Hamstring Reconstruction for Chronic Achilles Pathology

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Abstract: There are many accepted treatment options for chronic tears of the Achilles tendon. In cases involving a tendon gap of over 5 cm after debridement and removal of unhealthy tissue, a primary tendon reconstruction is recommended, as there is not enough healthy tissue to perform a direct repair. Various tendons have been used, including the peroneal tendons, the Flexor Hallucis Longus (FHL), as well as allografts including use of the Achilles, FHL, flexor digitorum longus, and semitendinosus tendons. We propose the use of a hamstring autograft, using both gracilis and semitendinosus. In addition, if the patient is young and active and hoping to return to sports, we recommended augmenting the Achilles reconstruction by transferring an FHL tendon to help restore full strength.

Key Words: Achilles reconstruction, chronic achilles tear, autograft, semitendinosus, gracilis

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HISTORICAL PERSPECTIVE

There are many reported options for the treatment of chronic Achilles ruptures in the literature. In cases where there is a deficit of ≥ 5 cm, it is generally accepted that tendon transfer (either autograft or allograft) should be utilized to replace the missing tissue.[1] Over the years, many surgeons have proposed different tendons, including the flexor digitorum longus (FDL), flexor hallucis longus (FHL), the peroneus brevis, gracilis, plantaris, as well as fascia lata.[1–3] There have also been reports of the use of allografts, a V-Y tendon lengthening technique, turndown flaps, and synthetic grafts to reconstruct the Achilles tendon.[2,4] All of these have significant risks associated, including risk of rejection of allografts and synthetic grafts, and not enough healthy tissue to make a V-Y lengthening or tendon flap successful.[2] Given the risks of these other methods, in patients with over a 5 cm gap or patients where $>50\%$ of the existing tissue is tendinotic, primary tendon transfer in indicated.[1] The FHL has been shown to have successful results, allowing patients more muscle and strength recovery than the other options.[1,4,5] The main problem with using the FHL is that it limits the patient's flexion in their big toe and involves a more morbid operation.[4,6] In a recent report, a semitendinosus autograft was noted to have been used to reconstruct chronic Achilles tears.[7] Another report describes using the semitendinosus using a calcaneal bone tunnel with varying methods of suturing the semitendinosus to itself, depending on the size of the tendon and size of the gap.[8] A different report presents a minimally invasive technique in which they attach the grafted tendon to both the distal and proximal Achilles stump.[9] However, this is not always possible if the distal stump needs to be completely debrided. In a separate report, a semitendinosus autograft was used as a way to augment a V-Y approach.[10] In addition, an endoscopic method of Achilles reconstruction using hamstring autografts showed nonsignificant strength deficits between the operated and nonoperated side with a 2-year follow-up.[11] These reports all note that the advantages of using a hamstring as opposed to a local foot tendon include avoiding the loss of foot function associated with an FHL transfer as well as a less invasive operation.[7–11] In addition, a hamstring autograft allows for the possibility of increased strength and minimal morbidity in the hamstring.[7,12] The technique of using 2 hamstring tendons, both a gracilis and semitendinosus, has also been described, reporting that it has been used successfully in 15 Achilles' in 14 patients. The authors report good results but have limited follow up and clinical and functional outcome measures.[6] It is our belief that use of gracilis in combination with semitendinosus autograft offers patients the best recovery following chronic Achilles ruptures. The FHL has a long track record for use augmenting Achilles tendon repairs and, overall, patients tend to do well. However, return to sports is limited because of the relative disparity between the FHL and the Achilles, which changes the vector of pull from anterior to posterior on the calcaneus and decreases toe flexion.[13] Return to sports, while underreported, is likely limited at best. We believe that adding the hamstring tendons increases postoperative strength. In addition, connecting to the proximal calf muscle can be challenging and require harvesting the FHL in the middle of the foot.[3] By using a hamstring tendon, you can avoid this difficult aspect of the procedure. Furthermore, there may be some atrophy in the calf which may be irreversible. It is important to note that although we are advocating the use of a hamstring graft, we are not dismissing the use of the FHL as we will often use it if we feel that added muscle will help the patient. In cases where the patient is young, active, and hoping to return to sports, we recommended augmenting the Achilles reconstruction by transferring the FHL tendon as well. Using an FHL in combination with gracilis and semitendinosus allows patients to make a more complete return to their preoperative strength levels. In isolation, we believe that FHL transfer can have success when patients are just looking to return to activities of daily living, but this leads to low rates of return to sports. We believe that with the addition of the hamstring tendons, patients will have higher rates of return to sports following Achilles reconstruction.

