

INSERTIONAL ACHILLES RUPTURE AND CALCANEAL AVULSION FRACTURES

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INTRODUCTION

Overuse tendon injuries may account for up to 50% of all sports injuries, with Achilles tendonopathy being a major factor in this number. The term tendonopathy is the preferred term as a generic descriptor of the clinical conditions (both pain and pathologic changes) in and around tendons arising from overuse. The histologic description of tendonosis (a degenerative pathologic condition with a lack of inflammatory change) and tendonitis (implying an inflammatory process) should only be used after histopathologic confirmation.¹ Tendonosis may exhibit fiber disorientation, scattered vascular ingrowth, and either hypo- or hypercellularity, which may not always be accompanied by pain. When symptoms do develop, the degenerated tendon may have undergone microtrauma or progressive failure leading to partial tears, inflammation, and subsequent symptoms of concomitant acute tendonitis or paratendonitis.²

Tendonopathy is a pathological state or process that can predispose a tendon to rupture. Insertional Achilles ruptures can occur as a result of acute trauma, chronic trauma, retrocalcaneal exostoses/enthesopathies, multiple steroid injections, a post-surgical complication from retrocalcaneal exostectomy, antibiotic therapy, or osteopenia of the calcaneus.

Although most Achilles tendon ruptures occur in the watershed zone following an intense sudden contracture of the gastroc-soleus complex, occasionally the tendon will rupture at its insertion. Chronic microtrauma creates tears in the tendon at or near the insertion, which may create poor attachment and may, with the correct mechanism of injury, result in complete loss of its attachment. Various exostoses and enthesopathies may weaken the tendon by encompassing and thinning the Achilles tendon insertion. It is not unusual for a patient who has had a long term retrocalcaneal exostosis to notice a sudden weakness in his/her gait pattern as a result of the tendon insertion loss. This provides a good argument for taking these patients to surgery earlier. Chronic steroid injections, especially the acetate or non-soluble steroids, are collagenolytic and can

easily weaken the Achilles tendon insertion resulting in rupture. There has been a historical correlation of fluoroquinolone antibiotic use with an increased risk of Achilles tendon ruptures that has recently been proven to have a similar magnitude to that associated with oral corticosteroids or non-fluoroquinolone antibiotics.³

Elderly patients and those with significant osteopenia are prone to insertional Achilles ruptures. Osteopenia creates thin cortices, which may not be able to resist severe tension placed on them at tendon attachments and therefore, a segment of bone may be pulled off by the tendon during sudden tendonous contractures. Avulsion fractures of the posterior superior calcaneus often occur from a forced dorsiflexion injury against an intact gastroc-soleal complex following a low-energy fall or stumble.

Calcaneal fractures represent approximately 2% of all fractures, of which 25-40% are classified as extra-articular.⁴ The rare avulsion of the posterior superior tuberosity usually does not involve the subtalar joint. Historically, this fracture is classified into 2 types distinguished by the involvement of the Achilles tendon, leading to a beak fracture or an avulsion fracture. However, Perotheroe questioned this distinction, suggesting that the 2 fractures are of the same entity and variations are only due to the insertion of the Achilles tendon. It should also be noted that the beak fracture may be a result of a direct blunt trauma to the posterior calcaneus.

This avulsion type fracture has also been documented in non-traumatic cases. The literature reports a pathological avulsion fracture of the calcaneus secondary to Paget's sarcoma. This patient presented with a 1-year history of pain to the heel with increased swelling over a period of 2 months. Radiographs demonstrated an avulsion fracture of the superior calcaneus with typical Paget features. Needle biopsy revealed a fibrous histiocytoma, which later led to a below the knee amputation 3 weeks later.⁵ The calcaneal insufficiency avulsion fracture has been described in a group of diabetic neuropathic patients. This fracture has been considered similar to the site of a fatigue fracture without history of trauma or overuse activity. Of interest, there is a slight variation in the traditional fracture pattern. Radiographically, the fracture line is parallel to the apophyseal

growth plate, usually only encompassing the superior calcaneus and extends horizontally just distal to the Achilles insertion (Figure 1).⁶

Loss of the gastroc-soleus complex results in a calcaneus gait. These patients must rely on the deep posterior muscle group recruitment to assist during the midstance and toe-off phases of gait. Over time, the ipsilateral hamstrings contract resulting in knee symptoms. The contralateral limb gets more compensatory stress resulting in symptomatology of that limb and proximal to the knee. The symptoms can affect the foot, ankle, leg, and back. Chronicity of a calcaneus gait results in gastrosoleus atrophy, flexor substitution, and significant hammertoe deformity.

