

Technique Update: The Utilization of a Flexible Implant and Bioabsorbable Anchor for Deltoid Rupture Repair in Bimalleolar Equivalent, Weber B Ankle Fractures

Frank A. Luckino III DPM¹, Mark A. Hardy DPM FCFAS²
¹ Resident Physician, Cleveland Clinic Foundation/HealthSpan, ² Director of Foot/Ankle Surgical Training, Cleveland Clinic Foundation/HealthSpan

Purpose

Today, the majority of deltoid ligament injuries are not repaired during surgical intervention for bimalleolar equivalent, ankle fractures. This is based primarily on Level III and Level IV studies where suboptimal results have been reported. Hence, acute deltoid repair may be indicated in certain cases (1). Therefore, we outline a new technique for deltoid rupture repair in select bimalleolar equivalent, Weber B ankle fractures.

Literature Review

Roughly 14,000 ankle fractures occur in the United States daily (1) with supination-external rotation (SER) or Weber B ankle fractures accounting for 80% of those fractures (2). SER type II injuries can typically be treated conservatively with non-operative management. SER type IV fractures may appear as an SER type II if the deltoid has been compromised and there is no medial malleolar fracture. The targe majority of the literature supports operative management of this injury pattern. It is paramount that a deltoid injury does not go unrecognized. A missed deltoid injury can lead to post-traumatic arthritis (3). Signs of injury may include ecchymosis, pain, and/or instability (4). Recent literature shows that medial tenderness as a predictor is not reliable as some patients may have superficial deltoid rupture only, which is not the main stabilizer of the medial ankle (2). A recent systematic review for deltoid evaluation in SER ankle injuries showed that manual stress or gravity stress external rotation test were most likely to predict deltoid injury. A medial clear space of 4mm with that value being at least 1mm greater than the superior tibiofibular articulation was most suggestive of deltoid compromise (4). Deltoid repair has been accomplished with direct end-to-end repair as well as both allograft and autograft tendon reconstruction (5). With the importance of the deltoid ligament as a stabilizer of the medial ankle, we outline a new type of deltoid rupture fixation during bimalleolar equivalent, Weber B ankle fractures utilizing FT TightRope® (Arthro-Naples, FL) Technology.

Technique



Radiograph displaying a Weber B ankle fracture and concurrent deltoid rupture (Fig. 1). A standard 3 cm incision was made over the medial malleolus for repair of the deep deltoid ligament (Fig. 2).



A complete attenuation of the deep deltoid ligament with complete exposure of the entire medial talar dome and medial ankle gutter was seen (Fig. 3).



The guidewire for the 2.7 mm drill bit was placed in the medial body of the talus just lateral to its anteroposterior articulation with that of the medial malleolus and the deep-deltoid fibers (Fig. 4). A drill bit was passed approximately 50% across the body of the talus, followed by use of the 4.5 mm tap in preparation for the 4.5 mm bioabsorbable TightRope FT anchor (Fig. 5).



The anchor was placed in a standard manner. One arm of the suture and the button attached to it were removed (Fig. 6).



Next, an oblique hole was drilled through the medial malleolus with a 2.5 mm drill bit. Care was taken not to injure the talar dome (Fig. 7). A micro suture passer (Fig. 8) was then passed into the medial gutter capturing the fibrewire from the anchor. The fibrewire was drawn out through the drill hole, and snugged close to the tibial cortex in anticipation for final security of the button to the tibial cortex after repair of the fibular fracture.



Therefore, attention was next directed to the lateral ankle where a fibular fracture was identified (Fig. 9) and anatomically reduced followed by the application of a lateral neutralization, one-third tubular plate. Attention was then directed back to the medial ankle where the ankle was placed into its 90-degree sagittal plane position with mild varus positioning of the ankle to reapproximate the ruptured deltoid fibers, after which the 2 arms of the fibrewire suture were secured with the button on the medial tibial cortex (Fig. 10). The ankle was then stressed and noted to be intact. Ankle gutters were noted to be symmetrical. No distal tibiofibular diastasis was appreciated. Normal distal tibiofibular overlap and restoration of the normal position of the malleoli were achieved after the surgery.

