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Cervical pedicle screw placement with patient-specific 3d-printed guides: accuracy and safety in a clinical experience

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Spinal Infections (Spine Parallel Session), October 14, 2024, 5:20 PM - 6:50 PM

Background: Cervical pedicle screw (CPS) instrumentation offers significant biomechanical advantages compared to lateral mass or transarticular fixation. Nonetheless, malpositioning complications constitute a relevant concern. Customized patient-specific 3D-printed templates have been developed to improve CPS placement accuracy and safety. The aim of this study is to present our experience with this surgical technique and its accuracy and safety in a clinical setting.

Methods: This single-center retrospective observational study of prospectively collected data included patients undergoing CPS fixation surgery using a patient-specific 3D template guide system. All patients underwent a 3D-volumetric high-resolution CT scan of the cervical spine for preoperative surgical planning. Postoperative CT scans were used to evaluate pedicle infraction, CPS trajectories and deviations between the planned and the actual screw position.

Results: A total of 115 CPS were implanted in 25 patients, with 107 (93.1%) screws completely placed inside the pedicle. Cortical breach within 2 mm was observed in 8 (6.9%) cases, with no cases of more severe pedicle infractions or perioperative neurovascular complication. No differences of CPS accuracies were found between each metameric fusion level, and between monolateral or bilateral templates. Mean total deviations were 0.75 mm vertically and 0.51 mm horizontally at the screw entry point, and 0.72 mm vertically and horizontally at the narrowest pedicle point. Mean total sagittal and transverse angular deviations were 2.94° and 3.04°, respectively.

Conclusions: Cervical pedicle screw instrumentation using patient-specific guides is safe and accurate, supporting the feasibility of this technique in posterior cervical spine fusion surgery.

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Evaluation of the SISS Score: Correlation of Clinical Outcomes and Radiological Progression in Spinal Pyogenic Infection

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Spinal Infections (Spine Parallel Session), October 14, 2024, 5:20 PM - 6:50 PM

Background: The Spinal Instability Spondylodiscitis Score (SISS) was created as a tool in the evaluation of stability in spinal pyogenic infections. Despite spine surgeon growing interest, the correlation between SISS scores and clinical outcomes remains inadequately explored. Moreover, the prognostic significance of initial SISS scores in predicting subsequent radiological progression is of paramount importance for effective treatment planning and prognostication.

Methods: This study involved a retrospective collection of clinical data and evaluation of radiological images from two centers located in the United Kingdom and Germany. The primary outcomes were defined as unfavorable outcomes (modified Rankin Scale, mRS 4-6) and the development of a neurological deficit during treatment. Radiological progression in patients treated conservatively and monitored with MRI was assessed and categorized into minor progression (including endplate erosion or disc collapse) and major progression (encompassing bony destruction, kyphotic or scoliotic angulation, or translation).

Results: The study incorporated 205 cases, 91 of which underwent conservative treatment, while 114 received surgical intervention. The cohort had a mean age

of 67 years, with 123 male participants. Patients were categorized based on their SISS scores as stable (23 cases), potentially unstable (147 cases), and unstable (35 cases). Within the stable group, 6 patients (26%) developed neurological deficits. Unfavorable outcomes were observed in 9 out of 23 cases (39%) in the stable group, 54 out of 147 cases (37%) in the potentially unstable group, and 18 out of 35 cases (52%) in the unstable group.

ANOVA variance analysis revealed statistically significant differences in continuous SISS scores between patients with no impairment ($p < 0.01$) and those with unfavorable outcomes ($p < 0.05$), as compared to other mRS categories. Subfactors 'Spinal alignment' and 'Bone lesion' had the strongest impact on the continuous SISS ($p < 0.001$).

The multilevel regression analysis indicated that the strongest predictor of an unfavorable mRS outcome were having a neurological deficit at admission ($p < 0.001$), and SIRS at admission ($p = 0.04$). The SISS score and location factors did not reach conventional levels of statistical significance in this model.

Major radiological progression involving the development of deformity was present in 47% across all conservatively treated groups.

Conclusions: The findings suggest that, while subfactors like 'Spinal alignment' and 'Bone lesion' are mainly determining SISS, the overall score's impact on mRS outcomes is less clear. Other factors, not included in the SISS, might also be important in determining outcomes. Furthermore, the data also indicates that an assessment of stability via the SISS is reflective of a specific point in time and that neurological impairments can emerge in conjunction with radiological progression. Hence, ongoing clinical and radiological reassessment during treatment is imperative to preemptively identify the risk of neurological deterioration.

