Surgical Treatment of Calcaneal Avulsion Fracture Using Four-Point Anchor Fixation: A Case Study

Candace J. Criscione, DPM[1], Emily R. Curley, DPM[2], Michelle T. Suh, DPM[3], Mark W. Rose, DPM, FACFAS[4]
[1]Third Year Podiatric Medicine Resident, MetroWest Medical Center, Framingham, MA
[2]Second Year Podiatric Medicine Resident, MetroWest Medical Center, Framingham, MA
[3]Attending Foot and Ankle Surgeon, Ridgewood, NJ
[4]Attending Foot and Ankle Surgeon, MetroWest Medical Center, Natick, MA

PURPOSE & LITERATURE REVIEW

Achilles tendon ruptures are a fairly common injury in podiatric medicine. Rupture of the Achilles tendon can be due to acute trauma, chronic trauma, retrocalcaneal exostoses, steroid injections, post-surgical complications, antibiotic therapy, or osteopenia/osteoporosis. The most common site of Achilles tendon rupture is in the watershed zone, however, rupture can also occur at the site of insertion on the calcaneus. While watershed Achilles tendon ruptures are fairly common, insertional Achilles tendon ruptures associated with calcaneal tuberosity fractures are less frequent, accounting for only 1.3% to 2.7% of all calcaneal fractures. Additionally, insertional Achilles ruptures with calcaneal tuberosity fractures and are more commonly observed in elderly patients due to osteopenia. Because of poor bone quality, sudden contracture of the triceps surae can cause avulsion at the posterior superior aspect of the calcaneus following a low-energy fall.

The Beavis classification system of calcaneal tuberosity fractures have been described as the following: type I fractures are simple avulsions from the tuberosity; type II fractures are referred to as “beak fractures”; and type III fractures arise from the infrabursal, middle part of the tuberosity. Patients with non- or minimally-displaced fractures and incomplete ruptures can often be treated conservatively with 8 to 12 weeks of non-weight bearing. Direct surgical repair is often utilized in displaced fractures with complete rupture of the tendon.

Standard surgical repair involves direct reinsertion of the Achilles tendon to the calcaneus using a variety of fixation methods. Suture anchor augmentation is a common method of reinserting the Achilles tendon which can be particularly advantageous in osteoporotic bone. The literature describes various techniques of direct repair of calcaneal avulsion fractures including Steinmann pins, Kirschner wires, compression screws, cerclage wires and, more recently, suture anchors. This case study presents direct surgical repair of an insertional Achilles tendon rupture using a Krakow suture technique on the proximal tendon stump with four-point anchor fixation on the calcaneus. To the best of our knowledge, the method described here used to directly repair a calcaneal avulsion fracture on an osteopenic patient has not been previously reported in the literature.

CASE STUDY

A case is presented of a 74 y/o female with past medical history significant for type II diabetes mellitus, hypertension, neuropathy, diverticulitis, anxiety, and depression who presented to the Emergency Department (ED) for left heel pain. The patient sustained the injury while getting undressed and described the mechanism of injury as ‘rolling’. Upon arrival at the ED, vital signs were stable and review of systems was negative. On physical exam, neurovascular status was intact with 2+ pedal pulses and light touch, vibratory, and proprioception within normal limits. Black and blue discoloration was noted to the posterior aspect of the left heel with moderate edema. Musculoskeletal exam revealed a palpable deficit at the posterior aspect of the left heel with a positive Thompson’s test. The patient was unable to actively plantarflex the left foot. X-rays (3 views of the left ankle) were obtained which soft tissue swelling and a 1.9 x 0.8cm amorphous area of calcification approximately 5cm proximal to the Achilles tendon insertion site and a large posterior calcaneal spur (fig 1). The patient was placed in a CAM boot with a cane and referred for an MRI and recommended to follow up with a podiatrist. MRI results revealed a complete tear of the Achilles tendon at the calcaneal insertion which was discussed with the patient’s PCP and Dr. Rose who recommended the patient be placed in a below knee cast (figs 3a, 3b). The patient followed up at the office of Dr. Rose approximately 2 weeks after sustaining the initial injury where she complained of moderate pain despite being non-weight bearing to the left foot. Surgical versus conservative treatment was discussed in depth with patient and the patient ultimately elected to proceed with surgical intervention for treatment of an insertional Achilles tendon rupture. The patient was subsequently underwent open repair of insertional Achilles tendon rupture with gastrocnemius recession of the left lower extremity.

CASE STUDY AND SURGICAL PROCEDURE

In the pre-operative holding area, a popliteal anesthetic block was performed to the patient’s left lower extremity. The patient was brought into the operating room and placed on the operating table in a prone position. The patient’s left lower extremity was marked pre-operatively and the correct site and side was confirmed upon entering the room. After a time-out was performed and the patient was successfully intubated under general anesthesia, the left lower extremity was then prepped and draped in the usual aseptic manner and the pneumatic thigh tourniquet was inflated to 300 mmHg.

CASE STUDY AND SURGICAL PROCEDURE (CONT.)

Attention was then directed to the posterior aspect of the left foot where a deficit could be palpated along the insertion of the Achilles tendon. A midline longitudinal incision was made slightly medial to avoid the sural nerve and small saphenous vein. Metzenbaum scissors were then used to dissect a full-thickness flap. The neurovascular structures were identified and retracted. All bleeders were ligated and cauterized as necessary. Thickened soft tissue surrounding the Achilles tendon was identified. The midline incision was deepened, exposing the peritenon which was incised and carefully reflected. A deficit about 4cm was appreciated intraoperatively with an avulsed bony fragment attached to the most distal aspect of the Achilles tendon. This bony fragment was excised and measured to be approximately 1.5 cm x 1 cm x 0.5 cm and passed from the operative site and sent as specimen.

