Novel Technique for Fixation of Medial Malleolus Fractures: A Biomechanical Study

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Introduction/Purpose: The traditional method for fixation of medial malleolar fractures has been with partially threaded (PT) lag screws extending beyond the physisal scar. Recent studies have shown fully threaded (FT) bicortical fixation in the tibial metaphysis provides superior biomechanical, radiographic and clinical outcomes. Risks with the bicortical technique include drill bit breakage, as well as injury to structures lateral to the tibial metaphysis if the far cortex is overdrilled. We hypothesized that far endosteal fixation, without penetration of the far cortex, would provide increased biomechanical strength compared to traditional PT lag screw fixation, while minimizing the risks associated with bicortical fixation.

Methods: Twelve matched pairs of cadaver ankles were harvested and an oscillating saw was used to make an osteotomy at a 45-degree angle to the axilla. The medial malleolus was then re-approximated and held in the correct orientation using two kirschner wires. A 2.7mm drill bit was used to drill a unicortical pilot hole perpendicular to the osteotomy. The left ankle was used for all PT 3.5mm cancellous screws and all screw lengths were 45mm. For the contralateral ankle, the 2.7mm drill bit was used to drill to the lateral tibial cortex. The depth gauge was then used and five millimeters was added to the measured number to achieve endosteal purchase with the appropriate FT screw. Screw lengths varied in size from 55-70 mm. Screws were then placed using a torque measuring screw driver and final torque was recorded. Finally, radiographs were taken to confirm appropriate placement.

Results: Average torque for unicortical PT cancellous screws was 5.02 inch-pounds with a standard deviation of 2.34. Average torque for all FT cortical screws was 7.63 inch-pounds with a standard deviation of 3.86 (Fig. 1A). A paired student’s t-test was performed comparing both fixation methods and the measured P-value was <0.01. Visual and radiographic inspection revealed no displacement of the fracture site using the FT endosteal screw (Fig. 1C).

Conclusion: Our results indicate superior biomechanical torque with far endosteal fixation as compared to a traditional PT lag screw, while minimizing risks associated with bicortical fixation. This novel technique may provide added strength with minimal risk in vivo. Further clinical studies comparing radiographic results and outcomes of far endosteal fixation versus bicortical fixation are needed to ascertain the value of this fixation technique for medial malleolus fractures.

Fig. 1. Comparison of unicortical 3.5 PT cancellous versus endosteal 3.5 FT cortical screws in matched cadaver pairs. *P<0.01. Radiographic comparison of PT endosteal screws (A) versus FT endosteal screws (C).