Optional Image

	TOTAL	SISS	SISS	SISS
		stable	potentially unstable	unstable
Admission status	205	23	147	35
Pain	182	9 39%	138 94%	35 100%
Neurological deficit	61	5 22%	43 29%	13 37%
SIRS	31	6 26%	21 14%	4 11%
Outcome				
mRS 0-1	76	7 30%	63 43%	6 17%
mRS 2-3	39	7 30%	23 16%	9 26%
mRS 4-5	65	7 30%	44 30%	14 40%
mRS 6 (death)	16	2 9%	10 7%	4 11%
Developing neurological deficit	25	6 26%	15 10%	4 11%
Conservative treatment		4	38	11
Minor progression		1 25%	6 16%	0 0%
Major progression		2 50%	18 47%	5 45%

Table 1. The table presents a summary of the clinical characteristics and outcomes of patients stratified by their Spinal Instability Spondylodiscitis Score (SISS) status: stable, potentially unstable, and unstable. The table details the distribution of admission statuses such as pain, neurological deficit, and Systemic Inflammatory Response Syndrome (SIRS), as well as the outcomes according to the modified Rankin Scale (mRS) and the frequency of developing a neurological deficit during treatment. Proportions of patients who underwent conservative treatment with radiological follow up and either minor or major progression are displayed below.

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Risk factors of screw misplacement by using intraoperative computed tomography image-guided navigation: a series of 1471 screws

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Spinal Infections (Spine Parallel Session), October 14, 2024, 5:20 PM - 6:50 PM

Background: The aim of this study was to identify potential risk factors for screw

misplacement after using an intraoperative computed tomography (iCT) guided navigation for Screw insertion.

Methods: A retrospective analysis of all patients following iCT navigated spinal pedicle screw placement between October 2015 and March 2022 was performed. Navigated drilling of the pedicle was followed by screw placement (with and without via K-wire). Screw position was checked by a further iCT scan. Screw position was assessed according to the Gertzbein-Robbins classification and the rates of screws actually revised intraoperatively were calculated.

Results: 256 consecutive patients were identified (50,39% male, 49,61% female). A total of 1471 Screws were implanted. Median age was 67 years. The all-over revision rate was 4,49%. Screws were placed in all spinal regions. Degenerative spine disease was the most common diagnosis (43,44%). No significant differences in revision rates were found for gender and age. Lumbar spine (6,25%), thoracic spine (5,86%), tumor (6,40%) and infection (7,98%) diagnosis were associated with highest revision rate. We also found significantly increased revision rates for overweight (BMI 25 to 30) and obesity (BMI > 30) at 4,17% and 7,38%.

Conclusions: The all-over revision rate was 4,49%. The highest revision rates were observed for tumor (6,40 %), infection patients (7,98 %), lumbar spine (6,25 %) and thoracic spine (5,86 %). Overweight and obesity also seems to be a significant risk factor for screw misplacement (BMI<25: 0,46%; BMI 25 to 30: 4,17%; BMI>30: 7,38%). None of the patients suffered from any neurovascular damage. No secondary operation to revise the misplaced screws was required.

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An International Multicentric Evaluation of Septic Patients with Primary Spondylodiscitis – The 2SICK Study of the EANS Spine Section

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Spinal Infections (Spine Parallel Session), October 14, 2024, 5:20 PM - 6:50 PM

Background: The management of septic spondylodiscitis presents a clinical challenge, with debates surrounding the timing of surgical intervention. The 2SICK study addresses the gap in knowledge concerning the efficacy of early surgery versus conservative management in these critically ill patients.

Methods: A multicentric, international retrospective cohort study encompassed cases from 2015-2022. Inclusion criteria were a CRP level >200 mg/l and a septic state upon admission. Patients were stratified by treatment modality (early surgery within 3 days of admission, delayed surgery after 3 or more days of non-surgical stabilisation, and conservative therapy). Chi-square tests, univariate analyses, stepwise and regularization-tuned multivariate regression analyses were used to examine outcome differences in mortality.

