Achilles tendinopathy management

High volume injections, surgery and differential diagnosis

Nicola Maffuli, University of Salerno, Alessio Giai Via, Mary University of London and Francesco Oliva, University of Rome examine the management of Achilles tendinopathy including high volume injections and surgery. The article also looks at true partial tears, plantaris pathology and MRI and differential diagnosis.

High volume injections for the management of Achilles tendinopathy

The source of pain associated with mid-portion Achilles tendinopathy has not been clarified yet. Some authors hypothesised that the main cause of the pain arises from the surrounding tissues.

Patients with chronic painful tendinopathy of the main body of Achilles tendon (AT) often present neovascularisation outside and inside the ventral part of the tendinopathic area[1]. However, neovascularity in absence of pain is not necessarily pathological, and, in athletes, it can just indicate a physiological response to physical training[2]. The ingrowth of sensory and sympathetic nerves from the paratenon accompanies the neovessel in chronic painful Achilles tendinopathy. These sensory and sympathetic nerves can release nociceptive substances, and may be the primary source of pain[3].High volume image guided injections (HVIGIs) target the neurovascular bundles growing from the paratenon into the AT. HVIGIs would produce local mechanical effects, causing the neovascularity to stretch, break or occlude, and pain relief could be explained by the destruction of these sensory nerves[3]. Denervation of the AT by releasing the paratenon may be the most important part of this procedure.

"Controversy exists regarding the existence of plantaris tears. Early descriptions of plantaris tears were later disputed, with several investigators questioning their existence. The advent of modern imaging technology along with surgically documented lesions confirmed these entities."

"We reported excellent results in 17 elite athletes after percutaneous surgical repair of Achilles tendon rupture. All patients came back to competing at high level and the average time to return to full sport participation was 4.8 ± 0.9 months (range 3.2 to 6.5)."

Several substances have been injected in and around tendons including normal saline, corticosteroids, local anaesthetic[4,5]. Platelet rich plasma application did not show the expected benefits in Achilles tendon[6]. In preliminary studies in patients with recalcitrant tendinopathy of the main body of the Achilles tendon, a HVIGI decreased the amount of pain perceived by patients, and improved functional activities in the short- and long-term[5,7]. A mixture of 10 mL 0.5% bupivacaine hydrochloride 25 mg of hydrocortisone acetate can be used for HVIGI in chronic Achilles tendinopathy, immediately followed by 4×10 mL of injectable normal saline. Hydrocortisone acetate is used to prevent the inevitable acute mechanical inflammatory reaction produced by the large amount of fluid injected in the proximity the tendon. The injection is performed under ultrasound guidance to avoid intratendinous corticosteroid injections. Patients are allowed to walk on the injected leg immediately, but they are strictly advised to refrain from high impact activity for 72 h. After this period, they are instructed to re-start heavy eccentric loading physiotherapy regime twice daily until they stopped their sporting career. Good results have been reported with this technique at short term follow-up[7]. In a more recent study[8], we used Aprotinin, an 85 amino-acid 65 kD basic polypeptide extracted from bovine lungs. It is a broad spectrum serine protease inhibitor, with inhibition of plasmin, trypsin and kallikrein, forming reversible competitive bonds with these enzymes, inhibiting their proteolytic action and their vasoactive effect in the first stages of inflammation. It may block matrix metalloproteinases (MMPs), including MMP-1, MMP-8 and MMP-13 (collagenases) and MMP-2 and MMP-9 (gelatinases), either directly or via inhibition of plasminogen and plasmin. At one year from the index injection, HVIGI produces statistically significant and clinically relevant improvement in VISA-A score, and is associated with a relatively high rate of return to sport in athletic patients. There were no serious adverse events related to the injections. Aprotinin has been recently withdrawn worldwide following major concerns about postoperative thrombosis and organ dysfunctions in patients who had received this metalloprotease inhibitor intraoperatively in doses several orders of magnitude greater than the ones used in the present study[9]. In our setting, we now use only hydrocortisone acetate for HVIGI.

In conclusion, HVIGI is effective to improve the symptoms of resistant Achilles tendinopathy. It is safe and relatively inexpensive, with the potential to offer an alternative management option before surgery, aiding a quicker return to sport[7]. HVIGIs warrant further investigation to try and understand the bases of its effects, and to better study its role in the management of Achilles tendinopathy.

Surgery for mid-portion Achilles tendinopathy

Tendinopathy of the main body of AT affects both athletic and sedentary patients. The incidence in top-level runners has been estimated between 7 and 9%[10], while 30% of patients have a sedentary lifestyle[11]. The etiopathogenesis of Achilles tendinopathy remains unclear. It has probably a multifactorial origin and it has been attributed to a variety of intrinsic and extrinsic factors[12].

Pain is the cardinal symptom of Achilles tendinopathy. It occurs at the beginning and a short while after the end of a training session. As the pathological process progresses, pain may occur during the entire exercise session, and, in severe cases, it may interfere with activities of daily living. Clinical examination is the best diagnostic tool. Location of pain 2–6 cm above the insertion into the calcaneum and pain on palpation are reliable and accurate tests for diagnosis[13] (Figure 1).

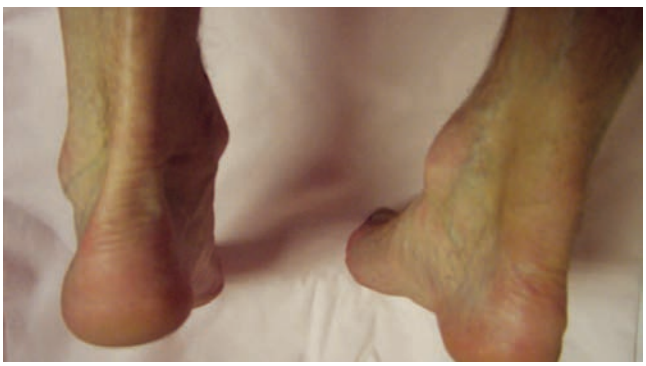

Figure 1: Achilles tendinopathy of the right Achilles tendon.

The management is primarily conservative. Eccentric exercise and shock waves have been proved to be effective for the treatment of Achilles tendinopathy[4,14]. However, conservative management is unsuccessful in 24% to 45.5% of patients, and surgery is recommended after at least 6 months of

conservative management[15]. For AT, frequency of surgery has been shown to increase with patient age, duration of symptoms, and occurrence of tendinopathic changes[16,17]. Both open and mini invasive surgical techniques have been described for treatment of tendinopathy of the mid-portion of Achilles tendon.

"Acute AT rupture is a serious injury. Most (75%) acute ruptures occur during recreational activities in men between 30–40 year old, but 25% of ruptures take place in sedentary patients."

Open surgery

Under locoregional or general anesthesia, the patient is placed prone with the ankles clear of the operating table. A tourniquet is applied to the limb to be operated on. The limb is exsanguinated, and the tourniquet is inflated to 250 mm Hg. The incision is made on the medial side of the tendon to avoid injury to the sural nerve and short saphenous vein (Figure 2). The skin edge of the incision should be handled with extreme care as wound healing problems

Figure 2: Incision used for open surgery: it lies just posterior to the medial border of the Achilles tendon. It avoids the sural nerve and the short saphenous vein, and the scar is away from the shoe counter.

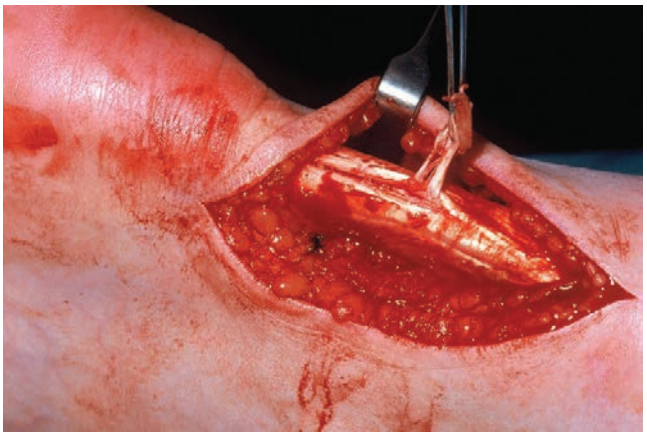

Figure 3: The tendinopathic tissue is excised.

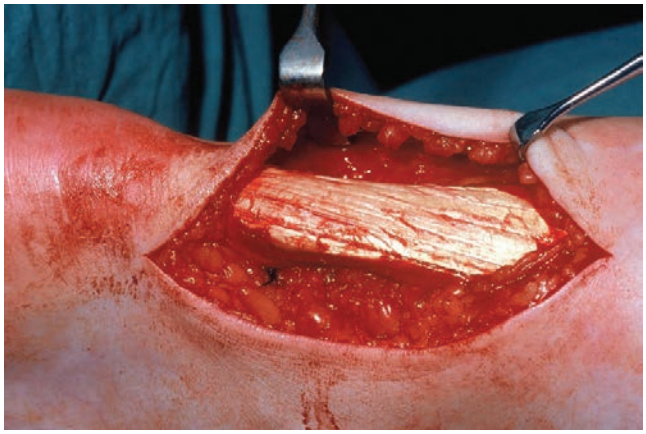

Figure 4: Appearance at the end of the procedure.

are serious problems. The paratenon is identified and incised. In patients with evidence of coexisting paratendinopathy, the scarred and thickened tissue is generally excised. Based on preoperative imaging studies, the tendon is incised sharply in line with the tendon fiber bundles. The tendinopathic tissue can be identified as it generally has lost its shiny appearance and it frequently contains disorganised fiber bundles that have more of a "crabmeat" appearance. This tissue is sharply excised (Figure 3). The remaining gap can be repaired using a side-to-side repair, but we leave it unsutured (Figure 4). If significant loss of tendon tissue occurs during the débridement, a tendon augmentation or transfer could be consider, even if we rarely undertake this additional procedure. Than the subcutaneous tissues is sutured with absorbable material, the skin edges are juxtaposed with Steri-Strips and a routine compressive bandage. The limb is immobilised in a below-knee synthetic weight-bearing cast with the foot plantigrade.

A period of initial splinting and crutch walking is generally used to allow pain and swelling to subside after surgery. After 14 days, the wound is inspected and motion exercises are initiated. The patient is encouraged to start daily active and passive ankle range-of-motion exercises. The use of a removable walker boot can be helpful during this phase. Weight bearing is not limited according to the degree of débridement needed at surgery, and early weight bearing is encouraged. However, extensive débridements and tendon transfers may require protected weight bearing for 4 to 6 weeks postoperatively. After 6 to 8 weeks more intensive strengthening exercises are started, gradually progressing to plyometrics and eventually running and jumping.

"The source of pain associated with mid-portion Achilles tendinopathy has not yet been clarified. The rationale behind the present management modality is that the sliding of the suture breaks the neo-vessels and the accompanying nerve supply decreasing pain."

Successful results have been reported with this surgical procedure. A systematic review of literature showed successful results in over 70% of cases[18], but these relatively high success rate are not always observed in clinical practice, probably because of the poor methods scores of many articles. Patients should be informed of the potential failure of the procedure, risk of wound complications, and at times prolonged recovery time[12]. Possible complications of this surgical procedure are wound healing problems, infection, sural nerve injury, rupture of AT and deep vein thrombosis.

Percutaneous Longitudinal tenotomies

Percutaneous longitudinal tenotomy can be used when there is no paratenon involvement and when the intratendinous lesion is less than 2.5 cm long. The procedure can be performed under ultrasound guide that is able to confirm the precise location of intratendinous lesions and produced similar results to open procedures[19].

Patients are operated as day cases. The patient lies prone on the operating table with the feet protruding beyond the edge, and the ankles resting on a sandbag. A bloodless field is not necessary. The tendon is accurately palpated, and the area of maximum swelling and/or tenderness marked,

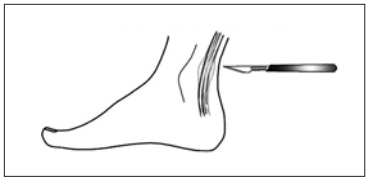

Figure 5: 11-scalpel blade inserted into the predetermined area with sharp edge pointing cranially.

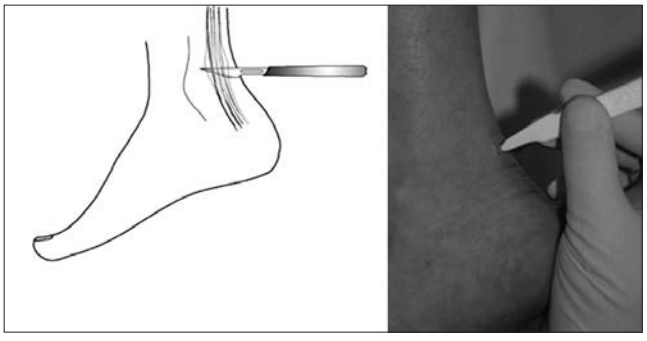

Figure 6: The blade penetrating the whole thickness of the Achilles tendon and a full passive ankle dorsi-flexion movement is produced.

and checked again by US scanning. The skin and the subcutaneous tissues over the Achilles tendon are infiltrated with 10–15 mL of plain 1% lignocaine (Lignocaine Hydrochloride, Evans Medical Ltd, Leatherhead, England). A number 11 surgical scalpel blade is inserted parallel to the long axis of the tendon fibres in the marked area in the center of the area of tendinopathy. The cutting edge of the blade points caudally and penetrates the whole thickness of the tendon (Figure 5). Keeping the blade still, a full passive ankle dorsi-flexion movement is produced (Figure 6). The scalpel blade is then retracted to the surface of the tendon, inclined 45° on the sagittal axis, and the blade is inserted medially through the original tenotomy (Figure 7). Keeping the blade still, a full passive ankle flexion is produced. The whole procedure is repeated inclining the blade 45° laterally to the original tenotomy, inserting it laterally through the original tenotomy. Keeping the blade still, a full passive ankle flexion is produced. The blade is then partially retracted to the posterior surface of the Achilles tendon, reversed 180°, so that its cutting edge now points cranially, and the whole procedure repeated, taking care to dorsiflex the ankle passively. Preliminary cadaveric studies showed that a tenotomy 2.8 cm long on average is thus obtained through a stab wound in the main body of the tendon[20]. A steristrip can be applied on the stab wound. The wound is dressed with cotton swabs, and a few layers of cotton wool and a crepe bandage are applied.

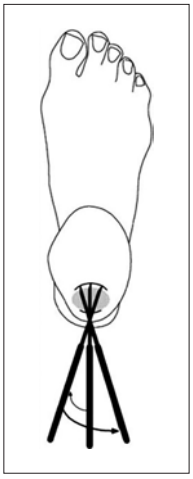

Figure 7: The procedure is repeated with blade inclining the 45° medial and 45° lateral to the original tenotomy.

After surgery early active dorsi- and plantar-flexion of the foot are encouraged. On the second postoperative day, patient are allowed to walk using elbow crutches weight-bearing as able, and weight-bearing are allowed after 2 or 3 days, when the bandage is reduced to a simple adhesive plaster over the wounds. Stationary bicycling and isometric, concentric and eccentric strengthening of the calf muscles are started under physiotherapy guidance after 4 weeks. Swimming and water running are encouraged from the second week. Gentle running is started 4–6 weeks after the procedure, and mileage gradually increased.

We reported excellent and good results in 63% of athletes with unilateral Achilles tendinopathy treated with ultrasound-guided percutaneous longitudinal tenotomy after

failure of conservative management, without any experiencing significant complications[19]. This technique is simple, can be performed on an outpatient basis, requires minimal follow-up care, it does not hinder further surgery if necessary and it should be considered in the management of chronic Achilles tendinopathy after failure of conservative management[20].

"Percutaneous longitudinal tenotomy can be used when there is no paratenon involvement and when the intratendinous lesion is less than 2.5 cm long."

Minimally invasive stripping for chronic Achilles tendinopathy

Four skin incisions are made. The first two incisions are 0.5 cm longitudinal incisions at the proximal origin of the AT, just medial and lateral to the origin of the tendon. The other two incisions are also 0.5 cm long and longitudinal, but 1 cm distal to the distal end of the tendon insertion on the calcaneus. A mosquito is inserted in the proximal incisions (Figure 8), and the Achilles tendon is freed of the peritendinous adhesions. A Number 1 un-mounted Ethibond (Ethicon, Somerville, NJ) suture thread is inserted proximally, passing through the two proximal incision (Figure 9). The Ethibond is retrieved from the distal incisions (Figure 10), over the posterior aspect of the Achilles tendon. Using a gentle see-saw motion the Ethibond suture thread is made to slide posterior to the tendon (Figure 11), which is stripped and freed from the fat of Kager's triangle.

The procedure is repeated for the posterior aspect of the AT. If necessary, using an 11 blade, longitudinal percutaneous tenotomies parallel to the tendon fibres are made. The subcutaneous and subcuticular tissues are closed in a routine fashion, and Mepore (Molnlycke Health Care, Gothenburg, Sweden) dressings are applied to the skin. A removable scotch cast support with Velcro straps can be applied if deemed necessary.

Post-operatively, patients are allowed to mobilise fully weight bearing. After 2 weeks patients start physiotherapy, focusing on proprioception, plantar-flexion of the ankle, inversion and eversion.

The source of pain associated with mid-portion Achilles tendinopathy has not yet been clarified. The rationale behind the present management modality is that the sliding of the suture breaks the neo-vessels and the accompanying nerve supply decreasing pain. Classically, open surgery has provided good results. However, wound complications can occur with these procedures. Minimal invasive technique reduce the risks

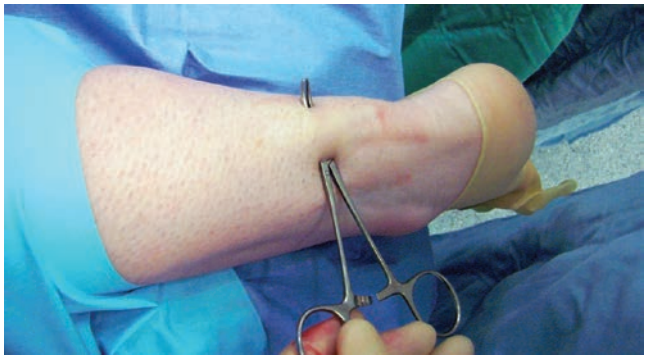

Figure 8: A mosquito is inserted in the proximal incisions.

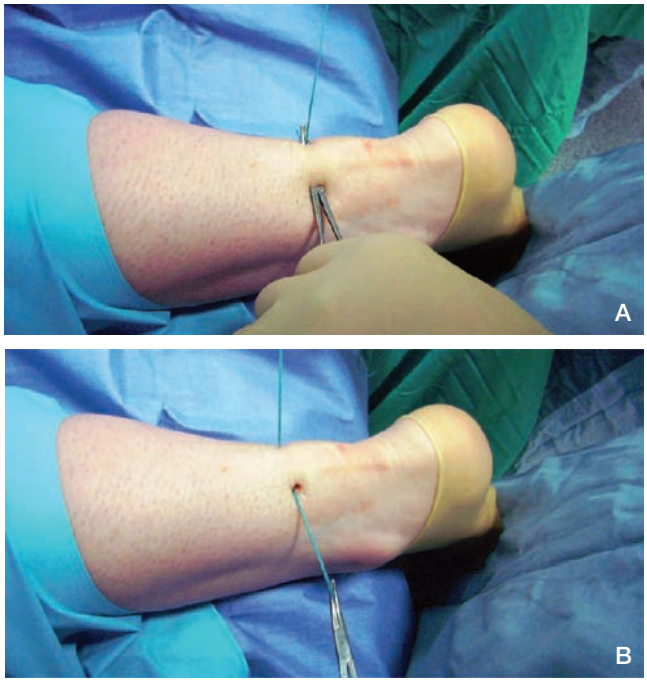

Figure 9: A Number 1 Ethibond (Ethicon, Somerville, NJ) is inserted proximally, passing through the two proximal incision over the anterior aspect of the Achilles tendon.

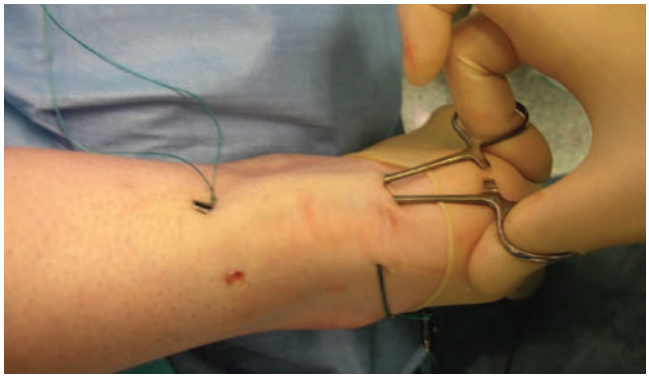

Figure 10: The Ethibond is retrieved from the distal incisions.

