures in traumatic cervical fracture patients often miss diagnosis of secondary injuries due to neurological symptoms and extraspinal injuries. Missed secondary injuries with unstable type as 21% of non-contiguous cervical spine injuries.
Objective: To identify factors associated with non-contiguous spine fracture in patients with traumatic cervical spine fractures.
Methods: The 12-year retrospective observational study included 588 patients with traumatic cervical spine fractures who be admitted at Maharaj Nakorn Chiang Mai Hospital between January 2011 to December 2022. Patients were categorized into two groups: those with non-contiguous spine fractures and those without non-contiguous spine fractures. Outcomes were analyzed using multivariable logistic regression. Results are presented as odd ratio (OR) and 95% confidence interval (95% CI).
Results: Among 588 patients, the incidence of non-contiguous spine fractures was 17.01% (100 of 588 patients). Independent factors associated with non-contiguous spine fracture were motor weakness (OR 1.89, 95% CI (1.19-3.01), p=0.007), intracranial injuries (OR 2.61, 95% CI (1.61-4.23), p=0.000), intrathoracic injuries diagnosed by E-FAST and chest radiograph (OR 2.88, 95% CI (1.77-4.69), p=0.040), and intraabdominal injuries diagnosed by FAST (OR 1.91, 95% CI (1.03-3.55), p=0.000)
Conclusion: The risk of non-contiguous spine fracture in patients with a traumatic cervical spine fracture will increase if patients have motor weakness, intracranial injuries, intrathoracic injuries, intraabdominal injuries. Whole spine CT or MRI imaging is beneficial in these patients to avoid missing the remote spinal injury.

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Novel technique of anterior decompression based on Augmented Reality with computed tomography navigation system

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Background and objective: Augmented reality (AR) technology has been introduced clinically for the accurate placement of instruments in the spine. More recently, microscopic AR has been used for minimally invasive and sufficient decompression. We have applied this novel technique to decompress the compressive lesion and/or find out appropriate anatomical structure in cervical anterior surgeries. Thus, we would demonstrate several cases treated with anterior cervical operation based on the novel AR technique.
Methods: Ten consecutive cases who underwent anterior cervical surgery for the treatment of ossification of posterior longitudinal ligament, cervical spondylosis, or cervical metastatic tumor. During each operation, an O-arm mobile intraoperative imaging system was used to create an augmented image model in the navigation system. Three-dimensional objects representing the surgical target were generated by applying anatomical mapping software (Stealth 3D Cranial SoftwareTM, Medtronic Navigation Inc. (Figure 3A) and were reconstructed on the 3D image. Regions of interest were transferred to the Zeiss OPMI Pentero microscope and were visualized on demand in the AR microscope view immediately before decompression. Perioperative safety and appropriate decompression were evaluated.
Results: We applied the AR technique to 5 OPLL cases, 3 spondylotic patients, and 2 metastasis cases, respectively. Sufficient decompression of ossification, appropriate foraminal decompression, expected marginal resection of metastatic lesion were fully performed. Adverse events, including violation of the vertebral artery, dural tear, or iatrogenic nerve injury, were not observed in all cases.
Discussion: AR technology can help with both accurate positioning and spatial recognition. Because cervical lesion often shows severe anatomical change in patients with spondylosis or metastasis, it is difficult to determine how much decompression is needed. We therefore applied microscopic AR to visualize such abnormal structure. AR technology is a promising means to provide intraoperative accuracy,
safety, and education in the field of spine surgery.

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The predictive value of spinal cord line on the decompression effect after cervical laminoplasty

Background: How to accurately predict the degree of spinal cord decompression after cervical laminoplasty before surgery remains a challenge.

Objective: This study aims to introduce the definition of the spinal cord line (SC line), its clinical classification, and its application strategies in cervical spine surgery for spinal cord decompression. Additionally, it examines the credibility and repeatability of this classification.
Methods: A total of 42 patients who underwent spinal cord decompression with cervical laminoplasty from January 2018 to December 2020 were included in the retrospective analysis, comprising 24 males and 18 females with an age range of 37 to 69 years (mean age: 55.3±9.3 years). Five spinal surgeons independently evaluated and classified the MRI images of the patients at intervals of 2 weeks, and Kappa consistency tests were performed to analyze the credibility and repeatability.
Results: Among the 42 patients, 13 were classified as SC line Type I, 14 as Type II, and 15 as Type III. The Kappa coefficients for inter-observer consistency ranged from 0.785 to 0.964, while the Kappa coefficients for intra-observer consistency ranged from 0.892 to 0.964, indicating satisfactory credibility and repeatability. Selecting the appropriate open-door segment based on the SC line classification resulted in satisfactory decompression for Type I, a relatively satisfactory decompression for Type II, and consideration of anterior approach surgery for Type III.
Conclusion: The SC line and its classification are practical and reliable, demonstrating good credibility and repeatability. The classification assists spinal surgeons in better predicting the outcome of spinal cord decompression following posterior open-door laminoplasty for cervical spine surgery, guiding the selection of the open-door segment and surgical approach, and thus holds value for widespread application.

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Bone loss following Prestige-LP cervical disc arthroplasty

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Background: Bone loss (BL) after cervical disc arthroplasty (CDA) is not well recognized. Prior studies hint at a possible link between BL incidence post-CDA and the prosthesis type, but data on BL after CDA with different prosthesis designs is limited.
Objective: This study aims to investigate BL occurrence after Prestige-LP CDA and its effects on clinical and radiological outcomes.
Methods: We retrospectively reviewed patients who underwent Prestige-LP CDA at our institution from January 2008 to October 2018. Clinical outcomes were assessed using JOA, VAS, and NDI scores. Radiographic parameters, including cervical lordosis, disc angle, ROM, HO, RASD, and BL, were collected.
Results: The study involving 396 patients and 483 CDA segments, BL occurred in 56.6% of patients and 52.8% of CDA segments. Most BL cases (88.2%) occurred within the first 3 months, with 19.1% progressing to a higher grade at 6 months. No progressive BL was observed after 12 months. Patients with BL were three years younger. BL occurrence was associated with the surgical method, with 2-level CDA having the highest incidence (76.7%). C5/6 showed more BL compared to C3/4 and C4/5. JOA, VAS, NDI scores significantly improved postoperatively. The ROM of the arthroplasty level in the BL group was relatively well maintained compared to the non-BL group. HO occurred in 57.9% of CDA segments in the non-BL group versus 38.8% in the BL group, and 19.9% of CDA segments in the non-BL group developed high-grade HO.
Conclusion: This study found BL to be common but self-limited after early postoperative CDA. It occurred 3 to 6 months postoperatively, more in younger patients, especially those with 2-level CDA involving the C5/6 segment. Despite its occurrence, BL did not affect clinical outcomes. Interestingly, patients with BL had a larger ROM at the arthroplasty level, likely due to a lower incidence and lower grade of HO.

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Transcriptomics-based study of the crucial serum markers of cervical and thoracic spinal cord injury

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Objective: To investigate the differential biomarkers and essential pivotal genes in the serum of SCI patients occurring in different segments of the thoracic and cervical spine and provide directions for the diagnosis and treatment of SCI.
Methods : 28 of the SCI cervical and thoracic spine samples were selected to identify differential genes. The GO and KEGG signaling pathway databases were selected for biological function annotation of the differential genes. The obtained differential genes were constructed into a PPI network, and the
10 HUB genes with the highest scores were identified using the MCC method. A Cervical-Thoracic classification diagnostic model was constructed by applying the XGBoost classification algorithm with these 10 HUB genes. Protein-drug interactions predicted target drug molecules.
Results : 218 differential genes were identified. 42 GO biological processes were screened by GO analysis. 6 KEGG Pathways were screened by KEGG analysis. The constructed differential gene PPI network consisted of 80 nodes and 141 edges, and the 10 genes with the highest MMC scores were used as HUB genes. The XGBoost classification algorithm was further applied to establish a Cervical-Thoracic classification and diagnosis model, which was verified to have significant classification effects. Finally, 10 possible drug molecules were identified based on the DSigDB database.
Conclusion : Spinal cord injuries occurring in different segments have different serum gene expression. The Cervical-Thoracic classification diagnostic model established by the 10 HUB genes has a significant classification effect, and the predicted 10 target drugs deserve further in-depth study.

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A new evaluation method for neck muscle tension: using ultrasound-guided needle electromyography for the study of recruitment response changes during the work of cervical deep muscle against gravity

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Objectives: 1. To explore the feasibility of using ultrasound-guided needle electromyography for the study of recruitment response in the work of cervical deep muscle against gravity. 2. To explore the differences of different deep cervical muscles' recruitment responses in the antigravity work, analyze the contribution of different muscles to the maintenance of flexion-neck posture, and to find the primarily responsible muscle that may cause chronic neck pain in muscle tension.
Methods: Recruiting 24 healthy adult subjects, using needle electrode electromyography to detect the EMG waveforms of musculi splenius capitis, musculi semispinalis capitis, semispinalis cervicis, longissimus capitis and musculi levator scapulae under the condition of the prone position, the head and neck protruding out the bedding of

the bed edge and wearing the 10kg dumbbell. Using SPSS software, independent samples rank-sum test was used to compare the initial recruitment response types of each group of muscles, and spearman grade correlation analysis was used for the correlation between
the initial recruitment response types of each group of muscles and the maximum duration of the recruitment response.
Results: 1.According to the rank-sum test of the initial recruitment response type of all the five groups of subjects, there was a significant difference in the initial recruitment response type between musculi semispinalis capitis and the other four groups of muscles (P <0.05), but the difference between the other four groups of muscles was not significant (P >0.05). 2.From the analysis of spearman grade correlation between the initial recruitment response type and the maximum duration of recruitment response in all the five groups of subjects, musculi semispinalis capitis possess the greatest correlation between the initial recruitment response type and the duration of recruitment response (rs =-0.690), semispinalis cervicis lower than it(rs =-0.535), longissimus capitis is the lowest(rs =-0.416), and no correlation in musculi splenius capitis and musculi levator scapulae (p >0.05).
Conclusions: 1. With the guidance of ultrasound, it is feasible to study the recruitment response of deep posterior cervical muscles during gravity resistance. It can be used as a new evaluation method for neck muscle tension. 2. In physiological conditions, the musculi semispinalis capitis has the greatest contribution to the process of resisting gravity to do work in the neck and has the greatest influence on the attenuation time of the overall muscle strength of the neck, which proves that it plays a major role in maintaining the flexion position and resisting the head gravity.

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Application of a angled cervical bone curette for free-hand subaxial cervical pedicle screw placement

Introduction: Although various subaxial cervical pedicle screw implantation techniques have been proposed, clinical operators have been unable to exactly determine the entry points and trajectory. The placement of CPS has generally been considered as technically demanding and associated with considerable lateral wall perforation rate. The objective of this article is to propose free-hand subaxial cervical pedicle screw placement techniques using a angled cervical bone curette and to investigate the clinical effectiveness of this technique.
Materials/Methods: A total of 67 consecutive traumatic or degenerative patients with 402 CPS placement using free-hand techniques by a 2mm angled cervical bone curette. In the operative process, The cortex of the lateral mass at the insertion point was partly removed with a high-speed burr. Then a 2mm small angled cervical bone curette was used to make a osseous cavity and to identify the pedicle entrance by touching the cortical bone of the medial pedicle wall. It was crucial to keep the transverse angle and make appropriate adjustment with guidance of the resistance of the thick medial cortical bone. By removing the cancellous bone of the cervical pedicle, the angled cervical bone curette was through it and then into the vertebral body. After tapping and repeated exploration in the correct trajectory direction with a small ball-tip probe , screws with 3.5mm diameter and 22-26mm length were placed. Screw implantation accuracy was assessed using postoperative CT.
Results: In 18 pedicles (4.5%) the procedure was aborted because of a small or nonexistent pedicle medullary canal. 337 pedicle screws (83.8%) were placed correctly, whereas 35 pedicles (8.7%) had noncritical perforations and 12 pedicles (3.0%) had critical perforations. The majority of the critical and noncritical perforations were at C4, and C5. There was no symptom and sign of neurovascular injuries.
Conclusion: Free-hand subaxial cervical pedicle screw placement can be performed using a angled cervical bone curette with acceptable safety and accuracy. The angled cervical bone curette can identify the pedicle entrance by touching the cortical bone of the medial pedicle wall easier than traditional tool, and can provide bigger transverse angle for precise pedicle screw trajectory.

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Characteristics of plasma lipid metabolism and potential biomarkers in patients with acute spinal cord injury

Objective: To compare the differences in plasma lipid metabolites between the patients with acute spinal cord injury (ASCI) and those without spinal cord injury in order to explore the pathophysiologic mechanism and search for possible new biomarkers of ASCI.

Methods: The patients with spinal cord injury in our hospital from September 20，2020 to January 20，2022 were enrolled in this study. They were divided into spinal cord injury group (ASCI group，n = 21) and control group (age- and sex-matched with the ASCI group，n = 21) . Non-targeted lipidomics analysis was performed on the blood samples to find the differences of lipid metabolites between the 2 groups. Univariate and multivariate statistical analyses were applied to explore the meaningful differential metabolites，and receiver operating characteristic (ROC) curve was used to evaluate the diagnostic efficiency of the selected differential metabolites.

Results: ①The orthogonal projection to latent structure discriminant analysis (OPLS-DA) and cluster heat map showed that there was a significant trend of separation between ASCI group and the control group. Multivariate statistical analysis identified totally 18 differential plasma lipid metabolites，including 12 of them significantly increased and 8 decreased in the ASCI group. ② There were 10 lipid metabolites such as diglyceride (DG) and phosphatidyl serine (PS) associated with an increased risk of ASCI，while 13 negative predictors，including phosphatidylinositol (PI) ，phosphatidylcholine (PC) ，lyticphosphatidylcholine (LPC) and triglyceride (TG) ，were associated with an increased risk of ASCI. ③ROC curve identified 2 possible biomarkers of ASCI，namely，PC (16∶0/22:6) (AUC = 0.91) and PC(18∶0 /22∶6) (AUC =0.9) ; ④The disturbed metabolic pathways included metabolism of glycerol phospholipid sphingomyelin，purine and pyrimidine in the ASCI patients，among which the disorder of glycerophospholipid metabolism was the most significant.

Conclusion: The characteristics of lipid metabolism are significantly changed in ASCI patients; a total of 21 differential lipid metabolites are identified，among which the disorder of glycerolphospholipid metabolism pathway indicates the most significant. PC may act as the potential biomarkers for the early diagnosis of ASCI.

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Clinical study of full endoscopic transoral atlantoaxial release and reduction combined with posterior internal fixation in the treatment of irreducible atlantoaxial dislocation

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Background: Transoropharyngeal open surgical approach to release irreversible atlantoaxial dislocation is currently a commonly used surgical procedure. However, there are also some problems: the soft tissue is seriously damaged after extensive release, which affects wound healing; the anatomical structure is not clear during the operation; oral intake cannot be taken early after the operation, which affects rapid recovery.
Methods: The clinical data of 27 patients with irreducible atlantoaxial dislocation, who underwent full endoscopic transoral atlantoaxial release and reduction combined with posterior internal fixation from February 2014 to November 2022, were retrospectively analyzed (including 11 males and 16 females, who were within 35-70 years old, with an average age of 50.5 years old). The preoperative and postoperative visual analogue scale (VAS) score for neck pain, Japanese Orthopedic Association (JOA) score, and American Spinal Injury Association (ASIA) grade were compared to evaluate the recovery conditions of the patient's clinical symptoms. In addition, the anterior atlanto-odontoid interval (AADI), and the cervical medullary angle (CMA) were measured to evaluate the postoperative reduction conditions.
Results: The follow-up time was 38-42 months, with an average time of 40.3 months. At the last follow-up, the VAS score of neck pain and JOA score were significantly improved compared with preoperative($P < 0.01$). At the last follow-up, the neurological function of these patients improved by 1-2 grades compared with the preoperative grade (ASIA grade).
Conclusion: Full endoscopic transoral atlantoaxial release and reduction combined with posterior internal fixation in the treatment of irreducible atlantoaxial dislocation was feasible and effective. *Correspondence: Zhi Zhang, MD, Department of Spine Surgery, Chengdu Fifth People's Hospital. 33# Ma Shi Street, Wenjiang District, 611130, Chengdu City, Sichuan Province, China. E-mail: wenkentspine@gmail.com

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Insufficient Blood Flow in the Cervical Radiculomedullalry Artery May Cause Ischemic Myelopathy

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Background/Objective: In degenerative cervical myelopathy (DCM), the pathogenesis is thought to be complicated by ischemic damage in addition to mechanical injury. With regard to ischemic spinal cord injury the radiculomedullary artery that feeds the thoracic spinal cord is well known as Adamkiewicz artery, therefore, I examined the cervical radiculomedullary artery in DCM patients (illustrated in Fig).
Methods:As ischemic spinal cord dysfunction can be reversible in part, intraoperative neuromonitoring was carried out to detect functional improvement during surgery. CT Angiography was performed postoperatively in patients whose motor evoked potential (MEP) amplitudes were increased with anterior cervical discectomy and fusion (ACDF) with anterior foraminotomy.
Results: In two patients spinal cord dysfunction at the start of surgery detected by low MEP amplitude was increased promptly with surgery. Although the preoperative cord compression was mild, their levels of spinal cord dysfunction were more than those predicted from radiculopathy. Postoperative CT angiogram showed that their radiculomedullary arteries run through the operated stenotic foramen (as shown in Fig).
Conclusion: In patients with DCM, impaired blood flow in the spinal arteries cause ischemic spinal cord dysfunction in addition to mechanical injury. It is important to consider the presence of vascular myelopathy in DCM.

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Does cervical pyogenic spondylodiscitis need surgery frequently?

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Background: Pyogenic spondylodiscitis (PSD) is increasing as the population ages. Comparing in lumbar spine, PSD in cervical spine is rare. But it is reported to need surgery more frequently than in thoracolumbar spine. The aim of this study is to clarify the features of cervical PSD.
Materials and methods: The consecutive cases of PSD hospitalized to our institution since January 2013 to March 2021 were retrospectively included. The diagnosis was confirmed with symptoms and MRI. Patients' background, co-morbidity like diabetes mellitus (DM), malignancy and malnutrition, causative organism, length of stay, and outcome were evaluated. Cure was determined as without recurrence more than 6 months. The patients were divided in two groups by location, with or without cervical lesion. Each parameter of two groups was compared.
Results: 72 patients were included. There were 72 cases, 43 males and 29 females. The age was 69.5 ± 15.0 (14-91) years. The height of PSD was 7, 15 and 60 in cervical, thoracic and lumbosacral, respectively. Some cases had multiple lesions, including 3 cases of cervical and other site of lesions. Then the number of cases without cervical PSD was 65. The age of cervical lesion and without cervical lesion was 70.3 ± 13.1 vs. 69.4 ± 14.3yrs, respectively, without statistical difference. The ratio of all co-morbidities was without significance. Among without cervical lesion group, only 3 cases had multiple lesions. Oppositely, 3 of 7 cases of cervical lesion were of multiple lesions ($p<0.001$). All 7 cases of cervical lesion cases were cured by conservative treatment. Contrary, 5 of thoracolumbar lesion cases needed posterior fixation surgery after failure of conservative treatment.
Conclusion: The features of cervical PSD are not different from PSD in other site. Basically, cervical PSD also can be treated with conservative therapy, same as thoracolumbar lesion.

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Ultrasonic osteotome assisted percutaneous endoscopic cervical circumferential decompression in the treatment of cervical spondylotic radiculopathy due to osseous foraminal stenosis

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Background: Cervical spondylotic radiculopathy (CSR) is characterized by cervical nerve root compression due to disc herniation or hyperplasia of Luschka joint, calcified discs, hyperplastic ligaments and loss of intervertebral height. Posterior endoscopic cervical decompression is regarded as the most direct minimally invasive decompression surgery in CSR due to the better visualization and less soft tissue injury. Endoscopic high-speed drill is the most commonly used bone grinding tool in endoscopic surgery. However, using a high-speed drill to grind the bony lesions in the ventral region of the nerve root and dura is a relatively high-risk manipulation.
Objective. To observe the clinical efficacy and safety of posterior percutaneous endoscopic cervical circumferential decompression assisted by ultrasonic osteotome in patients of CSR accompanying with osseous foraminal stenosis.

Materials and Methods. Between January 2020 and April 2021, 19 patients with CSR accompanying with osseous foraminal stenosis underwent posterior percutaneous endoscopic cervical circumferential decompression assisted by ultrasonic osteotome in our institutions were enrolled in this prospective clinical study. Inclusion criteria were as follows : 1) single-level CSR, unilateral radiculopathy with arm, neck or shoulder pain consistent with preoperative magnetic resonance imaging (MRI) and computed tomography (CT); preoperative cervical CT reconstruction imaging revealing osseous foraminal stenosis. 2) failure of standard conservative treatment for at least 2 months. Exclusion criteria were : 1) clear segmental instability or severe deformities; 2) myelopathy; 3) lateral and medial localization of disc herniation; and 4) more than two-level or bilateral symptom due to osseous foraminal stenosis. The neck disability index (NDI), the visual analogue scale (VAS), and the modified MacNab criteria were recorded at each follow-up interval. All patients underwent three-dimensional computed tomography (CT) of the cervical spine within 1 week after surgery to evaluate the decompression effect of osseous foraminal stenosis.

Results. There were 19 consecutive patients in the study. All operations were successfully completed with an average operating time of 75+11minutes. The mean follow-up period was 8.5 months (range: 6-12 months). The NDI and VAS scores for arm/neck pain improved significantly from preoperatively to the last follow-up. The satisfaction rate by modified MacNab criteria was 91.7% on the third postoperative day and 100% on the day of final follow-up. One patient experienced transit fingers numbness. There were no neurological complications such as increased arm pain and decreased limb muscle strength.

Conclusion: Posterior percutaneous endoscopic cervical circumferential decompression assisted by ultrasonic osteotome is an effective treatment for CSR accompanying with osseous foraminal stenosis. The usage of endoscopic-matched ultrasonic osteotome provides a safer and more efficient decompression method for foraminal bony decompression, which plays a positive role in reducing surgical time, improving surgical safety, reducing learning curve and complications.

Keyword ; Ultrasonic Osteotome, Cervical Spondylotic Radiculopathy, Minimally Invasive Technique, Osseous Foraminal Stenosis, Posterior Cervical Foraminotomy

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Characteristics of grafted bone fusion patterns and their impact on clinical outcomes following anterior hybrid decompression and fusion to treat multilevel degenerative cervical myelopathy.

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Background: For the treatment of multilevel degenerative cervical myelopathy (DCM), anterior hybrid decompression and fusion (AHDF) with corpectomy and discectomy using a dynamic plate and cage has exhibited a reduction in complications compared to conventional methods, with favorable clinical outcomes. However, in this hybrid technique, increased fusion segment may affect the grafted bone fusion rate.

Objective/Aim: To investigate the characteristics of grafted bone fusion patterns and their impact on clinical outcomes following AHDF.

Method: We included 18 patients who underwent AHDF for multilevel DCM from 2014 to 2023. All patients underwent single-level corpectomy with iliac bone graft and discectomy with cages for the adjacent segment. Evaluation of interbody fusion utilized local range of motion measured through X-ray and CT sagittal/coronal reconstruction images. In addition, CT axial images were employed to assess lateral fusion of the grafted bone. We investigated the rates of interbody and lateral fusion of the grafted bone and the relationship between the bony fusion and the neurological improvement.

Results: One year after surgery, the interbody fusion of the grafted bone and cage was observed in 9 (50%) and 10 (56%), respectively. On the other hand, lateral fusion of the grafted bone was observed in all 18 patients (100%). At two years after surgery, interbody fusion increased to 14 (78%) for the grafted bone and 15 (83%) for the cage. At one year after surgery, the recovery rate of JOA score was 63.0±21.4 in the grafted bone fusion group and 56.4±28.5 in the non-fusion group, with no significant difference.

Conclusions: In AHDF, lateral fusion of the grafted bone was observed earlier at one year postoperatively, followed by progressive interbody fusion over the subsequent two years. It was suggested that prolonged interbody fusion may not affect the improvement of myelopathy.

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Incidence and timing of spontaneous electromyographic activity alerts during cervical ossification of the posterior longitudinal ligament surgery: a prospective observational study

Background: Spontaneous electromyographic activity (sEMG) is one of modalities of intraoperative neurophysiological monitoring (INOM) and provides continuous real-time monitoring of the descending pathway, unlike Tc-MEP which is measured intermittently between surgical maneuvers. However, the incidence and timing of sEMG alerts are not yet understood.

Objective: To investigate the incidence and timing of sEMG alerts during cervical ossification of the posterior longitudinal ligament surgery (OPLL) by surgical technique.

Methods: A prospective observational study was conducted at a single institution from 2017 to 2022. Patients undergoing anterior decompression and fusion (ADF), laminoplasty (LAMP), or posterior decompression and fusion (PDF) for cervical OPLL were included. The incidence of Tc-MEP and sEMG alerts were investigated and statistically compared among ADF, LAMP, and PDF using chi-square test. Surgical maneuvers causing Tc-MEP and sEMG were investigated for each surgical procedure. Tc-MEP was alerted when the amplitude decreased to 30% or less from baseline, and sEMG was alerted when it lasted longer than 5 seconds in relation to the surgical maneuver.