INDICATIONS AND CONTRAINDICATIONS

In cases of Achilles tendinopathy with no gap, conservative treatment can be considered, and is recommended in elderly and nonactive patients. In chronic Achilles ruptures where there is a significant gap as well as significant signs of tendinotic tissue, or signs of infection, operative intervention is recommended, to allow the patient to return to activity (Fig. 1). Without operative intervention in these cases, the tendon will heal longer than its

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All patients were enrolled in our Hamstring Strength Study, which was approved by our IRB committee and each patient was consented to participate through the IRB protocol.

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FIGURE 1. Chronic affected Achilles tendon.

original length and the patient will not be able to return to day-to-day activities. They will likely experience increased dorsiflexion pain and weakness, which is manifested by difficulty walking on their toes. When deciding which operative path to pursue, it is important to assess the area of tendon gap as well as the amount of tendinotic versus reusable tissue in the patient as well as to assess their calf muscle strength, size, and function. We recommended that if the gap is larger than 5 cm,[13] reconstruction should be performed with the use of a gracilis and semitendinosus autograft. If the patient is active and hoping to return to sports, an FHL transfer can also be performed to augment the reconstruction and allow for greater strength in the tendon postoperatively.

PREOPERATIVE PLANNING

A bilateral Thompson test is performed, and positive results are noted to indicate an Achilles injury. Care is taken to observe the area of the Achilles, noting any swelling, tenderness to palpitations, as well as any palpable gaps. In addition to assessing pain, range of motion of the area is assessed. Special attention is paid to passive ankle dorsiflexion compared with the contralateral side. If dorsiflexion is increased, it can indicate attenuation of the tissue. Weight bearing anteroposterior, lateral, and oblique radiographs are obtained and assessed for overall alignment as well as any fractures in the area or to identify any tendinotic calcifications in the area. In addition,

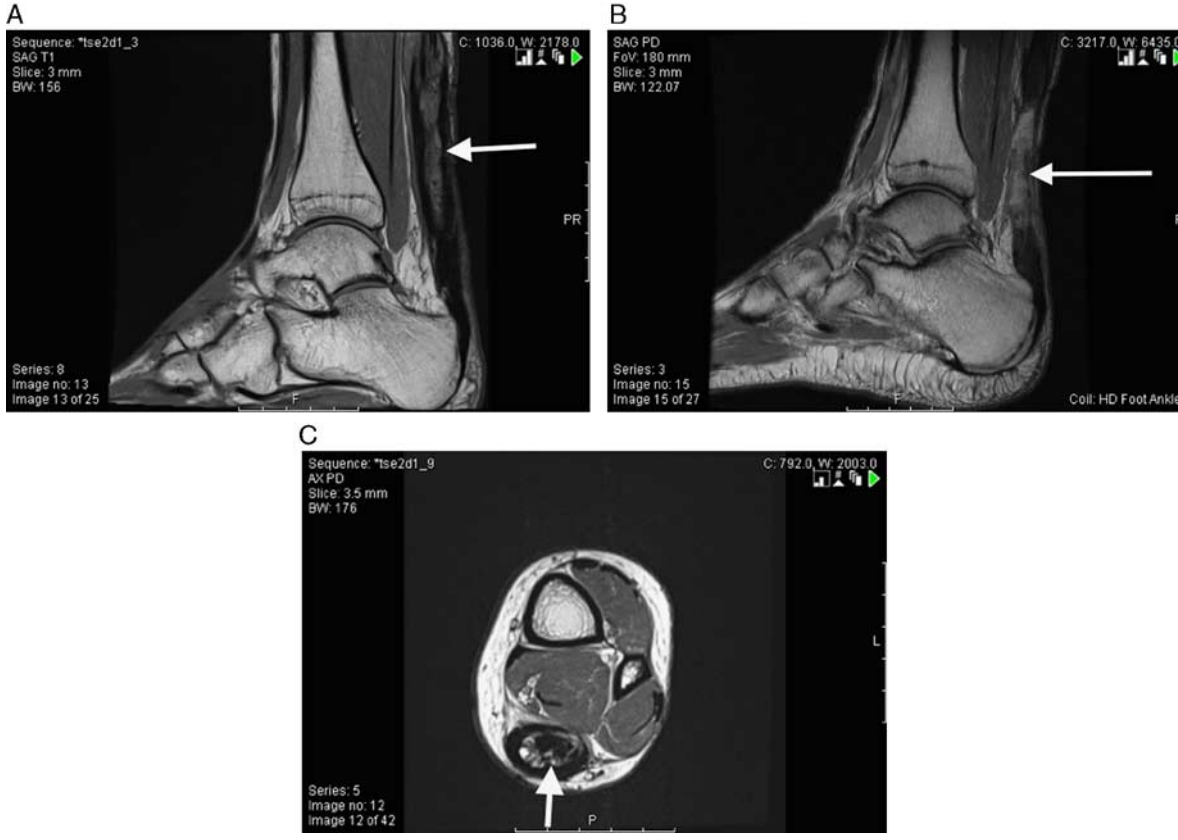

FIGURE 2. A and B, Sagittal MRIs showing high signal and severe tendinopathy (arrow) throughout the Achilles tendon. C, Axial MRI showing high signal and severe tendinopathy (arrow) in the Achilles tendon.

