



Contents lists available at ScienceDirect

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org

Achilles Tendon Reconstruction With Bone Block Allograft: Long-Term Follow-Up of Two Cases

Eric So, DPM, AACFAS¹, Devon Consul, DPM², Timothy Holmes, DPM, FACFAS³¹ Fellow, The CORE Institute, Phoenix, AZ² Resident, Grant Medical Center, Columbus, OH³ Faculty, Grant Medical Center, Columbus, OH

ARTICLE INFO

Level of Evidence: 4

Keywords:

cadaver
 calcaneus
 chronic injury
 flexor hallucis longus
 neglected rupture
 triceps surae

ABSTRACT

The treatment of neglected or chronically ruptured Achilles tendon is challenging. Various treatments for large defects associated with chronic Achilles ruptures have been described. Many surgeons recommend the use of a tendon transfer, turndown rotational flap, advancement flap, or reconstruction with Achilles tendon allograft with calcaneal bone block. Long-term outcomes of these procedures are unknown. We present 2 cases with the use of an Achilles tendon with calcaneus bone block allograft. At >8-year follow-up duration, both patients are afforded satisfactory levels of activity and are without pain or gait disturbance. This procedure is a viable option for Achilles ruptures with large defects, ruptures with small intact distal tendon portions, or re-ruptures of previously repaired Achilles tendons. The long-term outcomes of these case reports suggest that Achilles tendon reconstruction with bone block allograft is a viable option.

© 2018 by the American College of Foot and Ankle Surgeons. All rights reserved.

Achilles tendon ruptures are difficult injuries to treat, especially neglected ruptures or those that have previously been treated and failed. Chronic Achilles tendon ruptures are defined as those with a time period of 4 to 6 weeks between injury and surgical management (1). Patients with neglected Achilles tendon ruptures may recall a specific injury without prodromal symptoms such as pain or swelling, thus delaying diagnosis. Various surgical reconstruction methods have been introduced depending on the defect gap and the state of the remaining tendon, but a more difficult recovery time compared with those for acute ruptures is a challenge for the surgeon and the patient (2).

Neglected or misdiagnosed Achilles tendon ruptures are reported to occur 25% of the time and are considered neglected or delayed after 4 weeks without intervention (3). The delay makes surgical intervention more difficult owing to large tendon defects and degeneration within the Achilles tendon. Large Achilles tendon defects have been reportedly repaired surgically with the fascia lata (4), Achilles tendon rotational flaps (5), Achilles tendon allografts (5–7), and allograft-autograft combinations (8). Tendon allografts have also been reported for use in various other repairs, including anterior cruciate ligament and patellar tendon repairs (5). Repair of these Achilles tendons is difficult because of the lack of remaining viable tendon and limited techniques available

to repair a large defect. The bone block allograft provides the ability to reconstruct large defects not otherwise attainable through autologous turndown or advancement flaps.

The use of Achilles tendon allograft has shown good results in the reconstruction of anterior cruciate ligament tears, patellar tendon ruptures, and biceps tendon ruptures (4–7). However, its use in the reconstruction of chronic disease of the Achilles tendon is not well reported. Allograft Achilles tendon with bone block allograft may be a viable option for patients with chronic Achilles tendinosis with a large defect, because of its ability to preserve surrounding structures and allow for healing in more highly vascularized areas than the “watershed area” in the native tendon (9). The option also preserves the caudal rotation of native Achilles tendons and thus preserves function. This option should be considered only for patients with severe tendinopathy requiring significant removal of diseased tissue leaving a gap >5 cm (10). The literature is scant on the long-term outcomes of this procedure. We describe the long-term outcomes of surgery performed on 2 patients requiring Achilles tendon reconstruction with bone block allograft.

Technique

The anesthesiologist administers a regional blockade and general anesthesia. A pneumatic thigh tourniquet is applied to the operative extremity. The patient is manipulated into a secure prone position with great care to pad all osseous prominences. An Esmarch bandage is used to exsanguinate the operative extremity before inflation of the tourniquet. A linear incision is made to the level of the paratenon. The incision

Financial Disclosure: None reported.**Conflict of Interest:** None reported.

Address correspondence to: Eric So, DPM, Attention: Research, 285 East State Street, Suite 670, Columbus, OH 43215.

E-mail address: ericso70@gmail.com (E. So).



