

# Sustentaculum Fractures of the Calcaneus: An evaluation of fixation construct stability

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**INTRODUCTION:** Mal-reduction of the sustentaculum can affect the stability of the subtalar joint. Adequate reduction and fixation of the sustentaculum can be critical in the operative treatment of calcaneal fractures. The placement of fixation points into the sustentaculum is challenging and the optimal fixation construct is unclear. This study aimed to assess construct stiffness by comparing medial to lateral screw (MLS) vs lateral to medial plate (LMP) fixation for isolated sustentaculum tali fractures in cadavers and 4th generation composite bone (synthetic ankles). We hypothesized that LMP would provide greater stiffness to the construct compared with MLS.

**METHODS:** Five matched foot and ankle cadaveric paired specimens were used. The calcaneus and talus were harvested as a unit from all specimens while maintaining the subtalar joint and the central talocalcaneal interosseus ligament. For all specimens, an isolated sustentaculum fracture was simulated using a sagittal saw and osteotomes. For MLS, a 2.7 mm cortical sustentaculum screw was drilled and inserted from the tip of the sustentaculum to the lateral wall of calcaneum, avoiding the subtalar joint. For LMP, a 2.7 mm locking lateral calcaneal plate was used with one screw in the anterior process, one screw in the tuberosity, and a 2.7 mm locking sustentaculum screw. The same steps for fixation were repeated with the synthetic ankles. All procedures were performed by an orthopedic trauma fellow. All ankles, both cadaveric and synthetic, were loaded axially on the articular surface of the talus with an average body weight: 784 N (80 kg). Stiffnesses, calculated from the resulting force and displacement data, were used to compare each construct, and assess each construct's ability to resist external forces. For the cadaver specimens, a paired t-test was used to determine whether there was a statistically significant difference between MLS and LMP, while for synthetic ankles an unpaired t-test was used because there was no right/left pairing in the synthetic ankles as there were in the cadavers. The null hypothesis for both tests was that there was no difference in mean stiffnesses for MLS and LMP.

**RESULTS SECTION:** In the cadavers, mean stiffness for the LMP was 232.95 N/mm with standard deviation of 59.96 N/mm, while for MLS the mean stiffness was 239.72 N/mm with a standard deviation of 131.09 N/mm. The paired t-test demonstrated no statistically significant difference between LMP and MLS ( $p = 0.9293$ ). In the synthetic ankle model, LMP mean stiffness was 178.41 N/mm with a standard deviation of 22.72 N/mm and MLS mean stiffness was 261.50 N/mm with a standard deviation of 100.21 N/mm ( $p = 0.2339$ ).

**DISCUSSION:** In this study our statistical tests indicated that no significant difference is demonstrated between LMP and MLS in both synthetic ankle and cadaveric ankle models. However, the larger standard deviation in the MLS, particularly in the cadaveric model, may indicate decreased precision of placement compared to the LMP. To verify that this higher standard deviation is indeed due to precision of fixation and not sample size, higher powered studies using an increased number of samples are recommended to validate these trends.

**SIGNIFICANCE/CLINICAL RELEVANCE:** This work may influence the way in which orthopedic surgeons stabilize sustentacular fractures and provide a deeper understanding of calcaneal fracture fixation biomechanics.

## IMAGES AND TABLES:

Figure 1: Stiffness of LMP compared with MLS approach demonstrating lack of statistically significant difference between the two treatments for (a) cadaveric ankles and (b) synthetic ankles.