CLINICAL EXAMINATION

Clinical examination of the extremity with an insertional Achilles tendon rupture reveals edema about the ankle and lower leg. The patient will usually present with weakness of that extremity and reduced ability to stand and propel. One will see that there is a dell at the previous insertion site of the Achilles tendon and ecchymosis may be present peripherally about the ankle depending on the length of time after the injury. Thompson's sign is positive indicating loss of the gastroc-soleus complex, which is a squeeze test of the gastrosoleus muscle belly that will fail to produce plantarflexion of the foot. However, patients are able to recruit the other deep posterior compartment muscles and it may appear as though they have a functional Achilles tendon.

Due to the limited soft tissue coverage at the posterior calcaneus, an avulsion fracture may produce an open lesion at the site of the bony fragment. This wound may appear immediately at the time of injury or at a later date with delayed treatment. With decreased vascularity to this area, a necrotic ulceration may develop which can negatively affect surgical correction.

Roentgenographically, Kager's Triangle is obliterated and the insertional Achilles rupture may reveal a small or large segment of bone pulled away from the posterior superior calcaneus (Figure 2). MRI will reveal loss of continuity between the end of the tendon and the posterior superior calcaneus.

TREATMENT

Initial treatment for insertional Achilles ruptures revolves around reducing edema and offloading the extremity. Non-operative treatment is used for patients with non-displaced or minimally displaced fractures and incomplete ruptures of the Achilles tendon. A nonweight bearing



Figure 1. Non displaced insufficiency fracture in an insulin-dependent diabetes mellitus patient.

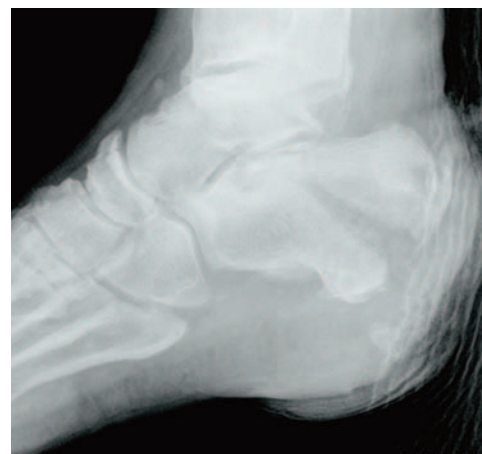


Figure 2. Achilles tendon has created large calcaneal avulsion fracture.

status is maintained for 8 to 12 weeks, initially in a gravity equinus cast with slow transition to neutral positioning. Physical therapy is paramount to restore plantarflexory strength and range of motion. Patients who are not surgical candidates can do well with an AFO with a "dorsiflexion stop," which will create a retrograde force on the knee and establish stability.

Surgical intervention is usually the treatment of choice and revolves around reattachment of the Achilles tendon and/or fixation of the calcaneus. Methods and techniques for primary repair of the tendon include direct reinsertion of the Achilles tendon to the calcaneus using various bone anchoring techniques e.g., Mitek, Opus, Parafix, and Arthrex, etc. The choice of bone anchor may vary depending on the quality of bone stock, the condition of the ruptured tendon,

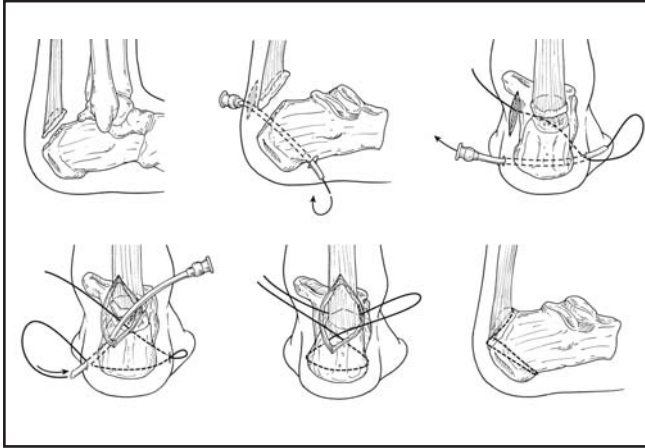


Figure 3. Technique demonstrating lateral paratendinous approach to stabilize avulsion fracture to main body of calcaneus. Adapted from reference 4.

the desired suture material, or the surgeon's preference. If a bone fragment is present, then reattachment may also be accomplished with a lateral paratendinous approach and tension band wiring (Figure 3). This technique, first described by Brunner and Weber, was modified by Coughlin to include a lag screw fixation of the bone fragments with a 6.5-8.0 mm cannulated screw. The tension band (18 or 20 gauge) was used to neutralize to the distraction forces of the Achilles tendon on the superior fragment.⁴ A larger calcaneal fragment may require 2 cannulated lag screws in a parallel fashion for adequate fixation.