Results: In 98 OPLL patients with a mean age of 63.8 years, mean body mass index of 27.0, a mean cervical Japanese Orthopedic Association score of 9.4, and mean occupancy ratio of 50.6%, the incidence of Tc-MEP and sEMG were 27% and 70%, respectively. When comparing ADF (39 cases), PDF (38 cases), and LAMP (21 cases), there was no significant difference in the incidence of Tc-MEP (ADF 28%, LAMP 14%, PDF 32%, $p=0.34$), however, sEMG occurred significantly more frequently in ADF (ADF 90%, PDF 68%, LAMP 38%, $p<0.001$). The surgical maneuvers with the highest incidence of sEMG was decompression including thinning OPLL (87%) in ADF, lamina excavation and decompression (both 40%) in PDF, and lamina excavation (33%) in LAMP (Figure).

Conclusion: Cervical OPLL surgery was a highly neuroinvasive procedure, with sEMG occurring in 70%.

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Biomechanical evaluation of a novel atlas polyaxial transverse connecting screw system, an in vitro human cadaveric study

Purpose: To introduce a novel transverse conneting screw system, and to evaluate the biomechanical stability of the novel screw system using human cadaveric specimens.
Methods: Six fresh-frozen cadaveric upper cervical spines were used in our study. Every specimen was tested under 5 conditions: intact group; unstable group; C1-C2 screw rod system group; C1-C2 + crosslink system group; atlas polyaxial transverse connecting screw (APTCS) system.
Results: Compared with the intact state, C1-C2 screw rod system, C1-C2 + CL system and APTCS showed statistically decrease ROM in all directions except for the unstable group under posterior extension direction ($p<0.05$). APTCS group has the least ROM in all directions ($p<0.001$).
Conclusion: The APTCS system was able to restore stability to the atlantoaxial joint. APTCS system has the advantages of easy installation, convenient bone grafting, and strong biomechanical strength.

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Recovery Process of Cervical Myelopathy after Laminoplasty Using Japanese Orthopaedic Association Cervical Myelopathy Evaluation Questionnaire: A Prospective Study

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Background: There are many reports regarding the postoperative recovery process after laminoplasty for patients with cervical spondylotic myelopathy (CSM). The Japanese Orthopaedic Association Cervical Myelopathy Evaluation Questionnaire (JOACMEQ), which is one of patient reported outcomes, has been recently used. However, there have been no reports of prospective recovery process according to the domain-specific “effective” criteria.
Objective: To clarify how long we can expect to improve each domain on JOACMEQ until change to “effective” after laminoplasty for CSM.
Methods: We recruited 84 CSM patients underwent laminoplasty in two institutions between 2018 and 2020. We obtained JOACMEQ at preoperatively, 1 month, 3 months, 6 months, 1 year and 2 years after surgery consecutively. We excluded the patients without consecutive evaluation for 2 years. The percentage of patients who were "effective" (i.e., (1) gain score increased by 20 points or more, (2) pre-treatment score was <90 points and post-treatment score was >90 points) at each postoperative time point was calculated for each domain. Once a case showed "effective", it was excluded from subsequent time point evaluations.
Results: Of 84, we could follow 63 patients for 2 years consecutively. The number of "effective" cases showed highest at 1 month postoperatively in the four domains except QOL. Subsequently, the number of new "effective" cases decreased. The percentages of "effective" were 80.4% for lower limb motor function, 76.7% for upper limb motor function, 71.8% for cervical spine function, 59.2% for bladder function, and 51.6% for QOL by 2 years postoperatively.
Conclusion: Although each functional impairment domain showed "effective" at 1 month postoperatively, QOL took longer to show "effective" than functional impairment. The percentage slowly increased up to 6 months postoperatively in QOL. Meanwhile, it was rare in patients with any domains which showed
"effective" for the first time after 1 year postoperatively (mean 3.8%).

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Three-Year Comparative Outcomes of Expansive Open-door Laminoplasty and Selective Laminectomy in Cervical Spondylotic Myelopathy

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Background: Laminoplasty is established for treating cervical spondylotic myelopathy (CSM), though it can lead to complications like C5 palsy, axial pain, postoperative kyphotic deformity and adjacent segment stenosis. To reduce invasiveness, our institution has adopted selective laminectomy for cases with fewer involved vertebrae.
Objective/Aim: This study compares three-year outcomes, including JOA score recovery rate, progression of kyphosis, and additional surgeries, between selective laminectomy and expansive open-door laminoplasty in CSM patients.
Methods: We retrospectively reviewed CSM patients from April 2010 to November 2020. Ten underwent expansive open-door laminoplasty (C3-C6 or C3-7), termed the conventional group, and 13 received selective laminectomy (1 or 2-level decompression), termed the selective group. We assessed JOA score recovery rate, C2-7 angle, C2-C7 sagittal vertical axis (SVA), and additional surgeries over three years, along with postoperative complications.
Results: At three years, the conventional group showed a 47% improvement in JOA score, similar to the 46% in the selective group. Median C2-C7 SVA increase was 3.8 mm for the conventional group and 4.3 mm for the selective group. No additional surgeries were needed in either group. The selective group had one case each of C5 palsy and axial pain.
Conclusion: Expansive open-door laminoplasty and selective laminectomy effectively treat CSM with similar JOA score recoveries and stable SVA. The absence of additional surgeries and low complication rates affirm the safety of these methods. Selective laminectomy can be a less invasive, viable alternative for CSM.

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Morphological analysis of OPLL progression in cervical spinal cord injury cases treated with posterior fusion

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Objective: To investigate the natural progress of ossification in cervical spinal cord injury (CSCI) cases with OPLL treated by posterior fusion surgery.
Methods: The subjects included 42 cases of CSCI with OPLL that underwent posterior fusion surgery between 2017 and 2021 and were amenable to follow-up with CT for more than 6 months. We investigated the union of the OPLL at the level of CSCI on postoperative CT. We measured the thickness of OPLL at the level of injury by CT at the time of injury and 6 months after surgery and calculated the thickness of OPLL. We divided the subjects into two groups: one with the union of OPLL after surgery and one without the union. We performed comparative analyses between the two groups and binary logistic regression analyses on the differences in thickness of OPLL, and DM. We assessed the rates of union for OPLL longitudinally at intervals of 3 months, 6 months, 1 year, and 2 years postoperatively.
Results: At the final observation, 30 cases (71.4%) got the union of OPLL at the level of injury, and the mean time from injury to the union of OPLL was 8.4 (2-28) months. The mean difference in thickness of the OPLL was -0.07 (-1.2-0.6) mm. There were no significant differences between the two groups in age, gender, BMI,

presence of DM, and the difference in thickness of OPLL. The rate of transformation into continuous type OPLL at intervals of 3 months, 6 months, 1 year, and 2 years were 12%, 37%, 57%, and 73%.

Conclusion: This study suggested that spinal fusion surgery has some effect of transforming OPLL into the continuous type and preventing the increase in thickness of their ossification. The rate of transformation into continuous type in both OPLL showed a progressive escalation over the specified period.

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Evaluating the efficacy of early decompression in SCIWORA with moderate contusion: A rat model study

Background : With an aging population, Spinal Cord Injury Without Radiographic Abnormality (SCIWORA) are increasing, yet no definitive treatment protocol exists. Previously, our group demonstrated the effectiveness of early decompression in SCIWORA rat models with mild contusion. However, spinal cord injuries are known to have different subsequent outcomes depending on the severity of the injury at the time of injury.

Objective : We evaluate the effect of decompression in SCIWORA rat model with moderate contusion.

Method: We utilized rats with chronic spinal cord compression established in our laboratory. Female Sprague-Dawley rats (aged 8 weeks) underwent surgical insertion of a hydrophilic polymer under cervical vertebrae to create asymptomatic chronic spinal compression. At 16 weeks, spinal cord injury (SCI) was induced using an impactor with 100kdyn. Rats exhibiting the targeted paralysis level (BBB score 8-12) were divided into three groups: Group A (no decompression, n=6), Group B (immediate decompression post-SCI, n=6), and Group C (decompression one week post-SCI, n=6). Their motor functions were assessed using the BBB score at 1, 3, 7, 14, 21, and 28 days post-SCI.

Result: There was no significant difference in BBB scores among the groups at any time point, including immediately post-SCI(Group A: 10.3±1.5, Group B: 10.3±0.8, Group C: 11±1.2) and after 28 days (Group A: 17.2±2.7, Group B: 16±2.4, Group C: 15.8±3.4).

Conclusion: This study suggests that the effect of decompression may result in different outcomes depending on the extent of damage. Adding histological evaluations, we will clarify the efficacy of early decompression in this model.

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Kaposiform hemangioendothelioma in double cervical vertebrae without Kasabach-Merritt phenomenon or cutaneous lesions: an extremely rare case

Background: Kaposiform hemangioendothelioma (KHE) is a rare, intermediate malignant vascular neoplasm that has a propensity for local infiltration. KHE is primarily observed in infants and adolescents, and it most often arises from superficial or deep soft tissue and bone. Currently, there are only six reported cases of KHE in the vertebrae. Moreover, KHE in the cervical vertebrae has never been reported.

Objective: To report on the diagnosis and treatment of a patient with KHE who had no cutaneous lesions or Kasabach-Merritt phenomenon (KMP).

Methods: The authors report a diagnostically challenging case of KHE affecting the double cervical vertebrae in a 40-year-old female without associated KMP or cutaneous lesions. The patient underwent a needle biopsy of C4, and the diagnosis of KHE was rendered by a multidisciplinary team (MDT) based on the pathological results. Accordingly, incomplete tumor excision, anterior cervical subtotal cortectomy, iliac autograft reconstruction, Slimlock plate instrumentation, and anterior interbody fusion were performed. Postoperatively, the patient was initially treated with thalidomide for 9 months, with little regression of residual lesions. Subsequently, the therapeutic regimen was switched to sirolimus for 12 months. Results Residual pain alleviated and visual analog scale scores improved from 4 postoperatively to 0 at the final follow-up. MRI indicated significant regression of the residual lesions with no signs of recurrence or metastasis. The patient experienced several sirolimus-induced adverse effects, including skin infection and increased total bile acid, that were controlled by symptomatic therapy and decreased sirolimus dosages.

Conclusion: KHE without KMP or cutaneous lesions is commonly misdiagnosed and mistreated. The MDT plays an important role in making the correct diagnosis and planning optimal treatment regimens. Surgical resection, when combined with postoperative sirolimus, presented significant clinical improvement. This case provides new insights into the diagnosis and treatment strategy for KHE patients presenting without cutaneous lesions or KMP

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Cervical dumbbell tumors: surgical strategy and clinical outcomes

Background: The resection of cervical dumbbell tumors raises several problems, including preservation of the nerve root, management of the vertebral artery, and reconstruction of spinal stability. An ideal surgical strategy should be able to minimize the recurrence rate and avoid cervical deformity.

Objective: To evaluate the clinical outcomes and to summarize the effective and safe surgical strategy for cervical dumbbell tumors.

Methods: From March 2007 to May 2016, 22 patients with cervical dumbbell tumors received tumor resection with/without instrumented reconstruction in our institution. The medical records of these patients were reviewed respectively. Radiographic evaluation, including cervical radiograph, computerized tomography, magnetic resonance imaging and computed tomography angiography, were performed before surgery, immediately after surgery and during the follow-up. Japanese Orthopaedic Association (JOA) score and complications were also evaluated. Results This study enrolled 10 males and 12 females with an average age of 40.3 years old. The average follow-up was 65.5 months. Seventeen patients underwent posterior approach and 5 had combined approach. Tumors involved nerve roots were transected in 5 cases. Single vertebral artery was ligated in 2. Histopathology revealed neurinoma, ganglioglioma, ganglioneuroma, neuroblastoma, paraganglioma and chondroblastoma in 15, 3, 1, 1, 1 and 1 case (s), respectively. The average postoperative JOA score was 13.9 and the average recovery rate was 51.4%. The complications included cerebrospinal fluid leakage in 9 cases, neurologic deterioration in 2 cases, esophagus injury in 1 and deep wound infection in 1. Tumor recurrence was found in 2 case, and one received revision surgery.

Conclusion: The overall clinical outcomes of tumor resection with/without instrumented reconstruction for cervical dumbbell tumors are satisfactory. Toyama classification combined with PUTH classification of spinal dumbbell tumors provides guidance to the implementation of surgical procedure for cervical dumbbell tumors

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Tandem Spinal Stenosis: A 845 Multiracial Asian Patients' Prevalence and Risk Factor Analysis

Background: Tandem spinal stenosis (TSS), characterized by stenosis occurring concurrently in the cervical and lumbar spinal regions, presents variably in the literature, with prevalence rates ranging from 5% to 60%.

Objective: This study seeks to elucidate the incidence of TSS and identify associated risk factors in a large, multiracial Asian population.

Methods: We retrospectively analyzed 845 adult patients who underwent T2-weighted MRI of the entire spine in 2008 at a university hospital. Patients with malignancies, fractures, or infections were excluded. Demographic information was collected, and patients were categorized by age and race. Canal measurements were taken at various vertebral levels and disc levels for cervical and lumbar spine. Using a 10mm cut-off, stenosis prevalence was determined for both cervical and lumbar regions. Statistical analyses, including t-tests and ANOVA, were employed. Additionally, multivariate logistic regression was conducted for lumbar stenosis, cervical stenosis, and tandem stenosis.

Results: The cohort comprised 458 males (54.2%) and 387 females (45.8%) with a mean age of 48 years. The majority were Chinese (544 patients). Mean midsagittal diameter measurements differed across cervical and lumbar segments. Cervical stenosis was identified in 40.5% of participants and lumbar stenosis in 58.8%, using the 10mm cut-off. Overall, Tandem Spinal Stenosis (TSS) was found in 26.7% of patients. The prevalence of TSS, reflecting trends in cervical and lumbar stenosis, escalates with age, ranging from 5.9% in the 18-29 age group to 57.1% in those aged 80-96. Notably, multivariate logistic regression identified reduced measurements at C3/4, C4/5, C5/6, C6/7, L4/5, and L5/S1 disc levels as significant risk factors for tandem stenosis. The data indicated an odds ratio of 1.33 for each level of cervical stenosis and 1.52 for each level of lumbar stenosis. Specifically, L5/S1 disc level stenosis emerged as a risk factor for cervical stenosis with an odds ratio of 1.80, while C4 vertebral level stenosis was a significant risk factor for lumbar stenosis, presenting an odds ratio of 3.44.

Conclusion: In conclusion, this study identified a significant incidence of TSS at 26.7% in a multiracial Asian population. These findings underscore the importance of thorough spinal assessment in patients presenting with stenotic symptoms and the need for further research into the mechanisms and management of TSS.

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Comparison of Titanium Mesh Cage, Nano-Hydroxyapatite/Polyamide Cage, and 3D-Printed Vertebral Body for Anterior Cervical Corpectomy and Fusion

Background: Titanium Mesh Cage (TMC) is widely used in anterior cervical corpectomy and fusion (ACCF). Though the fusion rate was high, cage subsidence resulted from high elastic module remains a major issue. In recent years, Nano-Hydroxyapatite/Polyamide (n-HA/PA66) Cage and 3D-printed vertebral body have been developed to address the subsidence issue after ACCF. The 3D-printed vertebral body had similar elastic module with bone and optimal pore size and porosity for bone ingrowth.

Objective: This study aims to compare the clinical and radiological outcomes of TMC, n-HA/PA66 cage, and 3D-printed vertebral bodies in ACCF patients.

Methods: This was a prospective non-randomized controlled study. We enrolled 60 patients undergoing ACCF using TMCs, n-HA/PA66 cages, or 3D-printed vertebral bodies from January 2020 to November 2021. For each group, there were 20 patients. Follow-up was conducted for minimum two years. Clinical outcomes, including JOA, NDI and VAS scores were collected pre-operatively and at each follow-up. Radiographic outcomes were collected at each visit, including FSU height, fusion rate, and cervical alignment. A loss of FSU height equal or greater than 3 mm was deemed implant subsidence.

Results: Postoperative FSU height loss at 2 years differed significantly among the TMC, n-HA/PA66, and 3D-printed vertebral body groups, measuring 3.07±1.25mm, 2.11±0.73mm, and 1.46±0.71mm, respectively ($P < 0.001$). The rates of implant subsidence were 45%, 20%, and 10%, respectively. Regarding the clinical data, only the JOA score at 3 months postoperatively showed a statistically significant difference ($P = 0.004$). All patients obtained solid fusion at 2-year follow-up.

Conclusion: At two-year follow-up after ACCF, the n-HA/PA66 cage group and the 3D-printed vertebral body group exhibited less FSU height loss and lower rates of implant subsidence compared to the TMC group. There appeared to be no significant differences in clinical outcomes among the three groups.

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Combined effect of artificial cervical disc replacement and facet tropism on the index-level facet joints: a finite element study

Background: Artificial Cervical Disc Replacement (ACDR) is an effective treatment for cervical degenerative disc diseases. However, clinical information regarding the facet joint alterations after ACDR was limited. Facet tropism is common in the sub-axial cervical spine. Our previous research indicated that facet tropism could lead to increased pressure on the cervical facet joints.

Objective: This study aimed to assess the impact of facet tropism on the facet contact force and facet capsule stress after ACDR.

Methods: A finite element model was constructed from computed tomography (CT) scans of a 28-year-old male volunteer. Symmetrical, moderate asymmetrical (7 degrees tropism), and severe asymmetrical (14 degrees tropism) models were created at the C5/C6 level. C5/C6 ACDR was simulated in all models. A 75 N follower load and 1 N·m moment was applied to the odontoid process to initiate flexion, extension, lateral bending, and axial rotation, and the range of motions, facet contact forces, and facet capsule stress were recorded.

Results: The severe asymmetrical model showed a significant increase in right-side facet contact force under extension, right bending, and left rotation after ACDR. The facet capsule stress in both the moderate and severe asymmetrical models were significantly higher than those in the symmetrical model after ACDR. The stress distribution on the facet surface in the asymmetrical models was different from that in the symmetrical model. The overall difference in stress distribution of the capsule ligament between symmetrical and asymmetrical models was not significant.

Conclusions: Facet tropism could considerably increase facet contact force and facet capsule stress after ACDR and result in abnormal stress distribution on the facet joint surface and capsule, which might be a risk factor for post-operative facet joint degeneration progression after ACDR, making facet tropism noteworthy when ACDR was considered as the surgical option.

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Early intervention in postop discitis a single center review

Objective: To evaluate the results of early surgical stabilization of postoperative discitis patients in term of pain relief and functional outcome.

Introduction: Postoperative infection in any field is a drastic complication both for patient and doctor.in spine surgery it is a rare complication but poses great and poses a great challenge for the treatment as any other bone infection. The reported incidence may vary a lot but usually remains around 1%. although local studies reported comparatively high incidence 4.4% and 15% respectively. it takes prolong course and may take months if not year to heal. The usually recommended treatment is rest analgesia and prolong antibiotics. But now trends are changing toward surgical intervention. focus should be on early detection of postoperative discitis and stating aggressive IV antibiotic therapy. if it fails to respond and there is obvious changes in disc space on plain x-ray or MRI early surgical intervention in the form of debridement of disc space and transpedicular screw stabilization of the involve segment should be considered.

Material and methods: Descriptive case series department of orthopedic and spine surgery Khyber Girls Medical college Peshawar from 2010 onward till date. Pain relief was measured using Visual Analogue Score (VAS) for back and leg separately. functional outcome was measured by Oswestry Disability Index (ODI).

Results: Total of 35 patients fulfill the criteria of the study and were included. Out of 35 patients 18(51.4%) were male and 17(48.6%) were female. Mean age of the group was 47.5 years (SD± 10.9 years) with minimum 22 years while maximum was 65 years. The most common level involved was L4-L5 with 20(57.1%) patients , 13 patient (37.1%) have L5-S1, while in 2(5.7%) patients L3-L4 were involved. On average patients underwent surgical intervention 15 weeks after initial surgery (SD± 3.9 weeks) ,with minimum 8 weeks while maximum was 24 weeks. Average follow-up was 29.2 (SD± 19.8 months) months with minimum of 2 and maximum 90 months.
Conclusion: Early surgical debridement and stabilization leading to fusion of the affected segment produces good results in term of pain relief and functional improvement.
Key words: Postoperative discitis, Oswestry disability index(ODI)

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Would the One-stage Combined Approach lead to better long-term neurological outcomes than the Posterior Approach alone in Multilevel Degenerative Cervical Myelopathy Patients with T2-Weighted Increased Signal Intensity? An 8-year follow-up results and propensity score matching analysis.
Background: T2-weighted increased signal intensity (ISI) is commonly recognized as a sign of more severe spinal cord lesions and worse postoperative neurological recovery in multilevel degenerative cervical myelopathy (MDCM). Whether the combined approach could achieve better decompression and better neurological recovery for MDCM patients with ISI remains disputed.
Objective: This study aimed to compare the neurological outcomes of posterior and one-stage combined posteroanterior approaches for MDCM with T2-weighted ISI.
Methods: A total of 83 consecutive MDCM patients with confirmed ISI with at least three intervertebral segments operated on between 2012 and 2015 were retrospectively enrolled. Preoperative demographic, radiological and clinical variables were collected, and neurological conditions were evaluated by the Japanese Orthopedic Assessment score (JOA). Propensity score matching analysis was conducted to produce pairs of patients with comparable preoperative conditions from the posterior-alone and combined groups. Both short-term and long-term surgical outcomes were evaluated, including the JOA recovery rate (JOARR) and complications.
Results: A total of 83 patients were enrolled, of which 38 and 45 patients underwent posterior surgery alone and one-stage posteroanterior surgery, respectively. After propensity score matching, 38 pairs of comparable patients from the posterior and combined groups were matched. The preoperative demographic, radiographic and neurological variables of both groups were comparable. The combined group presented prolonged surgery duration and greater blood loss. At short-term follow-up, the combined group presented a higher JOARR (p=0.024), while no significant difference in JOARR was observed between the groups at long-term. No significant difference was found in the overall complication and reoperation rates.
Conclusions: For MDCM patients with ISI, both posterior and one-stage posteroanterior approaches could achieve considerable neurological alleviations in short-term and long-term follow-up. With greater surgical trauma, the combined group presented better short-term JOARR but did not show higher efficacy in long-term neurological function preservation in patients with comparable preoperative conditions.

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PREOPERATIVE CLOSE REDUCTION OF CERVICAL FRACTURE DISLOCATION
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Study design: Retrospective study.
Purpose: To determine Reduction rate of cervical fracture dislocation using preoperative gradual in hospital skull traction.
Overview of literature: Cervical spine fractures dislocations are unstable injuries and requires surgical intervention and stabilization. The approach may be anterior, posterior or combined. Majority of the surgeons prefer anterior approach after initial close reduction of cervical fracture dislocation. If close reduction preoperatively fails, then posterior direct reduction is needed followed by anterior surgery.in this study we want to determine the rate of success(reduction) using preoperative gradual traction.
Method: This retrospective study was conducted at Spine Unit Hayatabad Medical Complex and Aman hospital Peshawar. All patient with cervical fracture dislocation presented between Jan 2015 to Jan 2019, who underwent cervical traction prior to surgical interventions were included in the study. The demographics, type of dislocation, preoperative traction duration and neurology of all patients were recorded. The success of reduction using closed in hospital gradual traction was assessed using lateral cervical spine x-ray. Data was assessed using SPSS version 20.
Results: A total of 52 patients were included in the study with a mean age of 30.06 years (SD± 8.03). In 35(67.3%) patients the dislocation was bifacet while in 17(32.7%) it was unifacet. Successful reduction using gradual in hospital awake traction was achieved in 39(75%) patients while in 13(25%) patients reduction was not achieved. Mean duration of preoperative traction was 3.6 (SD±1.1) days with minimum 2 days and maximum 7 days.
Conclusion: Gradual in hospital traction in awake patient is an effective means of reducing cervical fracture dislocation.
Key words: Cervical fracture dislocation, skull traction, ASIA scale

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Comparison of postoperative change in cervical alignment between modified muscle-sparing raising roof laminoplasty and conventional open-door laminoplasty for multilevel degenerative cervical myelopathy
Background: The modified muscle-sparing intermuscular “raising roof” laminoplasties (RL) have been devised to preserve posterior muscle-ligament complex and maintain cervical balance in treatment of multilevel degenerative cervical myelopathy (MDCM). However, the postoperative change of cervical balance following these procedures remains controversial.
Objective: This study aimed to compare the post-LP change in cervical balance of RL procedure and open-door laminoplasty (LP) for treating MDCM.
Methods: A total of 317 MDCM patients with preoperative cervical lordosis who underwent RL procedure or conventional LP between January 2015 and July 2022 were enrolled and followed up for a minimum of a 12-month. The clinical and radiological measurements were collected preoperatively and at the final follow-up.
Results: Of the 317 patients (198 males and 119 females), 266 underwent LP and 51 underwent RL procedure. No significant differences observed in the demographics, surgical characteristics and baseline cervical balance parameters. After surgery, the RL group and LP group presented similar cervical lordosis and range of motion, while the RL group reported smaller C2-7 SVA postoperatively (P=0.001). Regarding the change in cervical balance, the RL group demonstrated a decrease in C2-7 SVA

(LP:1.47±8.87, RL: -0.94±7.50 p=0.027), C7 slope (LP:0.77±6.06, RL: -2.04±5.12, p=0.003) and lower loss of cervical lordosis at flexion (LP: 10.05±11.52, RL:6.30±10.02, p=0.017), while the LP group presented increased SVA and C7 slope.

