Tourniquet Utilization During Achilles Tendon Repair Does Not Negatively Impact Tendon Excursion: A Biomechanical Cadaveric Analysis

Aaron Lam, Rushabh Vakharia[1], Samuel Swiggett[1], Amr Atef Abdelgawad, Afshin Razi[1], Orry Erez
[1]Maimonides Medical Center

INTRODUCTION: Achilles tendon ruptures have recently been in the forefront of research regarding surgical versus non-surgical treatment in the setting of acute injury. Various techniques have been utilized for these patients undergoing surgical repair including percutaneous, mini-open, and traditional open methods. Tourniquet placement during repair of these injuries can be in the thigh or calf region. Often the tourniquet is released prior to repair to improve excursion. The aim of this investigation was to perform a biomechanical cadaveric study to determine the impact of Achilles tendon excursion with and without various tourniquet locations.

METHODS: Cadaveric whole legs were placed in the prone position on a custom-made secure platform to fixate the hip and control rotation. A transverse incision 4 cm proximal to the insertion point of the Achilles tendon from the calcaneus was made to simulate a tear. Ethibond suture utilizing Krackow stitches were placed into the proximal portion of the Achilles tendons. The Krackow stitches were attached to an inline wire connection to an Instron machine for controlled tensioning (Figure 1). A tourniquet was applied either to the distal thigh or proximal calf which was insufflated to 300 millimeters of mercury (mmHg) during trials. Three cohorts were made during the investigation: no tourniquet (NT), tourniquet on the thigh (TT), and tourniquet on the calf (TC). Two pins with video markers were affixed, one being placed on the proximal portion of the tendon and the second just medial to the calcaneal insertion site (Figure 1). Each cohort underwent three cycles of data collection per leg. Initial and final distance were measured with calibrated calipers. The delta between the initial and final values being calculated. Data analyses were primarily descriptive for the cadaveric specimens. Continuous variables are reported as the means along with their standard deviation (SD). One way analysis of variance (ANOVA) was used to calculate the mean delta of the three cohorts across all the cadavers. Tukey's post-hoc analysis was used to determine which pairwise comparison was associated with statistical significance. For the investigation, an alpha value less than 0.05 was used as the threshold to quantify statistical significance.

RESULTS: Ten cadaveric specimens were analyzed with a mean age of 51.8-years $\pm$ 8.16 years (range: 38 to 63) with 90% being Caucasian and 10% Black. Laterality distribution was even between right and left leg. After 90-cycles for the cadaveric models, final mean excursion distance for NT, TT, and TC was 4.79 millimeters (mm) $\pm$ 2.01mm, 4.32mm $\pm$ 1.82mm, and 7.26mm $\pm$ 3.09mm; respectively (Figure 2). ANOVA testing demonstrated there was a statistically significant difference between the final Achilles Tendon excursion distance between the three cohorts (p<0.0001). Tukey's post-hoc for pairwise comparison did not find statistical significance between the NT and TT (Q = 1.07; p=0.729) cohort; however, there was a statistical difference between NT and TC (Q = 5.70, p=0.0003). The data also found statistically significant difference between TT and TC (Q = 6.78, p=0.00002).

DISCUSSION AND CONCLUSION: The aim of this cadaveric model was to assess whether tourniquet placement would influence the rate of Achilles Tendon excursion prior to surgical repair with sutures. The study demonstrated significant differences with either using or not using a tourniquet, with placement on the calf representing the greatest mean excursion distance. The study is important as it may guide orthopaedic surgeons that placement location and release of the tourniquet will not affect the excursion distance.

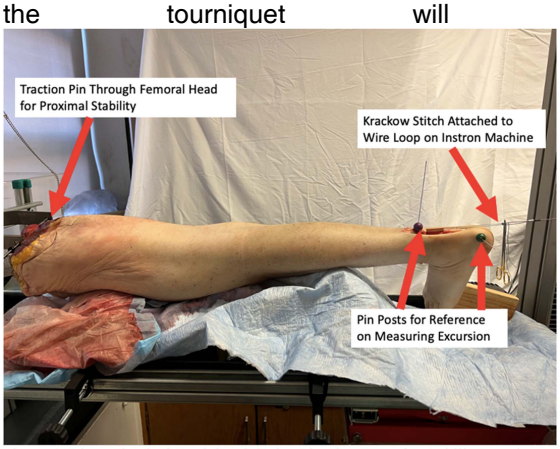

Figure 1. Biomechanical Model and Cadaveric Placement for Achilles Tendon Excursion

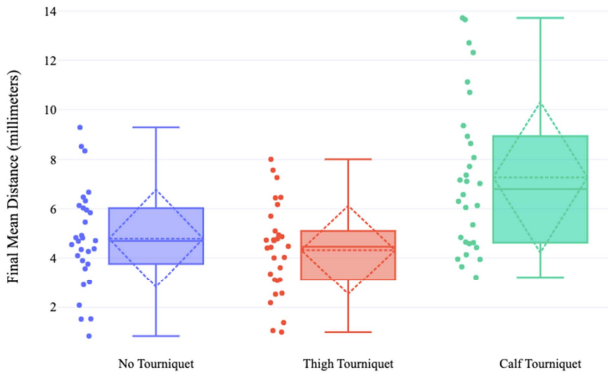

Figure 2. Box and Whisker Plot Demonstrating Final Mean Distance Between No Tourniquet, Thigh Tourniquet, or Calf Tourniquet