In chronic cases, myotendinous contracture has occurred resulting in a very atrophic muscle belly and shortening of the myotendinous unit. Various intra-tendinous lengthening and augmentation techniques are available for use (V-Y, tongue-in-groove, tendon flaps, muscle tendon transfers, etc.). The most common tendon transfers include FHL, PB, and PT. When osseous avulsion fractures are present, screws, wires, etc., will need to be used for stabilization of bone to bone.

POSTOPERATIVE CARE

Following primary tendon repair patients are casted non-weight bearing for a minimum of 4 weeks. This is the time necessary for collagen fibers to become longitudinally oriented. For the calcaneal avulsion fracture, the nonweight bearing status is maintained for 6-8 weeks or until radiographic consolidation is verified. We generally recommend early rehabilitation of these conditions assuming that the attachment of the tendon to bone is solid. We routinely send the patient to the physical therapist for 6-12 weeks in order to regain sufficient strength on the operated extremity for the patient to function independently. Usually the physical therapist will consider it successful when the patient can raise the heel off the ground with one foot. For avulsion fractures where the patient has severe osteopenia, appropriate time is allowed for osseous bridging to occur before significant stresses are placed on the bony fracture.

CASE PRESENTATIONS

Case #1

RS is a 62-year-old woman that missed the last step as she was descending stairs. Upon standing, the left leg felt weak and she later presented to our office with edema, LOM, and

pain of the left ankle and foot. Figures 4-10 take the reader through the surgical repair using Opus Magnum anchors for stabilization of tendon to bone. The patient was taken through standard postoperative care and released from our office to be seen as needed after 11 months.



Figure 4A. Significant edema noted about the ankle S/P Achilles insertional rupture.



Figure 4B. Note the index finger indentifying dell where the tendon has pulled away from bone.



Figure 5. MRI identifying loss of insertional point of Achilles tendon from posterior calcaneus.



Figure 6A. Achilles insertion lost and note small cortical segments of bone attached to the Achilles rupture site.

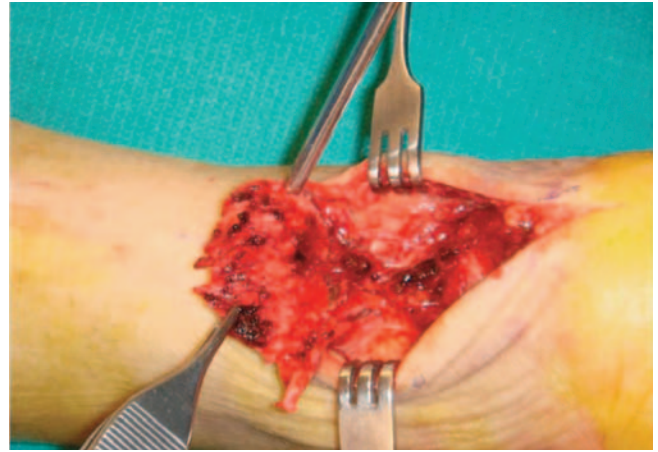


Figure 6B.

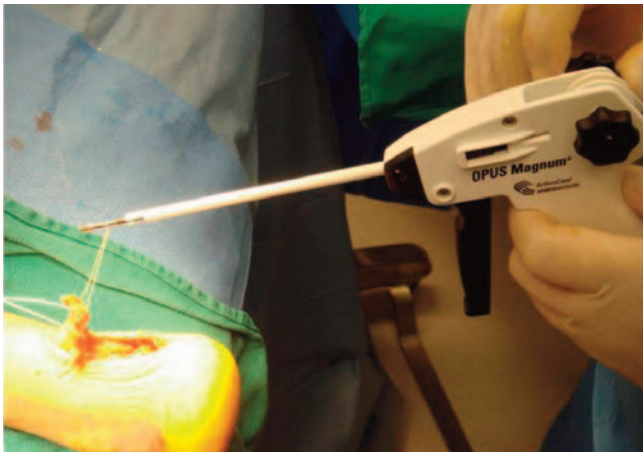


Figure 7A. Opus-magnum instrumentation showing anchors being inserted into body of calcaneus.