Conclusions: Both the LP and RL procedure had no significant difference on maintenance in cervical lordosis at short-term. However, the RL procedure demonstrated superiority in cervical balance preservation with a decrease in C2-7 SVA and smaller loss on cervical lordosis at flexion. Further research should be conducted to clarify the long-term change in cervical balance following the RL procedure.

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Early and Mid-term Outcomes of Surgical Correction for Severe Dystrophic Cervical Kyphosis in Patients with Neurofibromatosis Type 1

Background: Neurofibromatosis Type 1 (NF-1)-related cervical kyphoses, particularly severe cases with dystrophic change, are rarely reported. Although a few retrospective studies which focused on surgical approach or proximal junctional kyphosis were published, widely accepted guidelines for treatment still remain unclear. Besides, the mechanism, the influence on outcomes of skeletal dystrophy have never been analyzed in depth.

Objective: To evaluate the early and midterm outcomes of surgical correction for severe dystrophic cervical kyphosis in patients with NF-1 and analyze the pathomechanics and the influence on surgical efficacy of related systemic skeletal dystrophy. Methods Ten patients who underwent surgical correction for NF-1-related severe dystrophic cervical kyphosis were reviewed. Radiographic parameters, including local and global Cobb angle, sagittal vertical axis (SVA) and T-1 slope, were measured. The visual analog scale (VAS) score, Japanese Orthopaedic Association (JOA) score, Neck Disability Index (NDI), patient satisfaction index (PSI) and complications were evaluated. Results The average follow-up was 50.6 months. The local and global Cobb angle improved from the preoperative average of 82.0 degrees and 54.9 degrees to an average of 35.6 degrees and 29.8 degrees, respectively, at the time of final follow-up. The C2-7 SVA averaged 5.8 mm before surgery and 8.9 mm at the final follow up. The average T1 slope was -12.3 degrees before surgery and -1.6 degrees at the final follow up. The VAS scores, JOA scores and NDI improved significantly, and the overall satisfaction rate was 90.0%. One death and 4 instrumentation failures occurred, 3 patients demonstrated progression of the kyphosis, and 2 fusion failures were observed.

Conclusion: Surgical correction, specifically the combined anteroposterior procedure, is essential and effective for management of NF-1-related severe dystrophic cervical kyphosis. However, high incidences of complications were observed. NF-1-related continuous skeletal dystrophy remarkably affected the mid-term outcomes. Early prevention and targeted pharmacotherapy may be necessary

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Preservation of Cervical Posterior Muscle Volume and Cervical Alignment: Comparison Between three types of modified muscle-sparing laminoplasty and Conventional Open-Door laminoplasty for multilevel degenerative cervical myelopathy

Backgrounds: Several modified laminoplasties (LP) have been developed to preserve the posterior muscle-ligament complex and prevent postoperative axial symptoms and malalignment in treatment of multilevel degenerative cervical myelopathy (MDCM). The postoperative change of cervical alignment and posterior muscle volume (PMV) following these procedures remains controversial.

Research question: This study aimed to compare the post-LP change in PMV and cervical alignment of conventional LP and three types of muscle-sparing LPs, namely unilateral muscle-preservation laminoplasty (UL), spinous-process-splitting double-door laminoplasty (DL) and intermuscular "raising roof" laminoplasty (RL).

Methods: Consecutive MDCM patients who underwent LP, DL, UL or RL between February 2022 and May 2022 from single center were enrolled. The baseline data, surgical characteristics were collected. The preoperative and postoperative PMV were semiautomatically segmented and evaluated by ITK-SNAP and the cervical alignment of patients were measured. The PMV loss ratio was calculated by the change of PMV divided by preoperative PMV.

Results: A total of 79 MDCM patients were included in this study (LP: 20, DL: 20, UL:23, RL:16). No significant differences were observed in the preoperative demographics and surgical characteristics. The preoperative C2-7 cobb angles and PMV of four groups were comparable. At 1-year follow-up, all four groups showed favorable and comparable JOARR. The postoperative PMV of four groups were 2.430±0.68, 2.355±0.621, 2.416±0.667, and 2.595±0.667 *105mm3, respectively (p=0.652). The RL group showed least PMV loss ratio (LP: 10.02%±12.92%, DL: 8.69%±9.61%, UL: 13.69%±10.40%, RL: 3.12%±10.92%, p=0.037) and least loss of C2-7 cobb angle at neutral position and at extension. Multivariate regression revealed that the loss in cervical alignment was associated with the PMV loss ratio.

Discussion: The RL procedure demonstrated better efficacy in PMV and cervical alignment preservation compared to conventional LP in treating MDCM. The loss of cervical lordosis at neutral and at extension position was associated with the PMV loss ratio.

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Comparison of HA spacer and Mini plate in open-door laminoplasty.

background: Open-door laminoplasty is often performed for cervical spondylotic myelopathy. Methods for fixing the elevated lamina include suture suspension fixation, HA spacer fixation, and mini plate fixation. It has been reported that HA spacer fixation causes more lamina closure than suture suspension fixation. However, there are no studies comparing the HA spacer and Mini plate methods. Therefore, the purpose is to compare these two methods.

Method: We investigated cases in which cervical open-door laminoplasty (C3-C7) was performed at our hospital. Cervical spine CT was performed 1 week, 3 months, and 6 months after surgery. The state of hinge bone union and the lamina closure depending on the open angle were investigated for each segment.

result: There were 38 males and 11 females (183 lamina). It was HA spacer 99 and Mini plate 84. There was no difference in hinge bone union between each Segment (from C3 to C7). There was no difference in the Hinge bone union rate between HA spacer and Mini plate at 3 months (p=0.11). However, HA Spacer was significantly higher at 6 months (p=0.01, HA: 95%, Plate: 79%). Additionally, Lamina closure had larger HA Spacer at both 3 (p=0.01) and 6 months (p=0.01). One HA Spacer was broken, but the bone healed without nerve compression. Two screws broke out on the Mini plate, but bone union was achieved without any problems. There were no reoperations in all cases.

Consideration & Conclusion: Open-door laminoplasty using HA spacer resulted in high hinge bone union with mild lamina closure. Reoperation was not necessary with either method. CT was performed at 3 and 6 months, which is a little early for bone union assessment, and we expected a higher rate of bone union to occur over time.

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Reliability Validation and Clinical Application of the Huashan Clinical Classification System for Hirayama Disease

Background: The Huashan clinical classification system for Hirayama disease has recently been proposed and has been found useful for diagnosis and treatment. However, the reproducibility and reliability of the system remain to be verified. And the outcome of surgical interventions based on this system also needs to be further evaluated.
Methods: Patients diagnosed with Hirayama disease between 2019 and 2020 were recruited. Seven spine surgeons from four different institutions were trained as observers of the Huashan clinical classification system for Hirayama disease, with a 2-month interval for two rounds of classification. The interobserver and intraobserver agreement was analyzed. Patients classified into Type Ib and Type II in the Huashan clinical classification system were recommended for surgical treatment, in which multi-segmental anterior cervical discectomy and fusion (ACDF) were performed. Radiographic images, electrophysiological results, and clinical scores were evaluated including cervical lordosis (CL), C2-7 sagittal vertical axis (C2-7 SVA), T1 slope (T1S), range of motion (ROM), the maximal compound muscle action potentials (CMAPs) of abductor digit minimi and abductor pollicis brevis, the latency of the ulnar nerve F reaction, abnormal spontaneous action potentials, Selected Brief-Michigan Hand Questionnaire (SB-MHQ), and Odom scale.
Results: For all the observers, the agreement percentages were 78.5% (κ = 0.76), indicating substantial interobserver reproducibility. For distinguishing typical (Types I and II) and atypical (Type III) Hirayama disease among the different groups of observers, the percentage agreement ranged from 95.6 to 98.9% (κ = 0.74 - 0.92), indicating substantial to nearly perfect reproducibility. As for intraobserver agreement, the percentage agreement ranged from 68.3 to 81.7% (κ = 0.65-0.79), indicating substantial reliability. Surgical interventions were recommended for the patients with Type Ib and Type II. After two-segment ACDF, CL and T1S increased, whereas C2-7 SVA and ROM decreased. The maximal CMAPs of abductor digit minimi and the latency of the ulnar nerve F reaction improved bilaterally, as well as abnormal spontaneous action potentials reduced remarkably. The SB-MHQ and Odom scale improved notably after follow-up of 16.35 ± 9.21 months.
Conclusions: The Huashan clinical classification system is an essential and effective tool in the treatment of Hirayama disease. ACDF intervention for the patients with Type Ib and Type II in the system showed favorable radiological, electrophysiological, and clinical outcomes.

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The characteristics of cervical alignment in Hirayama disease
Background: Ischemic injury of the cervical anterior horn caused by the chronic dynamic cervical flexion compression of the spinal cord is one of the main pathogenicity mechanisms of Hirayama disease (HD). Therefore, the cervical sagittal alignment is particularly important in HD.
Objective: In this study, we systematically evaluated the cervical sagittal alignment in HD patients, revealing the correlation between the cervical alignment and the severity of disease, characterizing the predictive role of the cervical alignment on prognosis, and proposing lordotic reconstruction target for cervical alignment in the surgical interventions for HD patients.
Methods: Cervical sagittal alignments were measured in 154 HD patients and 143 asymptomatic individuals by C2-7 Cobb, C2-7 sagittal vertical axis (SVA), C2-7 range of motion (ROM), and T1 slope. Disabilities of the arm, shoulder, and hand (DASH) assessment, diffusion tensor imaging (DTI) scans and motor unit number estimation (MUNE) in bilateral abductor pollicis brevis were performed in all HD patients. Patients were followed up for 2-10 years after two-segment ACDF and re-evaluated for prognosis outcomes and radiological differences.
Results: Compared to asymptomatic individuals, the T1 slope and C2-7 Cobb were relatively smaller in HD patients, and 82.4% HD patients showed loss of cervical lordosis. The degree of cervical lordosis loss was significantly correlated with the severity of disease, exhibiting higher DASH score, lower MUNE values, and higher apparent dispersion coefficient (ADC) in DTI. At the same time, the C2-7 ROM are greater in HD patients than in the asymptomatic population. The flexion C2-7 Cobb was significantly correlated with fractional anisotropy (FA) value ADC value in DTI. During follow-up, the recovery of hand function and electromyography results showed statistical correlation with postoperative C2-7 Cobb.
Conclusion: HD patients present with a straight and flexible cervical alignment. Short-segment fusion with cervical lordosis reconstruction through surgery is an effective treatment strategy.

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The incidence, clinical features and risk factors for postoperative retropharyngeal hematoma and related dyspnea following anterior cervical discectomy and fusion: Single-center study of 10615 patients
Background: Postoperative retropharyngeal hematoma (PRH) and related dyspnea are rare but life-threatening complications following anterior cervical discectomy and fusion (ACDF). However, current studies regarding PRH after ACDF are limited.
Objective: The aim of this research was to investigate the incidence, clinical features, and risk factors associated with PRH and related dyspnea following ACDF.
Methods: Consecutive patients who underwent ACDF at a single institute from January 2010 to December 2021 were retrospectively reviewed. All patients with PRH were identified. For each PRH subject, three control subjects were randomly selected as control group. Preoperative demographic, surgical and clinical data of PRH patients were collected. The morphological features of the upper airways (prevertebral soft tissue thickness, PVT, level between the epiglottis and transverse arytenoid muscle, LET) were evaluated. Multivariate logistic regression analysis was used to determine the risk factors for RPH.
Results: Among the 10615 patients who underwent ACDF, 18 (0.17%) developed PRH. The median time from the index surgery to PRH formation was 8.5 hours (25 and 75 percentile: 4 hours to 24 hours). All the PRH patients presented initial symptoms such as wound swelling. Twelve (0.11%) patients presented dyspnea due to PRH, 2 and 1 of whom received emergent intubation and tracheotomy respectively. All patients underwent hematoma evacuation, and most of them presented with completely relieved symptoms after evacuation. A LET greater than 2, OPLL and higher diastolic blood pressure (DBP) before surgery were found to be risk factors for PRH formation.
Conclusion: Our study showed that the incidences of PRH and related dyspnea after ACDF were 0.17% and 0.11%, respectively. We demonstrated the risk factors for PRH to be (1) LET≥2, (2) OPLL and (3) higher DBP before surgery and advocate paying increased attention to upper airway morphological features for identifying the risk of PRH after ACDF.

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Characteristics of cervical alignment and hyoid bone position in the anterior cervical surgical position with neck pillow
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Objective: The purpose of this study was to investigate the characteristics of cervical alignment and hyoid bone position in the anterior cervical surgical position with neck pillow.
Methods: The subjects were 77 cases (age 65.4 y.o., M54:F23) who underwent anterior cervical spine surgery. Under three different neck positions (①preoperative neutral position, ②preoperative extension position and ③surgical position with neck pillow), O-C2 angle, C2-7 angle and hyoid bone location were assessed and statistically compared. The hyoid bone location was defined as b/a (a: C3 vertebral body height, b: distance from the upper C3 vertebral body to the intersection of the perpendicular line from the hyoid bone).
Results: Statistically significant differences (P<0.05) were found for O-C2 angle (①23.3±14.2、②37.8±11.3、③27.3±8.8) , C2-7 angle (①4.7±18.0、②17.9±16.9、③20.8±11.6) and hyoid bone location (①1.7±1.0、②0.87±0.88、③2.05±0.6), respectively. The coefficient of variation for the C2-7 angle was ①3.85, ②0.94 and ③0.56. The hyoid bone location showed a negative correlation with O-C2 angle (①r = -0.7, ②r = -0.64, ③r = -0.6) and a positive correlation with C2-7 angle (①r = 0.62, ②r = 0.4, ③r = 0.38)(all P<0.01).
Discussion: The results of this study suggest that the hyoid bone is raised by extension of the upper cervical spine via the suprahyoid muscles traction and lowered by lordosis of the subaxial cervical spine via the infrahyoid muscles. The surgical position with neck pillow provides a subaxial cervical lordosis with little variation avoiding hyperextension of the upper cervical spine. However, the hyoid bone goes down in surgical position than any preoperative upright positions, so a surgeon should pay attention on the hyoid bone location when approaching to C3/4 or above levels.

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Reoperation rates after anterior surgeries for cervical radiculopathy related with injection therapy: Korean national population-based cohort study

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Background. There is a low incidence of reoperation after surgery for cervical degenerative disease. Therefore, it is difficult to sufficiently power studies to find risk factors for reoperation rates. National population-based databases provide large, longitudinally followed cohorts that may help overcome this challenge. Patients undergoing anterior surgeries for cervical radiculopathy receive injection therapy due to their severe pain before operation. However, there has been no study to evaluate the preoperative injection therapy as a risk factor for reoperation.
Objective. To determine whether injection therapy is a risk factor for reoperation in the anterior surgeries for cervical radiculopathy in a national population of patients with long-term follow-up.
Methods. We used the Korean Health Insurance Review & Assessment Service national database to select our study population. We included 5,997 patients with diagnosis of cervical spondylotic radiculopathy who underwent anterior cervical surgeries from January 2009 to December 2009. The follow up period was 8.4 ± 0.9 years (3,070.4 ± 319.0 days). Seventeen percent of patients received an injection therapy in the preoperative period of three months. Age, gender, presence of diabetes, associated comorbidities, surgical levels, hospital types, and preoperative injection therapy were considered potential confounding factors.
Results. The reoperation rate over the entire follow-up period was 2.10%. The risk factors for reoperation were female gender (OR 0.716, 95% CI 0.531, 0.964), hospital of hospital types (OR 0.629, 95% CI 0.452, 0.875), and the presence of the injection therapy before operation (OR 2.645, 95% CI 1.491, 4.693).
Conclusions. Patients undergoing anterior surgeries for cervical radiculopathy receive injection therapy due to their severe pain before operation, and preoperative injection therapy increase the risk for reoperations following anterior cervical surgeries. The information is essential to discuss the operations with the patients with these factors.
Key words : Cervical spine, Radiculopathy, Reoperation, Injection therapy, Nationwide database, Long-term follow-up

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Safety and efficacy of Unilateral Biportal Endoscopy decompression for cervical spondylotic radiculopathy - A single-center prospective study

Background: Unilateral Biportal Endoscopy (UBE) is a minimally invasive approach to treat cervical spondylotic radiculopathy (CSR), which is a common condition caused secondary to disc herniation, disc degeneration, uncal osteophytes, or other conditions and manifesting as neuropathic radicular pain. Anterior cervical discectomy and fusion (ACDF) is the gold standard surgical technique for treating CSR. However, it has several disadvantages, including loss of mobile segment, adjacent segment degeneration (ASD), implant and approach-related complications, and high hospitalization costs.

Aim: The current study aims to evaluate the safety and efficacy of UBE decompression for CSR.
Methods: After obtaining IRB approval, we performed a single-center prospective study and included patients who underwent UBE decompression for CSR with a minimum of six months of follow-up. Patient demographics, peri-operative data, and length of hospital stay (LOS) were reviewed. Clinical outcomes were assessed using VAS scores for neck and arm, and NDI scores pre-operatively and at 1 and 6 months. A repeated ANOVA test was performed to measure the difference between VAS and NDI scores.
Results: 10 patients (M: 8, F: 2) with a mean age of 56.7± 10.2 were included. The mean follow-up period was 8.4±1.8 months. The average surgical time was 64.3±10.6 mins. The average LOS was 1 day. At the final follow-up, the mean VAS for arm pain improved from 6.4±0.7 to 0.6±0.5 (92% improvement) and the mean VAS for neck pain improved from 3.3±0.4 to 2.0±0.2 (40% improvement).NDI score improved from 23.2±1.95 to 5.7±0.6 at the final follow-up (75% improvement). There were no complications.
Conclusion: The current study concludes that UBE is a safe and effective surgical treatment option for patients with CSR with excellent clinical outcomes.

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MANAGEMENT AND LONG-TERM OUTCOMES OF MILD CERVICAL SPONDYLOTIC MYELOPATHY: A SYSTEMATIC REVIEW AND META ANALYSIS

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Mild cervical spondylotic myelopathy (CSM) is characterized by spinal cord compression in the neck due to cervical spine degeneration, leading to mild neurological symptoms. The primary goal of managing mild CSM involves symptom relief and halting disease progression, typically through conservative measures such as physical therapy, medications, and lifestyle modifications. Surgical intervention, like cervical decompression surgery, may be considered if conservative approaches fail or significant cord compression is present, and rehabilitation is crucial for post-operative recovery. This systematic review and meta-analysis aimed to identify common management practices and long-term effects associated with mild CSM, using PRISMA guidelines and focusing on studies published from 2016 to 2023. The study covered various interventions, including isometric exercises and analgesics like ropivacaine, and compare anterior and posterior surgical approaches. The analysis underscored the complexity of mild CSM and emphasized the need for personalized treatment decisions based on individual patient characteristics. The meta-analysis provided valuable insights into the efficacy of interventions, highlighting the consistently effective role of isometric exercises in symptom alleviation, the potential benefits of certain analgesics, and the significant considerations required when choosing between anterior and posterior surgical approaches. While no statistically significant improvements are observed in recovery rate or neck pain reduction with either approach, the study indicated a significant reduction in postoperative hospital stay with the anterior approach, emphasizing its potential advantages in healthcare resource utilization and patient recovery.

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EXPANSION DURAPLASTY FOR SPINAL CORD INJURY DECOMPRESSION: A SYSTEMATIC REVIEW AND META-ANALYSIS STUDY

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Spinal cord injury presents formidable challenges, necessitating timely decompression for enhanced neurological recovery, with expansion duraplasty gaining attention as a surgical approach. This systematic review and meta-analysis aimed to assess the efficacy and safety of expansion duraplasty in SCI decompression, focusing on reducing intradural pressure to mitigate secondary injury mechanisms. Despite increased clinical use, a lack of high-quality evidence underscores the necessity for a thorough review, scrutinizing various aspects such as patient demographics, surgical techniques, and postoperative outcomes. The study's stringent eligibility criteria ensured the inclusion of peer-reviewed, English-language studies focusing on patients diagnosed with SCI undergoing expansion duraplasty. Out of 14 surveyed studies, 10 met criteria, and only four were eligible for meta-analysis. The meta-analysis, encompassing 35 patients, revealed significant findings, indicating that higher ASIA grading correlated with shorter procedural duration. Additionally, monitoring intraspinal pressure post-surgery was notably reduced, and the duration of follow-up exhibited varied impacts on patient outcomes. A study analyzed documented a large number of improvement cases, while two other studies showed high proportions of stable and improved cases, suggesting potential outlier effects. Overall, the meta-analysis provides valuable insights into expansive duraplasty efficacy in SCI cases, emphasizing the importance of factors like ASIA grading, surgical duration, and post-operative monitoring in influencing patient outcomes, with potential implications for informing clinical guidelines and protocols in the challenging field of SCI management.

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Navigated Endoscopic Biportal Lumbar Spine Surgery

Background: Endoscopic Spine Surgery (ESS) has begun to get traction as an alternative to the traditional microscopic and tubular spine surgery particularly for lumbar decompression. It has demonstrated specific benefits in early post-operative recovery, while long-term outcomes remain equivocal, leading to its increasing popularity. However, one of the challenges associated with ESS is the learning curve. Many surgeons have chosen biportal endoscopic spine surgery due to its familiarity with other orthopedic arthroscopic procedures. A recent advancement in the field aims to flatten the learning curve further by incorporating navigation into ESS. This technology provides valuable information about the extent of decompression and confirms the levels while reducing radiation exposure.
Objective/Aim: To provide a technical guide and overview of navigated endoscopic biportal lumbar spine-surgery (NEBLS).
Methods: Patients are positioned prone on a radiolucent table and secured. The navigation system is set up with radiopaque markers set up over the posterior aspect and lateral (contralateral from operated side) of patient. The navigation field generator is positioned over the caudal end of the operating field, overlooking the operating site. A localizing tracker for registration is implanted into the sacrum under II guidance. Final fluoroscopy images are captured in AP and lateral views. Subsequently, standard incisions are made, and endoscopic biportal lumbar decompression is performed. When necessary, the navigated wand can be used to confirm the level, angulation, and extent of decompression. Pictures and videos will be displayed to illustrate the crucial steps of the navigated surgery.
Results: N/A

Conclusion: Our early experience with NEBLS show that it does reduce the amount of intraoperative imaging required and is a reasonably accurate alternative to repeated intra-operative imaging. However, it does come with a significantly long set up time and at present there are no tools available which integrates the navigation onto the camera or decompression instruments which can improve navigation experience significantly. Further trials of larger scale will be required to determine its efficacy.

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Cervical degenerative spondylolisthesis and spinopelvic parameter

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Background: Cervical degenerative spondylolisthesis is a crucial pathology predisposing to cervical myelopathy. While recent attention has focused on the correlation between cervical degenerative spondylolisthesis and cervical parameters like high T1 slope, little is known about its association with spinopelvic parameters.

Objective/Aim: This study aims to explore the link between cervical degenerative spondylolisthesis and Spinopelvic Parameters.

Methods: We analyzed 106 patients who underwent cervical spine surgery (2013–2022) with preoperative whole spine X-rays. Patients with a slip ≥ 2mm on lateral cervical X-rays were categorized into cervical degenerative spondylolisthesis (posterior + anterior) and control groups. Logistic regression assessed the relationship, considering age, gender, BMI, T1 slope, C2-7 angle, C2-7 SVA and spinopelvic parameters (SVA, TK, LL, PI, PT, SS). Subgroup analysis compared posterior and anterior spondylolisthesis groups.

Results: Degenerative cervical spondylolisthesis occurred in 55 cases (35 posterior, 20 anterior). Logistic regression revealed associations with T1slope (odds ratio 1.090, P<0.001*) and PT (odds ratio 1.050, P=0.040*). High PT correlated with cervical degenerative spondylolisthesis, suggesting a potential association with worsened sagittal balance or T1 slope compensation within normal ranges. Comparing posterior and anterior spondylolisthesis groups, no significant T1 slope or spinopelvic parameter differences were observed, but age (68.0±13.0 vs 74.9±6.1, P=0.030*), gender (28M/7F vs 9M/11F, P=0.016*) and C2-7 SVA (29.5±21.8 vs 43.9±19.3, P=0.017*) differed. Relatively young men and a small C2-7 SVA were associated with posterior spondylolisthesis, while older women and a large C2-7 SVA were associated with anterior spondylolisthesis.

Conclusion: Cervical degenerative spondylolisthesis is associated not only with a high T1 slope but also with a high PT.

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Prevalence and Risk Factors of Neuropathic Pain in Patients with a Rotator Cuff Tear

Background: Until now, few studies had investigated the neuropathic pain component in patients with a rotator cuff tear (RCT).

Objective: The aim of the study was to identify the neuropathic pain component in patients with RCT and to determine the factors correlated with neuropathic pain in patients with RCT.

Methods: We prospectively studied 101 patients who were less than 60 years old with full-thickness tears requiring arthroscopic rotator cuff repair and met the inclusion and exclusion criteria. Multiple regression analysis was performed to identify variables that independently affected neuropathic pain in patients with a RCT. The atrophy grades of the rotator cuff muscles were classified on magnetic resonance images according to the Goutallier classification. The size and medial retraction of the RCT were measured during arthroscopic repair for RCT.

