Tibialis Anterior Tendon Reconstruction Utilizing Split Tendon Turndown: A Case Report and Technique Guide

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Statement of Purpose

Tibialis anterior tendon (TAT) ruptures are challenging injuries. While direct end-to-end repair is the preferred approach for TAT ruptures, its applicability can be limited with substantial residual tendon defects. The authors introduce an innovative technique involving a minimal incision TAT turndown procedure supplemented with dermal matrix allograft. The success of this technique is exemplified through a case study involving a patient presenting a significant insertional defect.

Case Study

A 67-year-old male with a history of obesity presented with pain to the right anterior ankle for 2 months. He denied specific injury. Despite bracing, persistent pain and appreciable gait weakness caused him to seek treatment.

Physical exam revealed a decreased ability to invert the foot with 2/5 strength. Ankle dorsiflexion was diminished with grade 3/5 strength. Steppage gait noted with inability to perform heel walking on the right side. There was tenderness along the distal TAT and a bulbous mass 6 cm proximal to the insertion. There was moderate edema with some dermatological manifestations of early venous insufficiency in the pretibial region.

Radiographs were negative for osseous abnormalities. Suspicion was high for TAT rupture thus magnetic resonance imaging was obtained. Initially, the patient was treated conservatively with a controlled ankle movement walker with weight-bearing as tolerated. Pain control included non-steroidal anti-inflammatory medication, ice, and elevation. MRI revealed a full-thickness tendon stump at the level of the distal tibia near the tibiotalar joint, compatible with a high-grade tear. Severe tendinosis of the TA tendon was noted proximally. **(Figure 1)** All conservative and surgical options were reviewed. Due to deficits in functionality and persistent pain, the patient elected to undergo surgical intervention.

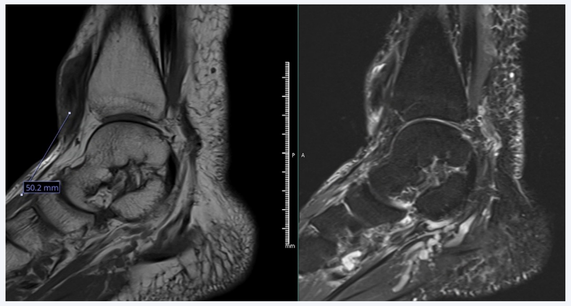

Figure 1: T1 (left) and T2 (right) Sagittal MRI imaging of a high-grade tear of the TA tendon with ~6cm deficit. Significant retraction and tendinosis were noted of the proximal TA tendon stump.

Operative Technique

A linear incision was made along the TAT from the proximal stump extending to the medial cuneiform. The TAT sheath and extensor retinaculum were incised sharply to reveal the tendon in its entirety. The proximal TA stump was bulbous with tendinosis. No viable distal TAT stump was available for direct end-to-end repair. Following debridement of non-viable tendon, an 8 cm deficit remained from healthy tendon to the insertion point (**Figure 2)**.

We mapped out a 2 cm portion of the residual tendon for preservation or "pivot point" (**Figure 3**). A separate incision was made 8-10 cm proximal to the pivot point at the anterior-lateral tibia, over the musculotendinous junction of the TA (**Figure 4**). The hemisected tendon length should be equal in length or slightly longer the defect for adequate flap-down repair and tensioning.

A stab incision was made midline to the most proximal extent of the TAT. Utilizing 2-0 suture tape the TAT was transected distally along the midline ensuring to leave an 8 cm viable tendon hemisection for turn-down and a 2cm of pivot point (**Figure 5**). The TAT was then transected at the myotendinous junction from medial to midline creating our hemisection for turn-down and repair. The pivot point and proximal aspect of our tendon hemisection were anastomosed with absorbable sutures (**Figure 6**).

With the ankle held in a neutral position, we performed a modified Krackow stitch technique with fiber loop suture to secure the TAT turn-down hemisection to the insertion. A 4.7mm biotenodesis screw was inserted centrally into the medial cuneiform from a dorsal to plantar direction securing the repaired tendon in an osseous tunnel (**Figure 7**). We ranged the ankle, and the repair was noted to be adequate. Surgeons should assess the need for tendoachilles lengthening or gastrosoleus recession if significant equinus remains, which was not noted in our case. A human dermal matrix allograft was sutured to the repaired tendon to augment the repair. This allograft encompassed the site of hemisected tendon spanning 4cm proximal and 4cm distal to the pivot point. The TAT sheath and superior extensor retinaculum were then repaired with an absorbable suture.