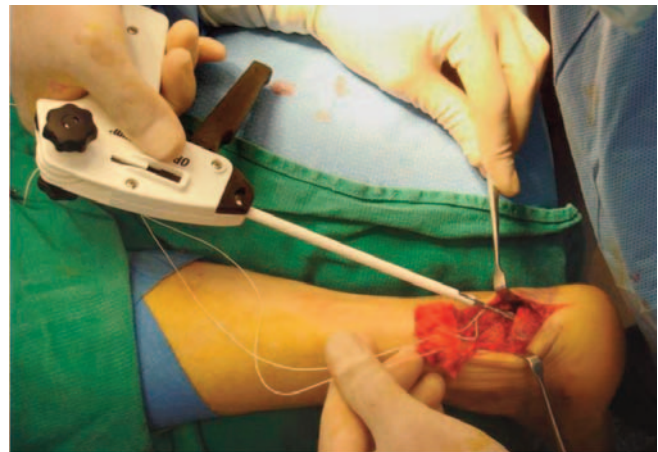


Figure 7B.



Figure 8. Sutures from each tack have been attached to the Achilles tendon distally prior to stabilization.



Figure 9. Sutures have stabilized the tendon to the osseous segment.



Figure 10A. Opus magnum anchors noted within body of the calcaneus.

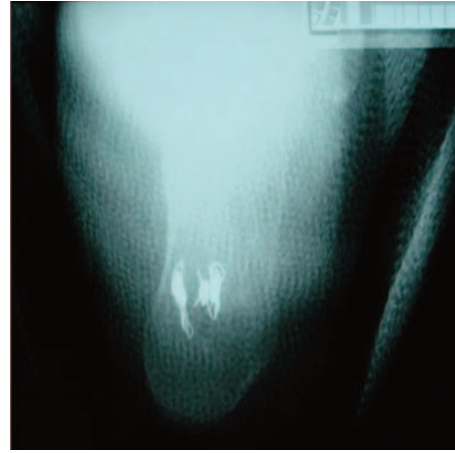


Figure 10B.

Case #2

RC is a 65-year-old man who was descending stairs at home, slipped and proceeded to “tumble” 5 more steps. Pain and swelling was instantaneous and referred for our services. He was placed in a Jones splint and scheduled for surgery. Figures 11-20 take the reader through his repair.

A Bunnell suture for the proximal tendon was used, Krakow suture technique for the distal remnant of tendo-achilles, Mitek anchors and below-knee casting were then used. The patient had excellent postoperative recovery following standard care and was last seen in our office fully recovered after 6 months.



Figure 11A. Note dorsiflexion of the right foot compared with the intact contralateral foot demonstrating appropriate plantarflexion.



Figure 11B.



Figure 12A. Intra-operative view identifies loss of insertion point of the Achilles to bone. Note the significant hematoma at the insertion point of where the Achilles was lost from calcaneus.



Figure 12B.

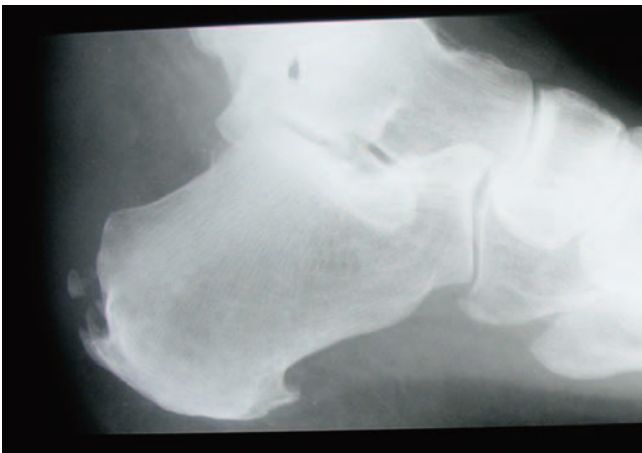


Figure 13A. Retrocalcaneal exostosis identifying bony substance in retrocalcaneal area.

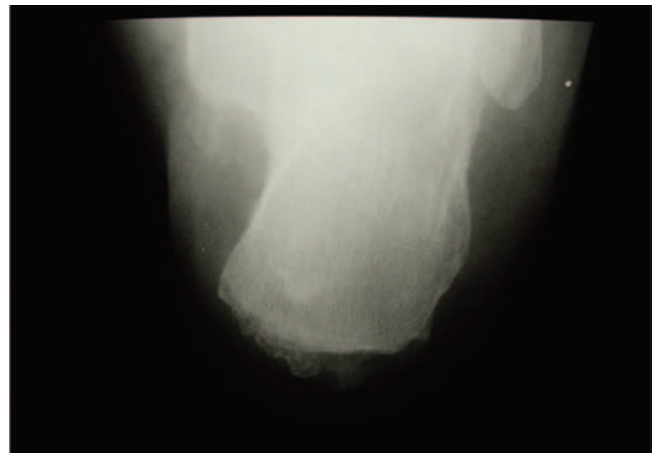


Figure 13B.