Results: Sixteen (15.8%) of the 101 patients had neuropathic pain according to the cutoff values on the DN4 questionnaire for diagnosing neuropathic pain. The neuropathic pain group had significantly higher prevalence of smoking (P = 0.042), more mean VAS during last 4 weeks (P = 0.008), larger cuff tear (P = 0.003), more medial retraction of cuff (P = 0.016), and severe fatty degeneration of rotator cuff than the nonneuropathic pain group.

Conclusion: The prevalence of neuropathic pain in patients with a full-thickness RCT requiring arthroscopic rotator cuff repair was 15.8 %. The neuropathic pain component was more relevant to the severity of pain and tear size in the patients with a full-thickness RCT. It is important to be aware of the existence of neuropathic pain when treating a patient presenting with pain due to a RCT because accompanying neuropathy with a RCT could have a worse effect on repair of a RCT.

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Correlation between Short-Form 36 Scores and Neck Disability Index in Patients Undergoing Anterior Cervical Discectomy and Fusion

Background: Patient reported outcomes and health-related quality of life (HRQOL) measures are frequently used to assess patients' health and their response to spine surgery. The Neck Disability Index (NDI) is one of the widely used tools for evaluating spine-specific outcomes in the neck, and the 36-item Short-Form Health Survey (SF-36) is an effective health status self-assessment tool

Objective: To determine how the Neck Disability Index (NDI), a cervical spine-specific outcome, reflects health-related quality-of-life, and if NDI is correlated to the 36-item Short-Form Health Survey (SF-36) scores.

Methods: We used the Pearson product-moment correlation coefficient to assess the validity of all items under NDI and SF-36, and the Pearson's correlation coefficient to assess the correlation between NDI and total SF-36 scores. The primary outcome measures were spine-specific health status- and general health status-measures after spine surgery, and these were evaluated every year for 2 years, using both NDI and SF-36 scores.

Results: NDI had a strong linear correlation with SF-36 and its two scales, the Physical Component Score (PCS) and the Mental Component Score (MCS), attesting to the validity of these two instruments. Among the eight subscales of SF-36, there was a strong linear correlation between NDI and PCS-physical functioning, PCS-bodily pain, and MCS-role emotional. Further, a moderate linear correlation was observed between NDI and subscales of PCS-role physical, PCS-general health, and MCS-social functioning, and between NDI and MCS-vitality and MCS-mental health.

Conclusion: Our findings suggest that the NDI adequately reflects the patient's physical and mental quality of life, implying that the use of NDI to assess functional outcomes can also be ultimately used to evaluate the patient's quality of life.

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A novel angle as one predictor for cage placement feasibility in surgical process of basilar invagination

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Background: Direct posterior reduction and manipulation of the atlantoaxial joint, accompanied by placement of spacers, is the state-of-the-art technique for treating basilar invagination (BI) and atlantoaxial dislocation (AAD). The hindrance of occiput to reaching up to the true atlantoaxial facets (AAF) during the surgery remains challenging for cage placement.
Aim: The aim of this study was to explore an objective and precise method of measuring the effect of the hindrance of occiput to reaching up to the true AAF and cage placement during surgery.
Methods: We collected the clinico-imaging data of 58 patients with BI and AAD (Group A) who underwent surgery in our hospital, and 78 control cohorts (Group B) were retrieved retrospectively. We measured facet-occiput slope angle (FOSA) in midsagittal CT (Figure 1). Patients were positioned prone for surgery based on preoperative flexion O–C2a, and access to the true AAF was observed intraoperatively. The cut-off value of FOSA for the feasibility of cage placement in BI and AAD patients was appointed when access to the true AAF was impossible due to the hindrance of occiput during surgery.
Results: The cut-off value of FOSA for the feasibility of cage placement was 34° with an area under the curve AUC of 0.800 (95 % CI: 0.672–0.928, P < 0.001) and the Youden index of 0.607. In patients with FOSA >34°, reaching up to the true AAF and 3D-printed cage placement was impossible. FOSA was negative in Group A and positive in Group B, significantly larger in females compared to males in both groups and significantly larger postoperatively in Group A.
Conclusion: FOSA can objectively measure the feasibility of cage placement when the patient is positioned prone per preoperative flexion O–C2a. A FOSA >34° is contraindication for cage placement.

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The effect of Fresh Osteoporotic Vertebral Compression Fractures in the Elderly on the Degree of Bone Mineral Density Increase with Romosozumab Administration

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Background: The effect of romosozumab ("ROMO"), whose main action is modeling, may be less effective in increasing bone mineral density(“BMD”) in the whole body when it is administered immediately after fresh osteoporotic vertebral compression fracture ("OVF"), as cells are used for bone repair. The purpose of this study is to investigate the effect of ROMO on bone mineral density in newly diagnosed OVF patients, especially in the elderly.
Method: Patients aged 75 years or older were defined as elderly, and those with at least 1 year of follow-up were included. Investigation period was 2019-2022. The study compared 22 patients (group F) with new OVF who received ROMO early in the treatment period and 49 patients (group N) without new OVF and started ROMO as an outpatient. The collected the data of bone density before and after ROMO administration, and TRACP5b, totalP1NP and 25OHvitaminD as blood data. Statistical methods included Mann-Whitney-U for comparison of the two groups and multiple regression analysis with the rate of increase in BMD as the objective variable.
Results: There was no significant difference in background factors, and group F had significantly lower lumbar spine BMD (group F: 5.8%, group N: 13.7%, p<0.001) and femoral neck BMD (group F: 0.1%, group N: 3.6%, p=0.07). Multiple regression analysis also showed that increased lumbar spine BMD was associated with total P1NP (p=0.001) and the presence of new OVF (p=0.04).
Discussion and Conclusion: The results of this study show the effect of ROMO on increasing BMD in elderly patients with new OVF was significantly less than in those without fracture. There is a possibility that in the elderly, mesenchymal stem cells are depleted, and when new OVF occurs, the cells are utilized at the fracture site, so the effect of increasing BMD in the whole body was not achieved.

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Mode establishment and preliminary clinical application effect analysis of anterior cervical surgery in outpatient setting

Objective: To establish the mode of anterior cervical surgery in outpatient setting, and evaluate its preliminary effectiveness.
Methods: A clinical data of patients who underwent anterior cervical surgery between January 2022 and September 2022 and met the selection criteria was retrospectively analyzed. The surgeries were performed in outpatient setting (n=35, outpatient setting group) or in inpatient setting (n=35, inpatient setting group). There was no significant difference between the two groups (P>0.05) in age, gender, body mass index, smoking, history of alcohol drinking, disease type, the number of surgical levels, operation mode, as well as preoperative Japanese Orthopaedic Association (JOA) score, visual analogue scale score of neck pain (VAS-neck), and visual analogue scale score of upper limb pain (VAS-arm). The operation time, intraoperative blood loss, total hospital stay, postoperative hospital stay, and hospital expenses of the two groups were recorded; JOA score, VAS-neck score, and VAS-arm score were recorded before and immediately after operation, and the differences of the above indexes between pre- and post-operation were calculated.
Results: The total hospital stay, postoperative hospital stay, and hospital expenses were significantly lower in the outpatient setting group than in the inpatient setting group (P<0.05). The satisfaction of patients was significantly higher in the outpatient setting group than in the inpatient setting group (P<0.05). The JOA score, VAS-neck score, and VAS-arm score of the two groups significantly improved at immediate after operation when compared with those before operation (P<0.05). No surgical complications, such as delayed hematoma, delayed infection, delayed neurological damage, and esophageal fistula, occurred in the two groups.
Conclusion: Outpatient surgery mode can significantly shorten the postoperative hospital stay, reduce hospital expenses, and improve the patients’ medical experience. The key points of the outpatient mode of anterior cervical surgery are minimizing damage, complete hemostasis, no drainage placement, and fine perioperative management. 【Key words】 Anterior cervical surgery; cervical spondylopathy; outpatient surgery.

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Posterior ligamentous complex reconstruction with artificial ligament in patients without cervical vertebral fracture: a technical note

Introduction: We describe an original surgical technique, advantages with the novel technology, and postoperative condition of patient who was first used of artificial ligament in reconstruction surgery of posterior complex ligamentous (PLC) injuries in patients without lower cervical vertebral fracture. The aim of this technique is to retain the mobility of the injured segment as much as possible on the basis of spinal stability, and try to treat these patients with dynamic reconstruction.
Methods: Detailed description of the reconstruction surgery with artificial ligaments carried out for C4-6 posterior complex ligamentous injuries in a 27-year-old male, with neck pain and restricted movement due to high fall injury accompanied by impaired movement of limbs, is presented.
Results: Immediately postsurgery, the patient's neck pain and quadriparesis had been improved. The spinal canal decompression and cervical spine sequence was satisfactory, the facet joint face was in good position and spinous process spacing returned to normal. After three months of rehabilitation, the patient reported improvement of symptoms, physical and imaging examination showed a significant improvement in the patient's condition. The patient's neck mobility motor function had improved further.
Conclusion: The present data demonstrates that the novel technique for reconstruction of PLC injury is feasible and safe. However, familiarity with cervical anatomy and adequate experience for the lateral mass screws placement during surgery are crucial for this procedure. Therefore, this surgery should be best conducted by a highly experienced cervical surgery team.

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The effect of the difference in C2-7 angle on the occurrence of dysphagia after anterior cervical discectomy and fusion with the Zero-P Implant System
Objective: The purpose of this retrospective study was to investigate the effect of the difference in C2-7 angle on dysphagia after anterior cervical discectomy and fusion (ACDF) with the Zero-P Implant System.
Methods: A retrospective analysis of 181 patients who underwent ACDF with the Zero-P Implant System and had at least one year of follow-up was performed from January 2011 to November 2018. All patients were divided into a non-dysphagia group and a dysphagia group to explore the effect of difference between postoperative and preoperative C2-7 angle (dC2- 7A) on postoperative dysphagia. At the same time, other possible related factors including the difference between postoperative and preoperative O-C2 angle (dO-C2A), sex, age, body mass index(BMI), intraoperative time, estimated blood loss, diabetes mellitus, hypertension, smoking, alcohol consumption, prevertebral soft-tissue swelling(PSTS), the highest segment involved in the surgery and the levels of surgery segments were analyzed.
Results: There were 139 patients in the non-dysphagia group and 42 patients in the dysphagia group. The single-factor analysis showed smoking, PSTS and dC2-7A was significantly different between two groups (P0.05). The results of multiple-factor analysis with an ordinal logistic regression model showed that smoking, PSTS and dC2-7A were significantly associated with the incidence of dysphagia ($P<0.05$).
Conclusion: The postoperative C2-7 angle has an important effect on the occurrence of dysphagia in patients undergoing Zero-P implant system interbody fusion surgery.

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Comparison of patient-reported postoperative dysphagia in patients undergoing one level versus two-level anterior cervical discectomy and fusion with the Zero-P Implant System
Introduction: We hypothesize that a greater number of surgical levels may result in a higher incidence of dysphagia due to more dissection of soft tissue, although whether the incidence of postoperative dysphagia differs between these procedures in anterior cervical discectomy and fusion (ACDF) with the Zero Profile (Zero-P) Implant System is unknown. Thus, the purpose of this retrospective study was (1) to investigate whether the incidence of postoperative dysphagia differs between one-level and two-level ACDF with the Zero-P and (2) to examine patient characteristics that may be associated with the occurrence of dysphagia after ACDF with the Zero-P.
Material and Methods: A retrospective analysis of 208 patients who underwent ACDF with the Zero-P Implant System and had at least one year of follow-up was performed from January 2013 to December 2018. The patients were divided into two groups based on the number of operated levels (one-level group, N=86; two-level group, N=122). Dysphagia was assessed based on the Bazaz grading system. The incidence of dysphagia and the severity of dysphagia at each follow-up were compared between the two groups. The patients were divided into two groups (nondysphagia group, N=160; dysphagia group, N=48), and covariates were obtained for multivariate analysis, including demographic parameters, surgical parameters, and radiographic parameters.
Results: The results showed that the incidence and severity of postoperative dysphagia in the two-level group were significantly greater at 1 week, 1 month and 3 months postoperatively than those in the one level group. The results of ordinal logistic regression showed that older age, two-level surgery, greater prevertebral soft tissue swelling (PSTS) and the difference between the postoperative and preoperative C2- 7 angle (dC2-7A) were significantly associated with a higher incidence of dysphagia after ACDF with the Zero-P.
Conclusion: Two-level ACDF with the Zero-P can result in a significantly greater incidence and severity of transient postoperative dysphagia. Older age, greater PSTS and the dC2-7A were also associated with postoperative dysphagia after ACDF with the Zero-P.
Keywords: ACDF, Zero-P, Cervical degenerative disc disease, Dysphagia

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Management of asymptomatic vertebral artery injury caused by a cervical pedicle screw malposition: a case report.
Background: Iatrogenic vertebral artery (VA) injury in cervical instrument surgery is a rare complication but could lead to serious sequelae. The criteria for dealing with this issue are not elucidated.
Objective: The authors report a successful case of internal trapping for preventing delayed onset thromboembolic complications after asymptomatic VA injury caused by a cervical pedicle screw malposition.
Methods: Posterior decompression and fixation from C3 to C6 was performed to patient with cerebral palsy. No arterial bleeding was observed during the operation, and no deterioration of neurological symptoms was observed after the operation. However, postoperative CT revealed a perforation of the right C3 transverse foramen by a pedicle screw. On CT angiography, the stenosis of right VA was at the C3 pedicle screw insertion site. VA angiography was conducted because it was difficult to judge from CT angiography whether the screw had caused intima damage. Right VA angiogram showed a 70% stenosis at the screw insertion site. The left VA was larger in diameter than the right VA.

Result: A 6-Fr Optimo balloon guiding catheter was placed in the right VA, and a Headway 17 microcatheter was navigated to the distal side of the screw by using a CHIKAI 14 micro guidewire. After a balloon occlusion test, the right VA was embolized with coils from the cranial side to the caudal side of the stenosed site. After embolization, the neurological findings did not worsen, and the MRI revealed no acute infarction. At the 24-month follow-up, he has not experienced any ischemic stroke.
Conclusion: Since the vessel was highly stenosed and there was concern about the risk of thrombus formation due to stagnation of flow, and the possibility of intimal damage could not be ruled out, internal trapping was performed considering the risk of delayed ischemic stroke that could cause serious sequelae.

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3D printing as a useful modality to aid Dystrophic Scoliosis Correction in Neurofibromatosis – A report of 2 cases

Background: Neurofibromatosis (NF) is associated with severe scoliosis with dural ectasia resulting in vertebral scalloping and spinal canal widening. This makes pedicle screw placement, as well as performing corrective osteotomies challenging due to the altered anatomy.
Objective: We present 2 patients with Neurofibromatosis type 1 and dystrophic scoliosis where use of pre-operative 3D printing improved surgical planning for a safer correction of their deformities.
Methods: Both patients consented to data extraction, radiographs, and clinical photos.
Results: Patient 1 was a 21-year-old Male with previous spinal instrumentation at 6 years of age. Severe left lumbar kyphoscoliosis was noted causing skin tenting. Radiographs showed a Cobbs angle of 107degrees from T12 to L5. He underwent L3-4 and L4-5 discectomy and removal of implants and application of halo. Second stage surgery involved left anterior thoracotomy with 5th rib resection, T3 to T9 anterior releases and discectomy with insertion of pedicle screws from T2 to T9 and sublaminar bands passed under T5. Four Smith-Petersen osteotomies were performed from T4 to T9 with vertebral column resection of L1-3. 3 weeks later, patient underwent the third and final stage surgery comprising vertebral body resection from L1 to L4, laminectomy of T12 and correction of scoliosis from T2 to ilium with rod placement. Patient 2 was a 50-year-old Female with right sided lumbar kyphoscoliosis. Radiographs showed a cobbs angle of 78 degrees from T12 to L3. She underwent anterior lumbar interbody fusion from L3 to S1 with interbody cages and application of halo frame. An interval second stage posterior instrumentation and correction of scoliosis from T9 to ilium was performed with symmetric pedicle subtraction osteotomy at L2 with multiple Smith-Peterson osteotomies from T8 to L3.
Conclusion: 3D printing in these 2 cases helped us plan and select levels to instrument, avoiding thinned pedicles, yet maintaining adequate screw density, plan osteotomy cuts at thinnest parts of bone, aided visual and tactile verification of bony anatomy intraoperatively and identify landmarks to localize the entry points for releases and bone cuts.

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The Impact of Adolescent Idiopathic Scoliosis on Flexion-Extension Range of Motion

Objective: To investigate flexion-extension range of motion in patients with Adolescent Idiopathic Scoliosis
Background: AIS is the most common cause of scoliosis, yet research into the range of motion in untreated patients is lacking. AIS patients are generally known to have reduced ranges of motion, especially in lateral bending and axial rotation. However, the range of motion in flexion-extension remains an area for investigation. Currently, one other study has investigated this via clinical measurements, and concluded that curve magnitude did not significantly impact flexion-extension. Other factors that may influence flexion-extension require further investigation.
Methods: Preoperative data such as age, gender, body mass index (in kg/m2) and their Risser age were taken. Radiographic data collected included Cobb angles and degree of movement in the flexion-extension films from the T12-S1 vertebrae. The degree of movement was measured by measuring the change in the angle between the inferior endplate of the superior vertebrae and superior endplate of the inferior vertebrae. The patient population was further divided into thoracic-dominant and thoracolumbar-dominant curves based on the Criteria for Selective Fusion and their Risser age. The data was then analysed based on the other data collected.
Results: A total of 63 patients were involved in the study (n=53 females, n=10 males). They had a mean age of 15.9 ±3.00 years old, mean BMI of 18.6±2.82 kg/m2. The mean major Cobb angle of the total patient population was 53.5±9.23 degrees. The degrees of movement at each level are as follows:
T12-L1: (2.67±3.96) degrees, L1-L2: (4.75±4.45) degrees, L2-L3: (7.56±4.98) degrees,
L3-L4 (8.87±4.76) degrees, L4-L5: (12.3±6.00) degrees and L5-S1:(11.5±7.99) degrees
Conclusion: By using radiographic data, this study identified that curve magnitude, joint laxity or curve type were not significant factors in impacting sagittal range of motion. An extension of this study could be done to investigate the impact of AIS on axial rotation and lateral bending.

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Post-operative Rod Straightening In Thoracoscopic Adolescent Idiopathic Scoliosis Correction Is More Common With Skeletal Immaturity But Does Not Result In Increased Adverse Outcomes

Background: Post-operative rod straightening is a unique phenomenon seen in thoracoscopic fusion for correction of adolescent idiopathic scoliosis. This has not been previously described in fusion surgeries for spinal deformity correction, and its underlying mechanism remains unknown.
Objective: To establish whether post-operative rod straightening in thoracoscopic single-rod fusion for correction of adolescent idiopathic scoliosis affects surgical outcomes.
Methods: We performed a retrospective review of data for female patients aged 11 to 20 years old with Lenke 1 curves that underwent thoracoscopic fusion for correction of adolescent idiopathic scoliosis between June 2000 to July 2013. Patients with post-operative screw pullouts were excluded. Patients with rod straightening (≥5°)(Group 1) seen on follow up were compared to those without rod straightening (<5° angular change)(Group 2). Our primary outcome measures were maintenance of overall curve correction over time, complications, and re-operation rates.
Results: 19 out of 40 (47.5%) thoracoscopic fusions without screw pullout demonstrated rod straightening (≥5°). Mean angular change of the rods were 7.7 ± 2.7° and 3.2 ± 1.4° in Group 1 (n=19) and Group 2 (n=21) respectively (p<0.001). Both groups showed similar (i) preoperative main thoracic curve sizes and flexibility, (ii) post-operative curve correction and maintenance of correction, (iii) complication profiles including adding on, loss of correction (>5°), rod breakage, and (iv) reoperation rates (Table 1). Mean follow up duration was similar between the groups at 98.6 ± 37.8months (Group 1) and 93.0 ± 43.2months (Group 2)(p=0.662). The proportion of patients with Risser Grade 0-3 at time of surgery was significantly higher in Group 1 at 78.9% (15/19 patients) than Group 2 at 14.3% (3/21 patients)(p<0.001).

Conclusion: Postoperative rod straightening is common in thoracoscopic fusion for adolescent idiopathic scoliosis correction, especially in the skeletally immature, without resultant increase in loss of curve correction, complications, and re-operation rates.

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Anterior cervical X-shape-corpectomy and fusion vs. anterior cervical corpectomy and fusion for two-level cervical spondylosis.

Introduction: When treating cervical spondylosis (CS) with moderately intricate compressions, the choice between two mainstream surgical techniques, anterior cervical corpectomy and fusion (ACCF) and anterior cervical discectomy and fusion (ACDF), could be a dilemma that ACCF shows sufficient surgical field decompression range while ACDF has fewer adverse events. To realize better management for CS patients, Anterior cervical X-shaped-corpectomy and fusion (ACXF) was proposed. ACXF aims to blend the strengths of both ACCF and ACDF to provide an alternative surgical option for two-level CS. ACXF was anticipated to have a broad surgical field, sufficient decompression range and fewer surgical adverse events.

Objective: The purpose of this study was to verify the clinical effect of ACXF in treating two-level CS by comparing to ACCF.

Methods: A retrospective comparative study was conducted in two cohorts of patients who underwent ACXF or ACCF to treat two-level CS between September 2019 and May 2021. Clinical and radiographical data of all the patients were collected preoperatively and at 3 months, 6 months, and 1 year postoperatively, followed by intra- and intergroup analyses and comparisons.

Results: A total of 57 patients were included, among whom 24 underwent ACXF and 33 underwent ACCF. The baseline data showed no intergroup significant difference. The ACXF group has significantly shorter drainage durations (2.13±0.61 vs. 3.48±1.30, $P < 0.001$) and drainage volumes (30.21±26.88 vs. 69.30±37.65, $P < 0.001$) than the ACCF group. ACXF could reach a transverse decompression range (TDR) of 11.72±1.26 mm, and significantly enlarged anteroposterior canal diameter ($P < 0.01$) and spinal canal area (SCA) ($P < 0.01$). Both techniques significantly improved clinical outcomes with comparable effects ($P > 0.05$). Meanwhile, the incidence of each complication in ACXF group was lower than that in ACCF group without significant difference ($P > 0.05$). ACXF achieves comparable fusion rate ($P > 0.05$) and significantly lower subsidence rate ($P < 0.01$) than ACCF at all time points.

Conclusion: As an innovative technique that combines ACCF and ACDF, ACXF has shown excellent clinical effects with a broad surgical field, sufficient decompression range, smaller subsidence rate and fewer complications. Thus, ACXF would be an ideal alternative treatment for part of two-level CS patients. However, further improvement and modification needs to be explored, especially about the development of ACXF-specialized internal fixation system.

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Long-Term Outcome of Three Approaches in Surgical treatment for Multilevel Cervical Spondylotic Myelopathy: Retrospective Cohort Study of 144 Cases Over An 8-year Follow-up

Background: Previous short-term study showed similar neurological outcomes for the three approaches, namely, anterior, posterior, and combined approaches for multilevel cervical spondylotic myelopathy (MCSM). However, we hypothesize that the combined approach might present better long-term neurological recovery.

Objective: This study aims to investigate the long-term neurological function recovery of cervical decompression surgery via three different approaches.

Outcome Measures: Consecutive MCSM patients confirmed clinically and radiologically who underwent cervical decompression surgery involving at least three intervertebral segments from January 2012 to May 2014 were included. Patients were classified into 3 groups by approach. Demographic data, perioperative variables, radiological features and neurological conditions (Japanese Orthopaedic Association score, JOA score) were assessed. Neurological function recovery, which was assessed by JOA recovery rate (JOARR) at two postoperative follow-up points: short- (over 12 months) and long-term (over 96 months).

Results: A total of 163 consecutive patients were enrolled and ultimately, 153 patients (93.9%) achieved short-term follow-up (minimum 12 months, average 20.5±7.6 months), and 144 (88.3%) achieved long-term follow-up (minimum 96 months, average 109.8±9.2 months). Of the 144 patients, there were 51 women and 93 men; the average age was 55.6±9.3 years; 17, 69, and 58 patients underwent the anterior, posterior, and combined approach, respectively. At the short-term follow-up, the JOARR of the three groups was 61.5% ± 25.1%, 53.6% ±46.1%, and 68.9% ± 23.7%, respectively (p=0.177). At the long-term follow-up, all three groups showed worsened JOARR compared with short-term follow-up (anterior: 57.5% ± 34.7%, posterior: 44.8% ± 52.2%, combined: 60.3% ± 52.3%; p=0.049). Two patients in the posterior group received revision surgery 1 year due to recurrent symptoms.

Conclusions: Over 8-year follow-up period, the three surgical approaches for MCSM achieved good neurological outcomes. The combined approach presented higher efficacy than posterior approach in neurological function preservation in both short- and long-term follow-up.

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Revolutionizing Care for Traumatic Cervical Spinal Cord Injury: The Integration of Expansion Duroplasty in Posterior Decompression – A Case Report

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Keywords: Traumatic cervical spinal cord injury, duroplasty, spinal decompression

Disclosures: No disclosures Traumatic spinal cord injury causes significant declines in quality of life and increases financial burdens.