Figure 11: The Ethibond is slid over the anterior aspect of the Achilles tendon with a gentle see-saw motion. The whole process is repeated over the posterior aspect of the tendon.

of infection, is technically easy to master, and inexpensive. It may provide greater potential for the management of recalcitrant Achilles tendinopathy by breaking neo-vessels and the accompanying nerve supply to the tendon[21]. It can be associated with other minimally invasive procedures to optimise results.

"A period of initial splinting and crutch walking is generally used to allow pain and swelling to subside after surgery. After 14 days, the wound is inspected and motion exercises are initiated. The patient is encouraged to start daily active and passive ankle range-of-motion exercises."

Surgical treatment of insertional calcific Achilles tendinopathy

Insertional calcific tendinopathy (ICT) of the AT occurs in different patients populations, including young athletes and older, sedentary and overweight people. Usually, radiographs evidence ossification at the insertion of the Achilles tendon or a spur on the superior portion of the calcaneus. A recent study showed that calcification is present in more than 92% of chronic insertional Achilles tendinopathy[22] (Figure 12), and it is often associated with retrocalcaneal bursitis or Haglund's deformity. The incidence of insertional CT of the AT is not clear. It varies from 5% to the most common presentation in athletes; calcifications of the main body of the tendon are at best uncommon.

The aetiopathogenesis of ICT is still controversial. Rather than formed by precipitation of inorganic ions, it seems to be the results of an active cell-mediated process in which resident progenitor cells with multidifferentiation potential may play a determinant role[23].

Figure 12: Insertional calcific tendinopathy of Achilles tendon.

The first line of management of ICT of AT is conservative. Eccentric exercises and extracorporeal shock wave therapy provided good results, but symptoms persist in 10% of patients and surgery is needed[24,25,26].

Surgical technique

Figure 13: Well-healed incision on the medial side.

The patient is placed prone with the ankles clear of the operating table. A tourniquet is applied to the limb to be operated on. Under locoregional or general anesthesia, the Achilles tendon is exposed through a longitudinal incision that is 1 cm medial to the medial border of the tendon, and is extended from the lower one third of the tendon up to 2 cm distal to its calcaneal insertion (Figure 13). The incision can be extended transversely and laterally in a hockey-stick fashion, if necessary. Sharp dissection is continued to the paratenon, which is dissected from the tendon and excised, taking care to preserve the anterior fat in Kager's triangle and not to injure the mesotenon. The retrocalcaneal bursa is excised, if there is evidence of bursitis. The Achilles tendon is inspected for areas that had lost their normal shining appearance and palpated for areas of softening or thickening. The areas that have lost their normal shining appearance, and the areas that are softer or thicker are explored by way of one to three longitudinal tenotomies; areas of degeneration are excised. The area of calcific tendinopathy is identified, it is exposed starting from its proximal and medial aspect and it is excised from the

calcaneus. The Haglund tubercle may be removed with a saw and a burr or rasp is needed to ensure there are no prominent spicules of bone remaining. The tendon is reinserted in the calcaneus using bone anchors. Two bone anchors are be used if 33% to 50% of the AT is disinserted; three soft bone anchors are used if 50% to 75% of the Achilles tendon is disinserted; four bone anchors are used if 75% or more of the Achilles tendon is disinserted (Figure 14); and five bone anchors are used if the Achilles tendon is disinserted totally. The AT is advanced in a proximal to distal fashion and reinserted in the calcaneum. We normally do not perform a tendon augmentation or a tendon transfer. After release of the tourniquet, hemostasis is achieved by diathermy. The wound is closed in layers using absorbable sutures. The skin wound is dressed with gauze, and sterile plaster wool is applied. A synthetic below-knee cast with the ankle plantigrade is applied.

Figure 14: Postoperative result at 24 months from the operation. Five anchors were used.