Figure 14A. Intra-operative view of large retrocalcaneal exostosis that thinned the insertion of the tendoAchilles and tendon once it has been stabilized with 2.0 Ethibond suture.



Figure 14B.

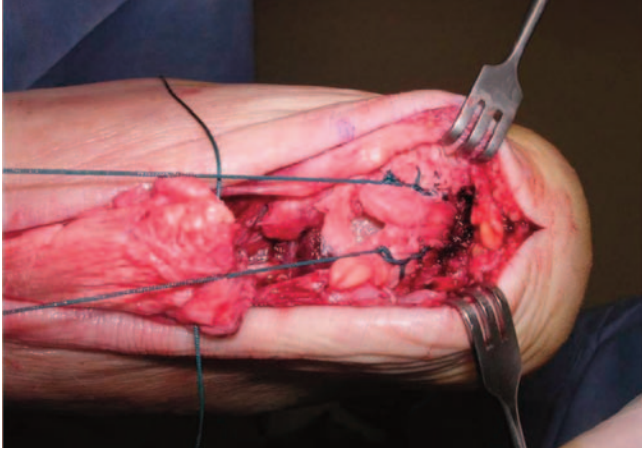


Figure 15A. Krakow suture placed within remnants of tendoAchilles at distal inferior calcaneus and Bunnell suture placed within the distal tendoAchilles.



Figure 15B.

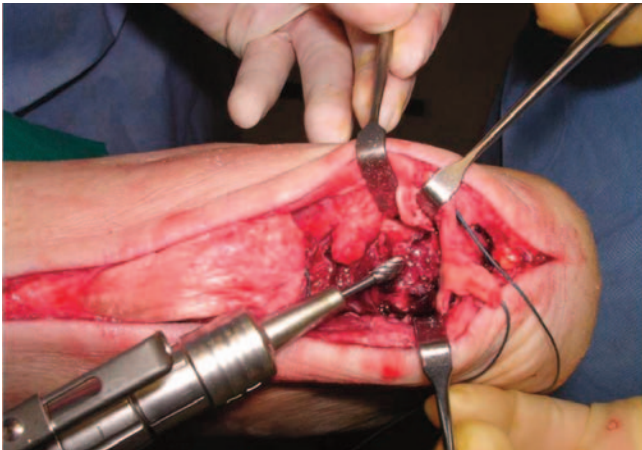


Figure 16A. Posterior superior calcaneus being remodeled and Mitek sutures being placed within body of the calcaneus.



Figure 16B.



Figure 17A. Excellent repair noted of Achilles tendon to body of the calcaneus.



Figure 17B. Note plantarflexion equal to that of contralateral view following repair.



Figure 18A. Wound closed in layers.



Figure 18B.

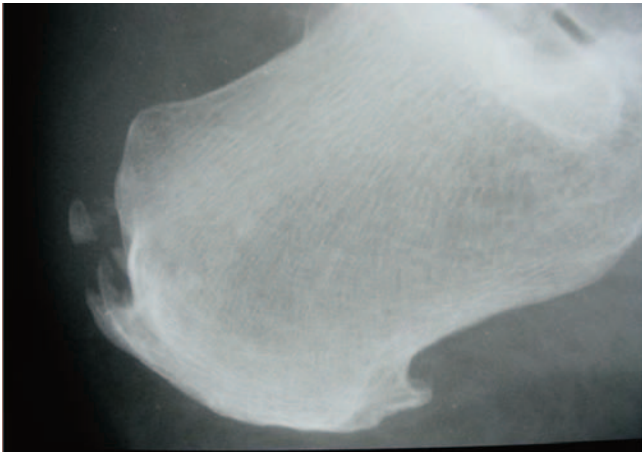


Figure 19A. Preoperative and postoperative radiograph identifying absence after resection of large exostosis posterior calcaneus and evidence of Mitek sutures stabilizing the construct.

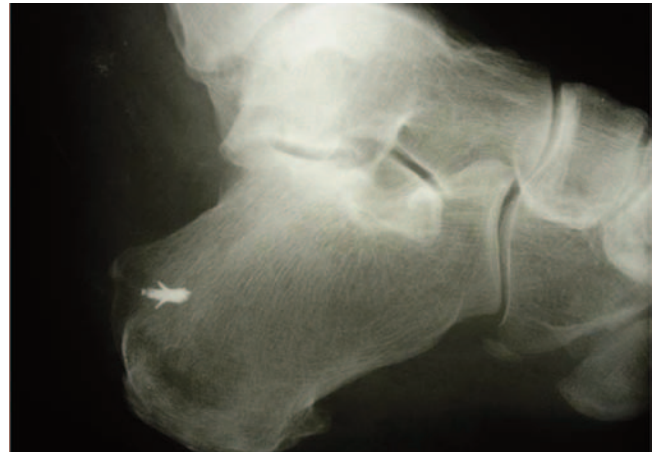


Figure 19B.



