A Cadaveric Biomechanical Evaluation of Anterior Posterior Compression II Injuries

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Purpose: Pelvic fractures are associated with high rates of morbidity and mortality and often require surgical intervention to restore function and reduce long-term complications. An anterior posterior compression (APC) II injury consists of disruption and widening at the pubic symphysis and anterior sacroiliac joint. Various fixation strategies exist, ranging from iliosacral to transiliac-transsacral screws; however, more literature surrounding specific ligamentous contributions to pelvic stability would aid in better utilization of current fixation methods and the development of novel techniques. The objective of this study is to characterize the 3-dimensional movement and stability of the sacroiliac (SI) joint pre- and post-APC II injury to create a model to improve the evaluation of fixation methods.

Methods: Six fresh-frozen cadaveric pelvises were dissected of all soft tissues, preserving joint capsules and all ligaments of the pelvic ring and floor. Each pelvis was secured at the proximal femur in a double-leg stance. S1 was axially and cyclically loaded to 60% body weight (BW) with an MTS servo-hydraulic loading system. Joint motion was tracked with an Optotrak motion analysis system. Each specimen was measured in the intact state and again following a 3-step progressively destabilized APC II injury model consisting of (1) PS: sectioning of the pubic symphysis; (2) JOINT: severing the ipsilateral anterior sacroiliac, sacrospinous, sacrotuberous, and interosseous ligaments, and disruption of the ipsilateral anterior/superior joint capsule; and (3) JOINT+ASI: severing the contralateral anterior sacroiliac ligaments.

Results: Compared to the intact state, there was a statistically significant increase in movement in the JOINT (ipsilateral 177%, $P<0.001$; contralateral 46%, $P<0.005$) and JOINT+ASI (ipsilateral 184%, $P<0.002$; and contralateral 62%, $P<0.002$) states bilaterally. Axial stiffness decreased after every successive disruption; 293 N/mm in the intact state, 250 N/mm in the PS state, 88 N/mm ($P<0.008$) in the JOINT state, and 73 N/mm ($P<0.0002$) in the JOINT+ASI state. No significant change was demonstrated in the PS state.

Conclusion: The PS resection had a minor impact on movement or stiffness; however, disruption of ipsilateral anterior/superior joint capsule, interosseous, and sacrospinous and sacrotuberous ligaments significantly destabilized both SI joints. The PS state did not create a significant decrease in movement or stiffness, perhaps indicating that injuries confined to the pubic symphysis cause no major reduction in the axial weightbearing capability of the pelvis. This study defines contributions of the regional components to pelvic stability in traumatic APC II injuries, providing a framework to evaluate the efficacy of fixation methods.