

Sustentaculum Tali Tunnel Placement for Augmented Ligament Reconstruction: A Cadaveric Study

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INTRODUCTION:

Progressive collapsing flatfoot deformities (PCFD) are commonly the result of the impairment of medial soft tissue structures including the posterior tibial tendon, deltoid ligament complex, and spring ligament. While these deformities have historically been treated surgically via lateral column lengthening osteotomies, only recently has medial soft tissue stabilization gained genuine momentum. Moreover, technological advancements have produced graft materials that have recently become available to help augment repair and stabilize the ligamentous structures to further obtain optimal results. With these procedures it is becoming increasingly important to become familiar with soft tissue and osseocartilaginous structures that may be at risk during blind tunneling techniques involving the subtalar joint and sustentaculum tali of the calcaneus.

The primary purpose of this cadaveric study was to describe an accurate and reproducible method for sustentacular osseous tunnel preparation for deltoid/spring ligament reconstruction. Additionally, our aim was to evaluate the adjacent structures at risk during sustentacular preparation and from this to establish a pragmatic radiographic tool that will allow for safe and reproducible results. Lastly we looked to evaluate the outcomes of various reaming sizes and the associated benefits or complications. We hypothesized that the posterior-inferior most aspect of the calcaneus would provide the safest region for guidewire endpoint, and that coronal placement between 15-30 degrees would avoid damage to the subtalar joint.

METHODS:

We assessed 20 cadaveric specimens and investigated anatomic and radiographic results of soft tissue, osseous, and cartilaginous compromise regarding lateral guidewire endpoint, coronal angulation of guidewire relative to the subtalar joint, and appropriate reaming diameter when performing blind tunneling of the sustentaculum tali and calcaneus.

RESULTS:

A total of 8 lateral structure violations occurred secondary to guidewire placement. The average distance to the peroneal tendons was 9.4 mm (range 0-25.8) with 5 tendons violated. The average distance to the peroneal tubercle was 16.2 mm (range 0-33.1) with 2 tubercles violated. The average distance to the sural nerve was 9.4 mm (range 0-23.7) with one nerve violated. There were only 7 specimens (35%) that the lateral calcaneal nerve branch was able to be identified, and the average distance was 16.67 mm (range 13.7-22.3) with no identified violations.

The average coronal trajectory angle in reference to the posterior subtalar joint facet was 29.9 degrees (range 10.6-41.6) and the median was 21 degrees. Only one specimen (5%) had structural damage from guidewire placement, and this was violation of the tarsal canal. At 5 mm reaming one specimen (5%) had an inferior wall blowout. Of note, this specimen in particular was of poor cadaver quality with qualitative characteristics of insufficient bone mass. At 6 mm reaming two additional specimens (10%) had inferior wall blowout. And at 7 mm reaming an additional eight specimens (40%) experienced structural damage, including four inferior wall blowouts, one middle facet fracture, one FHL compromise, one subtalar cartilage disruption, and one dorsal cortical disruption of the sustentaculum. Eight of the twenty specimens (40%) did not sustain any structural damage. In reference to guidewire endpoint, there were eight specimens with guidewire placement in quadrant 1 (40%), one in quadrant 2 (5%), and eleven in quadrant 3 (55%). There were no specimens found having the trajectory end in quadrant 4. No structure violations occurred with guidewires ending in quadrant 3 despite the increased incidence guidewires ending in this quadrant.

DISCUSSION AND CONCLUSION:

We identified the posterior-inferior most aspect of the lateral calcaneal surface to be a safe target region for guidewire and blind tunnel drilling, as well as relative safety when using drill bits < 7 mm. The results presented in this study provide insight for safe medial-to-lateral drilling of the calcaneus when performing blind tunneling techniques and can be used to help optimize postoperative results when performing deltoid and spring ligament repair augmented with graft materials.

