Structures at Risk with Plantar Approach Retrograde First Metatarsal Charcot Beam Screw Insertion: A Cadaveric Study

David Larson, DPM, Christopher Reb, DO, Christopher Hyer, DPM, Patrick Bull, DO, Jeffrey Weber, DPM

Category: Diabetes, Midfoot/Forefoot

Keywords: Charcot, Beam Screw, Midfoot, Safety

Introduction/Purpose: The plantar approach for medial column retrograde intramedullary fixation of Charcot midfoot deformity allows for easy access to the ideal starting point on the metatarsal head and is supported by good clinical outcomes data. The primary argument against this approach is iatrogenic damage to the plantar structures of the metatarsophalangeal joint (MTP), which could cause tendon imbalances resulting in hallux malleus deformity. However, thus far, such complications have rarely been reported. Based on available literature, it is unclear what types of plantar structure injury occur and at what frequency. The purpose of this study was to describe plantar first metatarsophalangeal joint structure damage caused by plantar approach retrograde intramedullary medial column beam fixation.

Methods: This was an IRB-exempt study. For each of 10 human cadaveric specimens, a 6.5mm cannulated screw system was used for plantar approach retrograde medial column intramedullary fixation. This entailed using fluoroscopy to percutaneously localize a 2.8-millimeter (mm) guide wire to the center-center position on the first metatarsal head and then advanced it into the center of the medial cuneiform. A small sagittal plane skin incision was made around the wire and subcuticular tissue was bluntly divided. Next, a 4.8-mm cannulated drill was passed through a drill sleeve over the wire. Then, a countersink was used without a tissue protector. Finally, the 6.5-mm screw was inserted until it was recessed beneath subchondral bone. The specimens were then dissected to evaluate damage to the plantar structures of the 1st MTP joint. Damage to named structures was categorized as none, less than 50%, greater than 50%, and 100%.

Results: The plantar plate was less than 50% damaged in all specimens. The flexor hallucis longus (FHL) tendon had less than 50% damage in 8 specimens. In one of two specimens with greater than 50% FHL damage, the torn portion of the tendon was tenodesed to the first metatarsal head by the screw (Figure). Although the medial flexor hallucis brevis (FHB) tendon was less than 50% damaged in 3 specimens and undamaged in the remainder, the medial sesamoid was less than 50% damaged in 8 specimens. In contrast, less than 50% damage occurred to the lateral FHB and lateral sesamoid in only 2 and 3 specimens, respectively. Additionally, some erosion of the plantar base of the proximal phalanx was observed in one specimen.

Conclusion: The plantar structures of the hallux MTP are a tightly constrained system, which are violated during plantar approach retrograde intramedullary medial column fixation. No structures were completely transected and high-grade damage (greater than 50%) was infrequent, occurring in only two FHL tendons. Low-grade damage (less than 50%) was frequently observed to involved the FHL, medial sesamoid, and plantar plate. Based on the current findings, an FHL splitting or preserving approach is advisable to avoid high-grade damage if plantar approach is desired. A dorsal arthrotomy approach avoiding plantar structures may also be considered.
50% of FHL Tendon entrapped within 1st MT by screw