Fig. 1. Incision continues distally to visualize the posterior aspect of the calcaneus for an osteotomy distal to the insertion of the tendon.

continues distally to visualize the posterior aspect of the calcaneus for an osteotomy distal to the insertion of the tendon (Fig. 1). All of the diseased Achilles tendon is then sharply resected. After debridement, at least some portion of the native tendon should remain at the proximal



Fig. 2. Native tendon should remain at the proximal graft attachment site to allow for adequate strength of suture repair.

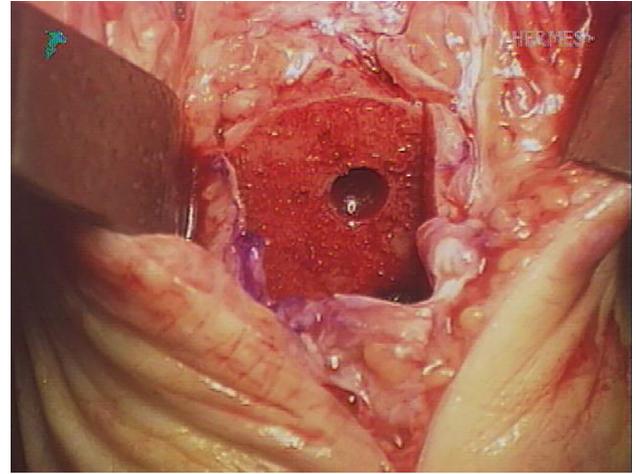


Fig. 3. Posterior superior aspect of the calcaneus is resected.

graft attachment site to allow for adequate strength of suture repair (Fig. 2).

The posterior superior aspect of the calcaneus is resected in a distal-posterior to proximal-anterior direction under fluoroscopic guidance. The width can range from 1.2 to 2.5 cm at its insertion (Fig. 3). After an initial resection is performed, the bone block can be placed on the posterior aspect of the calcaneus to gauge positioning of the allograft (Fig. 4). At this time, the bone block allograft may be contoured to precisely match the contour of the resected calcaneus (Fig. 5). After appropriate contouring of the bone block allograft,

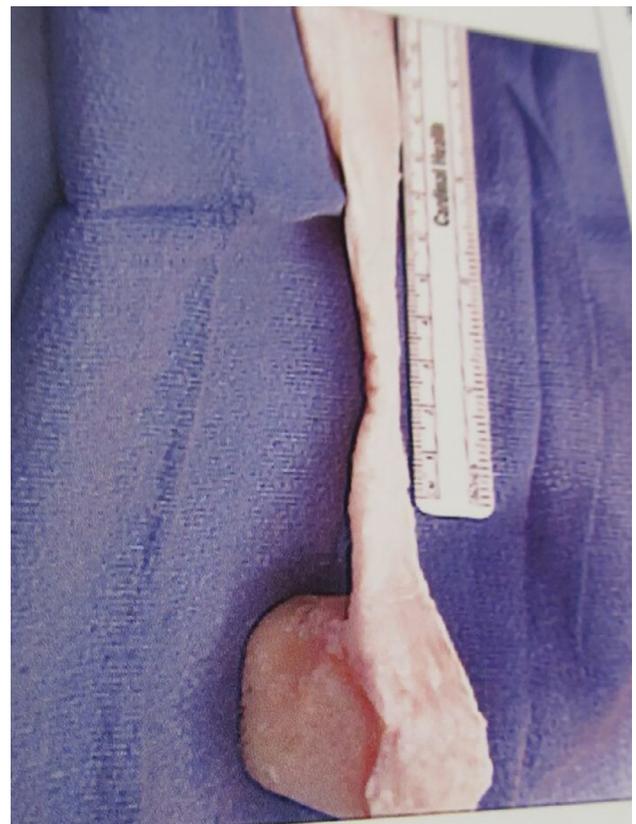


Fig. 4. Allograft with bone block.

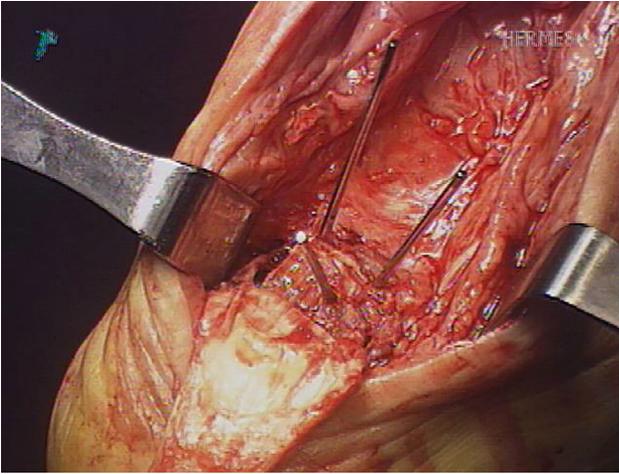


Fig. 5. Recontoured graft with temporary calcaneal fixation.

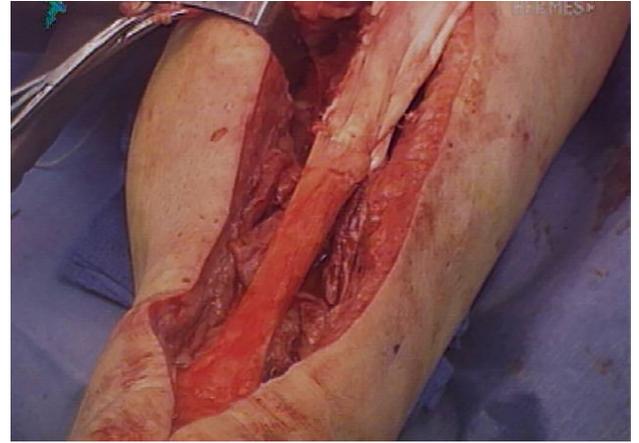


Fig. 7. End-to-end repair of tendon and graft.

fixation using 4.5 mm and 5.5 mm cannulated screws is placed (Fig. 6). Fluoroscopy is used to confirm appropriate alignment and placement of orthopedic hardware. The foot is then plantar flexed, and the proximal Achilles tendon is attached to the remaining proximal portion with an end-to-end repair (Fig. 7). Before repair, the proximal musculotendinous stump is stimulated with electrocautery to confirm the presence of adequate muscle contraction. Repair is performed with nonabsorbable suture. Care must be taken to repair the allograft under physiologic tension. Excess allograft tendon is sharply removed. Paratenon and subcutaneous closure is maintained with absorbable suture. Skin is closed with nonabsorbable suture. A

modified Robert Jones dressing with posterior splint is applied with the foot in gravity equinus.

Postoperative Protocol

Each patient was non-weightbearing for 4 to 6 weeks. At the first visit, the splint was removed, and the patient was placed into a fiberglass short-leg cast. Sutures were removed at 3 weeks. At 6 weeks, the patient was transitioned to weightbearing in a walking boot with heel lifts with progression to neutral over the next 4 to 6 weeks. Physical therapy was initiated at 6 weeks.

Case Report 1

A 52-year-old male had previously undergone an Achilles tendon debridement for Achilles tendinosis by an outside provider. However, the patient still experienced reduced and painful plantar flexion strength and range of motion. Magnetic resonance imaging (MRI) revealed severe degeneration of the remaining Achilles tendon (Fig. 8). Intraoperatively, there was extensive scarring and fibrotic tissue from his previous Achilles tendon surgery. This degeneration extended from the Achilles tendon insertion to 15 cm proximal to the insertion. The distal 15 cm of the Achilles tendon was removed. The Achilles tendon allograft with calcaneal bone block was used as previously described.



Fig. 6. Screw fixation.

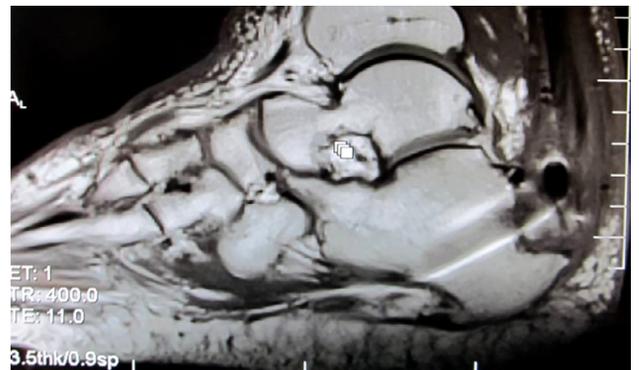


Fig. 8. Magnetic resonance scan noting severe degeneration of the remaining Achilles tendon.



Fig. 9. Postoperative surgical incision.