The Achilles tendon was then freed of all soft tissue adhesions along for mobilization of the tendons and increased reapproximation distally onto the calcaneus. An osteotome was then utilized to resect the posterior heel spur along the calcaneus. Using a rongeur, the friable ends of the Achilles tendon and hematoma were debrided.

Attention was then directed to the medial aspect of the leg where the gastrocnemius belly was palpated and an incision was made measuring approximately 3 cm in a vertical alignment. Using a fascial elevator, the fascia was bluntly dissected separating the subcutaneous tissue from the gastrocnemius fascia. An endoscope and a cannulated system was used to visualize the gastrocnemius fascia with good visualization. The endoscope and cannula was removed and the fascia was then resected using a 15 blade while the distal aspect of the Achilles tendon was being held with tension. Reduction of the deformity was noted. At this time both surgical sites were then irrigated with copious amounts of normal sterile saline.

Using 2-0 FiberWire, the Achilles tendon was sutured using the Krakow method. Using the Arthrex SpeedBridge system, 2 anchors were placed along the posterior aspect of the calcaneus proximally. The FiberTape from the proximal medial SwiveLocks was then sutured into the Achilles tendon. The needle was cut from the FiberTape at the appropriate level to form 2 strands of FiberTape. Using a free needle, both ends of the #2 FiberWire were then passed just distal to the FiberTape through the Achilles tendon to act as a buttress. These steps were then repeated to the lateral SwiveLocks, FiberTape and #2 FiberWire. Using an Allis clamp to provide tension along the Achilles tendon and with the foot actively plantar flexed, the #2 FiberWire along the medial and lateral aspects of the Achilles tendon were then tied down to tension. Two BioComposite SwiveLocks were then drilled and inserted into the posterior distal aspect of the calcaneus following manufacture's guideline. One strand of FiberTape from the lateral and one strand of FiberTape from the medial aspects were then inserted into the BioComposite SwiveLock C. These were pulled down to tension with the FiberTape held to the peak implant and marked along the laser line. The FiberTape was then pulled through the peak implant down to the outlined marker to account for the tension that will be applied once the peak implant was inserted. The implant was inserted with good tension and the remaining tails were cut with a 15 blade resulting in the final knotless repair. These steps were repeated on the medial side.

The surgical sites were then again irrigated with copious amounts of normal sterile saline. The periosteum was reapproximated using 3-0 Vicryl. Subcutaneous layer was then closed with 4-0 Vicryl and the skin was reapproximated using 3-0 and 4-0 nylon. The medial leg incision was closed using 4-0 Vicryl simple sutures. The incisions were dressed with a betadine-soaked non-adherent gauze and dry, sterile dressing. The pneumatic thigh tourniquet was deflated at 72 minutes and it was noted there is immediate hyperemic response to all digits of the foot. At this time, a posterior splint was then applied to the left lower extremity with the foot in a plantar flexed position. The patient was then transported to the PACU with all vital signs stable and neurovascular status intact.

FIGURE 1—PRE-OPERATIVE X-RAY

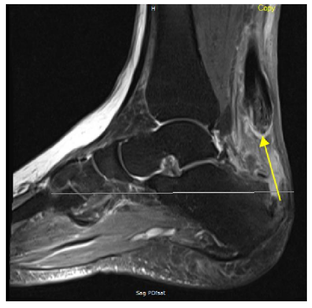
FIGURE 2—POST OPERATIVE X-RAY

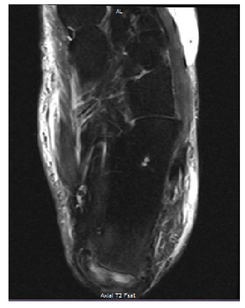
RESULTS & DISCUSSION

Post-operatively, the patient was instructed to maintain strict non-weight bearing protocol for 4 weeks in a posterior splint. Patient denied any pain or discomfort. Sutures were removed at 3 weeks. At 4 weeks post-operation, the patient was transferred to a CAM boot with a ½-inch heel lift and the patient was referred to physical therapy for active range of motion exercises. Physical examination at the six-week mark revealed active dorsiflexion of the ankle joint to 5 degrees and plantarflexion to 20 degrees without pain with manual muscle testing strength of 3/5. Physical examination at the ten-week mark revealed 5 degrees of dorsiflexion and 25 degrees of plantarflexion with a manual muscle testing strength of 4/5. At the 3 month post-operative visit, patient was instructed to gradually decrease of CAM boot by 1 hour each day with ½-inch heel lift for an additional 6 weeks. At final follow up four-and-a-half months post-operatively, the patient was able to fully weight bear without pain or discomfort.

This case study details a direct repair of calcaneal avulsion fracture using a four-point anchor fixation technique. Following direct repair, patients are often casted non-weight bearing for a minimum of 4 weeks. Non-weight bearing status is usually maintained for 6-8 weeks or longer if the patient has osteopenia. There are various methods of reattaching the Achilles tendon after a calcaneal avulsion fracture, however, bone quality needs to be taken into consideration when selecting anchoring techniques. In this case, we have a 74 year-old female who underwent direct surgical repair to a calcaneal avulsion fracture with complete rupture of the Achilles tendon using a four-point anchor fixation technique. The patient was able to return to her pre-injury weight bearing status with out any pain or discomfort four-and-a-half months post-operatively using this technique. We believe this is a viable procedure for a calcaneal avulsion fracture.

FIGURES 3a, 3b—PRE-OPERATIVE MRI





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