Reconstruction of an Achilles rupture with 12 cm defect utilizing Achilles tendon allograft and calcaneal bone block: A case report

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Chronic Achilles tendon ruptures, especially with extensive defects, are challenging to repair, and options are limited. We present a case of a neglected Achilles tendon rupture with a 12 cm defect, treated with an Achilles tendon allograft with a calcaneal bone block. The repair was augmented with a flexor hallucis longus (FHL) tendon transfer as well as human acellular dermal matrix. At 1-year follow-up the patient had no pain and was able to walk 2 miles at a time. There was no re-rupture of the affected limb, infection or allograft morbidity.

Keywords: Achilles tendon; chronic; tendon allograft; tendon rupture; surgical technique, FHL tendon transfer

A chronically ruptured or neglected Achilles tendon is defined as a rupture with 4-6 weeks between the time of injury and treatment [1,2]. An estimated 20-35% of Achilles ruptures have a delayed diagnosis due to unrecognized injury, misdiagnosis or late presentation [1,2]. Between injury and treatment, granulation tissue between tendon ends prevents apposition and fibrous tissue develops in the rupture site [3-5]. The triceps surae muscle continues to contract and the proximal tendon stump retracts and adheres to the surrounding fascia [6, 7]. Unrecognized injury and retraction of the tendon stump may result in large defects.

Various techniques have been described for surgical repair of the neglected Achilles tendon rupture including gastrocnemius tendon advancement, turndown flaps, autografts, allografts and tendon transfers [8-12]. Which technique provides the best outcome is unknown, and some techniques are limited to smaller defects.

We present a case of a chronic Achilles rupture with a 12 cm defect reconstructed with an Achilles tendon allograft with calcaneal bone block, augmented with a flexor hallucis longus (FHL) tendon transfer and human acellular dermal matrix.

Case Study

A healthy, very active, 71-year-old male initially presented with ankle weakness and difficulty with gait. He was treated by an outside provider for one year with presumed Achilles tendonitis. However, at presentation at the current attendings clinic, he had a palpable defect with a positive Thompson’s test for an Achilles rupture. There was minimal calf atrophy compared to the contralateral side. His gait was antalgic and apopulsive with poor balance. MRI demonstrated an Achilles rupture with approximately 9 cm retraction. The patient was initially offered permanent bracing because of his age. However, due to his good health, and very active lifestyle, he elected for surgical repair understanding the potential limitations of achieving a full recovery given the longstanding misdiagnosis. The patient was counseled on the probable use of allograft and tendon transfer because of the extensive defect.
Surgical technique

The patient was placed prone on the operative table under general anesthesia with a thigh tourniquet. A linear incision was made just medial to the midline of the Achilles tendon and deepened to expose the tendon. The rupture site was identified. The defect had filled with interposed scar tissue, with fibrofatty and mucoid consistency. This non-viable tissue was excised proximally to the level of the gastrocnemius aponeurosis which was noted to be healthy. The degenerated tissue extended distally to the Achilles insertion, with minimal healthy tendon attachment to the calcaneus. Following debridement and excision of diseased tissue, the defect measured 12 cm with the ankle in near maximal plantarflexion.

A frozen Achilles tendon allograft with calcaneal bone block was thawed and pre-tensioned to minimize viscoelastic creep. The calcaneal block portion of the allograft was fixated first, by creating a rectangular cut-out for insertion in the superior aspect of the patient's calcaneus. The calcaneal bone block was tamped into place and fixated with 2 crossed 3.5 cortical screws with washers.

Before attachment of the allograft proximally, the ankle was placed in 30 degrees of plantarflexion to create a tensioned repair. The proximal portion of the Achilles allograft was then sutured to the gastrocnemius aponeurosis with approximately 3 inches of overlap utilizing a combination of simple interrupted and Krackow suturing, with #2, and #2-0 fiberwire.

In order to improve strength and vascularity to the repair, an FHL transfer was also performed. The FHL tendon was harvested by releasing at the level of the posterior talus, sewn alongside the medial aspect of the Achilles at anatomic tension. The musculotendinous portion of the FHL was also sutured to the undersurface of the proximal repair site with the intent to bring vascularity closer to the repair.

Finally, a human acellular dermal matrix product was sewn over the proximal repair with 3-0 Vicryl, to provide reinforcement, and scaffolding for host tissue ingrowth. The incision was irrigated, the tourniquet was released and the patient was placed into a non-weight bearing compression splint with anterior and posterior slabs.

Figure 1 Intraoperative appearance of the chronic rupture site, interposed with fatty and mucoid diseased tissue or “pseudotendon”.

