Optimal Fixation for Horizontal Medial Malleolus Fractures
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Introduction: Multiple techniques have been described for fixation of the medial malleolus. Two parallel 4.0 mm partially threaded cancellous screws oriented perpendicular to the fracture line providing compression remains the gold standard for medial malleolus fixation. Smaller fragments, such as those with a sagittal splint in the anterior and posterior colliculus of the medial malleolus, may require a tension band. Neutralization plating has also been proposed for vertical shear fractures of the medial malleolus but is not a mechanically feasible construct when dealing with horizontal medial malleolus fractures. The use of a contoured 2.0 mm mini-fragment T-plate provides an alternative method of fixation for small medial malleolus fragments.1

Significance: Though a variety of techniques exist which provide fixation of horizontal medial malleolar fractures, the optimal technique and pattern of internal fixation remains unclear.

Methods: Identical horizontal osteotomies were created in synthetic distal tibiae using a jig. The specimens were randomly assigned to one of the four fixation groups (n = 10 per group) - plate: a contoured 2.0 mm mini-fragment 10-hole T-plate secured to the distal tibia using four 40.0 mm x 2.4 mm cortical screws; tension band: a standard figure-of-eight tension band was fashioned with 18-gauge wire and secured distally with two 2.0 mm diameter Kirshner wires placed parallel to each other; parallel screws: two 40 mm length, 4.0 mm diameter cancellous screws were placed parallel to each other; divergent screws: two 40 mm length, 4.0 mm diameter screws were placed with approximately 35° of divergence (Figure 1). The specimens were then tested using offset axial tension at 10 mm/minute until 2 mm of displacement occurred.

Results: The average stiffness was 177.7 ± 26.2 N/mm for the plate group, 124 ± 15.9 N/mm for the tension band group, 141.2 ± 23.9 N/mm for the parallel group, and 112 ± 22.2 (Figure 2A) for the divergent group. The average stiffness of the plate construct was significantly greater than any of the other constructs (p < 0.05). The average stiffness of the tension band, parallel, and divergent groups were not significantly different from each other (p > 0.05). The average force at 2 mm of displacement was 362 ± 72.2 N for the plate group, 266.7 ± 43 N for the tension band group, 291.7 ± 47.1 N for the parallel group, and 230.5 ± 44 N for the divergent group (Figure 2B). The average force at 2 mm of displacement was significantly greater with the plate construct than any other construct (p < 0.05). The average force at 2 mm of displacement of the tension band, parallel, and divergent groups were not significantly different from each other (p > 0.05).

Conclusion: Before this study, there had been no research comparing the biomechanical properties of fixation methods of horizontal medial malleolus fractures. Furthermore, no clinical study compares the outcome and complications of the different fixation methods. Using a contoured 2.0 mm mini-fragment T-plate as the method of fixation resulted in a stiffer construct that required more force for 2 mm of displacement when used to stabilize an osteotomy model of a horizontal medial malleolus fracture.

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References: