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Chronic Achilles Tendon Rupture Reconstructed With Achilles Tendon Allograft and Xenograft Combination

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ABSTRACT

More than 20% of acute Achilles tendon injuries are misdiagnosed, leading to chronic or neglected ruptures. Some controversy exists regarding how to best manage an acute Achilles tendon rupture. However, a general consensus has been reached that chronic rupture with ≥3 cm of separation is associated with functional morbidity and, therefore, should be managed operatively. It has been demonstrated that the functional outcomes of surgically treated Achilles ruptures are superior to the nonoperative outcomes in a chronic setting. In the present report, we reviewed 4 patients with chronic Achilles tendon ruptures that were successfully treated with an Achilles tendon interposition allograft and simultaneous augmentation with a xenograft. The median duration of rupture was 11 (range 8 to 16) weeks, the median gap between the proximal and distal segments of the tendon was 4.75 (range 3.5 to 6) cm, and the patients were able to return pain-free to all preinjury activities at a median of 14.5 (range 13.8 to 15.5) weeks, without the need for tendon transfer, lengthening, or additional intervention. The median duration of follow up was 37.25 (range 15.25 to 51.5) months, at which point the mean Foot and Ankle Outcomes Instrument core scale score was 97 ± 1 (mean normative score 53 ± 1), and the Foot and Ankle Outcomes Instrument shoe comfort core scale score was 100 ± 0 (mean normative score 59 ± 0). The combined Achilles allograft plus xenograft augmentation technique appears to be a reasonable option for the surgical treatment of chronic Achilles tendon rupture.

The Achilles tendon is the largest and strongest tendon in the body. It can withstand forces ≤10 times one's body weight and gains much of its strength from how the fibrils spiral 90° from their origin to insertion (1). It is composed primarily of type I collagen and small amounts of elastin (2). The tendon spans 3 joints, and, when it contracts, it can flex the knee, plantar flex the ankle, and supinate the subtalar joint. The population-based incidence rates and trends of acute Achilles tendon rupture are not known. Series from European data have reported a mean incidence of primary rupture of the Achilles tendon of 8.5 per 100,000, with a peak incidence in those aged 35 to 50 years (3). These estimates have been correlated with the North American population and might be increasing owing to the increase in the number of older adults participating in high-demand sports. Several well-established factors predispose an individual to Achilles tendon rupture, including overuse, diabetes mellitus, peripheral arterial disease, obesity, inflammatory and autoimmune conditions (4), catabolic steroid use (5), quinolone antibiotic therapy (6), birth control medication, and hormone replacement therapy.

The Achilles tendon receives its primary blood supply from the musculotendinous junction with the gastrocnemius and soleus muscles, the osseous insertion into the calcaneus, and multiple mesotenon vessels between its origin and insertion, and the paratenon. The area that most commonly ruptures is the mid-portion, which is supplied by the paratenon and, as such, is the least vascularized area of the Achilles tendon (7). This watershed area is situated approximately 2 to 6 cm from the Achilles insertion into the calcaneus, and it contains a high concentration of water and type I collagen in cases in which the tendon has been damaged or injured.

Controversy is ongoing regarding how to best manage acute Achilles tendon tears, and published reports have supported either operative or nonoperative methods (8,9). However, it is well established that considerable functional morbidity is commonly associated with chronic or neglected Achilles tendon ruptures that display at least several centimeters of separation between the proximal and distal segments of the tendon. Such patients often develop balance and gait dysfunction and often have particular difficulty climbing stairs, ladders, and inclines. More than 20% of acute Achilles tendon ruptures will be misdiagnosed, leading to chronic or neglected

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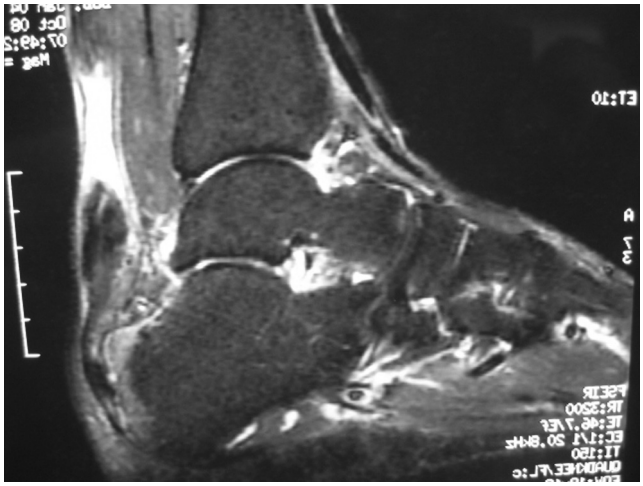

Fig. 1. Magnetic resonance imaging scan showing an Achilles tendon rupture with retraction and gapping between the tendon ends.

ruptures (10). A chronic rupture has usually been defined as a tear that has not been appropriately treated within 4 to 8 weeks of injury. A number of adverse, pathologic changes accompany untreated Achilles tendon ruptures. Failure to immobilize or repair the ruptured tendon will typically result in contracture of the gastrocnemius-soleus-Achilles mechanism, with retraction of the proximal and distal margins of the rupture and a resultant gap between the tendon ends (Fig. 1). Within 2 weeks of injury, in the absence of adequate treatment, hematoma and subsequent fibrous organization will occur, and the tendon ends will become bulbous and adhere to the superficial fascia and posterior compartment layers (deep muscle fascia). The ensuing scar tissue forms a pseudotendon that is disorganized and incapable of transferring contractile force or withstanding physiologic tensile forces, which results in the loss of ankle strength and function.

