The Biomechanical Advantage of Locked Versus Non-locked Symphyseal Plating of Unstable Pelvic Ring Injuries

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Background: Symphyseal plate systems for treating pubic symphysis diastasis in unstable pelvic ring injuries are available with locked and nonlocked capabilities. Locked plating systems were developed to improve postoperative stability and reduce the risk of failure, although a biomechanical advantage for locked symphyseal plating has yet to be experimentally demonstrated.

Methods: In this comparison of locked vs. nonlocked symphyseal plating during simulated single leg-stance loading of OTA 61-C 1.2 (unilateral sacroiliac joint disruption and pubic symphysis diastasis) fractures, 14 pelvic models were constructed and tested (Sawbones full pelvic models, foam with cortical shell). S1 sacroiliac screws (Synthes 7.3, cannulated, partially threaded) were inserted via standard technique under direct visualization and real-time fluoroscopy. Anterior fixation consisted of symphyseal plating (Synthes 3.5-mm, 6-hole, locked symphyseal plate) used in either a locked (7 models) or nonlocked fashion (7 models). The affected hemipelvis was supported by an articulating femoral head and wire cables tensioned to recreate the effects of the abductor musculature. A contralateral load of 80 N was used to simulate the weight of the contralateral limb. Each model was cyclically loaded through the sacrum to a maximum of 350 N at 1 Hz for a total of 1000 cycles, representing the biomechanics of single leg stance. A series of markers were placed along each side of the pubic symphysis. Motion of each marker was tracked using a video-based 3-dimensional tracking system. Relative motion was measured between opposing markers across the symphysis in regards to gap formation, shear along the symphysis, and along an axis perpendicular to the other two (anterior translation of the unsupported hemipelvis at the symphysis).

Results: Anterior translation at the end of cyclic loading was larger for the nonlocked models than the locked models. At the onset of loading, average (± standard deviation) anterior translations for the non-locked and locked models were 1.6 ± 0.5 mm and 1.2 ± 0.5 mm, respectively ($P = 0.182$). At 1000 cycles, the anterior translations for the nonlocked and locked models were 2.3 ± 0.6 mm and 1.4 ± 0.6 mm, respectively ($P = 0.015$). No significant differences were identified for gap formation or shear motion ($P > 0.3$).

Conclusion: The results indicate that locked plating of symphyseal injuries provides a more stable construct for repetitive loading.