Analysis/Discussion

Reviewing the literature, there are a small number of studies regarding the repair of an acute deltoid tear in contrast to the larger volume of literature on reconstruction of chronically lacerated ligaments. Some authors have advocated direct repair of the acute ruptured ligament where others suggest that healing will occur as long as the ligament ends are in close proximity to one another and normal osteoarthrogenous alignment of the ankle has been restored (8).

A few decades ago it was common practice for acute deltoid rupture repair; however, this fell out of favor towards the end of the 20th century (1). According to the review by Stullens et al., there are 6 studies whose primary goal was to answer the need for deltoid ligament repair in bimalleolar equivalent ankle fractures. Analysis of these articles showed that a normal medial clear space after adequate fixation of the fibular fracture did not necessitate exploration medially. The authors concluded that direct repair is only necessary when there is interposition of ligament on the medial side. However, the majority of these articles were level IV studies where sub-satisfactory results were reported which brings to light the possible need for acute deltoid repair (1). Previous studies have suggested that just 1mm of lateral displacement of the talus within the ankle mortise can reduce tibiofibular contact by 42% leading to post-traumatic arthritis (9). Hence, maintaining stability about the ankle joint is of utmost importance.

Medial clear space widening may also be suggestive of syndesmotic instability. Though this is more common in pronation external rotation (PER) injuries, it may present itself in SER injuries as well (6). A study of 238 unstable SER type Weber B ankle fractures with concurrent deltoid injuries showed syndesmotic instability in 39% of their patients after fibular fracture fixation (7). Syndesmotic instability may be tested intra-operatively via the external rotation test and/or cotton test. (8) Lack et al. recently described a technique for deltoid repair utilizing an "anchors-and-past" reinforcement procedure (5). Our approach, however, obviates the need for additional screw placement in the medial malleolus and distruption of the posterior fibula tendon sheath as mentioned in their article. In conclusion, the FT TightRope is an option for deltoid rupture repair in bimalleolar equivalent, Weber B ankle fractures where medial gutter widening persists despite adequate fixation of the fibular fracture and an intact or repaired syndesmosis.

References

1. Blumren EM. Deltoid ligament injuries in ankle fractures. *Foot Ankle Int* 33(3): 239-238, 2012.
2. Stullens BAK, Bakermans van den Brink MFJ, Kroop M, Verhaar HJ. The diagnosis and treatment of deltoid ligament lesions in supination-external rotation ankle fractures: a review. *Sport Traumatol Rehabil* 7: 73-85, 2012.
3. Chen P, Wang Y, Wang C. Ultrasonographic examination of the deltoid ligament in bimalleolar equivalent fractures. *Foot Ankle Int* 29(9): 885-888, 2008.
4. Bakermans van den Brink MFJ, Mulderman EA, Deen van CH. Evaluation of the integrity of the deltoid ligament in supination external rotation ankle fractures: a systematic review of the literature. *Arch Orthop Trauma Surg* 128: 227-235, 2008.
5. Lack W, Pridemall P, Farnino J. Anatomic deltoid ligament repair with anchor-to-past suture reinforcement technique. *Innov Orthop* 3: 22-27(25), 2013.
6. Bakermans van den Brink MFJ. Diagnosing syndesmotic instability in ankle fractures. *World J Orthop* 2(1): 31-36, 2011.
7. Stark E, Tomatta P, Cranny MR. Syndesmotic instability in Weber B ankle fractures: a clinical evaluation. *J Orthop Trauma* 21(9): 624-648, 2007.
8. Coughlin MJ, Mann RA, Saltzman CL. Athletic injuries to the soft tissues of the foot and ankle. In *Surgery of the Foot and Ankle*, p 1473. Mosby Elsevier, Philadelphia, 2007.
9. Beard RA, Jackson ST. Fractures of the distal part of the tibia with associated dislocation of the deltoid ligament. *J Bone Joint Surg Am* 6(5): 1346-1352, 1947.
10. Pi, Ramsey, W Hamilton. Changes in tibiofibular area of contact caused by lateral heel shift. *J Bone Joint Surg Am* 58: 256-257, 1976.