•Biomechanical Comparison of Thoracolumbar Burst Fracture Stability with Traditional and Integrated Expandable Corpectomy Spacers: The Effect of Footprint Size, Supplemental Fixation, and Fracture Screws

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Purpose: While traditional unstable burst fracture reconstruction has been evaluated clinically, there are several factors that remain unstudied—namely, effect of spacer footprint size, integrated screws inside the spacer, and the use of pedicle screw at the burst fracture level. This study evaluated L1 reconstruction and the motion profiles of the three variables mentioned, all of which have the potential to affect the kinematic signature.

Methods: Six human cadaveric spines (T11-L3) were tested on a six-degrees-of-freedom simulator enabling unconstrained motion in flexion-extension (FE), lateral bending (LB), and axial rotation (AR), following simulated burst fracture at L1. Expandable corpectomy spacers with/without integrated screws (Fi/F) (FORTIFY-I/FORTIFY, Globus Medical, Audubon, PA) were tested. Small end plates (21 × 23 mm) and large end plates (22 × 40-50 mm) were used on the expandable corpectomy spacer. Bilateral pedicle screw posterior instrumentation (PI) was used one level above/below the fracture. Alternately, a lateral plate (LP) was utilized. Additional bilateral pedicle screws were inserted at the burst fracture level (L1) for further fixation. Constructs were tested in order: (1) preoperative, (2) Fi_{21x23}, (3) Fi_{21x23} + PI, (4) Fi_{21x23} + PI + L1, (5) F_{21x23} + PI + L1, (6) F_{21x23} + PI, (7) F_{21x23} + PI + LP, (8) F_{21x23} + LP, (9) $F_{22x40\text{-}50}$ + LP, (10) $F_{22x40\text{-}50}$ + PI + LP, (11) $F_{22x40\text{-}50}$ + PI, (12) $Fi_{22x40\text{-}50}$ + PI, and (13) $Fi_{22x40\text{-}50}$.

Results: Across FE and LB loading modes, bilateral pedicle screws reduced preoperative motion by 69% on average; however, AR average motion increased. Significant differences were observed in FE and LB (except F_{21x23} + LP). The effect of spacer footprint size was negated in the presence of posterior rods, and resulted in near equivalent motion. While not significantly different, the $F_{22x40\text{-}50}$ + LP provided more stability than F_{21x23} + LP, especially in FE and AR. By and large, the spacer with integrated screws was comparable to spacer (without screws) + LP across all modes, the only exception being in LB, where the lateral plate imparts the majority of rigidity. All corpectomy spacers benefited from pedicle screws, especially in axial rotation where high levels of flexibility were seen with anterior-only constructs. Screws at the burst fracture level imparted additional stability compared to preoperative conditions (87% FE, 72% LB, 17% AR), especially in AR.

Conclusion: This study sought to quantify motion effects of various constructs in the context of L1 burst fracture reconstruction. With bilateral posterior fixation, integrated-screw expandable corpectomy spacers and expandable corpectomy spacers with lateral plate showed biomechanical similarity. There were no notable motion differences as a result of footprint size, except in the absence of pedicle screws. Clinical use of the larger end plate

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has other benefits such as reduced propensity for fracture or subsidence via the stronger cortical ring. Bilateral pedicle screw fixation at the burst fracture level did provide additional stability; however, more stability may be needed in AR.

See pages 99 - 147 for financial disclosure information.