Results: A total of 189 patients, with a mean age of 69 years, were evaluated. Among these, 36 underwent conservative therapy, 79 underwent early surgery, and 74 received delayed surgery. The subgroup undergoing delayed surgery exhibited the lowest mortality rates, with 4.1%. In comparison, the mortality rates for early surgery and conservative therapy were 28.2% and 27.8%, respectively. The ideal time frame for delayed surgery, in terms of mortality, was found to be between 10 and 14 days from admission. Accounting for confounders, delayed surgery was found to be significantly associated with decreased mortality ($p < 0.01$) compared to conservative therapy, and early surgery with increased mortality compared to conservative therapy ($p < 0.05$). Positive predictors of mortality were found to be age, reduced GFR, raised creatinine, multiple organ failure, cervical location of the infection, erosion of endplates, presence of psoas abscess and tachycardia at admission ($p < 0.05$). Negative predictors were days between admission and surgery and the presence of epidural abscess ($p < 0.05$).

Conclusions: Delayed surgery was found to be associated with significantly less mortality compared to early surgery and conservative therapy in patients with septic spondylodiscitis. The likely optimal window for surgery is 10 to 14 days

from admission. The strongest predictors of death were early surgery within 3 days of admission, vertebral endplate erosion, and multiple organ failure.

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The role of Vitamin D for incidence of and mortality after aneurysmal subarachnoid hemorrhage

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Aneurysms (Vascular Parallel Session), October 14, 2024, 5:20 PM - 6:50 PM

Background: Aneurysmal subarachnoid hemorrhage (aSAH) has been described as an inflammatory disease. Vitamin D has systemic anti-inflammatory properties and may therefore reduce the risk of development and rupture of intracranial aneurysms (IA). We aimed to investigate the association between vitamin D and the incidence and mortality after aneurysmal subarachnoid hemorrhage (aSAH) using the UK Biobank.

Methods: We retrieved data from the UK Biobank, a prospective population-based cohort study of 502,411 participants, initiated in 2006. Serum 25-hydroxyvitamin D [25(OH)D] levels were analyzed between participants with ruptured IA and the general population. 25(OH)D levels were classified as sufficient (> 50nmol/L), deficient (<50nmol/L) and severely deficient (<30nmol/L). Multivariate logistic regression analysis and Cox regression were performed and adjusted for demographic characteristics and vascular risk factors.

Results: During the 16-year follow-up period (April 2006 - May 2022), 1,447 aSAH were reported. Compared to the general population, aSAH patients had a female preponderance (60.23% vs. 51.71%, $p < 0.0001$) with a higher prevalence of smoking (67.09% vs 60.40%, $p < 0.0001$) and higher systolic blood pressure (142.7 mmHg vs. 140mmHg, $p < 0.0001$). Participants with vitamin D deficiency (<50nmol/L), had a higher incidence of SAH than participants with sufficient 25(OH)D levels (> 50nmol/L; odds ratio (OR) 1.448, confidence intervals (CI) 1.036 - 2.2026, $p = 0.0303$). This association was more pronounced in patients with severe vitamin D deficiency vs. sufficient 25(OH)D levels (OR = 2.052, CI = 1.278 - 3.294, $p = 0.0029$). Vitamin D insufficiency (hazard ratio (HR) 0.940, CI 0.638 - 1.386, $p = 0.7534$) or severe vitamin D insufficiency (HR 0.982, CI 0.565 - 1.815, $p = 0.9517$) were not predictive for mortality after aSAH.

Conclusions: Individuals with vitamin D deficiency and severe vitamin D deficiency have a higher risk of aSAH than those with sufficient vitamin D levels, but vitamin D deficiency did not influence mortality outcome after aSAH. Future studies might investigate potential benefits of Vitamin D supplementation in preventing rupture in IA.

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Intra-Operative Neurophysiological Monitoring (IONM) Role During Aneurysm Surgery: a Technological Support for a Better Outcome

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Aneurysms (Vascular Parallel Session), October 14, 2024, 5:20 PM - 6:50 PM

Background: This observational retrospective study analyzes the value of the Intra-Operative Neurophysiological Monitoring (IONM) during aneurysm surgery. The aim is to identify the correlation between post-operative deficits and IONM.

Methods: Adult patients with unruptured aneurysms treated from September 2019 to August 2023 were included in the study. IONM comprised Motor Evoked Potentials from transcranial (tcPEM) and direct cortical (dcPEM) stimulation with cortical strip. The monitoring was continuous during surgery, and the