1 Surgical intervention within 24 hours of the injury can significantly improve neurological outcomes. 3,4 Advances have been made but management remains challenging and outcomes remain uncertain. 5 This is a case of a 35-year-old male with cervical traumatic spinal cord injury managed with laminectomy and duraplasty. The patient received C5 as the last normal level for sensation. C5 motor was ⅗, C6 to C7 were ⅕, and a grade of 0/5 below. The no perianal sensation, bulbocavernosus reflex, clonus nor Babinski reflex was appreciated. Computed tomography scan showed C3 spinolaminar fracture, C4 bilateral laminar fracture, and C5 burst fracture with posterior elements translating anteriorly to the canal. MRI revealed spinal cord edema from C3 to C6, absence of CSF flow anteriorly and posteriorly at C5, and 8mm canal diameter. At 20 hours postinjury, patient underwent C3-C6 posterior decompression, C3-C6 instrumentation, and expansion duraplasty. At postoperative day 1, sensory improved from grade 0/2 to 1/2 at C6 to S5; the patient converted from ASIA A to ASIA B. Postoperative day 3, C5 myotome improved from ⅗ to 5/5 bilaterally while 1/5 for C6 and C7; the patient is now ASIA C. At 3 weeks, noted motors improved: C6 and C7 from ⅕ to ⅖ bilaterally, and C8 and T1 myotomes bilaterally were 0/5 to ⅕, and lower extremities from 0/5 in all myotomes to ⅕ on right L2 and L3; left L2 improved from ⅖ to ⅗ and left L4 from ⅕ to ⅘. Bony decompression without

expansion duraplasty is analogous to decompressive craniectomy without durotomy for traumatic brain injury, which is largely ineffective at reducing intracranial pressure.2,6,7 Duroplasty may be able to change the standard of care for managing patients with traumatic spinal cord injuries.

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Cerebrospinal fluid leak and epidural haematoma following excision of intradural spinal tumours – need for a drain?

Glenys POON, Chin Lik TAN, Tseng Tsai YEO

Background: Cerebrospinal fluid (CSF) leak and epidural haematoma are two possible complications following surgery for excision of intradural spinal tumours. Some surgeons advocate the use of subfascial drain to reduce the risk of these complications. However, the effectiveness of this practice is still not well understood.

Objectives: To review the effectiveness of subfascial drain placement in preventing CSF leak and epidural haematoma in surgery for intradural tumour excision.

Methods: Clinical notes for adult patients (>18 years old) who underwent intradural spinal tumour excision between January 2020 and November 2023 at our institution was reviewed. Data on occurrence of CSF leak and epidural haematoma that required surgical intervention within 30 days from surgery was collected.

Results: A total of 47 patients (12 male, 35 female; age 54.7 ± 16.2 years old) were included in this study. The most common histology was schwannoma (n=26, 55.3%) followed by meningioma (n=12, 25.5%). Of these, only two patients (4.3%) had a subfascial drain inserted during operation. Within 30 days from surgery, there was only one case (2.1%) of CSF leak that required return-to-operating room for dural repair and insertion of lumbar drain. One patient returned with a pseudomeningocoele presenting as a back lump without CSF leak, but this resolved with conservative management. There was no case of post-op epidural haematoma. Both the patients with drain inserted did not suffer from any complication.

Conclusion: The low rate of use of subfascial drain in our institution precludes a direct comparison of the outcome with surgeries performed without a drain. However, based on our series, the rates of CSF leak and epidural haematoma following surgery for excision of intradural tumours are low. Hence we propose that drains need not be routinely inserted following such surgeries, to prevent drain-related complications.

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Risk factors of bone loss after Prestige-LP cervical disc arthroplasty

Background: Cervical disc arthroplasty (CDA) is a potentially feasible alternative surgical technique for patients with cervical disc degeneration disease (CDDD). Periprosthetic bone loss (BL) is a radiological phenomenon which was proposed in recent years. The impact on surgical outcome and inner mechanism of BL are still unclear.

Objective: This study aims to the study aims to comprehensively explore the risk factors of BL and attempted to furtherly reveal its underlying mechanism.

Methods: A retrospective and comparative study was conducted of consecutive patients who had undergone one-level CDA, two-level CDA or two-level hybrid surgery (HS) at our institution to treat CDDD. Demographic and perioperative data were routinely recorded. The radiological images of all patients at pre-operation, 1-week post-operation and last follow-up were collected to evaluate the following radiological parameters. Patients were divided into different groups in reference to existence and degree of BL, following with inter-group comparisons.

Results: A total of 324 patients were enrolled in this study, among whom 170 underwent one-level CDA, 120 underwent two-level CDA and 94 underwent two-level HS, with 384 arthroplasty segments involved in total. BL was detected in 57.72% (187/324) patients and 53.91% (207/384) arthroplasty segments during the whole follow-ups. The final multivariate regression model shows that age≥45 years and two-level HS were independently associated with a lower risk of BL. Besides, a greater change of disc angle (ΔDA) was an independent risk factor of BL. The results further indicated an association between two-level HS and lower severity of BL. Severe BL was demonstrated to lead to a higher rate of endplate subsidence and collapse.

Conclusion: Younger age and greater ΔDA were independent risk factors of BL, while HS potentially exerted preventative effect. Bone remodeling and micromotion may potentially initiate the BL process. Simultaneously, intraoperative procedures may also influence the occurrence of BL.

Subsequent research should focus on elucidating the mechanisms and preventive measures for severe BL.

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Predicting postoperative cervical imbalance after open-door laminoplasty in patients without preoperative imbalance in patients with multilevel degenerative cervical myelopathy: A retrospective study

Background: The laminoplasty (LP) is an effective method for the treatment of multilevel degenerative cervical myelopathy (MDCM). The postoperative increase in C2-7 sagittal vertical axis (cSVA) after LP could lead to cervical pain and have impact on long-term neurological function and quality of life. However, the risk factors of posterior cervical imbalance (cSVA more than 40 mm) remain controversial.

Objective: This study aimed to investigate the risk factors for post-LP cervical imbalance in patients without preoperative cervical imbalance for treating MDCM.

Methods: A total of 259 MDCM patients without preoperative imbalance who conventional LP between January 2015 and January 2022 were enrolled and followed up for a minimum of a 12-month. The patients were divided into balance(B) group and imbalance (IB) group based on postoperative cSVA. The clinical and radiological measurements were collected preoperatively and at the final follow-up.

Results: Of the 259 patients, there were 169 males and 90 females, and the average age is 55.2±10.5 years old. There was a total of 18 patients who developed postoperative cervical imbalance, and 241 patients did not. No significant difference in postoperative Japanese Orthopedic Association score recovery rate was found between the B and IB groups (P>0.05). The IB group presented significantly higher age, greater preoperative cSVA, higher male ratio, more segments operated on and higher incidence of hypertension and diabetes mellitus. Forward multivariate analysis revealed that male sex (OR=11.78, p=0.036), higher preoperative cSVA (OR=1.23, $p < 0.001$), diabetes mellitus(OR=5.2, p=0.019), higher preoperative C2-7 Cobb angle(OR=1.13, p=0.006) are independent possible risk factors, while higher preoperative C7 slope (OR=0.86, p=0.028) was protective factors for cervical imbalance.

Conclusions: Male sex, higher preoperative cSVA, diabetes mellitus and higher preoperative C2-7 Cobb angle are independent possible risk factors for cervical imbalance, while higher preoperative C7 slope was protective factors for cervical imbalance.

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Anterior cervical revision surgery

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Introduction: We report the intraoperative findings and postoperative course of three cases of anterior cervical revision surgery performed in our institute.

[Case1] A 67-year-old man underwent C2-5 anterior decompression fusion surgery for progressive myelopathy caused by cervical OPLL. Postoperative CT showed some residual ossification and insufficient decompression. The patient had residual hand numbness on the side of the residual ossification and decreased grip strength compared to the opposite side. The patient requested reoperation one year after the initial surgery. The reoperation was approached from the same side as the initial surgery. Soft tissue scar formation was observed on the plate and on the dura mater, but the surgery was completed without major problems.

[Case 2] 48-year-old male. After cervical total disc replacement, implant failure was observed. Two months after the initial surgery, the implant removal and anterior fusion surgery was performed. Reoperation was performed from the same side as the initial approach. The surgery and postoperative period were uneventful, and the patient had no major postoperative complications.

[Case 3] 45-year-old male underwent anterior decompression and fixation of C3-5 for C3/4 adjacent intervertebral disorders after C4-6 anterior surgery performed 8 years before. Because of concerns about soft tissue adhesion due to the long course since the initial surgery, a contralateral approach was chosen. The soft tissue of the contralateral side (initial surgery side) of the anterior neck was stiff, and it was difficult to move the trachea and esophagus to the opposite side. Postoperatively, the patient developed hoarseness.

Discussion: The possibility of asymptomatic vocal cord palsy or recurrent nerve palsy on the entry side during the initial surgery should be considered. Preoperative otolaryngological examination (swallowing evaluation, laryngoscopy, etc.) is recommended for revision surgery. To avoid bilateral recurrent nerve injury, a reoperative approach ipsilateral to the initial surgery is recommended.

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Impact of surgical timing on neurological outcomes for acute traumatic central cord syndrome – a single institution perspective

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Introduction: Acute traumatic central cord syndrome (ATCCS) is the most common form of incomplete spinal cord injury. There have also been recent paradigm shifts in the management of ATCCS, with evidence advocating for early surgery to improve, but this has yet to be demonstrated in Asian populations.

Aim: Describe the characteristics of patients with ATCCS and analyse the impact of surgical timing on outcomes.

Material and Methods: We conducted a retrospective, single-center cohort study of patients with ATCCS in our tertiary institution from January 2015 to June 2023. The primary outcome was improvement in American Spinal Injury Association (ASIA) impairment scale (AIS) grade on 6-month follow-up. Secondary outcome was improvement in functional impairment measure (FIM). Timing of operation was stratified into 4 groups based on time of admission: < 24 hours, 24 – 48 hours, 48 – 72 hours and > 72 hours.

Results: 94 out of 152 patients were excluded, resulting in 58 patients for analysis. The mean age was 65.5 (SD 11.3) years and median AIS grade was D (Range 2). 37 (63.8%) patients underwent surgery, with the median time to operation being more than 72 hours. At 6-months follow-up, 17 (29.3%) patients had improvement by at least 1 AIS grade. There were no significant differences between conservatively and surgically treated patients in AIS grade improvement ($p = 0.49$) and FIM improvement ($p = 0.18$). There were no significant differences in timing of surgery for primary ($p = 0.07$) and secondary outcomes ($p = 0.09$). Logistic regression showed that timing of surgery was not significantly associated with AIS grade improvements and also that age, presenting UEMS and LEMS were significantly associated with improvement in FIM.

Conclusion: There were no significant differences in outcomes between surgically treated and conservatively managed ATCCS, and timing of surgery was not found to be significantly associated with outcomes in our institution.

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Gender Disparities and Trauma Influence in Anterior Cervical Spine Surgery: A 1-Year Retrospective Analysis of ACDF and ACCF in dr. Moewardi Public Hospital

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Background: Anterior Cervical Discectomy and Fusion (ACDF) and Anterior Cervical Corpectomy and Fusion (ACFF) are cervical operating procedures indicated for cervical myelopathy caused by traumatic or non-traumatic injury such as degenerative, infection, or metabolic bone diseases on the cervical spine region. However, data of patients who underwent these procedures have not been documented in our hospital which served as a tertiary referral hospital

Objective: This study aims to evaluate the demographic profiles of patients who underwent ACDF and ACCF for the last one-year period at Dr. Moewardi Public Hospital, Indonesia

Methods: We retrospectively reviewed medical records of patients who had ACDF and ACCF procedures at Dr. Moewardi Public Hospital from October 2022 to October 2023. Patients with complete medical records and follow-up data were included, and patients with a history of prior cervical spine surgery were excluded. Data including patients' age, sex, the chosen procedure (ACDF or ACCF), and classification of cervical spine pathology (Trauma or non-trauma) were collected. The data were analysed using SPSS version 23.

Results: A total of 23 patients were involved (4 males and 9 females, 22-72 years old). ACDF was more common than ACFF procedure with ratio of 2:1 (69.6%) and (30.4%) and it was also more common due to non-traumatic injuries (10 patients). The number of traumatic and non-traumatic injuries were 10 (43.5%) and 13 (56.5%) patients, with majority of men experienced traumatic injuries (9 patients).

Conclusion: In the examined one-year period at Dr. Moewardi Public Hospital, there are 23 patients underwent ACDF or ACCF procedures. ACDF was more prevalent, particularly in non-traumatic cases. Majority of the patients were men with trauma being the significant factor. This study highlights demographic and procedural trends, offering insights for future research and clinical considerations in managing cervical spine pathology in the region.

Keywords: Anterior Cervical Discectomy and Fusion, Anterior Cervical Corpectomy and Fusion, Cervical Spine Surgery, traumatic injury, non-traumatic injury

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Deep learning model for automatic diagnosis of 'Sandwich' deformity using X-ray images

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Background: The 'Sandwich' deformity is a distinct anomaly observed in the craniocervical junction, which results in an elevated risk for C1-C2 dislocation or atlantoaxial dislocation (AAD). Given the low incidence rate along with limited experience in diagnosing and treating it among doctors leading to a high rate of missed diagnoses or misdiagnoses significantly impacting early detection and treatment as well as disease prognosis for these patients.
Objective: The study is aimed to develop a model which can diagnose this condition using readily available X-rays so that patients can be diagnosed at the earliest possible stage.
Methods: A retrospective study was conducted on all patients who underwent surgery for atlantoaxial dislocation in the Department of Orthopedics at Peking University Third Hospital from January 1, 2022 to December 31, 2022. Extension, neutral, and flexion lateral view X-ray images of these patients were collected for model train, validation, and testing. ResNet50 was applied as the base model for training. Precision, recall, f1-score, and area under curve (AUC) of receiver operating characteristic curve were employed to assess the performance on the test set.
Results: A total of 249 patients were enrolled to the study, with 747 images were enrolled for training, validation, and testing dataset. Among these patients, 'sandwich' deformities were observed in 46 individuals (18.5%), while 'non-sandwich' deformities were present in the remaining 203 cases (81.5%). The precision, recall, f1-score, and AUC of 'sandwich' deformities was 0.56, 0.83, 0.67 and 0.92, respectively.
Conclusion: A diagnostic model for the identification of 'sandwich' deformity was developed and validated, which can facilitate the diagnosis and screening of diseases associated with this deformity on a larger scale.

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Clinical and radiological outcomes following foramen magnum decompression for Chiari 0 malformation

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Background: Chiari 0 malformation is a rare recently-described form of Chiari malformation, whereby patients experiences symptoms similar to Chiari 1 malformation but without evidence of tonsillar herniation. However, the definitive management for this condition remains uncertain.
Objective/Aim: To present a case of Chiari 0 malformation we managed, and to review the current literature to understand the surgical strategies previously attempted, and their clinic-radiological outcomes.
Methods: Review of patient's case note and imaging, followed by literature review of the topic.
Results: A 53 year-old woman presented with several months of neck pain and dysaesthesia in left upper limb and chest. Magnetic resonance imaging (MRI) spine revealed a syringomyelia from C2 to T7, but without tonsillar herniation fulfilling Chiari 1 criteria. She was diagnosed with Chiari 0 malformation, and underwent foramen magnum decompression (FMD). Five months later, her limb pain and sensation have improved. MRI spine showed reduction in the size of syrinx. Literature search returned 8 papers describing outcomes of Chiari 0 malformation following surgical intervention. They covered 33 patients (age: 2 weeks to 52 years old). All but one patient underwent FMD as the initial treatment. Of these, 26/32 patients also had C1 laminectomy done and 31/32 had duraplasty. Post-op MRI demonstrated reduction in syrinx size in 31/32 patients. 27/32 patients experienced significant improvement or resolution of symptoms after surgery. One patient underwent syringopleural shunting as the initial treatment, but deteriorated after 9 months. He subsequently underwent FMD and duraplasty, which provided long-lasting symptom resolution.
Conclusion: Current literature suggests that surgical decompression to restore craniovertebral junction CSF flow is the most optimal treatment for patients with Chiari 0 malformation. Our case highlights the success of FMD in improving patient's symptom and decreasing syrinx size. We believe that in carefully-selected patients, FMD without duraplasty may be sufficient, to reduce duraplasty-associated risks.

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Comparison of vertebral wedge and kyphotic angle between modified cortical bone screw trajectory and the traditional pedicle screw trajectory in thoracolumbar fractures.

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Background: Cortical bone trajectory (CBT) has superior pullout strength, insertional torque, and toggle test performance. However, shorter screws are limiting factors because of divergent caudo-cranial trajectories. The Dhulikhel Hospital modification in CBT (CBT-DH) with a caudo-cranial trajectory in parallel configuration allows longer screw placement with technical ease.
Objective: This study aims to compare the Vertebral Wedge Angle (VWA) and Kyphotic Angle (KA) correction loss in thoracolumbar fracture treated with CBT-DH technique and the traditional pedicle screw (TPS).
Methods: Twenty-five consecutive patients with AO Type A and B thoracolumbar fractures managed with CBT-DH from October 2021 to September 2022 were compared to the historical cohort of 35 consecutive patients treated with TPS. Patients had been followed for up to 12 months in the CBT-DH group and 6 months in the TPS group. Vertebral Wedge Angle (VWA) and Kyphotic Angle (KA) and were compared between the two groups at 6 months for loss of correction (difference in angle between immediate postoperative and 6-month follow-up). Similarly, the postoperative correction achieved in VWA and KA (difference in angle between preoperative with immediate postoperative) was compared at 12-month follow-up VWA and KA (difference in angle between preoperative with 12 -months follow up)

Results: Both groups, the CBT-DH group (mean age: 40 years; male/female: 15/10; AO Type A: 10; Type B: 15), and the TPS group (mean age: 38 years; male/female: 22/13; AO Type A: 20; Type B: 15), were statistically similar (P > 0.05). Though the number of vertebrae fixed (3.28 ± 0.89 vs 3.71 ± 0.61) and number of pedicle screws used (6.4 ± 1.27 vs 6.97 ± 1.35) were more in
the TPS group (p≤0.05), the immediate postoperative VWA correction achieved (CBT-DH group: 10.7° ± 5.9° vs. TPS group: 11 °± 5.1°) and the immediate postoperative KA correction achieved (CBT-DH group: 13.8° ± 8.04° vs. TPS group: 14.4° ± 6.7°) were not significantly different (p>0.05).
The loss of VWA in the CBT-DH group (1.9° ± 1.4°) was significantly lower than the TPS group (3.2° ± 2.5°) (p = 0.024), with a difference of 1.3° (95% CI, 0.18 to 2.4°) at 6-month follow-up. However, the loss of KA was not significant (CBT group: 4.86° ± 3.6° vs. TPS group: 4.86° ± 3.6°; p = 0.85). The correction achieved in VWA (10.72° ± 5.91°) and KA (13.79°± 8.05°) at postoperative and 12 months (7.71°±5.8° and 9.09°±9.5°, respectively) in the CBT-DH group was not significant.
Conclusion: The modified CBT fixation is equivalent to superior compared to traditional pedicle trajectory in terms of maintaining of vertebral wedge angle and kyphosis angle correction achieved. The corrections achieved were maintained in the modified CBT technique for one year follow-up.

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What does a spine surgeon needs to know about the use of propofol in total intravenous anaesthesia for spine surgeries?

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Presenter: Dr Lim Xinyi

Background: In spinal surgeries with neuromonitoring, total intravenous anaesthesia (TIVA) using propofol and opioids remains the choice of anaesthesia. Despite its prevalence, the risks associated with propofol remains poorly understood by the average orthopaedic practitioner.
Aim: The aim of this study is to emphasize key complications linked to propofol use pertinent to spinal surgeries.
Methods: A PubMed search identified relevant literature on TIVA in spinal surgeries.
Results: Propofol-related infusion syndrome is a rare but fatal complication seen in high doses (>5mg/kg/h) or prolonged (>48h) administration, with only a single case report post-deformity correction surgery. Metabolic acidosis, rhabdomyolysis, cardiac arrhythmias and acute kidney injuries are more commonly reported especially in staged surgeries. Glucocorticoids like methylprednisolone and dexamethasone, often used in patients with cord compression, have been identified as risk factor for developing PRIS particularly when combined with catecholamines from the surgical stress response. Propofol induces a dose-dependent depression of cortically evoked responses, increasing the stimulation threshold and dampening the transcranial motor evoked potentials waveform amplitude – a phenomenon also known as anaesthetic fade. Other contributing factors include prolonged duration of surgery, blood loss and decrease in body temperature. New strategies such as the use of intra-operative bispectral index, use of adjuncts (such as 3% desflurane and lidocaine infusion) aim to mitigate these effects and reduce propofol dosage. Risk factors of propofol-associated hypertriglyceridaemia and pancreatitis were also discussed, with a case presentation illustrating a rare instance of lipid emulsion on the surface of pooled blood during surgery obstructing vision.
Conclusion: Spinal surgeries under TIVA face complications from high propofol dosages. Factors specific to deformity correction cases, such as blood loss, prolonged surgery, and heat loss, increase the risk of false-positives in neuromonitoring.

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Comparison of Surgical Outcomes between Laminoplasty, Posterior Decompression and Fusion, and Anterior Decompression and Fusion for K-line (–) Cervical OPLL

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Background: For patients with K-line (-) cervical ossification of the posterior longitudinal ligament (OPLL), laminoplasty (LMP) generally yields the least neurological improvement. Therefore, anterior decompression and fusion (ADF) or posterior decompression and fusion (PDF) have been proposed for K-line (-) OPLL. However, data on the risks and benefits of these three procedures for K-line (-) OPLL are still insufficient.
Objective/Aim: To compare surgical outcomes between LMP, PDF, and ADF in patients with K-line (-) OPLLS
Methods: A retrospective study. A total of 56 patients who underwent LMP (n=25) or PDF (n=9) or ADF (n=19) surgery for cervical myelopathy caused by K-line (-) OPLL were included. In PDF surgery, kyphosis correction was performed using a pedicle screw system for indirect decompression of the spinal cord. Medical records were reviewed to assess demographic data, neurological recovery, intraoperative and postoperative complications. Outcomes were compared among three groups.
Results: Neurological improvement ratio of Japanese Orthopaedic Association (JOA) score of LMP, PDF, and ADF groups were an average of 33, 39, and 57 % respectively. Surgical complications included postoperative C5 paralysis in 1 case (4%) in the LMP group, 4 cases (44%) in the PDF group, and 1 case (5%) in the ADF group. In the ADF group, dysphagia and delirium occurred in 2 (11%) and 1 patient (5%), respectively, all of these occurred in men in their 70s. One patient (5%) in the ADF group required Halo vest fixation due to graft dislodgement.
Conclusion: PDF surgery is the alternative treatment of choice for K-line (-) OPLL, but should be carefully indicated, especially when kyphosis correction is performed, because of the high risk of postoperative C5 paralysis. ADF surgery is relatively safe and effective for K-line (-) OPLL patients under 70 years of age.

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Factors associated with improved urinary function after traumatic cervical spinal cord injury: Analysis in AIS grade C

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Back ground: The urinary function has a significant impact on quality of life in patients with cervical spinal cord injury. However, factors related to the urinary function have not been reported a lot.
Objective: The purpose of this study was to determine the proportion of patients with cervical spinal cord injury who are able to urinate by themselves after urinary disfunction and the associated factors.
Methods: Among patients who underwent posterior fusion surgery for acute cervical spinal cord injury between 2017 and 2021, we conducted a retrospective analysis of patients with an AIS of C on admission (53 males and 11 females, mean age 68 years, mean length of hospital stay 6 months). We investigated age at admission, gender,

NLI, anatomical injury level, ASIA motor score, complications, Prognostic nutritional index (PNI) 4 weeks postoperatively, and method of urination at discharge. The patients were divided into two groups: self-urination group (able to urinate without a catheter) and catheter group at the time of discharge.
Results: 35 patients (55%) in the self-urination group and 29 patients (45%) in the catheter group. There were no significant differences between the two groups in age, gender, NLI, anatomic injury level. There were significant differences in ASIA motor score on admission (32 vs. 22; p=0.006) (self-urination group vs. catheter group), incidence of pneumonia (0% vs. 24%; p=0.002), and delirium (6% vs. 24%; p=0.04). There were significant differences in PNI at 2weeks (38 vs. 35; p=0.03) and 3 weeks (38 vs. 34; p=0.001) after operation.
Conclusion: The rate of self-urination at discharge was 55% in AIS C cervical spinal cord injury patients. The self-urination group had less severe paralysis at admission, suggesting that this was a factor associated with the acquisition of self-urination. Complications and poor nutrition in acute phase may be impeding improvement of urinary function.