The patient had an uneventful immediate postoperative period. At 8.5 years after surgery, the patient's visual analogue scale score is 0 of 10. He is able to do activities of daily living including playing golf. His ankle, midfoot, and hindfoot joints are pain free and intact. The skin is well coapted (Fig. 9). Manual muscle testing demonstrates 5 of 5 strength to ankle plantarflexion. Range of motion reveals 10 degrees of

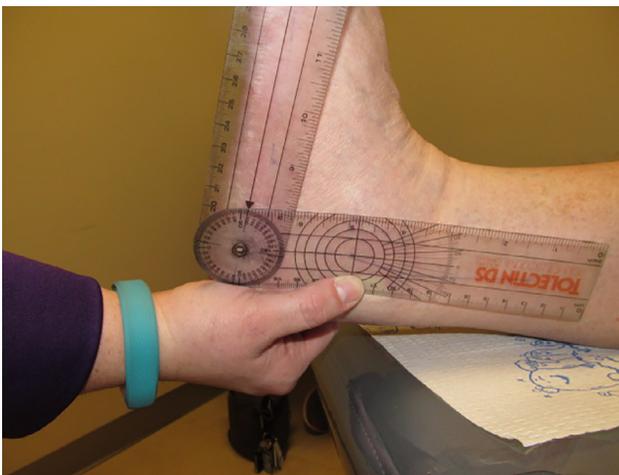


Fig. 10. Range of motion demonstrating 10° of passive and 15° of active dorsiflexion of the ankle.



Fig. 11. Final radiographic examination reveals intact hardware with incorporation of the allograft from Case 1.



Fig. 12. Reruptured Achilles tendon.

passive and 15 degrees of active dorsiflexion of the ankle (Fig. 10). Calf circumference is equal to the contralateral leg. Radiographic examination reveals intact hardware with incorporation of the allograft (Fig. 11). No gait disturbance noted. The patient remains ambulatory in a tennis shoe.

Case Report 2

A 37-year-old female had undergone a primary Achilles tendon repair. In the postoperative period, the patient re-ruptured her Achilles repair, which was confirmed with MRI (Fig. 12). She elected to undergo a second repair of her Achilles tendon at that time. However, 2 years postoperatively, the patient continued to have pain and debilitation. She was unable to perform a single-limb heel raise with pain along the posterior tibial tendon and Achilles tendon and was unable to perform activities of daily living because of notable gait disturbance. After failing conservative treatment, she requested surgical intervention. The patient underwent an Achilles tendon allograft with calcaneal bone block, posterior tibial tendon repair, and talonavicular and subtalar joint arthrodesis.

Intraoperatively, she was noted to have 8 to 10 cm of degenerative Achilles tendon and significant tendinosis at the calcaneal insertion. The distal 10 cm of Achilles tendon was nonviable and was therefore excised. The Achilles tendon allograft with calcaneal bone block was incorporated as previously described (Fig. 13). The patient experienced an uneventful postoperative recovery. At maximum follow-up duration of 9.7 years postoperatively, the patient relates no issues to her operative extremity. She has 5 of 5 muscle strength to the right Achilles and



Fig. 13. Final radiographic examination of the Achilles tendon allograft with calcaneal bone block incorporation from Case 2.

complete ability to perform a single-leg heel raise. Range of motion reveals 8 degrees of dorsiflexion with 40 degrees of plantarflexion (Fig. 14). The Achilles tendon remains pain free and intact.



Fig. 14. Range of motion reveals 8° of dorsiflexion with 40° of plantarflexion.

Discussion

Chronic Achilles tendon ruptures with large defects can cause significant dysfunction. Although accommodative bracing may provide exterior ankle support, it does not allow for a return to full function. Surgical reconstruction offers the potential to restore patients to their full strength and activity level (11). Although only a few reports exist on reconstruction using Achilles tendon allograft, all of them demonstrate good results (5,6,9,12,13). The introduction of an Achilles tendon allograft is based on the success of anterior cruciate ligament reconstruction of the knee. The advantages of Achilles tendon allograft are that fixation and suture can be done by various methods because the tendon length is sufficient, and an ideal outcome can be anticipated after final healing because the shape and thickness are the same as those of the original tissue. However, there is limited literature regarding the long-term outcomes of treating chronic Achilles tendon ruptures with bone block allograft.

The flexor hallucis longus tendon is frequently used to augment the ruptured gap for reconstruction of neglected chronic ruptures. The flexor hallucis longus is the plantar flexor and is stronger than the peroneus brevis and flexor digitorum longus (14). Its axis of contractile force more closely resembles that of the Achilles tendon, and it works in phase with the gastrocnemius-soleus complex. Because it also has the advantage of being transferred without neurovascular interference due to proximity with the Achilles tendon, the transfer can be implemented to fortify muscle strength with other reconstruction techniques (15).