Figure 20. Chronic tendo Achilles repair has been undertaken and needed length of the proximal tendon was accomplished using a V-Y plasty.

Case #3

RB is a 51-year-old man with a past medical history significant for chronic renal insufficiency with dialysis treatments, insulin-dependent diabetes mellitus, peripheral neuropathy, and mid-foot Charcot breakdown with ulceration of the right foot. He presented to the VA Podiatry clinic for regular wound care when he related having difficulty walking because his right foot “felt floppy.” Clinical examination revealed a palpable bony mass just proximal to the calcaneus with a skin dell, increased width of the distal Achilles tendon and a positive Thompson’s test (Figure 21). Radiographic evaluation showed a superior calcaneal avulsion fracture and the magnetic resonance image confirmed a 2.5 cm retraction of the Achilles tendon with significant edema about the superior calcaneus (Figures 22-23).

Given this patient’s significant co-morbidities, surgical intervention was carefully planned. The surgical dissection revealed an insertional rupture of the Achilles tendon with fragmented bone throughout the distal aspect (Figure 24).



Figure 21A. Moderate edema about the posterior ankle and calcaneus and slight dorsiflexed position of foot to leg following rupture.



Figure 21C. Ulcer at midfoot from Charcot joints.

Once the hematoma and fibrous tissue was excised, the superior calcaneus was curetted to bleeding cancellous bone (Figure 25). Under fluoroscopic guidance, two 5-mm Parafix bone anchors were inserted posteriorly into the calcaneus from superior to inferior. With the foot in plantarflexion, the connected suture was used to reattach the Achilles tendon to the calcaneus (Figures 26-30).

After adequate closure, the patient was placed in a below-knee fiberglass cast with nonweight bearing for 6 weeks. He was transferred to a weight-bearing plantarflexed CAM boot and started on physical therapy. Plantarflexion of the CAM walker was gradually reduced from 20 degrees to neutral over the course of 2 months. At the 6-month follow up, the patient was walking uneventfully in a custom shoe to accommodate the previous midfoot breakdown. He also has full plantarflexion strength of the gastroc-soleus complex and no residual ulcerations. Radiographic evaluation showed recalcification of the superior calcaneus to the distal Achilles tendon (Figure 31).



Figure 21B.



Figure 22. Note wafer of bone distracted proximally from superior posterior calcaneus. Significant midfoot collapse is noted as result of Charcot joints.



Figure 23. MRI reveals loss of continuity of tendon to the insertion of the calcaneus.

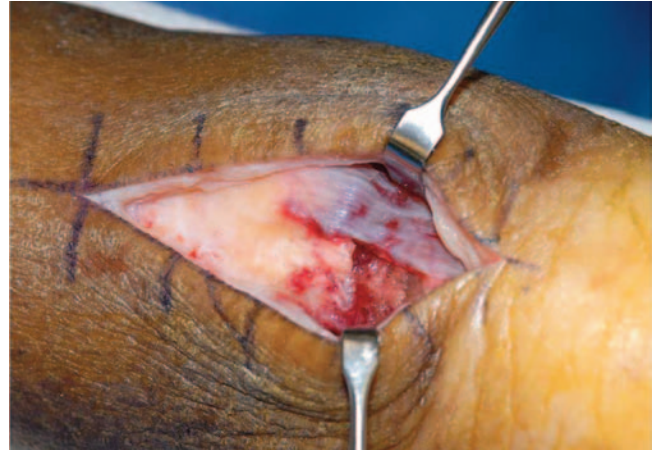


Figure 24. Intra-operative views showing tendoAchilles retracted after pull-off of bone from calcaneus and minuscule remnant of tendon attached to superior posterior calcaneus.

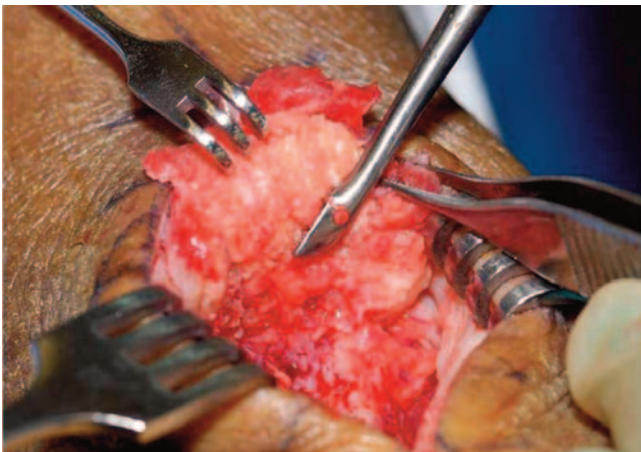


Figure 25A. Distal tendon reveals very small fragments of cortical bone and sponge identifies remnants of bone and hematoma removed from site.

