Reduction Clamp Force Associated with Syndesmotic Overcompression: A Pilot Study

Jacob Haynes, MD; *Steven Cherney, MD; Amanda Spraggs-Hughes, MA; Christopher McAndrew, MD; William Ricci, MD; Michael Gardner, MD; Washington University, St. Louis, Missouri, USA*

Background/Purpose: Syndesmotic malreduction is one of the strongest predictors for a poor outcome in patients with ankle trauma. Recent studies have found that syndesmotic overcompression is possible and very common. Syndesmotic reduction typically involves using a reduction clamp to position the fibula within the distal tibial incisura. The relationship between the magnitude of force generated by the reduction clamp during syndesmotic reduction and the incidence of syndesmotic overcompression has not been previously studied. The purpose of this study was to quantify the clamp force used during syndesmotic reduction and to evaluate the effect of clamp force on overcompression in a clinical cohort. Our hypothesis was that increased reduction clamp force will lead to syndesmotic overcompression.

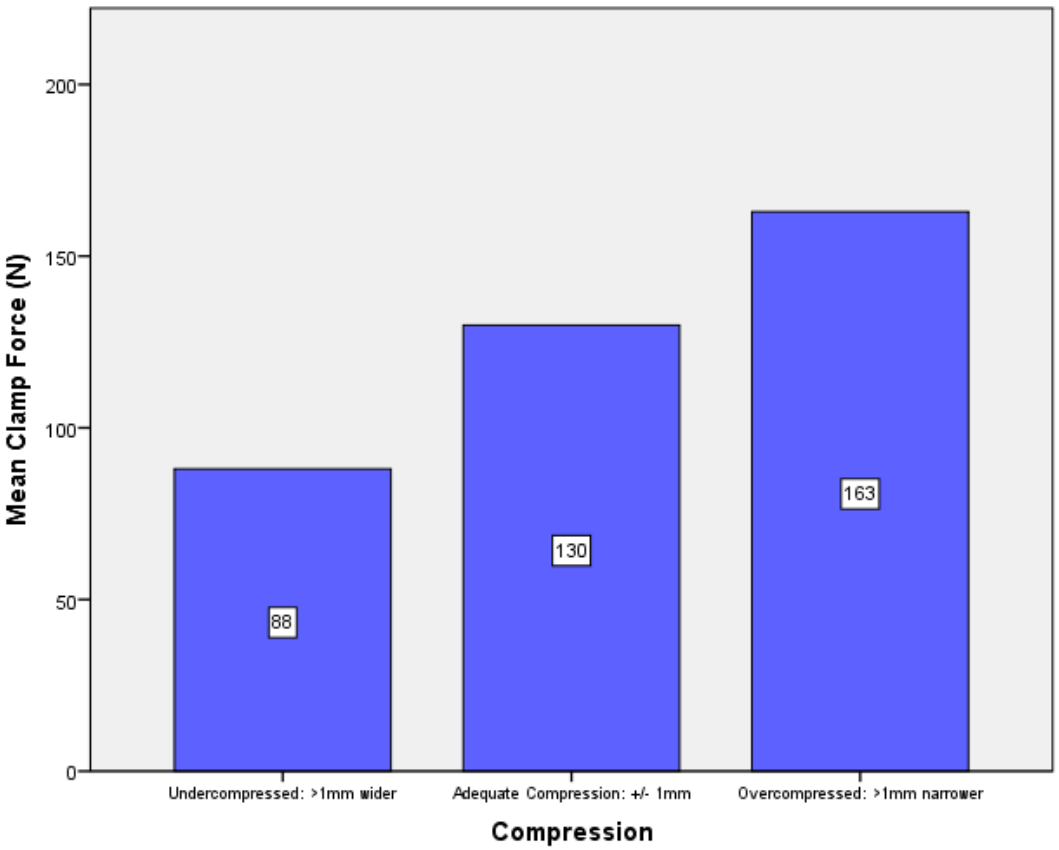
Methods: A prospective cohort of 21 patients with syndesmotic injuries treated with clamp reduction and screw fixation were enrolled. A standard pointed reduction clamp modified to include a load cell on one tine was utilized for syndesmotic reduction. One of three fellowship-trained orthopaedic trauma surgeons reduced the syndesmosis using standard techniques using the modified load cell clamp. Clamp force was recorded after final clamping and prior to screw fixation. Reduction was assessed fluoroscopically, and compared to the contralateral uninjured ankle. Surgeons were blinded to the clamp force. Bilateral ankle CT scans were obtained postoperatively to assess reduction accuracy. Multiple standardized measurements, based on a previously published protocol, were used to assess reduction. These measurements evaluated sagittal and coronal plane translation, and rotation of the fibula relative to the incisura. "Overcompression" was defined as 1 mm or greater of difference in fibular medialization when comparing the operative side to the noninjured side. The clamp force was also correlated to patient factors including BMI (body mass index), age, and number of days from injury to surgery. Two-tailed t tests and Pearson correlations were used to compare the results of the reduction with the intraoperative clamp force, as well as correlate clamp force with the patient factors, using $P < 0.05$ as significant.

Results: Increased clamp force significantly correlated with syndesmotic overcompression ($r = 0.444$, $P = 0.044$). Syndesmotic overcompression was seen in 11 of 21 patients (52%). Two patients (10%) had undercompression of the syndesmosis of >1.0 mm compared to the noninjured side. Eight patients (38%) had adequate syndesmotic compression, where the coronal plane fibular translation was within 1.0 mm of the noninjured side. The mean reduction clamp forces were 88 N (standard deviation [SD] 11) for the undercompressed group, 130 N (SD 56) for the adequately compressed group, and 163 N (SD 79) for the overcompressed group. The overall range of recorded clamp force was 36 to 261 N. Of the patient factors examined, both increased BMI ($r = 0.140$) and days from injury to surgical fixation ($r = 0.101$) positively correlated with increased clamp reduction force.

Conclusion: This pilot study demonstrated a significant correlation between increased clamp forces and syndesmotic overcompression, and determined objective forces that lead

to overcompression. Biomechanical studies have shown that the distal tibiofibular joint undergoes physiologic widening with ankle dorsiflexion, therefore it is likely that overcompression and rigid fixation of the syndesmosis results in decreased ankle motion. Our results indicate that surgeons should be cognizant of the clamp force used for syndesmotic reduction. Further investigation will correlate clamp force and overcompression to ankle range of motion and functional outcomes.

Figure 1. Reduction Clamp Force vs. Amount of Syndesmotic Compression



See pages 47 - 108 for financial disclosure information.