This option should be considered only for patients with severe tendinopathy requiring significant removal of pathologic tissue leaving a gap >5 cm (10,16). This procedure preserves the caudal rotation of the Achilles tendon, obviates the need to sacrifice surrounding structures, and yields acceptable functional outcomes (9). Hanna et al (9) reported initial results of a series of 6 patients. Patients were able to get up from a seated position and walk up and down stairs without issue. All patients reported a mild limp, and most noted lack of strength. However, follow-up was limited to 16 to 32 months. Results at a long-term follow-up duration were not reported. The current report is distinguished from Hanna et al (9) by the length of follow-up. Our patients demonstrated that at long-term follow-up duration, this procedure does afford satisfactory ambulation without gait disturbance and return to high-level activity with full incorporation of the allograft.

In conclusion, this case report illustrates the long-term outcomes of Achilles tendon reconstruction with bone block allograft. We believe this procedure is predictable in restoring function and strength, alleviating pain, and providing high rates of satisfaction. We believe that Achilles tendon allograft with calcaneal bone block allograft is a viable option for a subset of patients with extensive Achilles tendinopathy.

References

- Maffulli N, Ajjis A. Management of chronic ruptures of the achilles tendon. *J Bone Joint Surg Am* 2008;90:1348–1360.
- Wegrzyn J, Luciani JF, Philippot R, Brunet-Guedj E, Moyon B, Besse JL. Chronic Achilles tendon rupture reconstruction using a modified flexor hallucis longus transfer. *Int Orthop* 2010;34:1187–1192.
- Inglis AE, Scott WN, Sculco TP, Patterson AH. Ruptures of the tendo Achilles: an objective assessment of surgical and non surgical treatment. *J Bone Joint Surg Am* 1976;58:990–993.
- Duhameil P, Mathieu L, Brachet M, Compere S, Rigal S, Bey E. Reconstruction of the Achilles tendon with a composite anterolateral thigh free flap with vascularized fascia lata: a case report. *J Bone Joint Surg Am* 2010;92:2598–2603.
- Nellas ZJ, Loder BG, Werheimer SJ. Reconstruction of an Achilles tendon defect utilizing an Achilles tendon allograft. *J Foot Ankle Surg* 1996;35:144–148.
- Lepow GM, Green JB. Reconstruction of a neglected Achilles tendon rupture with an Achilles tendon allograft: a case report. *J Foot Ankle Surg* 2006;45:351–355.

7. Hansen U, Moniz M, Zubak J, Zambrano J, Bear R. Achilles tendon reconstruction after sural fasciocutaneous flap using Achilles tendon allograft with attached calcaneal bone block. *J Foot Ankle Surg* 2010;49:86.e5–86.e10.
8. Beals TC, Severson EP, Kinikini D, Aoki S. Complex Achilles reconstruction for massive soft tissue loss: allograft, autograft, and use of a temporary cement spacer. *J Orthop Trauma* 2010;24:e78–e80.
9. Hanna T, Dripchak P, Childress T. Chronic Achilles rupture repair by allograft with bone block fixation. *Foot Ankle Int* 2013;35:168–174.
10. Kuwada GT. Classification of tendo Achillis rupture with consideration of surgical repair techniques. *J Foot Surg* 1990;29:361–365.
11. Cetti R, Christensen SE, Ejsted R, Jensen NM, Jorgensen U. Operative versus nonoperative treatment of Achilles tendon rupture: a prospective randomized study and review of the literature. *Am J Sports Med* 1995;23:571–574.
12. Kocabey Y, Nyland J, Nawab A, Caborn D. Reconstruction of neglected Achilles' tendon defect with peroneus brevis tendon allograft: a case report. *J Foot Ankle Surg* 2006;45:42–46.
13. Yuen JC, Nicholas R. Reconstruction of a total Achilles tendon and soft-tissue defect using an Achilles allograft combined with a rectus muscle free flap. *Plast Reconstr Surg* 2001;107:1807–1811.
14. Silver RL, de la Garza J, Rang M. The myth of muscle balance. A study of relative strengths and excursions of normal muscles about the foot and ankle. *J Bone Joint Surg Br* 1985;67:432–437.
15. Hahn F, Meyer P, Maiwald C, Zanetti M, Vienne P. Treatment of chronic Achilles tendinopathy and ruptures with flexor hallucis tendon transfer: clinical outcome and MRI findings. *Foot Ankle Int* 2008;29:794–802.
16. Myerson MS. Achilles tendon ruptures. *Instr Course Lect* 1999;48:219–230.