Editorial

# Structured evaluation of C7 instrumentation omission for posterior cervicothoracic fixation

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While skipping C7 is often performed in cervicothoracic fusion, few studies have examined parameters and effects related to this technique. The authors build on previous work to investigate the outcomes of omitting C7 screws compared to instrumenting the C7 vertebra in posterior cervicothoracic fixation (1,2). We congratulate the authors on their retrospective study of 314 patients in which they compare 19 patients with C7 fixation to 295 patients without C7 instrumentation with 1-year follow up (2). Comprehensive comparison of complications, operation time, blood loss, fusions rate and long-term radiographic outcome were reviewed. The authors discovered that omission of the C7 level in cervicothoracic constructs resulted in profound reduction in estimated blood loss (EBL) of over 350 mL. Operative time was similar between groups and complications were insignificant in both groups. Radiographic analysis revealed that patients who received C7 bridge experienced increased postoperative sagittal vertical axis (SVA) (29.3±13.1 *vs.* 20.2±3.1 mm; P=0.008), but there was no significant difference between groups in correction of SVA, T1 slope, or cervical cobb angle.

In a critical evaluation of the present study, we question the accuracy of conclusions drawn from the findings of the present analysis stemming from suboptimal study design. First, the two patient groups (n=19 *vs.* n=295 patients) are unevenly balanced. An imbalance of more than 1:10 is considered strong and requires statistical techniques to compensate, such as under-sampling of the majority group (3). Increasingly unbalanced study groups reduce the statistical power (4). For example, a sample ratio of 1:2 *vs.* 1:4 will decrease the power from 0.94 to 0.77. Assuming a difference in fusion rate between the two groups of 10%, a sample size of 398 (199 patients in each group) would be needed (5). Post hoc analysis would help determine if this unbalanced case number still allows for proper interpretation of data.

Further, there are several indications that both study groups are sufficiently heterogeneous to hinder proper comparison. For instance, a significant difference in bone-morphogenetic protein (BMP) usage was found between the patient groups (21% of the C7 fusion group *vs.* 30% of the C7 bridge group). Because the fusion rate was lower in patients without C7 fixation despite more frequent use of BMP is inconsistent with findings as pseudarthrosis rate in this group would be expected to be higher (6,7). The significantly elevated EBL in the group with C7 fixation raises similar concerns—perhaps outliers, differing health status, or surgical approach such as use of cages may explain this difference (8). It is not expected that routine placement of two additional screws would explain a blood loss of an additional 347 mL for single operations and similar exposure as was found. A higher percentage of complications in the C7 fusion group (10.5% *vs.* 6.4%) may also allude to differences in preoperative health status. Additionally, the postoperative SVA is significantly lower (20.2 *vs.* 29.3 mm) for the C7 fusion group when compared to the C7 bridge group, while baseline values were similar. The SVA results cannot therefore be interpreted as equal, as claimed, and shows that a difference in 15.8 mm of correction was achieved for the C7 fusion group.

We recommend similar sample sizes and detailing of preoperative baseline health characteristics and health

status to fortify the study design and justify conclusions. Differences in EBL, use of BMP, and complication rate may infer altered preoperative health characteristics between groups. Although the authors show that cervicothoracic constructs with C7 instrumentation omission are safe, achieve correctional goals, and have similar long-term outcomes, study design concerns would need to be addressed to substantiate claims on blood loss and radiographically similar outcomes over time.

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