Several surgical techniques have been described to repair neglected rupture of the Achilles tendon, and Myerson (11) and others have described a classification system (Table 1) matching the injury and repair methods. Additional methods have been described when direct anastomosis of the proximal to distal margins is not possible. These techniques have included free tendon transfer, local tendon transfer, and natural and synthetic graft or material augmentation of the repair (12). The augmentation methods have included the use of autogenous or allogeneic fascia lata, plantaris, flexor hallucis longus, or peroneal tendon, human dermal matrix, mesh and various composite materials, and xenografts (13). In an effort to better understand our treatment of chronic, neglected Achilles tendon ruptures, we reviewed the outcomes of a series of 4 patients we had treated using a fresh-frozen Achilles allograft combined with augmentation with a xenograft.

Case Report

From September 2009 to October 2012, 4 patients had presented to the senior author's (S.H.) private orthopedic surgical practice with chronic Achilles tendon ruptures that had been present for ≥8 weeks from injury, displayed a gap >3 cm at surgery, and were not amenable to delayed primary tendon repair. The patients were treated operatively with an allograft augmented with a xenograft. Postoperatively, they were treated according to a protocol aimed at functional rehabilitation. The rarity of this condition in the senior author's (S.H.) practice and the retrospective nature of the present study made the identification of the patients relatively simple, because they had presented sequentially for care. After undergoing surgery and rehabilitation, the patients were reassessed at a minimum of 12 months postoperatively, at which time they completed the Foot and Ankle Outcomes Instrument (FAOI), a health measurement instrument that has been shown to produce valid information (14). The FAOI core score characterizes the functional outcomes and the FAOI shoe comfort score characterizes shoe comfort or discomfort. Standardized scores are calculated such that 0 represents a poor outcome and 100, the best possible outcome. Normative scores were referenced to a mean score of 50 for the general healthy population. Scores >50 indicate better outcomes and those <50 indicate worse outcomes in terms of function and comfort relative to the mean.

Table 1
Treatment of chronic Achilles ruptures

Injury	Treatment
Type I (rupture <3 cm)	End-to-end repair and posterior fasciotomy
Type II (3- to 6-cm defect)	V-Y lengthening with or without tendon transfer, free graft
Type III (>6 cm defect)	Tendon transfer combined V-Y lengthening, for free graft

All the patients (Table 2) were male and were nonsmokers or former smokers, with a median age of 50 (range 40 to 63) years. The median duration from the Achilles tendon rupture to the day of surgical intervention was 11.5 (range 8 to 16) weeks. The median length of the gap between the proximal and distal margins of the ruptured tendon directly measured with a ruler at the surgery was 4.75 (range 3.5 to 6) cm. All 4 patients were treated with an Achilles tendon interpositional allograft and a simultaneous xenograft augmentation technique as described. All patients underwent successful repair of a chronic Achilles rupture using this combined technique without any major intraoperative or postoperative complications.

All the surgeries were performed with the patient under intravenous sedation and a popliteal nerve block (30 mL 0.12% Marcaine [Carestream Health, Rochester, NY] diluted to 0.25%) and local tendon injection using 1% lidocaine with epinephrine 1:100,000, performed by the anesthesiologist. All patients were placed in the prone position, with both lower extremities prepared and draped; a tourniquet was not used in any of the operations. A posteromedial incision was made over the Achilles tendon to avoid injury to the sural nerve, which we consider to course from proximally to distally approximately 5 mm lateral to the lateral margin of the Achilles tendon. The typical incision was made just distal to the gastrocnemius–soleus complex and just proximal to the distal insertion of the Achilles tendon. The initial dissection aimed to separate the superficial fascial and paratenon layers. In the central area of the incision at which the rupture and scarring had occurred, both the paratenon and the superficial fascial layer were dissected as 1 unit. The proximal and distal ends of the Achilles tendon were isolated through the incision, and the fibrous (scar) pseudotendon was identified within the gap (Fig. 2). The tendon ends were identified and debrided to stumps consistent with discernable quality tendon tissue and not remodeled scar tissue or degenerative tissue from tendinosis.

After debridement and preparation of the recipient site wound bed, the allograft Achilles tendon was placed in the surgical wound to gauge the length required to span the gap (Fig. 3). The true tendon gap was measured with the ankle in the neutral resting position and was compared with the prepared unaffected side. The distal and proximal ends of the patient's remaining Achilles tendon were incised transversally, creating a separation of anterior and posterior tendon ends for the Achilles tendon allograft to seat directly into (intrasubstance delivery) the proximal and distal stumps, where it was secured proximally and distally (Fig. 4) using 2-0 FiberWire® (Arthrex®, Naples, FL) with the tendon under physiologic tension and the foot slightly plantar flexed at the ankle.