Comparison of Posterior Wall Acetabulum Fracture Stabilization Methods: A Biomechanical Study

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INTRODUCTION: Simple posterior wall acetabulum fractures are amongst the most seen fracture patterns of the acetabulum. To address this fracture pattern surgically, our institution utilizes a 2.7mm "H" 5-hole midfoot plate in a buttress fashion with its large surface area. This plate offers several technical benefits such as ease of insertion and no need to pre-contour. However, there is no current literature comparing the biomechanical equivalency of the "H" plate to other more commonly used constructs for simple posterior wall fractures [1,2]. Using pelvis saw bone models, we compared the biomechanical rigidity of the standard of care posterior wall fixation constructs to the use of an isolated 2.7mm "H" midfoot plate for non-comminuted posterior wall fractures. Our hypothesis, the "H" plate will have comparable rigidity to the other previously studied constructs and will withstand 1,000 N cyclic loading without loosening.

METHODS: A simple posterior wall fracture was created on total of 12 hemi-pelves from 4th generation saw bones. Each fracture was repaired with the use of either a 3.5mm pelvic recon plate (RP), a 3.5mm pelvic recon plate augmented with a 1/3 tubular spring plate (SP), or a 2.7mm "H" midfoot plate (HP). Each construct was then subjected to cyclic loading at 30deg of flexion and 20deg adduction until equilibrium was reached. [1] Three Optitrack reflectors were placed on the rim of the posterior fragment and 3 more on the ilium of each construct (Fig.1). The relative translation motion of the ilium bone fragments were measured in 3 principal planes during cyclic loading from 50 N to 1050 N sinusoidal cycles in load control at 0.5 Hz. The total vector of relative translations was calculated from the vectors in each principal planes.

RESULTS SECTION: In terms of relative motion at the fracture site, there were no significant differences between the 3 groups. All measures of motion were completely elastic, with no evidence of changes during cycling.

DISCUSSION: All constructs maintained elastic relative motions within a fraction of a mm, compatible with bone healing. The HP group showed no biomechanical differences between the other constructs with cyclic loading. Some limitations to this study include the use of saw bones versus cadaveric bone, as well as difficulty in creating a uniform fracture pattern for each hemi-pelvis. Nonetheless, this preliminary data suggests that the HP configuration alone could be just as effective at addressing these fractures as the RP and RS configurations.

SIGNIFICANCE/CLINICAL RELEVANCE: Adding this evidence of biomechanical equivalence to proven methods, to our clinical experience of improved technical ease as well as decreased surgical time and blood loss, the use of an "H" plate could be a superior construct for simple posterior wall acetabulum fractures.

REFERENCES: [1] Pease, F, et al, J Orthop Surg, 27(3):1-7, 2019. [2] Wu, X, Internat. Orthop, 42:673-679, 2018.

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IMAGES AND TABLES:

Fig.1. The acetabular fragment was loaded with the ball of a hip prosthesis. The non-reflective tape covered the metal fixation so the Optitrack could follow the reflectors. The total vector of relative motion from X, Y and Z measures were compared for each configuration (left). The H plate configuration is shown (right).

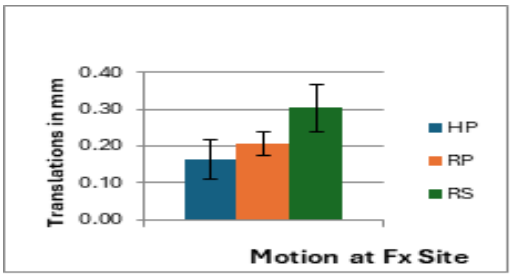

Fig. 2. Results of motion at fracture site.