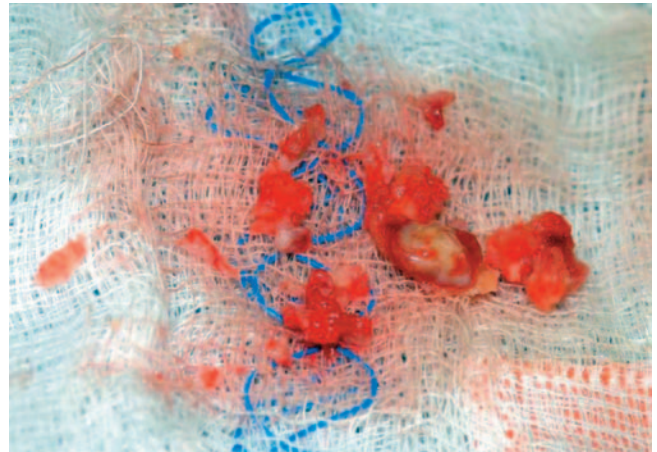


Figure 25B.

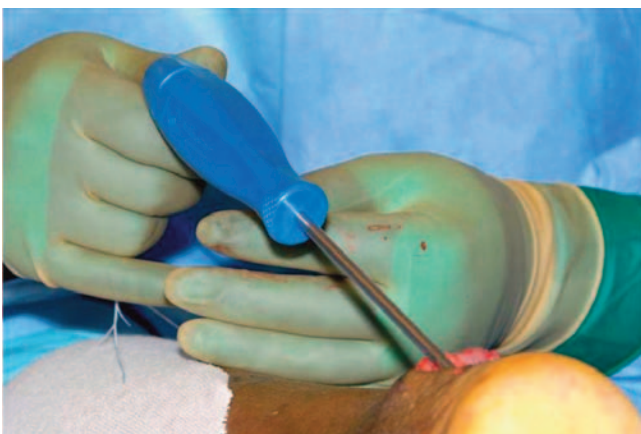


Figure 26A. Instrumentation used to insert Parafix into bone. Note sutures attached to Parafix exiting the bone.

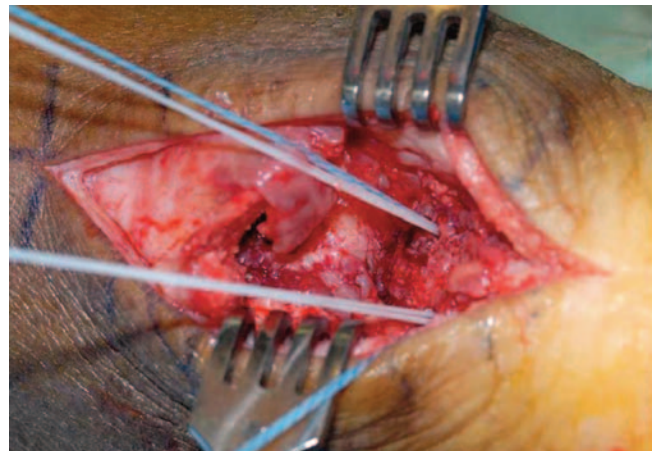


Figure 26B.

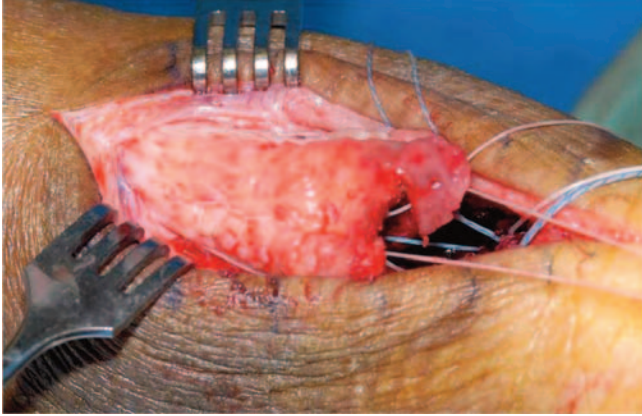


Figure 27A. Note differentiation in colored sutures that are inserted into the distal tendon prior to stabilizing to bone.