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Considerations for the use of Anterior Cervical Corpectomy and Fusion Following Cervical Trauma: A Case Series

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Background: The treatment of an unstable cervical spine following cervical trauma is done through the reduction and stabilization of the injured segment. Surgical decompression and fusion in cervical spine injuries can be done through an anterior, posterior or combined approach. Although offering decompression flexibility in cases of multiple level cervical trauma, the posterior approach comes with certain drawbacks, notably extensive soft tissue manipulation which may lead to an inflammatory response in multiple trauma cases. Although only limited to 2 level cervical trauma cases, the anterior approach involves less extensive soft tissue damage, and may as well result in less post-operative complications such as pneumonia and ease of post operative wound care.
Aim: To assess the functional and neurological outcome of anterior cervical corpectomy and fusion (ACCF) following cervical trauma
Methods: This case series represents 12 patients with subaxial cervical trauma that underwent anterior cervical corpectomy and fusion (ACCF) procedure. Pre and post operative neurologic condition were assessed for comparison. Post operative complications were noted and the karnofsky score was evaluated for functional impairment
Result: We described 12 patients who underwent ACCF procedures with an improvement in neurologic function observed in 2 of the patients. whereas the remaining patients maintained similar functions as to prior of the procedure.
Conclusion: Anterior cervical corpectomy and fusion (ACCF) remains an invaluable approach in cervical trauma cases due to the nature of the procedure leading to less soft tissue manipulation, and easier post operative wound management. Due to the anterior nature of the
procedure, there is a lower risk of post-operative pulmonary complications otherwise observed in the prone position of a posterior approach.

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Sagittal parameter: Does it influence my practice in low grade spondylolisthesis?

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Objectives: A sagittal balance is a good tool to improve the functional outcome of spine spondylolisthesis surgeries. The aim of this study is to evaluate its functional outcome when considered in preoperative planning for low grade spondylolisthesis surgeries.
Method: Thirty patients diagnosed as low-grade spondylolisthesis had undergone surgery at NITOR after failed medical treatment had been evaluated preoperatively by measuring the sagittal balance parameters which include SVA, spinopelvic angles, lumbar lordosis, pelvic tilt, sacral slope, and pelvic incidence and then measure it along a follow-up period of 1 year postoperatively started from June 2017 and correlate it with functional outcome using Oswestry score (ODI)and VAS. Correction of parameters has been estimated preoperatively by manual estimation and Surgi map application then applied during the operation.
Results: All patients were treated by posterior instrumentation and fusion by TLIF cages. The mean of lumbar lordosis and mean spinopelvic angles were increased in a statistically significant manner. Pelvis tilt was decreased in a statistically insignificant manner. The mean of pelvic incidence was not changed and statistically insignificant, and this is matching the fact that pelvic incidence is a constant parameter. The sacral slope was increased in a statistically insignificant manner. Results showed that 27 had a statistically significant improvement in their ODI >20% at the last visit. Three patients had a poor clinical outcome with ODI score of >20% improvement, and we noticed that the level of pathology was at the level of L4L5, SVA was positive and worsen postoperatively, and, it is accompanied by decreased lumbar lordosis. Change in ODI means statistically significant improvement when considering sagittal parameters reoperation and during operation.
Conclusion: Sagittal balance parameters should be considered in the surgical management of low-grade spondylolisthesis cases to improve their functional outcome.

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Single stage posterior vertebral column resection (PVCR) for the correction of rigid & severe spinal deformity - an analysis of 28 cases

Sharif Ahmed Jonayed, Abdullah Al Mamun Chaudhury, O.Z.M Dastagir, Shah Alam

Introduction: Treatment of a severe & rigid kyphotic deformity due to any cause is always challenging to the treating Spine Surgeon. Nevertheless, Vertebral Column Resection (VCR) has evolved over the past century to become a viable last resort for correction of the most challenging spinal deformities through a single, posterior approach.
Method: This is a prospective case series of 28 patients either with a severe (Cobb angle >60) or rigid kyphotic deformity who underwent treated for correction of deformity by a single stage PVCR from July 2016 to June 2022.
Results: Mean age of the patient was 30.2 years with a mean follow-up time 27 months. Average operating time was 420 minutes (range 320-760 minutes). Overall final postoperative kyphotic Cobb angles correction ranged from 30.4° to 55.9°. ODI improved from 58.6 ± 6.5 to 10.5±3.2. VAS was improved from 6.7 ± 0.5 to 1.7±0.8. Most

frequent complications observed in our series were massive blood loss with a mean of 740 ml (range 560- 1380), dural tear (8%), thoracic root pain (4%) and neurological deterioration (4 cases -3 transient and 1 late onset). Mean recovery period for neurological recovery was 3months.Surgical site infection rates range from 2.9% to 3.7%
Conclusion: Although the PVCR is a highly technically demanding, exhaustingly lengthy, and associated with a variety of complications but can be performed safely with proper training and patience for correcting these deformities with a satisfactory outcome in a resource constrained environment like us.
Keywords: Posterior Vertebral Column Resection (PVCR), Severe kyphotic deformity, Rigid deformity.

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Efficacy, safety, and reliability of single posterior approach for unstable thoracolumbar burst fracture treated with anterior reconstruction & posterior instrumentation.

Sharif Ahmed Jonayed, Abdullah Al Mamun Chaudhury, O.Z.M Dastagir, Shah Alam

Introduction: Management of unstable thoracolumbar burst fracture is still a controversial issue. Fracture morphology, neurologic status, and surgeon preference play major roles in deciding the appropriate approach. Though the combined anterior and posterior instrumentation provides the most stable repair, but optimizing neural decompression & stable internal fixation using a single approach over the least number of spinal segments is the goal. Moreover, the use of both approaches on a trauma patient may increase morbidity. Anterior reconstruction of spine through only one approach can provide an effective outcome.
Aims & objectives: The purpose of this study is to evaluate neurological, functional and radiological outcome of the anterior reconstruction of spine by single posterior approach in cases of unstable thoracolumbar burst fractures.
Methods: Eighteen patients with acute unstable thoracolumbar burst fractures (T-11 to L-4) with neurological deficit from July 2012 to June 2022 in the age group of 16-60 years with McCormack's score six or more and thoracolumbar injury severity score (TLISS) five or more were included. Neurological status, visual analogue scale (VAS), angle of kyphotic deformity, McCormack's score and TLISS score were evaluated.
Results: The mean duration of surgery was 255 minutes. The mean blood loss was 440 ml. Mean improvement of ASIA scale was 1.67 in a patient with incomplete spinal injury whereas patient with complete spinal injury remain same at last follow-up. The mean preoperative kyphotic angle was improved from 25 degrees to 5 degrees postoperatively. Visual analogue score improved from 6.1 to 1.7.
Conclusions: Single posterior approach is a safe, cost effective and reliable surgical approach for reconstruction of all the columns of spine. It reduces the operative time, blood loss, the morbidity associated with combined approach with a good outcome
Keywords: Anterior reconstruction, Posterior approach, Unstable, Burst fracture, Titanium cage

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Efficacy, Safety, and Reliability of the Single Anterior Approach for Sub axial Cervical Spine Dislocation

Sharif Ahmed Jonayed, Abdullah Al Mamun Chaudhury, O.Z.M Dastagir, Shah Alam

Background: Though there is ongoing controversy regarding the best treatment option for cervical spine dislocation (CSD), anterior cervical surgery with direct decompression is becoming widely accepted. However, managing all cases of sub axial CSD entirely by a single anterior approach is rarely seen in the published literature.
Methods: The study comprised patients with sub axial CSD who underwent surgical stabilization utilizing a single anterior approach. Most of the CSD was reduced and anterior cervical discectomy and fusion (ACDF) were performed. Anterior cervical corpectomy and fusion (ACCF) were done in unreduced dislocations. The patient's neurological condition, radiological findings, and functional outcomes were assessed. SPSS version 25.0 (IBM Corp., Armonk, NY) was used for statistical analysis.
Results: The total number of operated cases was 64, with an average of 42 months of follow-up. The mean age was 34.50±11.92 years. The most prevalent level of injury was C5/C6 (57.7%). Reduction was achieved in 92.2% of cases; only 7.8% of patients needed corpectomy. The typical operative time was 84.25±9.55 minutes, with an average blood loss of 112.12±25.27 ml. All cases except complete spinal cord injury (CSI) were improved neurologically (87.63%). The mean Neck Disability Index (NDI) was 11.14±11.43, and the pre-operative mean visual analog score (VAS) was finally improved to 2.05±0.98 ($P<0.05$). In all cases, fusion was achieved. The most common complication was transient dysphagia (23.4%). After surgery, no patient developed or aggravated a neurological impairment. Implant failure was not observed at the final follow-up except for two cases where screws were pulled out partially.
Conclusion: Based on the results of this study, a single anterior approach is a safe and effective procedure for sub axial CSD treatment with favorable radiological, neurological, and functional outcomes.
Keywords: Traumatic cervical spine injury, anterior cervical corpectomy and fusion (accf), sub axial cervical spine dislocation (csd), anterior cervical discectomy and fusion (acdf), single anterior approach

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Acute Traumatic sub-axial central cord Syndrome: Can delaying surgery causes disaster?

Sharif Ahmed Jonayed, Abdullah Al Mamun Choudhury, Md. Shah Alam, OZM Dastagir

Introduction: Traumatic central cord syndrome (TCCS) is an incomplete spinal cord injury defined by greater weakness in upper versus lower extremities, variable sensory loss, and variable bladder, bowel, and sexual dysfunction. The optimal timing of surgery for TCCS remains controversial.
Objective: The purpose of this study was to evaluate whether timing of surgery for TCCS predicts neurological outcomes, length of stay, and complications.
Methods: Forty-two patients with TCCS without fracture or dislocation were identified and divided into two groups described as two groups i.e. early surgery and delayed surgery group. Clinical outcomes including ASIA Motor Score (AMS), Japanese Orthopaedic Association (JOA) score upon admission and follow-up, change in AMS, and JOA recovery rate were analyzed. Logistic regression analysis was performed to show the correlation between timing of surgery and clinical outcomes.
Results: All patients received a minimum of 1-year follow-up and showed significant neurological recovery at the final follow-up. No statistical differences in final AMS and JOA scores were observed between the two groups. There is insufficient evidence that lengths of hospital or intensive care unit stay differ between patients who undergo early versus delayed surgery. Furthermore, there is insufficient evidence that timing between injury and surgery predicts mortality rates or serious or minor adverse events.
Conclusion: Surgery for TCCS ,24 hours after injury appears safe and effective. Although there is insufficient evidence to provide a clear recommendation for early

surgery (24 hours), it is preferable to operate during the first hospital admission and within 2 weeks after injury.

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Investigation of spontaneous facet fusions after surgery for thoracolumbar vertebral fractures: More than half of cases had spontaneous facet fusions

Background: Few reports have mentioned spontaneous facet fusion after surgery for thoracolumbar vertebral body fractures. The purpose of this study is to evaluate spontaneous facet fusion after surgery for thoracolumbar vertebral body fractures and investigate the predictors of spontaneous facet fusion.

Methods: We retrospectively reviewed 36 patients who were undergone surgery without bone grafting for thoracolumbar vertebral body fractures and evaluated facet fusion with Computed Tomography at 1 year after surgery. We used three surgical procedures: (1) balloon kyphoplasty (8 patients), (2) percutaneous posterior fixation (22 patients), (3) lateral approach corpectomy and percutaneous posterior fixation (6 patients). We investigated level of facet fusion and measured the preoperative and postoperative local kyphotic angle of a fractured vertebra.

Results: 21 patients (58%) had at least single-level facet fusion (F group) and 15 patients (42%) had no facet fusion (C group). Level of facet fusion was adjacent to a fractured vertebra in all patients. 13 patients had facet fusion at only cranial side of a fractured vertebra, 2 patients had facet fusion at only caudal side of a fractured vertebra, and 6 patients had facet fusion at both cranial and caudal side of a fractured vertebra. Preoperative local kyphotic angle was 7.7° in F group and 4.4° in C group (p=0.11), and Postoperative local kyphotic angle was 9.8° in F group and 2.8° in C group (p=0.03). There were no significant differences in age, gender, the prevalence of osteoporosis, level of fractured vertebra, and surgical procedures between two groups. Conclusion:

58% of patients who were undergone surgery without bone grafting for thoracolumbar vertebral body fractures had spontaneous facet fusion at 1 year after surgery. 90% of the patients had facet fusion at cranial side of a fractured vertebra. The predictor of spontaneous facet fusion was large postoperative local kyphotic angle.

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Biomechanical Aspect Following Occipito-Cervical Fusion: Evaluation of Sagittal Profile Alterations and its Relation to Functional Outcomes

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Background: Occipitocervical fixation (OCF) is an effective treatment for a range of craniovertebral junction (CVJ) disorders, providing a high rate of successful fusion while also enabling efficient decompression. However, OCF may result in a compromise in sagittal balance which may affect not only structural conditions of the vertebra but also functional outcomes related to daily activities.

Aim: To observe sagittal parameters following occipitocervical fixation and find relations with patient functional outcome

Methods: This case series represents 7 patients with occipitocervical fixation due to cervical condition. Pre and post operative neurologic conditions were assessed for comparison. Cervical sagittal balance was measured using angle measurements obtained from lateral X-ray examination Pelvic parameters, and thoracic kyphosis angles were obtained through measurements from full spine x-ray examinations. Functional outcome was done using the mJOA scoring system. Correlation between each sagittal parameter and mJOA were assessed.

Result: A total of 7 cervical condition patients with neurologic function scores ranging from AIS B to AIS E. Measured cervical parameters means, O-C2 angle 19.40^{O} (± 4.80) , O-C7 angle 40.20^{O} (± 1.98), C2-C7 angle 21.60^{O} (± 4,62). Postoperatively O-C7 angle had not change significantly while O-C2 angle decreased and C2-C7 increased vice versa. Post operative pelvic parameter related to sagittal balance had shown change. Functional mJOA score also related to pelvic parameter alteration.

Conclusion: Occipitocervical instrumentation procedures can lead to a compromise in sagittal balance through changes in cervical and pelvic parameters. Increased muscle activity as compensation may result in postoperative pain and affect functional outcome.

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Considerations for the use of Anterior Cervical Corpectomy and Fusion Following Cervical Trauma: A Case Series

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Background: The treatment of an unstable cervical spine following cervical trauma is done through the reduction and stabilization of the injured segment. Surgical decompression and fusion in cervical spine injuries can be done through an anterior, posterior or combined approach. Although offering decompression flexibility in cases of multiple level cervical trauma, the posterior approach comes with certain drawbacks, notably extensive soft tissue manipulation which may lead to an inflammatory response in multiple trauma cases. Although only limited to 2 level cervical trauma cases, the anterior approach involves less extensive soft tissue damage, and may as well result in less post-operative complications such as pneumonia and ease of post operative wound care.

Aim: To assess the functional and neurological outcome of anterior cervical corpectomy and fusion (ACCF) following cervical trauma

Methods: This case series represents 12 patients with subaxial cervical trauma that underwent anterior cervical corpectomy and fusion (ACCF) procedure. Pre and post operative neurologic condition were assessed for comparison. Post operative complications were noted and the karnofsky score was evaluated for functional impairment

Result: We described 12 patients who underwent ACCF procedures with an improvement in neurologic function observed in 2 of the patients. whereas the remaining patients maintained similar functions as to prior of the procedure.

Conclusion: Anterior cervical corpectomy and fusion (ACCF) remains an invaluable approach in cervical trauma cases due to the nature of the procedure leading to less soft tissue manipulation, and easier post operative wound management. Due to the anterior nature of the procedure, there is a lower risk of post-operative pulmonary complications otherwise observed in the prone position of a posterior approach.

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Impact of intervertebral foramen area after cervical spinal correction / fixation surgery

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Introduction: Laminoplasty enables sufficient decompression in multi-segmental cervical spondylotic myelopathy (CSM). However, CSM with kyphosis may lead to poor surgical outcomes by interfering with posterior shifting of the spinal cord. In such case, corrective fixation using cervical pedicle screw (CPS) is selected. In the other hand C5 nerve palsy is a troublesome complication in surgery for cervical myelopathy. However, the precise mechanism is still unclear. The purpose of study was to investigate the effect of correction surgery by CPS for intervertebral foramen. To investigate the cause of postoperative C5 paralysis after cervical spine correction or fusion surgery.
Retrospective study Methods: Forty-five patients who underwent correction surgery using CPS (25 male.20 female, a mean of 73 years old) were enrolled in the present study. 87 fusion level (174 foramen) were evaluated foraminal area (FA), head-caudal diameter and anteroposterior diameter in CT reconstruction image at pre-operation(pre-op) and final follow-up (FU). C2/7 angle and local angle were measured in XP. We statistically evaluated the change of FA and diameter between pre-op and FU. Correlations between local correction angle and FA, diameter were further evaluated. 174 foramens were evaluated foraminal area (FA), head-caudal diameter and anteroposterior diameter in 3dimensional reconstruction CT image at pre-operation(pre-op) and final follow-up (FU). C2/7 angle and local angle were measured in XP. We statistically evaluated the change of FA and diameter between pre-op and FU. Correlations between local correction angle and FA, diameter were further evaluated. Evaluate changes in area with pre- and post-operative CT
Results: Postoperative FA was 28.6mm2 at pre-op and 30.7mm2 at FU (p,0.004). C2/7 were -3.3/3.3 degree and local angle were -0.01/ 0.43 degree (pre-op/ FU). When investigating the relationship between FA and cervical spinal X-ray parameters, the local correction angle was more strongly related than the C2/7 angle.The correlation between corrected local angle and FA was significantly negative correlation (p,0.03). Furthermore, the anteroposterior diameter of the foramina after correction by CPS showed negative correlation. The foramina decreased when the local angle was corrected by 10 degrees or more, and significantly narrowed (15%) in 15 degrees or more.
Discussion: When we are going to plan cervical correction surgery for dropped head syndrome or cervical myelopathy with kyphosis, it is necessary to avoid corrective angle 10 degree at each level. retrospective study
Kindaijp120092

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The efficacy of brace-compliancy in Adolescent Idiopathic Scoliosis

Background: Brace treatment for Adolescent Idiopathic Scoliosis (AIS) is effective in altering the natural history of AIS. Brace compliance however is difficult to achieve as it reduces the quality of life of the wearers.
Objective: This study aims to review the effects of brace compliancy on the cobb angle progression particularly in the patients who were non-compliant with the brace.
Method: A prospective single centre review was performed for patients who underwent bracing treatment for AIS between 2018 to 2023. Demographic, clinical and radiological data were reviewed.
Results: 151 patients with 126 (83.4%) female patients were recruited. The mean age was 12.4 years old. 93 (61.6%) patients were non-compliant with the mean Risser score of 1.24 and a mean cobb angle of 26.2° prior to the bracing. The mean duration of brace wearing was 1.85 years. The mean brace wear time is 6.9 hours per day. Patients with no curve progression had a mean cobb angle progression of 2°. In contrast, brace non-compliant patients in the high-risk group had a mean curve progression of 9.24°. 58 (38.4%) patients were compliant with mean Risser score of 1.34 and mean cobb angle of 26.53° prior to bracing. The mean duration of brace prescription was 1.47 years with mean wear time of 16.0 hours per day. For patients with no curve progression, the mean cobb angle progression was 0.63°. In contrast, brace compliant patients in the high-risk group had a mean 6.67° curve progression. Comparing the two groups of patients, the compliant group had lesser mean cobb angle progression of 1.4° for the group with no curve progression and 2.57° for the high-risk group.
Conclusion: Although bracing is important to curtain the curve progression in the high-risk group of patients, longer brace-hour may not be necessary in the face of non-progression of the curve.

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Postoperative Complications in Anterior Cervical Surgery - Is there a Higher Incidence of Dysphagia and Respiratory Complications with Long-Segment Anterior Cervical Surgery?

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Background: In anterior cervical spine surgery, complications such as dysphagia and respiratory disorders can be problematic.
Objective: This study investigates whether the length of fixation in anterior cervical spine surgery is associated with perioperative dysphagia and respiratory complications.
Methods: 105 cases who underwent anterior cervical spine surgery at our hospital since 2013 were enrolled. Cases with fixation of two or fewer vertebrae were classified as Group S, and those with fixation of three or more vertebrae as Group L.
The parameters examined were the frequency of dysphagia, the frequency of serious respiratory complications such as reintubation or tracheostomy, and pneumonia, as well as the number of days required for discharge or transfer postoperatively.
Results: There were 61 cases in Group S and 44 in Group L. The average number of fixed vertebrae was 1.5 in Group S and 3.5 in Group L. The proportion of severe dysphagia requiring gastrostomy tube for nutritional management was significantly higher in Group L (Group S ; 3%, Group L; 13%). The number of cases requiring treatment for severe pneumonia, reintubation, or tracheostomy was one in Group S and four in Group L. One case in Group S developed severe pneumonia early postoperatively and required reintubation, and three cases in Group L required airway re-securing due to laryngeal edema post-extubation. The number of days required for discharge postoperatively was 11.9 days in Group S and 24.7 days in Group L, but cases with respiratory complications required an average of 58.8 days of hospital management.
Conclusion: Cases with short-segment anterior cervical surgeries had relatively few complications and could be discharged early.

Long-segment anterior cervical spine surgeries are associated with higher rates of postoperative complications, including severe dysphagia in 13% of cases and significant respiratory issues in 9%. Cases with these complications required long-term hospitalization.

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The Therapeutic Effects of Neuropathic Pain Medications on a Rat Model of Cervical Spinal Cord Injury Without Bone Injury.

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Background: Elderly individuals with cervical spine disorders, such as spinal canal stenosis or cervical spondylotic myelopathy, are experiencing a recent increase in cervical spinal cord injury without bone injury resulting from minor external forces. This increase contridutes to neuropathic pain, characterized by hypersensitivity, significantly addecting daily life. In recent years, it has become known in the clinical field that gabapentinoids (voltage-gated calcium channel α2δ1 ligands) have a therapeutic effect on neuropathic pain. Mirogabalin besylate (MGB) is approved in Japan for the treatment of neuropathic pain and is in clinical development for this indication elsewhere in Asia. The purpose of this study is to assess the utility of MGB in addressing central neuropathic pain using a rat model of cervical spondylotic myelopathy.

Methods: We made a rat model of chronic spinal cord compression inserting water-absorbing polyurethane sheet into sublaminar space. At 8 weeks postoperatively, a non-osteogenic cervical spinal cord injury causing hypersensitivity was induced using an IH impactor with a force of 50 kdyn. Behavioral assessments were conducted over 5 days after administering MGB to three groups: the control group, high-dose group (10 mg/kg), and low-dose group (2.5 mg/kg). VonFreyHair was applied before and after surgery to identify individuals exhibiting decreased sensory thresholds.

Results: After 5 days of post-injury administration, the VonFreyHair 50% response threshold showed improvement in both the high-dose group (6.1±2.8) and low-dose group (5.8±3.1) compared to the control group (3.1±1.8). Significant improvement was observed in both high-dose and low-dose groups up to 3 weeks after administration. However, at the 4-week, a recurrence of hypersensitivity was noted in the high-dose group (9.4±3.1) compared to the low-dose group (5.4±3.9).

Conclusion: This model of hypersensitivity, induced by a relatively mild crushing injury in chronic cervical cord compression, demonstrates prolonged hypersensitivity. The study elucidates the efficacy of MGB on central neuropathic pain.

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Endoscopic techniques for Degenerative spine: where are we ?

Bambang Darwono, MD., Ph.D

Endoscopic spinal surgery began as percutaneous discectomy attempted by Hijikata et al. in 70s and Kambin in 80s. Screiber, Suezawa and Leu were the first to have the idea to perform using endoscope (discoscopy). First generation of Spinal Endoscopic surgery was Transforaminal endoscopic lumbar discectomy introduced by Hal Mathews and Tony Yeung in the second half of 1990s, Schubert and Hoogland (2007). Since the introduction of endoscopic drills by Choi et al. (2008), the second generation was Interlaminar uniportal and biportal lumbar discectomy mainly in L5-S1 disc herniation. Evolution to third generation was Endoscopic decompression and Endoscopic foraminotomy due to rapid development in techniques and equipment to treat stenosis with/without instability. Decompression of central and lateral recess stenosis is now possible by interlaminar approach, and decompression of foraminal or extraforaminal stenosis through foraminotomy. The fourth generation due to recent developments in surgical equipment, supported endoscopic techniques, and now can be used for interbody fusion as a treatment for various lumbar spinal disorders. Newer innovation the endoscopic techniques and concept can be used for treatment the Cervical and Thoracic degeneration.

Where are we now, after endoscopic techniques show many advantages in preserving anatomic structures compare to open surgery in degenerative spine.

The nature of illness of Lumbar degeneration. The description of Lumbar degenerative cascade regarding anterior and middle column by theory of Kirkaldy Willis (1978) should be completed with Baastrup theory (1933) describing posterior column degeneration. Baastrup theory was supported by Bristol study (2010) and Auckland study (2012). Proposed New classification based on 3 columns theory of biomechanic construct degenerative changes (Darwono-Radchenko,2018), describe completely the pathologic changes/deformers of spine degeneration involving three columns and could be used to justified various evidenced based treatment.

The nature of illness of degenerative spine deformity is combination of 2 factors:

-stabilizer: disc, facet joint, ligaments, muscles

-Pathologic changes/deformers: osteophyte, facet trophism, spinal canal stenosis, flavum infolding and degeneration, enlargement of spinous process, Kissing spine and laminae (3 columns theory)

The Gold standard of Treatment is open decompression surgery, but this will sacrifice part of the stabilizers, and as a consequence then we need artificial stabilizer or implant and fusion.

The question is, if we could preserve the stabilizers, do we need fusion ?

Reasonable concept of endoscopic techniques for degenerative spine diseases is to preserve the stabilizer and remove the deformers. This concept will support the nature of healing, refunctioning the spine stabilizer and result in correction of the spine deformity without fusion device.

