

Biomechanical Analysis of a Modified Triangular Osteosynthesis Technique for Treatment of Spinopelvic Dissociation

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Purpose: Spinopelvic dissociation in young patients often consists of high-energy bilateral sacral fractures. It is hypothesized that a modified technique using the same L5 instrumentation, iliac bolts, and transsacral-transiliac screw fixation augmented with S1 pedicle screws is thought to increase construct stiffness through improved direct mechanical advantage for fracture stability. The purpose of this study was to biomechanically assess the stability of different fixation constructs for spinopelvic fractures.

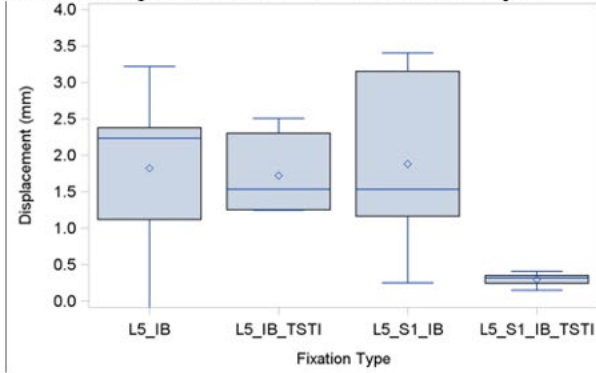
Methods: A model with a U-type sacral fracture with a 2-mm gap was created. Fixation options tested were bilateral L5 pedicle screws with rods attached to iliac bolts (L5-IB), bilateral L5 pedicle screws with rods attached to iliac bolts with a transsacral-transiliac screw (L5-IB+TSTI), bilateral L5 and S1 pedicle screws with rods attached to iliac bolts with a transsacral-transiliac screw (L5-S1-IB+TSTI), and bilateral L5 and S1 pedicle screws with rods attached to iliac bolts (L5-S1-IB). The pelvis models were loaded with 300 N and vertical, horizontal, and angular displacements were compared with analysis of variance.

Results: Compared to L5-IB, L5-IB+TSTI had less horizontal ($P = 0.16$) and angular ($P = 0.002$), but similar vertical ($P = 0.83$) displacement. L5-S1-IB had similar horizontal ($P = 0.40$), angular ($P = 0.68$), and vertical ($P = 0.90$) displacements. Compared to L5-IB+TSTI, the L5-S1-IB construct had less angular ($P < 0.001$) but similar horizontal ($P = 0.10$) and vertical ($P = 0.72$) displacements. Compared to L5-IB+TSTI, the L5-S1-IB+TSTI construct had less vertical ($P = 0.004$) but horizontal ($P = 0.18$) and angular ($P = 0.29$) displacements. Compared to L5-S1-IB, the L5-S1-IB+TSTI construct had less vertical ($P = 0.002$) and angular ($P < 0.001$), but horizontal ($P = 0.73$) displacements. The difference in vertical displacement between the L5-S1-IB+TSTI construct and the other 3 constructs were significant ($P < 0.05$), with the other 3 constructs being statistically similar. Furthermore, the L5-S1-IB+TSTI construct had the greatest load to failure vertically compared to the other 3 constructs ($P < 0.05$).

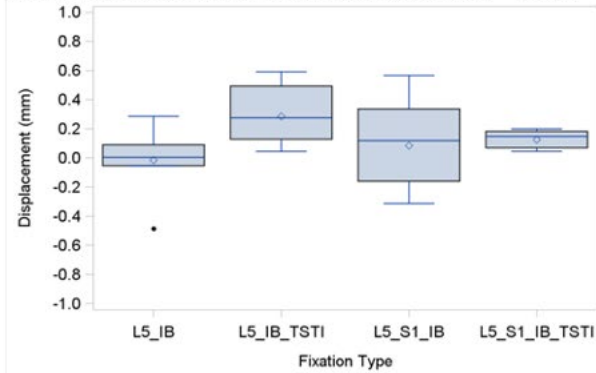
Conclusion: A modified triangular osteosynthesis construct for lumbopelvic fixation consisting of bilateral L5 and S1 pedicle screws with rods attached to iliac bolts with a transsacral-transiliac screw resulted in the least amount of fracture displacement compared to all other constructs in a spinopelvic fracture model. The modification of triangular osteosynthesis with S1 pedicle screws for lumbopelvic fixation in spinopelvic dissociation U-type fractures provides the greatest biomechanical fixation strength, which may lead to less displacement and improved clinical outcomes.

Figure 1: Vertical, Horizontal, and Angular Displacements at Peak Load of the 20th cycle

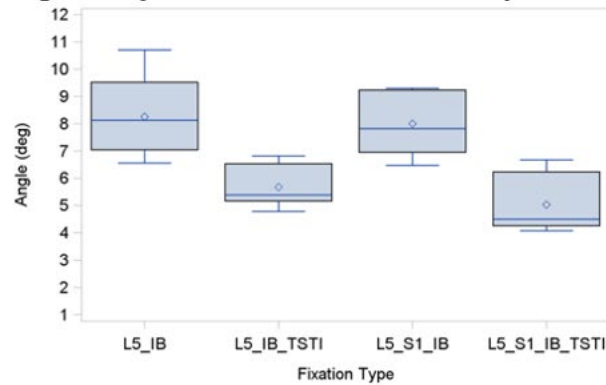
Vertical Displacement at Peak Load of 20th Cycle



Horizontal Displacement at Peak Load of 20th Cycle



Angular Displacement at Peak Load of 20th Cycle



POSTER ABSTRACTS