MRI of the injured ankle is obtained and evaluated to assess the location and length of the rupture, as well as the quality of the remaining tissue (Fig. 2).

TECHNIQUE

The patient is placed in a prone position on the operating room table. A tourniquet is placed on the operative thigh and inflated to 250 mm Hg.

Hamstring Autograft Harvest and Preparation

A 3 cm incision is made using a medial approach to the tibia at the midway point between the top of the tibial tubercle and the posteromedial border of the tibia (Fig. 3A). The sartorial fascia is divided in line with its fibers to expose the gracilis and semitendinosus, between the superficial medial collateral ligament and sartorial fascia. Metzenbaum scissors are used to remove the adhesions holding the tendons to the medial head of the gastroc (Fig. 3B). The tendons are harvested using a Linvatec tendon stripper (ConMed, Utica, NY). Any muscle remnants of the tendons are removed using a ruler and then they are attached to a Graft Master III (Smith & Nephew, Andover, MA) to be prepared (Fig. 3C). In our experience, the gracilis is usually between 3.5 mm and 4.5 mm in diameter and between 22 cm and 28 cm in length. The semitendinosus is usually between 4 mm and 5 mm in diameter and between 23 cm and

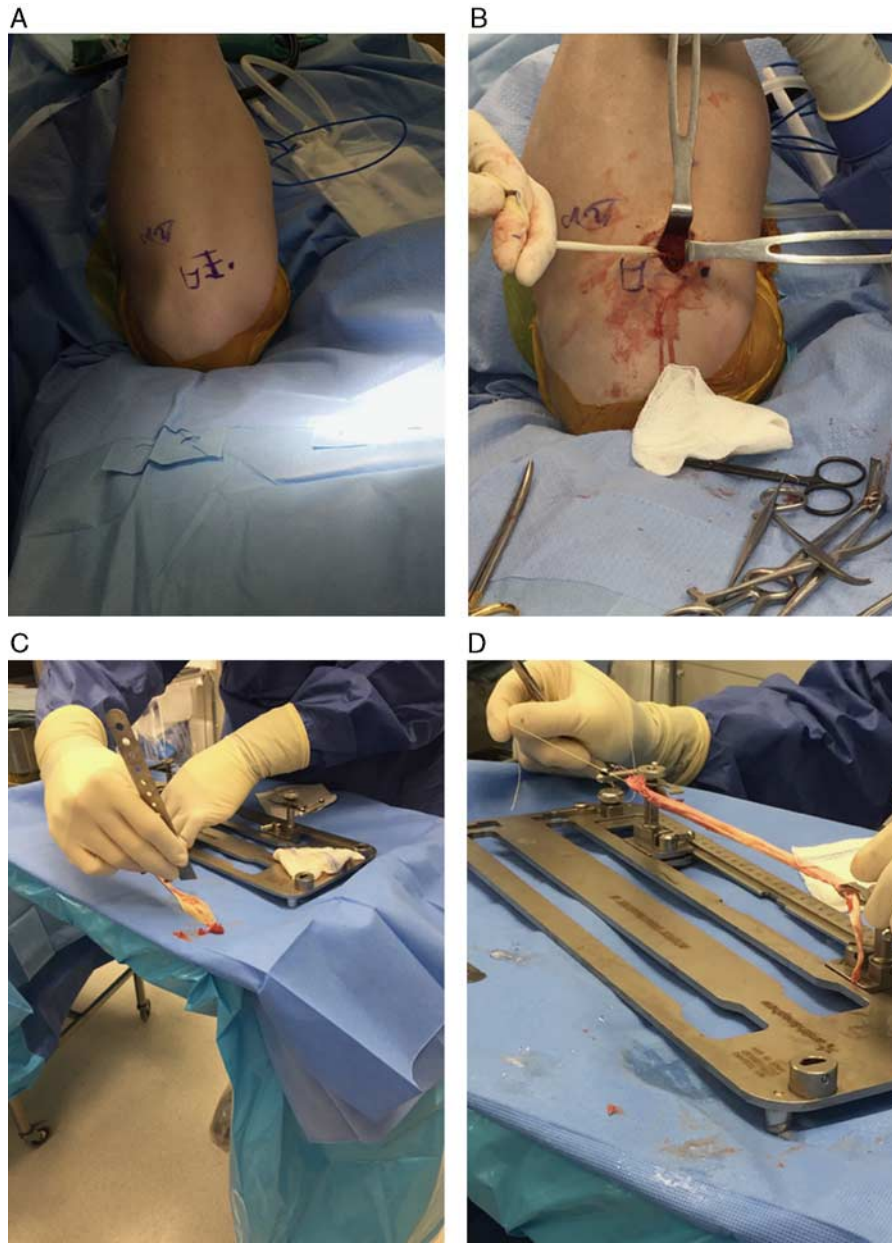

FIGURE 3. A, An incision is made between the tibial tubercle (the box) and the posteromedial border of the tibia (the dot). B, The gracilis is mobilized between layers 1 and 2 with a penrose drain. C, Muscle remnants are removed from the harvested tendons using a ruler. D, The tendons are attached to the Graft Master III (Smith & Nephew, Andover, MA) and are tubularized.

30 cm in length. The 2 tendons are tubuluarized using a 0-vicryl suture with a modified Krakow stitch and the final length and diameter are measured (Fig. 3D).

Achilles Reconstruction Using Autograft

The Achilles is identified and an incision is made over the tendon. Care should be taken to cheat medial to midline when making the incision because of the improved vascular supply in the area. If the patient has a previous incision, the old incision is used in order to decrease the potential for complications. Dissection is carried down to the level of the Achilles tendon. At this point, the ruptured areas of the tendon are removed and the quality of the remaining tendon is assessed by looking for small tears, tissue integrity, and tissue quality (Fig. 4A). On the basis of appearances, texture, and consistency, the surgeon determines the areas on the tendon that are healthy enough for repair. A tunnel is drilled into the base of the calcaneus, just anterior to the Achilles