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Cast Test: Surgical Outcome Prediction of Thoraco-Lumbar Spine Correction surgery for sagittal vertical axis (+) Type Dropped Head Syndrome: A Report of Initial 5 Cases

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INTRODUCTION & DISCUSSION: Dropped Head Syndrome (DHS) is defined as a syndrome showing passively correctable chin-on-chest deformity caused by a significant weakness of the neck extensor muscle power. Regardless of the underlying causes, a classification based on the spinal sagittal alignment has been proposed by Miyamoto and colleagues. According to their report, DHS can be classified by the value of 7th cervical vertebra sagittal vertical axis (SVA) into SVA (-) and SVA (+) types. SVA (-) type DHS shows apparent cervical spine kyphosis and compensatory lumbar hyper-lordosis and/or thoracic hypo-kyphosis. SVA (+) type DHS is primarily caused by kyphotic deformity in the thoraco-lumbar spine leading to an increase in T1spope. Large T1 slope needs compensatory increase in cervical hyper-lordosis to

keep forward gaze. If decompensation of cervical spine hyper-lordosis occurs, it easily results in head drop. As for surgical strategy, there is ongoing debate regarding surgical options for SVA (+) type DHS.

METHODS: Study design: Small case series (Initial report of case series).

Five consecutive patients who received thoraco-lumbar spine kyphosis correction for SVA (+) type DHS in our institute from 2019 to 2023 were included into the present study. Application of a body cast pone position on Risser table. Immediate reduction of dropped head symptoms was considered as positive cast tests.

RESULTS: In all 5 cases, a significant improvement in dropped head symptoms was observed immediately after applying the body cast. In all 5 cases, a significant improvement in dropped head symptoms was observed after surgery.

CONCLUSION:The Cast test might be useful for surgical decision-making and patient explanation in cases of SVA (+) type DHS

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Long term outcomes of thoracoscopic anterior selective thoracic fusion in adolescent idiopathic scoliosis (AIS) for in Lenke 1 & 2 curves – 10 year follow up review

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Background: Thoracoscopic anterior selective fusion (T-ASF) is a minimally invasive alternative method of scoliosis correction as compared to posterior spinal fusion. Advantages of the ASF include decreased blood loss, shorter instrumentation and sparing of the spinal musculature. However there is a paucity of literature on long term outcomes of this surgical technique.

Objectives: This study reviews the long term outcomes of T-ASF in treating AIS.

Methods: Clinical, operative and radiographic data on all female patients with Lenke 1&2 curves, aged 11- 20 years old, who underwent an T-ASF between Jan 2000 – Dec 2013 at our institute were reviewed. Patients underlying musculoskeletal disease, prior spinal surgeries and a follow up duration of <2 years were excluded.

Results: A total of 128 patients were identified with an average follow up of 8.0 $\pm$ 3.1 years. Average age was 14.2 $\pm$ 2.1 with a median Risser score of 3 (0-5). 7.7 $\pm$ 0.6 levels were fused with estimated blood loss of 313 $\pm$ 270 ml . Average main thoracic (MT) curve was 49.6 $\pm$ 8.9° pre op which corrected to 11.2 $\pm$ 5.7° post op with a correction of 77.3 $\pm$ 10.5 %. Average thoracolumbar (TL) curve was 30.0 $\pm$ 7.9° which corrected spontaneously to 9.6 $\pm$ 5.0° post op with a correction of 62.5 $\pm$ 18.1%. At final follow up correction MT was 12.9 $\pm$ 8.3° and TL was 8.9 $\pm$ 6.4°. 3 patients (2.3%) underwent revision to a posterior construct for adding-on, an additional 1 patient (0.7%) underwent rod exchange for rod breakage. 23 patients (17.9%) experienced a >5°loss of correction in any coronal curvature at final follow up due to adding on and/or superior screw pull-out.

Conclusion: Overall long term outcomes of the T-ASF are satisfactory with good and durable post operative curve correction and comparable long term complication rates to posterior fusion surgeries.

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Radiographic assessment and clinical outcomes of conservative management in Atlanto- Axial Osteoarthritis: A study of 108 patients

Context: Atlanto-axial osteoarthritis (AAOA) is a degenerative cervical spine disorder predominantly affecting the elderly. The patients typically present with cervico-occipital pain and restricted and painful neck rotations. The condition is mainly diagnosed with an open-mouth view, and conservative management is the mainstay of treatment.

Aims: To evaluate the effectiveness of conservative management and a novel technique of Greater Occipital Nerve block in AAOA and assess the radiographic changes in facet angles and autofusion of the facet joints following conservative management.

Methodology: This was a single center, retrospective cohort study of all patients managed conservatively for Atlantoaxial osteoarthritis. Functional improvement of the patient was assessed using the changes in VAS and NDI scores. Serial X rays were analysed and changes in facet angles and occurrence of auto fusion was noted.

Results: The C1 C2 facet angle on the affected side is significantly lower on the affected side in patients with AAOA. A significant improvement in symptoms was noted in terms of the NDI scores and ODI scores after completion of treatment. 15.47% of patients developed auto fusion of the diseased joint.

Conclusion: Conservative management is the mainstay of AAOA treatment and has helped relieve pain and improve the quality of life in these patients.

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Cervical kinematic MRI: efficacy in evaluation of patients with cervical myelopathy

Introduction: The dynamic change in the spinal canal space with cervical motion acts as a significant factor contributing to the development of cervical cord compression. This dynamic or “occult” cord compression may not be visualized on the conventional MRI taken with the neck in the neutral position. Based on this, kinematic Magnetic Resonance (kMRI) imaging was introduced to analyze the dynamic compression of the spinal cord in flexion and extension, mimicking the natural conditions. The purpose of the study was to evaluate the usefulness of kMRI in the assessment of cervical myelopathy and to identify the changes in the hyperintense lesion(HIL) and compression levels on kMRI images.

Materials and Methods: A retrospective observational study of 369 patients with cervical myelopathy was undertaken. The patient’s cervical kMRI was obtained, and the subaxial cervical spine was evaluated for changes in canal stenosis and hyperintense lesion in different cervical spine positions at each disc level from C3-T1. The canal stenosis was graded as per Muhle’s classification and HIL as per the classification given by Chen et.al.

Results: A total of 1845 disc spaces were analyzed. Grade 3 stenosis was seen in 19.51% (360/1845) in neutral MRI, 36.58% (675/1845) in extension MRI, and 10.73% (198/1845) in flexion MRI. The increase in the grade of stenosis in extension was statistically significant. Also, in 82/1845 (4.44%) disc spaces, HIL was seen only on flexion MRI.

Conclusion: MRI with cervical extension allows identifying spinal canal stenosis better than neutral films. Flexion imaging gives better visualization regarding the presence and extent of HIL. Thus, kMRI might help in the treatment decision to achieve better results in patients with cervical myelopathy.

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Computed tomography based morphometric analysis of 500 subaxial cervical spine pedicles in Asian subcontinent population: An Indian Population based study

Introduction: Variability in cervical pedicle anatomy with each level and narrow corridor of safety in terms of neurovascular injuries for insertion of Cervical Pedicle Screws (CPS) make it a challenging procedure. Knowledge of pedicle dimension and trajectory is important for safe insertion of CPS. There is limited data on the cervical pedicle morphometry in Indian Population.

Methods: Computed Tomography scans of 500 subaxial cervical spine vertebrae from 50 patients using single helical cone-based CT machine who underwent posterior instrumentation were analysed. Parameters of pedicle width (PW), pedicle height (PH), pedicle transverse angle (PTA), and pedicle sagittal angles (PSA) were calculated on multiplanar reformatted images.

Results: The mean pedicle width (PW) ranged from 4.23±0.72 (C3 in females) to 6.53±0.84 (C7 in males) with incidence of PW less than 4.00 mm was 12% at C3, 6% at C4 and 2% at C5 0% at C6 and C7. The mean pedicle height (PH) ranged from 5.33±0.63 (C3 in females) to 6.84±0.74 (C7 in males). PW and PH were smaller in females than of male which was statistically significant ($P<0.05$). Mean pedicle transverse angle (PTA) ranged from 36.81±6.89 (C7) to 47.79±5.81 (C5) and mean pedicle sagittal angle (PSA) ranged from 17.13±5.47 (cranially directed at C3) to -13.87±5.63 (caudally directed at C7). Angular parameter of PTA and PSA had non-gender difference.

Conclusion: In our Indian population, Pedicle dimensions (PW and PH) were smaller than European and American population. Cervical Pedicle Screws insertion with 3.5mm pedicle screw was found to be safe at C5, 6, 7 with C3 and C4 level to be cautiously evaluated on CT images for feasibility of Cervical Pedicle Screws insertion to avoid any catastrophic complication.

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Cervical TDR is superior to ACDF for single level cervical disc prolapse: 5 year average follow up study

Introduction: Anterior cervical discectomy and fusion (ACDF) has been standard of care for degenerative cervical disc pathologies. ACDF results in loss of motion and increased loading of adjacent disc levels. The Adjacent segment disease (ASDis) rates in literature varies from 25-92%. Cervical total disc replacement (TDR) is a proposed alternative to ACDF.

Methodology: Retrospective review of patients who underwent TDR at a single level between January 2009 and December 2022. Age matched patients who underwent ACDF at the same levels from our database with a minimum follow up of two years were analysed for comparison. All parameters were measured independently by two consultant spine surgeons.

Results: 37 TDR patients and 36 ACDF patients were analysed. The mean follow-up of TDR patients was 5.79 $\pm$ 2.96 years and ACDF patients was 10.88 $\pm$ 2.86 years. The improvement in neck pain, arm pain, neck disability index (NDI) was significantly higher in TDR group as compared to ACDF group. Improvement in mJOA score and Nurick grades was seen in both the TDR and ACDF groups but the difference was not statistically significant. TDR group had better restoration of ROM at index , adjacent upper and lower levels as compared to ACDF. Incidence of adjacent segment degeneration in the ACDF group (19.4%) was greater than the TDR group. Restoration of cervical lordosis was observed in TDR group.

Conclusion: TDR is superior for alleviation of neck pain, arm pain and disability secondary to neck pain as compared to ACDF. TDR has added advantage of better restoration of cervical kinematics at index level, adjacent upper and lower levels with decreased incidence of ASDis. Thus, in selected patients TDR is superior to ACDF.

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Does intraoperative cell-salvaged autologous blood transfusion in metastatic spine tumour surgery improve long-term clinical outcomes? A prospective clinical study

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Background: Allogeneic blood transfusion (ABT) is the current standard of blood replenishment for metastatic spine tumour surgery (MSTS) despite known complications. Salvaged blood transfusion (SBT) addresses majority of such complications related to ABT. However, surgeons today remain reluctant to employ SBT in MSTS.

Objective/Aim: This prospective clinical study aims to ascertain the long-term clinical outcomes of intraoperative cell salvage (IOCS) in MSTS.

Methods: Our study included 98 patients who underwent MSTS from 2014 to 2017. Patients were divided into three groups: no blood transfusion (NBT), ABT and SBT. Primary outcomes assessed were overall survival (OS) and tumour progression (TP), that was evaluated using RECIST (v1.1) employing follow-up radiological investigations at 6, 12, 24, 36 and 48 months. Primary tumours of MSD were also subgrouped based on vascularity and analysed.

Results: Our study had a total of 98 patients [53:45(M/F)] with a mean age of 60 years old. All three BT groups were comparable for demographics and tumour characteristics (p=0.215). Overall median blood loss was 400 mL [IQR 200-900 mL] and overall median BT was 620 mL (IQR: 110 – 1600 mL) for patients receiving BT. 33 (33.7%) patients received SBT, 39 (39.8%) received ABT and 26 (26.5%) had NBT. There was no significant difference between the OS of patients who underwent ABT or SBT, as compared to NBT (p=0.136). However, OS was better in SBT than in ABT group (Figure 1). On multivariate analysis, SBT did not show any increase in 4-year tumour progression [Adjusted HR 0.57; 95% CI 0.14-2.22; p=0.423]. Total blood loss was also not associated with tumour progression [Adjusted HR 0.51; 95% CI 0.15-1.65; p=0.26].

Conclusion: This is the first long term prospective study to report on the clinical outcomes of SBT in comparison with control groups in MSTS and affirms the clinical role of SBT in MSTS.

Keywords: Metastatic spine tumour surgery, Intraoperative cell salvage, Salvage blood, Allogenic blood, Overall survival rate, Tumour progression

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Vacuum Assisted Closure and Local Drug Delivery Systems in Spinal Infections A review of current evidence

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Background: Spinal infections are showing increased incidence throughout the years as our surgical capabilities increase, coupled with an overall aging population with greater number of chronic comorbidities. The management of spinal infection is of utmost importance, due to high rates of morbidity and mortality, on top of the general difficulty in eradicating spinal infection due to the ease of hematogenous spread in the spine.
Objective/Aim; We aim to summarise the utility of Vacuum Assisted Closure (VAC) and Local Drug Delivery Systems (LDDS) in the management of spinal infections.
Methods: A narrative review was conducted for this paper. The concept of our treatment algorithm for the use of VAC and/or LDDS in spinal infections was done as an expert opinion by the two senior spine surgeons in this manuscript.
Results: A total of 62 studies were included in this review. We discussed the utility of VAC as a tool for management of wounds requiring secondary closure, as well as how it is increasingly being used after primary closure as prophylaxis for surgical site infections (SSIs) in high-risk wounds of patients undergoing spinal surgery. The role of LDDS in spinal infections was discussed, with preliminary studies showing good outcomes when patients were treated with various novel LDDS. We discuss the role of various LDDS such as antibiotic bone cement (ABC), vancomycin powder and closed suction irrigation systems (CSIS). However, the current literature for LDDS is limited to small case series and there is still a lack of prospective comparative studies to establish the role of LDDS in wound healing.
Conclusion: We have summarised and given our recommendations for the use of VAC and LDDS for spinal infections. A treatment algorithm has also been established, to act as a guide for spine surgeons to follow when tackling various spinal infections.
Keywords: Spinal Infections; Vacuum Assisted Closure; Local Drug Delivery Systems; Treatment algorithm

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When would Minimally Invasive Spinal Surgery not be preferable for Metastatic Spine Disease?

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Background: Metastatic Spine Tumour Surgery (MSTS) is an important treatment modality of Metastatic Spinal Disease (MSD). Open spine surgery (OSS) was previously the gold standard of treatment till the early 2010s. However, advancements in MSTS in recent years have led to the advent of minimally invasive spinal surgery (MISS) techniques for the treatment of MSD. The clear benefits of MISS has resulted in a current paradigm shift towards today's gold standard of MISS and early adjuvant RT in treating MSD patients. Nonetheless, despite the improvements in surgical techniques and the rise of literature supporting MISS for MSD, there are still certain situations whereby MISS is not desirable or even suitable.
Objective/Aim: We aim to highlight considerations for not using MISS in MSD in today's clinical context.
Methods: This narrative review was conducted using PubMed, Medical Literature Analysis and Retrieval System Online (MEDLINE), The Cochrane Library and Scopus databases through 31 Aug 2023. The vast personal experiences of the senior authors also circumstantiated the various situations that were inappropriate for MISS.
Results: A total of 43 studies were included in this review. We discussed advantages and various situations appropriate for MISS for MSD in today's clinical context. Nonetheless, there are still various unique circumstances in which MISS may be less suitable (Table 1). The considerations can be split into: profile of MSD patients, location of vertebrae involved with metastasis, tumour characteristics, as well as other miscellaneous factors such as equipment and adjuvant therapy availability.
Conclusion: Our manuscript is the first to discuss circumstances where MISS is less applicable, despite advantages it may confer over traditional OSS. MSTS should be individualized to the patient, depending on the experience of the surgeon. OSS is still a time-tested approach that holds weight in MSTS and should be readily utilised depending on the clinical situation.
Keywords: Metastasis, Spine, Tumour, Open Surgery, Minimally Invasive Surgery

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Pre and Post 3D printed PEEK composites: A detailed compositional analysis for optimized tensile and flexural properties

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Background: 3D printed PEEK (Polyether Ether Ketone) is finding its place in orthopedic and spinal surgery as personalization of implants have become more important in recent years. Advantages of PEEK are that it is biocompatible, with young's modulus that is closer to bone, reducing stresses at the bone-implant interface. However, PEEK is inherently hydrophobic, which often hinders cell attachment, resulting in inadequate bone bonding and reduced stability in load-bearing implants. Hence, there is a requirement of development of new PEEK composites, to improve the biomechanical properties of the material.
Objective/Aim: In this study, we developed a PEEK composite (PEEK+HA+Mg2SiO4) as extruded filaments and 3D-printing by optimizing parameters in Fused Deposition Modeling (FDM). We aim to study the pre-printed and post-printed characteristics of these implants to highlight any biomechanical differences that may arise from the printing process.
Methods: A composite consisting of 75% PEEK, 20% HA, and 5% Mg2SiO4 was employed. This blend was processed into filaments using twin-screw extrusion and used for 3D printing via Fused Deposition Modeling (FDM). Investigation on surface attributes, thermal properties, structural characteristics, and chemical compositions, as revealed through SEM-EDS, TGA, XRD, and FTIR, respectively, highlights viable differences between the composite filament and the 3D-printed PEEK composite. Mechanical tests for tensile and flexural properties were conducted in strict adherence to the appropriate ASTM standards, using suitable mechanical instrument.
Results: 3D printed PEEK composites showed improved flexural strength and modulus compared to PEEK composite filaments. The 3D printing process also shows that the processes of filament extrusion and FDM 3D printing do not induce any structural alterations in the molecular composition of PEEK composites.
Conclusion: 3D printed PEEK composites are easily replicable and further analyses should be done to study the clinical application of these composites. They confer improved biomechanical properties, and have the potential to be used for various applications in orthopaedic surgery.
Keywords: 3D printing, PEEK Composites, Surface and thermal analysis, Mechanical properties.

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A review on NiTinol shape memory smart material in Spine Surgery: Precise 3D Printing, Biocompatibility and Potential Clinical and Surgical applications

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Background: There has been an increase in metastatic spine disease (MSD) and metastatic spine tumour surgery (MSTS) in recent years with longer lifespans and improved surgical techniques. This in turn spurs innovation in implants and materials, in order to develop the implant best suited for patients' needs. However, selecting the right implant is crucial due to unique spine mechanics. Spinal implants require exceptional biocompatibility, elasticity, and properties like strength and fatigue resistance to suit the properties of the spine. Recently, NiTinol shape memory smart material has been described as a unique implant material that can potentially confer biomechanical advantages when used clinically. Despite these benefits, designing NiTinol implants with precise features is challenging. 3D printing has since emerged as a promising solution for tailoring implants to individual medical needs.
Objective/Aim: In this review, we aim to offer an in-depth exploration of the potential uses of NiTinol shape memory smart material in spine surgery today.
Methods: A systematic review will be conducted. This review utilizes existing literature to bridge the gap across various aspects of NiTinol implants, including biocompatibility and clinical applications.
Results: NiTinol confers many advantages in medical applications due to their shape memory effect and superelasticity. Dynamic NiTinol rods have been showed to allow controlled movement to maintain spinal function while correcting deformity and addressing instability. Vertebral body stapling has also emerged as a promising concept for clinical utilization.
Conclusion: NiTinol smart material has shown great potential for use in various aspects of spinal surgery. However, further in vivo studies encompassing diverse patient groups are needed to investigate the long-term systemic effects of these "smart" implants. Substantial research is also required to refine implant materials for future patients requiring spinal instrumentation.
Keywords: Orthopaedic Surgery, NiTinol smart material, 3D printing, biocompatibility

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Hybrid Technique versus Long Fusion Technique in Multilevel Cervical Degenerative Disc Disease – An Analysis of Functional, Radiological, and Neurological Outcomes

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Introduction: In multiple cervical degenerative disc disease (MCDDD), a hybrid technique (HT) is one new modality of surgical treatment. It involves the combination of anterior cervical discectomy and fusion (ACDF) and total disc replacement (TDR), is thought to have the advantages of both, resulting in achievement of motion function and solid fusion. The present study compared the hybrid technique with the long fusion technique (multiple ACDF) in terms of functional, radiological, and neurological outcomes.
Materials and Methods: We included patients with MCDDD in our institutional hospital from 2011 to 2022 who underwent long fusion and HT. We evaluated the preoperative functional (SF-36, neck disability index, and numerical rating scale), radiological (cervical lordosis) and neurological (sensory and motoric functions) and 12-months postoperative functional, radiological, and neurological measurements. The improvements of the outcomes were compared between long fusion and HT groups.
Result: A total of 32 patients were included in our retrospective study. From the analysis, there was significant improvement of postoperative functional, radiological, and neurological measurements in both groups. There was no significant difference in the radiological and neurological outcomes between both groups. However, HT groups showed better functional outcomes compared to long fusion group.
Discussion and Conclusion: Both types of surgery were safe and effective in treating patients with MCDDD. Both long fusion and HT provided great ability in correcting cervical lordosis, however functional outcomes of the HT was better compared to long fusion. This might perhaps due to preservation of motion segment.
Keywords**:** Multiple cervical degenerative disc disease; hybrid technique; Long fusion technique; Functional outcomes; Neurological outcomes; Radiological outcomes

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Improvement of Intra Operative Nerve Monitoring Signal during Surgical Decompression Served as Prognostic Factor of Improvement of Functional Outcomes in Patients with Cervical Myeloradiculopathy

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Introduction: For many years, during intraoperative nerve monitoring (IONM), only somatosensory evoked potential (SSEPs) were monitored during spinal cord surgeries before motor-evoked potential (MEP) techniques were developed. Combination of SSEP/MEP monitoring provided higher sensitivity and higher positive/negative predictive values than single-modality monitoring techniques to assess spinal cord integrity. There is insufficient evidence on the therapeutic relationship between IONM changes during cervical spinal decompressive surgery for cervical myeloradiculopathy diseases and functional outcomes. In this current study, we retrospectively assess the effect of IONM changes in predicting postoperative neurological recovery and functional outcomes in patients with cervical myeloradiculopathy diseases. The primary objective of the present study was to investigate whether IONM positive changes can predict functional outcome after varied surgical interventions for cervical myeloradiculopathy.
Materials and Methods: We included patients with cervical myeloradiculopathy diseases in our institutional hospital from 2011 to 2022 who underwent surgical decompression either with cervical disc replacement (CDR), anterior cervical discectomy and fusion (ACDF), laminoplasty, and posterior stabilization. We evaluated the preoperative and 12-months postoperative functional (SF-36, neck disability index, mJOA-INA, and numerical rating scale) data and the results of intraoperative SSEP and MEP monitoring. We evaluated which intraoperative monitoring provided the most significant prognostic factor for functional improvement and which surgical procedure had the most significant correlation with the IONM findings.
Result: A total of 100 patients were included in our retrospective study. From the analysis, intraoperative MEP monitoring provided the most significant prognostic factor for functional improvement in patients with cervical myeloradiculopathy underwent ACDF procedure.

Discussion and Conclusion: During ADCF procedure for cervical myeloradiculopathy disease, improvement of intraoperative MEP could provide better prognosis for functional improvement.

Keywords: Intraoperative nerve improvement; Cervical myeloradiculopathy; Somatosensory evoked potential; Motor-evoked potential

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Closing the Debate: Anterior Cervical Discectomy and Fusion versus Cervical Disc Replacement for Single Level Cervical Degenerative Disc Disease

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Introduction: In the last decade, cervical disc replacement (CDR) as an alternative procedure to anterior cervical discectomy and fusion (ACDF) due to the preservation of motion and the avoidance of adjacent segment disease, has been investigated in many randomized controlled trials (RCTs). The large number of RCTs comparing CDR and ACDF for cervical degenerative disc disease (CDDD) have rendered this question as the most studied matters in spinal practice. The aim of this study was to closing the debate between CDR and ACDF in single level CDDD and made the conclusion whether to choose one over another.

Materials and Methods: We included patients with single level CDDD in our institutional hospital from 2011 to 2022 who underwent CDR and ACDF. We evaluated the preoperative functional (SF-36, neck disability index, mJOA-INA, and numerical rating scale) and radiological (cervical lordosis) measurement, and 12-months postoperative functional and radiological measurements. We also evaluated complications, re-operation rate, return to work, need of analgesia, and cost analysis between two procedures.

Result: A total of 50 patients were included in our retrospective study. From the analysis, there was significant improvement of postoperative functional and radiological measurements in both groups. There were no significant difference in the functional and radiological outcomes between both groups. However, CDR group showed lower complications, re-operation rate, and need of analgesia and higher return to work and overall healthcare cost compared to ACDF group.

Discussion and Conclusion: CDR would be chosen in the setting of high demand of activity return and higher financial ability while ACDF was an effective alternative in patients with lower demand of activity return and lower financial ability

Keywords: Single level cervical disc replacement; Cervical disc replacement; Anterior cervical discectomy and fusion

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Evaluation of the Intraoperative Sufficiency of Anterior Cervical Decompression for Myeloradiculopathy Diseases

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Introduction: To date, anterior decompression is the most common choice for surgical decompression of myeloradiculopathy diseases. However, it is technically demanding with some difficulties in obtaining sufficient decompression, both in a cranio-caudal direction and in the lateral portion of the vertebral body. In this study, we analysed the efficacy of visual observation combined with three-dimensional fluoroscopy and intraoperative motor-evoked potential (MEP) in the evaluation of the sufficiency of bone removal during anterior decompression.

