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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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Introduction: 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.

Material and Methods: This retrospective observational study of prospectively collected data included patients undergoing CPS fixation surgery using a patient-specific 3D template guide system. In all surgical procedures 3D-printed templates were used. All patients underwent a 3D CT scan of the cervical spine for preoperative surgical planning. Postoperative CT scans were used to evaluate pedicle perforation, 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%) of the 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.

Conclusion: Cervical pedicle screw placement using patient-specific guides is safe and accurate, supporting the feasibility of this technique in posterior cervical spine fusion surgery. The significant biomechanical advantages of CPS could allow increased fixation strength over lateral mass screw techniques with potential reduction of fusion area.