Load-Stable Posterior Column Acetabulum Fracture Fixation: A Biomechanical Comparability Study

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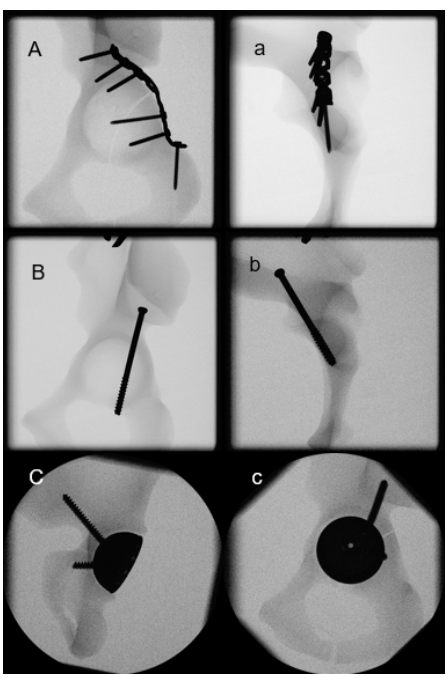
Purpose: The rate of acetabular fractures (AFs) is increasing in all industrial nations with posterior column fractures (PCFs) accounting for 18.5 to 22% of these fractures. Treating displaced AFs in elderly patients is a known challenge. The optimal surgical strategy using open reduction and internal fixation (ORIF), total hip arthroplasty (THA), or percutaneous screw fixation (SF), remains debated. Additionally, with either method, post-surgical weightbearing protocols are also ambiguous. The aim of this study was to evaluate construct stiffness and load to failure following a PCF stabilization with standard plate osteosynthesis, screw fixation, and THA with a screwable cup under full weightbearing conditions.

Methods: 12 anatomical composite osteoporotic pelvises were used in this study. A posterior column fracture according to the Letournel classification was created in 24 hemipelvis constructs that were stratified into 3 groups (n = 8) as follows: Group PCPF: posterior column fracture with plate fixation, Group PCSF: posterior column fracture with screw fixation, and Group PCSC: posterior column fracture with screwable cup fixation. Biomechanical testing was performed on a servohydraulic material testing system. The samples were loaded cyclically at a rate of 2 Hz with a valley load of 20 N and a peak load starting at 200 N that was increased at a rate of 0.05 N/cycle until failure. Relative displacements of the bone fragments were measured using a stereographic camera system and outcome parameters were calculated.

Results: Initial construct stiffness was 154.8 ± 68.3 N/mm, 107.3 ± 41.0 N/mm, and 133.3 ± 27.5 N/mm, for the plate fixation, screw fixation, and cup fixation, respectively, with no significant differences between the groups, P = 0.173. Furthermore, the number of cycles to 1 mm of total anterior displacement were 7822 ± 2281 cycles, 3662 ± 1664 cycles, and 5989 ± 3440 cycles, for the plate fixation, screw fixation, and cup fixation, respectively, with a significant difference between the plate and screw fixation, P = 0.012.



Conclusion: Standard ORIF with plate osteosynthesis as well as primary THA with a screwable cup of PCF demonstrated encouraging results for a post-surgical treatment concept with a full weightbearing approach. Further biomechanical studies should be initiated using cadaver bones and larger sample sizes for a better understanding of AF treatment with full weightbearing and its potential as a treatment concept for PCF fixation.