Figure 2: Cadaver specimen - 8 cm deficit noted from the remaining healthy tendon to the insertion point at the medial cuneiform.

Figure 3: A 2cm portion of the residual tendon for preservation or "pivot point" as mapped out and marked.

Figure 4: A separate incision made 8-10 cm proximal to the pivot point at the anterior-lateral tibia, over the musculotendinous junction of the TA. The measured tendon deficit dictates the second incision placement for proper tendon harvest and turn-down repair. The measured length begins at the 2 cm "pivot point".

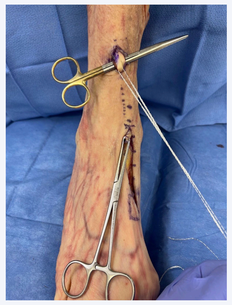

Figure 5: 2-0 Suture tape is placed into a 1cm tendon stab incision to hemisect the tendon. Suture tape is brought to the distal incision through the tendon sheath with hemostats. The authors recommend a "sawing" motion of the 2-0 suture tape to be performed, slowly transecting the TAT down the midline.

Figure 6: The TAT is then transected at the myotendinous junction from medial to midline creating our hemisection for turn-down and repair. The pivot point and proximal aspect of our tendon hemisection were anastomosed with absorbable sutures.

Figure 7: With the ankle held in a neutral position, a 4.7mm biotenodesis screw was inserted centrally into the medial cuneiform from a dorsal to plantar direction securing the repaired tendon in an osseous tunnel.

Results

The patient was followed postoperatively for 12 months. At final follow-up, the patient's postoperative VAS pain score was 1.0. The postoperative FAAM score was 81/84 (96%). The Oxford muscle power strength was 5/5, with a symmetrical ankle joint range of motion. The patient was "very satisfied" and would undergo again. No postoperative complications noted. At one year, he is pain-free without restrictions.

Analysis and Discussion

TAT ruptures remain a challenging pathology for surgeons to manage, as there is a lack of treatment guidelines and functional recovery is unpredictable.

Atraumatic ruptures resulting from chronic degenerative tendinopathy are multifactorial, commonly seen in patients over the age of 45.[1,2] Known factors contributing to atraumatic rupture include comorbidities such as diabetes mellitus, kidney disease, lupus, and various inflammatory arthropathies. Corticosteroid and fluoroquinolone use may also cause degeneration and increase risk for degeneration and subsequent tendon rupture.[3-5] The location of TA tendon rupture most commonly occurs in the TA watershed region, located 5 to 30 mm proximal to the insertion on the medial cuneiform.[6]

Surgical repair of TA ruptures is indicated when bracing doesn't meet functional demands. [7,8] Direct end-to-end repair is the preferred method for TA tendon ruptures. However, upwards of 60% of TA ruptures are not amenable to direct end-end repair after non-viable tendon is resected because of the large residual tendon defect.[7] Management of residual tendon defect is especially pertinent in the management of chronic ruptures, and various surgical techniques have been described based on injury chronicity and defect size. [2,3,7-11]

Herein, we illustrate a minimal incision TAT turndown technique and a successful case report highlighting the utility of this technique. Indications include chronic TA ruptures (insertional or mid-substance) where the size of the residual defect after debridement inhibits end-end repair. The described repair technique offers intra-operative versatility, as the same repair technique may be employed for a large range of TA tendon defect sizes, which may be unpredictable prior to tendon debridement.

To our knowledge, this technique has not been described in the literature. Although similar techniques have been described by Reb et al[7] our technique was utilized in a case where there was no viable distal tendon stump. Because of this deficit, the distal tendon was fixated directly into the medial cuneiform. This technique also differs in the amount of incisional exposure required. Additionally, harvest and transposition of the native TA tendon hemisection can be accomplished through minimal-incision exposure, which can be useful in patients with comorbidities or a tenuous skin envelope.

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