tendon. The tunnel does not go all the way through the calcaneus. The diameter of the tunnel should match the diameter of the prepared graft which is the overall diameter of the tubularized prepared tendon(s) that are being used. The harvested hamstring tendons are brought through the tunnel (Fig. 4B). If both the semitendinosus and gracilis are being used in combination, they will be tubularized together and should be brought through the tunnel together. They are fixed in place with a Bio-Tenodesis interference screw (Arthrex, Naples, FL). The screw should be the same size as the tunnel or, if it differs, 0.25 mm larger than the tunnel in order to ensure a strong bite (Fig. 4C). The hamstring tendons are then brought back proximally. They are tensioned with the ankle in 10 to 15 degrees of plantar flexion. A pulvertaft type maneuver is then used to bring the hamstring graft through the proximal Achilles stump (Fig. 4D). The tendon is then brought back down and tied to the stitches coming out of the Bio-Tenodesis screw and

FIGURE 4. A, The distal stump is identified and removed. If the distal stump is intact and normal quality tissue, then we will not remove it. B, The hamstring graft is brought through a drill hole in the base of the calcaneus. C, The hamstring graft is secured in place with a Bio-Tenodesis screw. D, The hamstring graft is tensioned with the ankle in 10 to 15 degrees of plantarflexion. E, A pulvertaft weave is used to bring the hamstring graft back down. Using the whole hamstring graft, we are able to double the graft over and make it all the way down, where it is then secured in place.

any of the remaining distal tendon (Fig. 4E). One suture will be coming through the screw and the other will be outside of the screw in the tunnel, making it effectively act like an anchor.

Performing an FHL Transfer

The FHL transfer should be made using a posterior approach. First, the fascia over the FHL is incised, mobilizing the tendon. The FHL is then harvested from the tarsal canal, usually taking approximately 4 cm of tendon. The 4 cm is measured from the musculotendinous junction posteriorly. The FHL is then led through the distal Achilles stump in a pulvertaft weave, and it is tensioned with 10 to 15 degrees of ankle plantar flexion. Number 2 orthocord is used to secure the FHL in place. The FHL sutures from the FHL transfer are then tied to the hamstring graft. The hamstring graft is also woven through the distal Achilles tendon stump (Fig. 5).

Closing

The subcutaneous tissues are repaired using 3-0 vicryl. The skin is closed using 3-0 prolene. The patient is then placed in a nonweight bearing splint in plantar flexion.