Materials and Methods: We included patients with cervical myeloradiculopathy diseases in our institutional hospital from 2011 to 2022 who underwent anterior surgical decompression either with cervical disc replacement (CDR), anterior cervical discectomy and fusion (ACDF), or anterior cervical corpectomy and fusion (ACCF). We evaluated the preoperative and postoperative functional (SF-36, neck disability index, mJOA-INA, and numerical rating scale) data. We evaluated the sufficiency of anterior decompression using combination of intraoperative three-dimensional fluoroscopy and MEP improvement. The anterior decompression was said to be sufficiently decompressed if visually the dura had been seen without any bony and posterior longitudinal ligament (PLL) obstruction in all perimetry, if the intervertebral disc had been cleared off bony obstruction from the three-dimensional fluoroscopy image, and increased MEP of 50% or more from the baseline. Partial decompression was said if visually and radiologically the decompression was sufficient (PLL was removed) but the MEP increase was less than 50%; or if visually the PLL is left intact without any bony obstruction in all perimetry with clear bony obstruction from the three-dimensional fluoroscopy image with increased MEP of 50% or more. We evaluated whether the functional outcomes correlated with the sufficiency of the anterior decompression. We also evaluated the rate of complications between sufficiently decompressed and partially decompressed patients.

Result: A total of 100 patients were included in our study. 60% patients were deemed to be sufficiently decompressed while other 40% were partially decompressed. Analysis showed that in immediately postoperative and 6-months follow up, patients with sufficient decompression had significantly higher functional outcomes compared to patients with partial decompression. However at 12-months follow up, there was no significant difference in the sufficiently decompressed and partially decompressed groups. Sufficiently decompressed patients had higher rate of complications

Discussion and Conclusion: This study provided classification for the sufficiency of anterior decompression for cervical myeloradiculopathy disease. Patient with sufficient decompression would come with immediate improvement of functional outcomes with the expense of higher risk of complications, while patient with partial decompression would have significant improvement of functional outcomes at the mean of 12 months after surgery.

Keywords: Sufficiency of anterior cervical decompression; Cervical myeloradiculopathy diseases.

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Preliminary results and pitfall of O arm navigation assisted cervical spine surgery

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Stereotactic navigation provides real-time anatomic referencing during operation and is helpful in accurate placement of spinal instrumentation. Change in spinal alignment intraoperatively created considerable registration errors using pre-operative CT. Over the last decade, advanced improvements in computer-aided navigation improved accuracy and shortened intra-operative registration time. There is intimate relationship between the cervical vertebrae and its surrounding neurovascular structures and screw breach places nearby structure at risks. There has been a surge of image-guided technology in order to improve the accuracy. As a result, the use of

stereotactic navigation has become increasingly more mainstream. However, due to the high mobility of cervical spine, it is still questionable that if the intra-operative accuracy works as well as that in thoracolumbar spine surgery. We retrospective review our cervical spine surgical cases and the preliminary results showed clinically acceptable accuracy of screw position (grade 0 and 1) is over 95%. This study also demonstrated the practicalities of stereotactic navigation, our registration methods and direct referencing, and shares tips and pitfalls on clinical practices for this burgeoning technology, all with a focus on complex cervical spine surgery using the Medtronic O-arm and StealthStation (Medtronic, Minneapolis, MN, USA). As a result, stereotactic navigation is an effective tool in cervical spine surgery, particularly improving instrumentation accuracy in the setting of atypical anatomy or complex cervical spine surgery. However, the surgeon requires constant vigilance, not complacency in using navigation systems.

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Outcomes of thoracoscopic anterior selective thoracic fusion in adolescent idiopathic scoliosis (AIS) for in Lenke 1 & 2 curves – a 2 - 10 year follow up review

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Background: Thoracoscopic anterior selective fusion (T-ASF) is a minimally invasive alternative method of scoliosis correction as compared to posterior spinal fusion. Advantages of the ASF include decreased blood loss, shorter instrumentation and sparing of the spinal musculature. However there is a paucity of literature on long term outcomes of this surgical technique.
Objectives: This study reviews the long term outcomes of T-ASF in treating AIS.
Methods: Clinical, operative and radiographic data on all female patients with Lenke 1&2 curves, aged 11- 20 years old, who underwent an T-ASF between Jan 2000 – Dec 2013 at our institute were reviewed. Patients underlying musculoskeletal disease, prior spinal surgeries and a follow up duration of <2 years were excluded.
Results: A total of 128 patients were identified with an average follow up of 8.0 ± 3.1 years. Average age was 14.2 ± 2.1 with a median Risser score of 3 (0-5). 7.7 ± 0.6 levels were fused with estimated blood loss of 313 ± 270 ml . Average main thoracic (MT) curve was 49.6 ± 8.9° pre op which corrected to 11.2 ± 5.7° post op with a correction of 77.3 ± 10.5 %. Average thoracolumbar (TL) curve was 30.0 ± 7.9° which corrected spontaneously to 9.6 ± 5.0° post op with a correction of 62.5 ± 18.1%. At final follow up correction MT was 12.9 ± 8.3° and TL was 8.9 ± 6.4°. 3 patients (2.3%) underwent revision to a posterior construct for adding-on, an additional 1 patient (0.7%) underwent rod exchange for rod breakage. 23 patients (17.9%) experienced a >5°loss of correction in any coronal curvature at final follow up due to adding on and/or superior screw pull-out.
Conclusion: Overall long term outcomes of the T-ASF are satisfactory with good and durable post operative curve correction and comparable long term complication rates to posterior fusion surgeries.

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Neurological Function Improvement After Excision of Cervical Schwannoma with Limited Resources - Case Report

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Introduction: 15% of all occurrences of central nervous system cancers are spinal schwannomas, an uncommon kind of intradural extramedullary tumor. For surgeons to execute surgical intervention for total tumor excision, the anatomical placement and constrained space present problems. Other difficulties include the lack of defined recommendations for this malignancy and the low literacy rate.
Case Presentation: A patient, 55 years old with a diagnosis of inferior paraplegia Upper Motor Neuron Type caused by intradural extramedullary tumor VC6-VTh1 suspect Schwannoma with bilateral radiculopathy, confirmed by symptoms, investigations, and operative findings. She was successfully treated with decompression laminectomy and tumor excision as well as durotomy and duroplasty with posterior cervical fusion with lateral mass screw on VC4-VTh1 to maximize results. Follow up 4 months after surgery, the patient could walk on her own.
Discussion: Schwannomas are slow-growing tumors. Therefore, the patient's diagnosis frequently comes too late. Up to 90% of patients feel axial discomfort and/or radicular pain, along with motor and sensory abnormalities. This is brought on by spinal cord compression symptoms that cause changes in sensory, motor, and autonomic functions (pain, numbness, and paresthesia). Magnetic Resonance Imaging is the gold standard to diagnose schwannomas. Surgery for removal of spinal lesions is preferably proceed using intraoperative monitoring (IOM) with microscope and microsurgery instrument such as Cavitron Ultrasonic Surgical Aspirator (CUSA) to improve total removal of the tumor[14]. However in this case, because of the limited resources, we used surgical loupe to perform as possibly as total removal of the tumor.
Conclusion: Total excision is the best option to minimize recurrence and increase the chances of a patient's survival.
Keywords: IDEM tumor, schwannoma, MRI, total resection

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1-Year Clinical Demographic Analysis of Anterior Cervical Discectomy or Corpectomy and Fusion (ACDF or ACCF) in Tertiary Facility: A Single Center Retrospective Study

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Background: Anterior Cervical Discectomy and Fusion (ACDF) and Anterior Cervical Corpectomy and Fusion (ACCF) are commonly utilized for treating cervical myelopathy. However, the demographics of patients who underwent these procedures have not been documented in our center.
Objective: We aim to evaluate the demographic of patients who underwent ACDF or ACCF for 1 year in Dr. Moewardi General Hospital to reveal the patterns of interventions.
Methods: A retrospective observational study was conducted in accordance with STROBE guidelines. Patients from October 2022 to October 2023 with complete medical records who underwent ACDF or ACCF were searched from our database. Patients with a prior history of cervical spine surgery were excluded. Patient demographics (age and gender), surgical procedure (ACDF or ACCF), and etiology classification (trauma or non-trauma) were extracted. Statistical analyses were conducted using STATA/MP 17. Significance was determined by p-value <0.05.
Results: All patients respected the inclusion criteria, 23 patients were included, 14 males and 9 females underwent either procedure. The average age was 51.35 ± 12.20 years. Sixteen patients (69.5%) underwent ACDF procedures (male/female; 7/9). Six were identified as trauma and the rest as non-traumatic patients. ACDF patient's mean age is 49.93 ± 9.31 years. Seven patients (30.4%) underwent ACCF procedure, all being male; 4 accounted as traumatic and 3 as non-traumatic patients. ACCF patient's mean age is 56.14 ± 15.94 years. We found statistical significance of gender distribution among groups (p=0.019). Etiology (p=0.650) and age (p=0.105) are insignificant between groups.
Conclusion: In 2022-2023 we performed ACDF twice as much as ACCF. We found significant differences in gender distribution among ACDF and ACCF groups. Distribution of traumatic or non-traumatic etiology shows no statistical difference between groups. In our case, ACCF was generally performed in older patients compared to ACDF.
Keywords: Anterior Cervical Discectomy and Fusion; Anterior Cervical Corpectomy and Fusion; Trauma; Non-trauma; Cervical myelopathy

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Neurological Improvement After Debridement of Cervical Intradural And Extramedullary Tuberculosis Abscess: A Case Report

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Background: Tetraparesis can be caused by spinal cord compression. This condition is caused by extramedullary or intramedullary compression. Tuberculosis is one of the causes of intramedullary compression. Spinal tuberculoma is also an extrapulmonary manifestation of tuberculosis involving the central nervous system. Spinal intramedullary TB has a similar presentation like intramedullary spinal cord tumor. Clinical and physical examination findings, radiograph, and biopsy HPE are modality used to verify the diagnosis. Surgical and anti tuberculosis drugs are the options for spinal TB treatment.
Methods: This article presented the case of patient with tetraparese UMN type due to cervical intradural and extramedullary tuberculosis abscess. The initial X-Ray and magnetic resonance imaging investigation indicated intramedullary lession. The patient underwent surgical treatment with laminectomy decompression of VC 5-7, posterior spinal fusion of VC 3 – VTh3, durotomy, tumor excision, biopsy and HPE. The result of the biopsy examination is Tuberculosis.
Result: The patient improved neurological status include motoric and autonomic function in 6 weeks after surgery. The motoric improved from ASIA Impairment Scale C to D, the autonomic improved from unable to able to hold the defecation and urination.
Conclusion: Tetraparesis is one of the symptoms of spinal tuberculosis. Surgical treatment like laminectomy decompression in this case is resulting the improvement in neurological function and better outcome.
Keywords**:** laminectomy, intramedullar tuberculosis, tetraparesis, upper motor neuron

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MRI-based lesion quality score assessing ossification of the posterior longitudinal ligament of the cervical spine

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Running title: MRI-based lesion quality score for assessment cervical ossification of posterior longitudinal ligament
Introduction: No method yet exists for MRI-based determination of ossification of the posterior longitudinal ligament (OPLL) of the cervical spine using objective criteria. The purpose of this study was to develop an MRI-based score to determine whether a lesion represents a cervical OPLL lesion and establish the objective diagnostic value. Retrospective cohort in a single medical institution
Methods: Thirty-five patients undergoing surgery for OPLL (Group A) and 99 patients undergoing cervical disc arthroplasty for soft disc herniation (Group B) between 2011 and 2020 were retrospectively included. All OPLL lesions on unenhanced MRI scan were correlated with a corresponding CT scan. Demographics were similar between groups. The regions of interest for signal intensity (SI) were defined as the darkest site of the lesion and the cerebrospinal fluid (CSF) at the cerebellomedullary cistern. The T1 and T2 LQ scores were measured as the ratio of the SI at the darkest site of the lesion divided by the SI of the CSF. Using unenhanced magnetic resonance imaging (MRI) images, the T1- and T2- lesion quality (LQ) scores were calculated. Receiver operating characteristic (ROC) analysis was performed to calculate the area-under-the-curve (AUC) of both LQ scores as a predictor of the presence of OPLL. Computed tomography- (CT-) based Hounsfield unit (HU) values of OPLL lesions were obtained and compared with both LQ scores. We compared the LQ scores for each manufacture of MRI scanner using Student's t test to confirm the validity of the LQ score by scanner type.
Results: The T1 and T2 LQ scores in Group A were significantly lower than those in Group B ($p < 0.001$). ROC analysis determined that T1 and T2 LQ scores of 0.46 and 0.07, respectively, could distinguish the presence of OPLL with an accuracy of 0.93 and 0.89, respectively ($p < 0.001$). When the T1 LQ score of the lesion is <0.46, a

diagnosis of OPLL could be suspected with 100% sensitivity and 92.3% specificity. HU moderately correlated with T1 LQ score (r = −0.665). Both LQ scores were unaffected by manufacturer type.

Conclusions: This study found a correlation between the MRI-based T1 LQ scores and CT-based HU value for identifying OPLL lesions. Additional studied should validate that the T1 LQ score on the unenhanced MRI scan can identify cervical OPLL.

Key words: ossification of the posterior longitudinal ligament, MRI scan, lesion quality score, computed tomography, Hounsfield Units, receiver operating characteristic analysis, retrospective cohort study

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90 days morbidity outcome for the novel technique of C3 dome C7 reverse dome-hybrid open-door laminoplasty in C3-C7 spinal cord compression - A Retrospective Study Of Clinical Outcome Data

Alagan Gnanam, Tan Jun Hao Gabriel Liu

Background: C3 dome C7 reverse dome-hybrid open-door laminoplasty has been hypothesised to reduce post-operative complications due to the preservation of dorsal paraspinal muscles. However, there has not been enough research into the postoperative complications of C3 dome-hybrid open-door laminoplasty as well as clinical outcome scores.

Aims/Objectives: The aim of this study is to analyze 90 days postoperative morbidity outcome among patients who underwent C3 dome-hybrid open-door laminoplasty especially to look out for C5 palsy.

Methods: This is a single center prospective study of all patients who underwent C3 dome-hybrid open-door laminoplasty. A total of 70 patients were included in the study. Demographics data, radiographic parameters, and post-operative clinical outcome scores and C5 palsy rate were collected at pre-operative, immediate post-operative and 3-month postoperative marks.

Results: A total of 70 patients were included in this study. The mean age was 63.8 ± 8.5 years. 43 (61.4%) patients were male. K-line was positive in 93.9% of patients (n=62) pre-operatively. Among the 70 patients 61.4% (n=43) had cervical spondylomyelopathy, 31.4% (n=22) had ossification of posterior longitudinal ligament and 7.1% (5) had central cord syndrome.

Post-operative radiological data: C2-C7 Lordosis was preserved (Pre-operative: 9.9°±10.7°, Immediate post-operative: 10.3°±11.0° , p-value = <0.001).

With respect to immediate post-operative complications, the average intra-operative blood loss was 222.50mls±124.2mls. None of the patients required blood transfusion post-operatively. No postoperative dysphagia or wound infection among the patients. 10.4% of the patients (n=7) reported post-operative pain during the follow-up requiring world health organization level 3 opioid analgesia and above. 1.5% (n=1) had postoperative C5 palsy. Furthermore, patients had statistically significant improvements in their outcome scores during the 3 month follow-up period which includes JOA score (Pre-operative: 12.7±4.0 , 3-month post-operative: 14.7±2.4), VAS Arm (Pre-operative: 0.90±1.64 , 3-month post-operative: 0.05±0.22), VAS Neck (Pre-operative: 2.1±2.09 , 3-month post-operative: 0.62±1.28), SF 36 PCS(Pre-operative: 38.7±8.3 , 3-month postoperative: 43.6±8.2), SF MCS (Pre-operative: 50.2±11.8 , 3-month postoperative: 52.9±8.6) scores (p ≤ 0.01).

Conclusions:

The novel C3 dome-hybrid open-door laminoplasty technique is associated with reduced immediate post-operative complications as well as improved postoperative outcome scores.

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Does C3 dome C7 Reverse Dome-hybrid open-door laminoplasty Prevent Adjacent Segment Disease? - A Retrospective Study Of Clinical Outcome Data

Tan Jun Hao, Wang Chongyan, Alagan Gnanam, Gabriel Liu

Background: C3- dome and C7 Reverse Dome hybrid laminoplasty has been designed to reduce post-operative complications and improve range of motion when treating C3-C7 spinal cord compression. However, there has been no radiological report to describe the postoperative effects on the segment where the dome osteotomy has been performed. The aim of this study is to identify potential radiological changes at the junction between the C3 dome osteotomy and C7 reverse laminoplasty at 2 years follow-up.

Aims/Objectives: This study aims to report the radiological findings of patients who underwent C3 dome-hybrid open-door laminoplasty in a single center, specifically focusing on the incidence of adjacent segment disease.

Methods: This is a single center retrospective study of all patients who underwent a C3 dome-hybrid open-door laminoplasty. A total of 43 patients were included in the study, all of whom had 2 years follow-up data. Demographics data, radiographic parameters, and post-operative clinical outcome scores were collected at pre-operative, 6-months, 1-year, 2-years post-operatively. C3/4 and C6/7 adjacent segment disease was assessed using the grading system reported by Liu et al previously, which assesses changes in disc height, size of anterior syndesmophyte and posterior syndesmophyte, anterior and posterior listhesis, facet arthropathy and disc morphology.

Results: A total of 48 patients were included in this study. The mean age was 65.62 ± 7.64 years. 35 (72.9%) patients were male. K-line was positive in 87.5% of patients (n=42) pre-operatively. Basic radiographic data: C2-C7 Lordosis was preserved (Pre-operative: 9.9°±10.7°, Post-operative: 10.0°±11.3° , p-value = <0.001). Range of motion was preserved (Pre-operative: 33.6°±16.8°, Post-operative: 28.7°±11.9° , p-value =0.147). At the C3/4 level, no statistically significant differences were found in changes including worsening disc height (p=0.391), facet joint (p=0.768), anterior syndesmophyte (p=0.361), posterior syndesmophyte (p=0.721), anterolisthesis (p=1.000) and posterolisthesis (p=0.324). At the C6/7 level, no statistically significant differences were in disc height change (p=0.166), facet joint deterioration (p=0.083), anterior syndesmophyte formation (p=0.556), posterior syndesmophyte formation (p=0.446), development of anterolisthesis (p=1.000) and posterolisthesis (p=1.000). Furthermore, patients had statistically significant improvements in their JOA, VAS Arm, VAS Neck, SF 36 PCS, SF MCS scores (p ≤ 0.01).

Conclusions: The novel C3 dome-hybrid open-door laminoplasty technique prevents the development of C3/4 and C6/7 adjacent level disease, even at mid to long-term follow-up.

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A Rare Case of Esophageal Rupture Folowing Anterior Cervical Corpectomy Fusion (ACCF) in Pathological Fracture due to Spondylitis Tuberculosis

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Introduction: Esophageal rupture is an uncommon and potentially deadly complication that can happen after anterior cervical corpectomy fusion (ACCF) with mortality rates ranging from 6% to 34%. Therefore, we wanted to report a case of esophageal rupture in patient with pathological Fracture due to Spondylitis TB.
Methods: A 55-year-old male initially complained of back pain since 6 months before admission which was worsened over the past 2 months. Patient had history of haemoptysis and weight loss. He was then diagnosed with Pathological Fracture C5-6 and T5-6 due to spondylitis tuberculosis. He was planned for debridement, ACCF, biopsy, and culture. Two days after the surgery, the patient began to complain of difficulty swallowing and hoarseness. Besides, the drain was filled when the patient drank water or milk.
Results: Results of esophagography and endoscopy confirmed the presence of esophageal rupture. Laparotomy gastrostomy feeding and abscess drainage were performed to address the esophageal rupture. After that, the patient's hoarseness improved and he was able to eat soft foods via gastrostomy tube.
Conclusion: Esophageal perforation was a potentially life-threatening complication that could occur after ACCF. Prompt identification was crucial for effective treatment, as the outlook greatly relied on the time elapsed between symptom onset and treatment initiation. Clinician must be able to distinguished between dysphagia due to esophageal rupture or edema.
Keywords**:** anterior cervical corpectomy fusion, esophageal rupture, esophageal perforation, spondylitis tuberculosis

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OPTIMAL DEFORMITY CORRECTION IN ANKYLOSING SPONDYLITIS: A CASE WITH POSITIVE OUTCOME

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Introduction: Ankylosing Spondylitis (AS) is a chronic inflammatory arthritis affecting the axial skeleton, characterized by pain, stiffness, and potential spinal fusion. Typically emerging in young adults, particularly men, AS's global prevalence is influenced by genetic factors, notably the HLA-B27 marker. The diagnosis of AS is based on clinical and radiographic features. Radiographic evidence of sacroiliitis provides the best nonclinical indicator of the presence of the disease. Corrective spinal osteotomy and fusion procedures for segmental instability may be indicated in selected patients.
Methods: We presented a case of a 25-year-old male with AS who underwent corrective spinal osteotomy and fusion procedures including ponte-osteotomy and pedicle subtraction osteotomy.
Results: A 25-year-old male with a three-year history of back pain was diagnosed with AS based on positive HLA-B27, elevated inflammatory markers, and characteristic imaging findings. Treatment with subcutaneous etanercept showed efficacy, but progressive deformity necessitated surgical intervention. The orthopedic approach involved ponte-osteotomy, pedicle subtraction osteotomy, and using cobalt chrome rods. Imaging, including pre- and post-operative sagittal vertical axis (SVA), revealed significant improvements in C2-C7 and C7-S1 alignment. Post-operatively, the patient reported substantial improvements in pain, mobility, and overall functionality based on The Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) and The Ankylosing Spondylitis Disease Activity Score with CRP (ASDAS-CRP) score.
Conclusion: This case underscores the challenges in managing AS, with successful outcomes achieved through a collaborative approach. Medical therapy addressed inflammation, and orthopedic interventions, specifically ponte osteotomy and pedicle subtraction osteotomy, corrected deformities. Post-operatively, significant improvements in clinical aspects and spinal alignment were observed, emphasizing the importance of this interdisciplinary strategy for optimizing the quality of life in individuals with AS.
Keywords: Ankylosing Spondylitis; Deformity Correction; Ponte Osteotomy; Pedicle Substraction Osteotomy; Multidisciplinary Management

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Multiple Compressive and Burst Fracture of Thoracolumbar Level after Selective Spinal Fusion Surgery: A Case Report

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Introduction: Around 27% of individuals with injuries at the thoracolumbar with neurological deficits impact through lifelong disability which resulting in severe consequences for the patient, including the loss of productive years and a considerable economic burden on society.
Methods: We presented a case report of 52-year-old conscious male with multiple compressive and burst fracture of thoracolumbar level.
Results: Patient came to emergency department came with fracture at Th7 vertebral and left transverse process of Th7, Th10 vertebra, Th12 vertebra, and right lamina of Th12, right lamina of L2. Surgery was performed two days after initial clinic presentation. The patient underwent multi-level spinal fusion by pedicle screws of level T9 and T11, T12, L2, L3 with rods and crosslink was applied. Laminectomy decompression was done at level L1. After discussion stabilization of Th7 were not performed and post operative results showed significant improvement
Conclusion: The clinical and radiological outcomes of surgery, including spinal mechanical stability, neurologic deficit, significant spinal deformity revealed satisfactory results even though stabilization at level Th7 were not performed

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Neurological survivorship following surgical decompression for cervical myelopathy

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Background: Patients receiving decompression surgery for degenerative cervical myelopathy (DCM) may suffer from deterioration following an initial period of neurological improvement. **L**ong-term data on postoperative neurological survivorship remains limited.
Objective: To assess neurological survivorship after primary decompressive surgery in patients with DCM and to identify predictors for postoperative deterioration.

Methods: A longitudinal clinical data set containing surgical details, medical comorbidities, and radiographic features was assembled for 195 patients who underwent a surgical procedure for DCM between 1999 and 2020, with a mean period of observation of 75.9 months. Kaplan-Meier curves were plotted, and a log-rank test was performed for the univariate analysis of factors related to neurological deterioration. Lasso regression facilitated variable selection in the Cox proportional hazards model for multivariate analysis.

Results: Overall neurological survivorship was 89.3% at 5 years and 77.3% at 10 years. Cox multivariate analysis following lasso regression identified elevated hazard ratios (HRs) for suture laminoplasty (HR, 4.76; $p < 0.001$), renal failure (HR, 4.43; $p = 0.013$), T2 hyperintensity (HR, 3.34; $p = 0.05$), and ossification of the posterior longitudinal ligament (OPLL) (HR, 2.32; $p = 0.032$). Subgroup analysis among subjects with OPLL demonstrated that the neurological deterioration was significantly higher in the absence of fusion (77.8% compared with 26.3%; $p = 0.019$).

Conclusions: Overall, patients who underwent a surgical procedure for DCM exhibited an extended period with neurological improvement. Cervical fusion was indicated in OPLL to reduce neurological deterioration. Our findings on predictors for early deterioration facilitate case selection, prognostication, and counselling as the volume of primary cervical spine surgeries and reoperations increases globally.