Figure 2 The proximal excised portion of the diseased Achilles.

Figure 3 Additional excision of nonviable, calcified degenerated tissue at the distal Achilles stump.
Planning of graft placement following excision of the chronic rupture.

The proximal Achilles allograft was sutured into the gastrocnemius aponeurosis after securing the distal calcaneal block with 2 crossed screws.

A human cellular dermal matrix was overlaid as the final step.

Patient demonstrating ability to perform partial heel rise on the reconstructed side.

Patient demonstrating ability to perform heel rise on the contralateral side for comparison.

**Post-operative protocol**

The patient was splinted for 14 days and remained non-weight bearing. Following suture removal, the patient was casted in plantarflexion, remaining non-weight bearing for the next 4 weeks. At 6 weeks, the patient was referred to physical therapy and was also transitioned to weight bearing in a walking boot with heel lifts and progressed gradually to neutral by decreasing the heel lifts. At 12 weeks, he was transitioned out of a boot to a shoe.

**Results**

The patient had no complications during follow-up. At 1 year follow-up, the patient reported no pain and was able to return to normal daily activities, and walk 2 miles. His range of motion was symmetrical to the contralateral side, and manual muscle testing revealed only slight weakness. He was able to perform heel rise symmetrical to his contralateral side. X-rays showed incorporation of the calcaneal block graft. He was overall pleased with the surgery.
Discussion

Large defects following Achilles ruptures are challenging. Delay in diagnosis may lead to retraction of the tendon stump, and atrophy of the gastrocnemius muscle. Furthermore, if significant tendinosis was present prior to rupture, the actual defect may be larger than presumed following debridement. Ofili in 2016 reported that MRI underestimates the true extent of Achilles tendinosis [18]. Indeed, our patient had a 12 cm defect following debridement despite MRI initially predicting a 9 cm defect.

While smaller defects may be typically treated by gastrocnemius advancement or flap, there is no consensus on how to manage larger Achilles defects. In the author’s experience, gastrocnemius advancement techniques allow repair of only up to 6-8 cm defects. Our patient had a 12 cm defect and therefore, with limited repair options, it was felt appropriate to utilize Achilles tendon allograft. Additionally, given the significant disease in the distal stump at the insertion, there was no viable tissue to suture the Achilles allograft, and therefore the calcaneal bone block proved useful for distal reattachment. One risk of a calcaneal bone block would be delayed or non-union. Deese in 2015 and Ofili in 2016 have reported delayed union with incorporation at the calcaneus. [12,19] Our patient showed radiographic healing at 6 weeks post-op.

Reconstruction using an Achilles tendon allograft with a calcaneal bone block has previously been demonstrated to have good results [18,19]. These studies did not include an FHL transfer. The FHL transfer is a relatively simple, in-phase transfer with the potential benefits of increasing strength of the repair and providing additional plantarflexion power. Additionally, the FHL transfer theoretically may provide additional vascularity from the flexor hallucis muscle belly to the repaired Achilles. The FHL transfer has been shown to have high patient satisfaction and minimal donor morbidity has been noted with this procedure [21-24]. From a technical standpoint, the use of a calcaneal bone block with screw fixation may limit the ability to secure an FHL transfer with biotenodesis as creating an additional bone tunnel adjacent to the screws may create stress risers. Therefore in the current case the FHL tendon was sutured side by side instead.
Disadvantages with allograft procedures are the risk of disease transmission, longer allograft incorporation time, and increased cost. There is also a potential amount of creep in allograft tendons. In addition, Hanna in 2014 reported that 4 of 6 patients with an Achilles allograft with calcaneal bone block ambulated with a limp and complained of weakness at 16-32 months [18]. It is important to counsel patients with longstanding neglected ruptures, that recovery of full strength may not be possible. Our patient, however, appeared to be able to perform a symmetrical appearing single heel rise on examination.

In our case, we augmented the allograft repair with FHL transfer and human acellular dermal matrix. Human acellular dermal matrix acts as a scaffold for host revascularization and cellular growth. [25] A few studies have described acellular dermal matrix augmentation to strengthen an Achilles tendon rupture site, all with favorable outcomes without any re-ruptures. [26-29] Therefore, the final addition of the dermal matrix in our patient was intended to assist with incorporation of the large allograft.

In conclusion, Achilles tendon reconstruction with tendon-bone block allograft augmented with FHL transfer and a human acellular dermal matrix may successfully repair a severely degenerated and neglected Achilles tendon rupture. We believe this technique can be useful for Achilles tendon ruptures with large deficits up to, and perhaps more than 12 cm.

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References