POSTOPERATIVE MANAGEMENT

After the procedure, patients are placed in a nonweight bearing splint for 2 weeks. After 2 weeks, if the wound is healed, the sutures are removed and the patient is transitioned into either a cast or a CAM boot. If the wound has not healed, the patient is placed into a cast and returns in 1 week to reassess the wound healing and either progresses to a CAM boot or goes back into a cast. Partial weight-bearing in the CAM boot is started at 4 weeks postoperatively and progression into a sneaker is made at 3 months postoperatively. Patients are instructed to begin physical therapy at 6 weeks postoperatively.

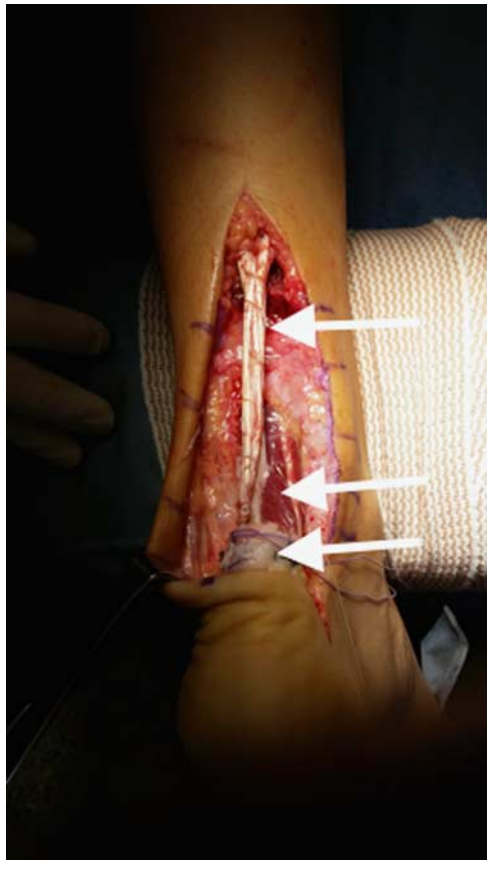

FIGURE 5. Patient with both a hamstring graft (top arrow) and FHL tendon transfer (middle arrow). The Achilles stump is indicated by the bottom arrow.

COMPLICATIONS

Complications include postoperative wound infection and risk of rerupture of the reconstructed tendon. In addition, with any tendon transfer procedure, a possible complication is a loss of function in the original site of harvest. It is our intention that by harvesting hamstring tendons as opposed to other foot tendons, the morbidity is reduced and there is little to no loss of strength in the donor site. To date, we have not seen pull out of the tendon, stretching of the tendon or sural nerve injury using this technique. In a study we are currently performing, we are analyzing donor site morbidity when hamstring tendons are used for foot and ankle applications. Currently, our results show little donor site morbidity, with the only significant strength differences being slightly decreased peak knee flexion torque strength at high degrees of flexion (70 and 90 degrees) as compared with the nonoperated side. Of the 36 patients enrolled in our study, 32 (89%) reported no pain at the donor site, with the remaining 4 (11%) reporting mild to moderate symptoms.[14]

RESULTS

Using the hamstrings to reconstruct chronic Achilles tears has been used by the senior author since 2011. In a study that we are currently conducting, preliminary results have shown success with minimal complications or return to the operating room. Patient satisfaction as well as strength was assessed at least 1 year postoperatively, and of 7 patients who responded, 2 were satisfied and 5 were very satisfied. All 7 would recommended the surgery. All 7 patients were given preoperative and postoperative Foot and Ankle Outcome Score Questionnaires, and improvements were noted in all 5 measures (pain, symptoms, daily activities, sports activities, and quality of life).

POSSIBLE CONCERNS, FUTURE OF THE TECHNIQUE

We believe that the technique presented here offers patients with chronic Achilles tears a way to regain as much strength as possible without suffering any additional foot morbidity that would be associated with transfer of a local foot tendon. If the existing muscle quality is good in the triceps surae, we recommended using only a hamstring graft. If there is significant atrophy or retraction of the tendon, then we recommended using a hamstring as well as FHL in order to maximize the vector from the calf muscle as well as augment with additional muscle from the FHL. In addition, by using an autograft as opposed to an allograft, this technique helps eliminate the added risks of an immune response or rejection that may accompany the use of allografts.

To minimize time on the table, we advocate that the hamstring harvest be done with the patient in a prone position. However, this can be quite difficult as the tendons are harder to visualize from this position. One potential concern for the widespread use of this technique is the comfort of foot and ankle surgeons harvesting the hamstring tendons. If the surgeon is not comfortable harvesting the tendons from a prone position, the tendons can be harvested with the patient in a supine position. Once this part of the procedure is complete, the patient would then be flipped into a prone position for the Achilles reconstruction portion of the operation.

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