

Posterior Malleolar Fracture Fixation with Posterior Plating versus a Modified Anterior-Posterior Four Screw Construct: A Cadaveric Biomechanical Study

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INTRODUCTION:

There continues to be controversy regarding the optimal fixation strategy of large posterior malleolar fractures while treating trimalleolar ankle fractures. The purpose of this study was to compare the biomechanical stability in a cadaveric model of a modified anterior-posterior (AP) 4-screw construct versus posterior plate fixation of posterior malleolar fractures.

METHODS:

Twenty fresh-frozen (10 matched-pairs) human cadaveric below-knee specimens were prepared with an oblique osteotomy of the posterior malleolus, resection of medial and lateral ankle ligaments, and posterior dislocation of the tibiotalar joint to produce unstable Mason 2A posterior malleolar fractures. With random selection, one specimen from each pair was fixed with a modified AP 4-screw construct and the other with a 5-hole one-third tubular plate with 4 cortical screws. The specimens were then axially loaded in neutral ankle position for 50,000 cycles to simulate protected weightbearing, and subsequently loaded to failure in 20 degrees of plantarflexion. Fracture displacement and load to failure were recorded. Statistical significance was set at $p < 0.05$.

RESULTS:

There was no difference in displacement between the two constructs under axial cyclic loading after 50,000 cycles (screws, 1.32 ± 0.26 mm vs plate, 1.26 ± 0.48 mm, $p = 0.82$). Additionally, there was no difference in the load to failure represented by 2 mm of displacement of the fracture site (screws, 3856 ± 617 N vs plate, 3939 ± 569 N, $p = 0.81$). When considering maximum load to catastrophic failure, the two constructs were statistically equivocal (screws, 4867 ± 718 N vs plate, 4862 ± 1020 N, $p = 0.99$). On average, posterior malleolar fractures in the study had sagittal height of 47.25 mm, sagittal angle of 7.35 mm, axial angle of 29.70°, with 50% involvement of the tibial plafond and no difference in measurements between groups ($p > 0.34$).

DISCUSSION AND CONCLUSION:

For the fixation of large, unstable Mason 2A posterior malleolar fractures involving roughly 50% of the articular surface, our modified AP 4-screw construct may offer similar biomechanical stability while avoiding prone positioning and extensive posterior surgical exposure associated with posterior plating.