A Cadaveric Study of Three Fixation Constructs for Talonavicular Arthrodesis
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Summary: Talonavicular arthrodesis, whether performed in isolation or as part of a triple arthrodesis, has been useful in the management of hindfoot deformity as well as degenerative and inflammatory arthritis. Difficulties with nonunion of this hemispheric joint may be due to limited compressive force and asymmetric contact area resulting from traditional medial screw fixation. We hypothesized that two contemporary fixation constructs (medial & lateral screws, or medial screw augmented with a dorsal plate) provide a larger, more congruent contact area and improved contact forces than those seen with standard medial screw fixation. Further, these augmented fixation techniques can be performed reliably without injury to the deep neurovascular bundle.

Introduction: Talonavicular arthrodesis, whether performed in isolation or as part of a triple arthrodesis, has been useful in the management of hindfoot deformity as well as degenerative and inflammatory arthritis. Difficulties with nonunion of this hemispheric joint may be due to limited compressive force and asymmetric contact area resulting from traditional medial screw fixation. We hypothesized that two contemporary fixation constructs (medial & lateral screws, or medial screw augmented with a dorsal plate) provide a larger, more congruent contact area and improved contact forces than those seen with standard medial screw fixation. Further, these augmented fixation techniques can be performed reliably without injury to the deep neurovascular bundle.

Methodology: Twenty-four non-osteoporotic cadaveric feet (12 matched pairs) were utilized. The talonavicular joint was dorsally exposed to allow insertion of a TekScan pressure sensor (Boston, MA) prior to final screw placement. Group 1 specimens (N= 8 feet) were fixed with two medially placed, partially threaded 5.0 mm cannulated screws placed from the navicular tuberosity. Group 2 (N=8) fixation consisted of a medially placed screw augmented with a dorsal 2-hole locking plate. Group 3 specimens (N=8) were fixed with a similar medial cannulated screw and a second dorsolateral screw placed percutaneously. Contact area and force (and thereby pressure, indirectly) were measured across the joint after fixation. ANOVA was performed for the mean contact area and force measurements. Following pressure measurement, Group 1 & 2 specimens also had percutaneous placement of a dorsolateral screw similar to Group 3; open dissection then allowed direct measurement of the distance from the lateral screw to the deep peroneal nerve and dorsalis pedal artery.

Results: The differences between the groups were assessed by one-way analysis of variance along with Tukey test to compare by two groups. Those who received medial and lateral screw had a greater mean contact area of 2.05 than those who received medial screws and combination of medial screw and plate, 1.52 and 1.58 respectively, the difference being statistically significant. The two group comparisons using Tukey test showed a significant difference between groups 1 and 3 and groups 2 and 3. Due to inadequate sample size (power was 9% to 16%, when sample size is 8 in each group), force and pressure failed to show significant differences between groups. The mean distance from the dorsolateral screw to the lateral edge of the deep neurovascular bundle was mean (SD) 7.62 (3.7)mm.

Conclusion: Use of a medial and lateral screw construct or a medial screw with dorsal plate provides greater contact area across the talonavicular joint than standard medial screw fixation or screw and plate fixation. Further biomechanical and clinical studies are warranted to confirm the optimal technique to maximize fusion of the talonavicular joint. Percutaneous placement of the lateral screw can be performed carefully to avoid injury to the nearby neurovascular bundle.