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

Stefano Colonna¹, Nicola Marengo¹, Ayoub Saaid¹, Marco Ajello¹, Geert Mahieu², Diego Garbossa¹, Fabio Cofano¹. ¹ University Of Turin, Turin, Italy; ² Orthopedic Surgery Department, Antwerp, Belgium

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

Jonathan Neuhoﬀ¹, Andreas Kramer², Santhosh Thavarajasingam², Rebecca Sutherland³, Hugh McCaughan³, Ehab Shibani⁴, Frank Kandziroa¹, Benjamin Davies⁵, Andreas Demetriades⁶, Florian Ringel². ¹ Bgu Frankfurt Am Main, Frankfurt am Main, Deutschland; ² Department of Neurosurgery, University Medical Centre Mainz, Johannes Gutenberg University, Mainz, Germany; ³ Department of Infectious Diseases, Western General Hospital Edinburgh, Edinburgh, United Kingdom; ⁴ Department of Neurosurgery, Universitätsklinikum Augsburg, Augsburg, Germany; ⁵ Department of Academic Neurosurgery, Addenbroke's Hospital, Cambridge University Hospital NHS Healthcare Trust, Cambridge, Cambridge, United Kingdom; ⁶ Edinburgh Spinal Surgery Outcome Studies Group, Department of Neurosurgery, Royal Infirmary Edinburgh, Edinburgh, United Kingdom

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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 stable	SISS potentially unstable	SISS 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	25	6 26%	15 10%	4 11%
neurological deficit				
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

Bastian Stemmer¹, Pia Baptist¹, Sebastian Ertl¹, Ehab Shibani¹, Dorothee Mielke¹. ¹ Universityhospital Augsburg, Augsburg, Deutschland

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