The Utilization of FT Tightrope Technology for Deltoid Rupture Repair in Bimalleolar Equivalent, Weber B Ankle Fractures
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Introduction
Roughly 14,000 ankle fractures occur in the US daily (Bluman) with supination-external rotation, or Weber B ankle fractures accounting for 80% of all ankle fractures (stufkens). 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 malleolus fracture. The large 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 catastrophic arthritis (ramsey). Signs of injury may include ecchymosis, pain, or instability (beckerom). Recent literature shows that medial tenderness and/or pain is not infallible as some patients may have superficial deltoid rupture only, which is not the main stabilizer of the medial ankle (stufkens). 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 common test was to expose the deltoid muscle by a lateral incision and lateral radiograph (Bakerom). Medial clear space widening may also be suggestive of syndromic instability. Though this is more common in pronation external rotation (PER) injuries, it may present itself in SER injuries as well (beckerom WUO). A study of 238 unstable SER type Weber B ankle fractures with concurrent deltoid injuries showed syndromic instability in 33% of their patients after fibular fracture fixation (stufkens). Syndromic instability may be tested intra-operatively via the external rotation test and/or cotton test (hook test) (Coughlin). The purpose of this paper was to outline a new type of deltoid rupture fixation during bimalleolar equivalent Weber B ankle fractures utilizing FT Tightrope (Arthrex) Technology.

Technique
After having received preoperative antibiotics, anticoagulant therapy and pneumatic stocking on opposite leg and preoperative popliteal nerve block, the patient was taken to the operating room and placed on the table in the supine position where she underwent successful general anesthesia. Thigh tourniquet was applied in standard manner. Leg prepped and draped in the usual sterile manner. Standard lateral incision was made, first sharply, then bluntly. Bleeders cauterized as appropriate. Peroneal incision was made exposing the long posterior spike to the Weber B fracture. The fracture was reduced, held in place with AO reduction clamps, followed by the insertion of two lag screws. One was a 4.5-cancellous screw used in static fashion; the other a 3.5-mm lag screw placed more distally. Excellent compression and maintenance of reduction was achieved. Reduction clamps were removed followed by the insertion of a six-hole one-third tubular locking plate with two locking screws placed above and below the primary fracture line. Tripolar fluoroscopy confirmed excellent position of the fibular fracture. External rotation test was then performed. Syndromes was noted to be intact but valgus rotation of the ankle joint was appreciated on stress maneuver consistent with rupture of the deep deltoid ligament.
Therefore, the talus was rocked back into the mortise with dorsiflexion and inversion force applied and temporarily stabilized with an 0.062 K-wire across the joint. This was followed by a 1.0 cm incision made over the level of the proximal aspect of the medial malleolus and blunt dissection carried down to the level of the cortical wall followed by the insertion of the guidewire through the medial malleolus into the medial body of the talus. The wire entered the bisection of the medial malleolus approximately 1 cm from its tip and into the medial body of the talus with care taken to ensure that it did not violate the shoulder or the talus dome. The wire was taken to the level of the subtalar joint but not across the articular surface. Next, the drill, overdrill and tap were utilized in proper technique. The tip of the overdrill was passed just into the wall of the medial talar body. The tap was passed down to the level but just shy of the subtalar joint after removal of the medial malleolar guidewire. Next, the Arthrex Mini-Tightrope FT absorbable anchor was passed into the talar body and utilizing live fluoroscopy, confirmation was made that it was within the body of the talus but not through the subtalar joint, and it was in the midline of the talus body as confirmed under lateral radiographs. The driver was then removed. The cortical button was then slightly tapped into the medial malleolus and multiple surgeon knots were tied across the button. The temporizing positional guide wire was removed. The ankle was placed through a range of motion with frontal plane and transverse plane stresses applied with no increased excursion of the distal tibiofibular syndromes nor of the medial gutter. No restriction on dorsiflexion was appreciated either.

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 failed deltoid ligaments. Some authors have advocated direct repair of the acute ruptured ligament while others suggest that healing will occur as long as the ligament ends are in close proximity to one another and even crossfire of the ankle mortise has been restored (baird). 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 (bluman). According to Stufkens and colleagues, there are 11 studies whose primary goal was to answer the need for deltoid ligament repair in acute ankle fractures. Results 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 not necessary unless there is interposition of ligament on the medial side after fibular fracture reduction/fixation. 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 (bluman). A study by Schuchardt et al showed that radiographic assessment is not always an adequate predictor of deltoid injury in isolated lateral malleolar fractures. Arthroscopic examination prior to fibular repair showed rupture in some cases which were not apparent on pre-injury radiographs. Previous studies have suggested that just 1mm of lateral displacement of the talus within ankle mortise can reduce tibiofibular contact by 42% leading to post-traumatic arthritis (ramsey). According to Bluman, surgical repair typically consists of end to end repair or the use of bone anchors. No articles to our knowledge have proposed the role of FT tightrope technology for acute deltoid repair.