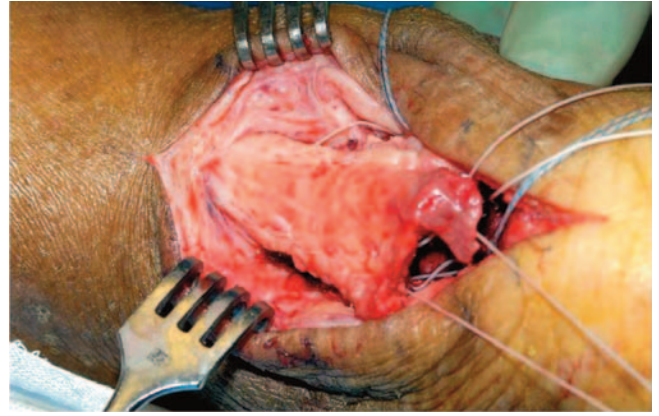


Figure 27B.

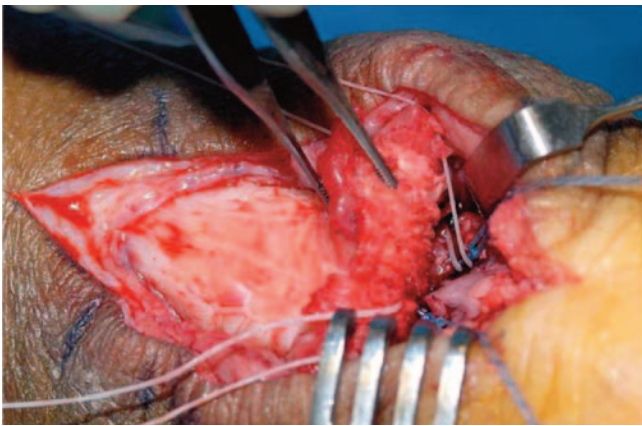


Figure 28A. Small fragment of bone removed from distal tendon and stabilization of tendon using Parafix sutures supplemented with simple interrupted nonabsorbable sutures.

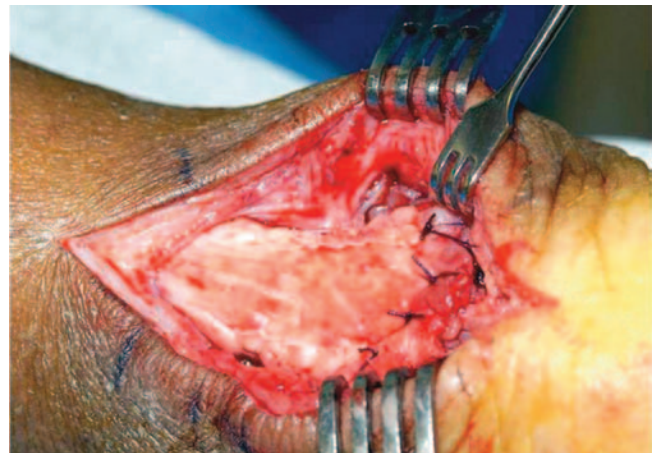


Figure 28B.



Figure 29. Complete closure of the wound. Note the slight plantarflexion of the foot on the leg identifying excellent stability of surgical site.



Figure 30A. Postoperative radiographs identifying Parafix sutures within the inferior cortical margins of the calcaneus.



Figure 30B.



Figure 31. 6 months postoperative. Note the excess bone formation at the Achilles tendon insertion.

SUMMARY

Insertional Achilles ruptures can be debilitating injuries with deleterious effects on human locomotion and biomechanics. Current techniques are available that enhance excellent tendon or osseous repair. An excellent postoperative physical therapy regimen for a period of 6-12 weeks is encouraged allowing the patient to regain more than 95% of their gastroc-soleus complex function. These techniques will create a patient who is independent and able to carry on most activities of daily living.

REFERENCES

1. Rees, J, et al. Management of tendinopathy. *Am J Sports Med.* 2009;37:1855-68.
2. Morelli V, James E. Achilles tendonopathy and tendon rupture: conservative versus surgical treatment. *Prim Care Clin Office Pract* 2004;31:1039-54.
3. Seeger JD, et al. Achilles tendon rupture and its association with fluoroquinolone antibiotics and other potential risk factors in a managed care population. *Pharmacoepepi Drug Safety* 2006;15: 784-92.
4. Coughlin M, et al. Fractures of the calcaneus. In: *Surgery of the Foot and Ankle.* St. Louis: Mosby Elsevier; 2007. p. 2053-5.
5. Sharma, H, et al. Pathological avulsion fracture of the calcaneus secondary to Paget's sarcoma. *Foot* 2005;15:95-7.
6. Kathol, M, et al. Calcaneal insufficiency avulsion fractures in patients with diabetes mellitus. *Musculoskel Radiol* 1991;180:725-9