Patients are discharged the day of surgery within 8 hours of the operation. Patients are mobilised with crutches and immediate weight bearing may be commenced after surgery. After two weeks the wound is inspected, the cast may be removed and patients may commence active plantar flexion, inversion and eversion exercise. A walker boot with the ankle in neutral can be used for 4 weeks. The patients are encouraged to continue to bear weight on the operated limb and to gradually progress to full weight bearing, if they are

not already doing so. Stationary cycling and swimming are recommended from the 2nd week after removal of the boot. We allowed return to gentle training 6 weeks after removal of the boot. Gradual progression to full sports activity at 20 to 24 weeks from the operation is planned according to the patients' progress. Resumption of competition depends on the patients' plans but is not recommended before 6 months after surgery.

We reported excellent and good results in 16 patients of 21 who underwent this surgical procedure[27]. They came back to their pre-injury level of activity at an average of 24.5 weeks following surgery. The remaining 25% patients did not experience problems in the activities of daily living but they could not return to their normal levels of sporting activity. We did not experience any case of traumatic dis-insertion of the reattached tendon. Johansson et al recently reported good outcome in 69% of patients, moderate in 25% and poor 6% of cases at an average follow-up of 35 months[28]. The authors also suggested that good outcome was related concomitant resection of a Haglund's deformity, even if this difference was not statistical significant (p=0.0613), probably due to the small size of the sample.

"Tendinopathy of the main body of AT affects both athletic and sedentary patients. The incidence in top-level runners has been estimated between 7 and 9%, while 30% of patients have a sedentary lifestyle."

Management of rupture in athletic vs non athletic patients

Acute AT rupture is a serious injury. Most (75%) acute ruptures occur during recreational activities in men between 30–40 year old, but 25% of ruptures take place in sedentary patients[29]. The incidence rate ranges from 6 to 18 per 100,000 per year[30]. Management of acute ruptures of the AT is still controversial. In conservatively managed patients, healing in a lengthened position may determine loss of calf muscle strength. In addition, incomplete healing of the gap between the two tendon stumps may contribute to the high re-rupture rate, up to 13%[31].

Operative management provides lower re-rupture rate, early functional treatment, less calf atrophy, and stronger push off than non-surgical treatment, at the expenses of long incisions, wound complications such as infections, and, occasionally, painful scars. But recent well conducted randomised controlled trials showed that conservative and open surgery management produce, in an unselected population, similar functional results[12]. Willits et al[33] showed acceptable and clinically similar outcomes of patients with acute Achilles tendon ruptures, who had been treated with accelerated functional rehabilitation alone compared with those who had received operative repair and accelerated functional rehabilitation, but may result in an higher re-rupture rate. A recent meta-analysis demonstrated that non-operative management using functional bracing with early mobilisation has similar re-rupture rates to open surgical treatment with regard to re-rupture rate, range of motion, calf circumference, and functional outcomes and it has the advantage of a decrease number in other complications[34]. The authors found that the risk of complications for surgically treated patients was 3.9 times that of non-surgically treated patients, which resulted in an absolute risk increase of 15.8%[34].

"In conclusion, HVIGI is effective to improve the symptoms of resistant Achilles tendinopathy. It is safe and relatively inexpensive, with the potential to offer an alternative management option before surgery, aiding a quicker return to sport."

Open, percutaneous, or minimally invasive procedures have been successfully used, especially in young and active subjects. Open surgery provides good strength to the repair, low re-rupture rates, and reliably good endurance and power to the gastrocnemius-Achilles tendon complex. However, open surgical approaches have resulted in high risk of infection and morbidity. Review articles and meta-analysis showed high costs and a 20-fold higher rate of complications than conservative treatment[35]. Therefore, minimally invasive procedures have been successfully used to avoid these complications[36]. Minimally invasive Achilles tendon repair provides many advantages. Major advantages are less iatrogenic damage to normal tissues, lower postoperative pain, accurate opposition of the tendon ends minimising surgical incisions and improved cosmesis. A recent systematic review reported a rate of superficial infections of 0.5% and 4.3% after minimally invasive and open surgery, respectively, and deep infections did not occur in subjects who had undergone minimally invasive repair[37]. The reason for this is that, when performing an open repair, the surgical trauma may add insult to injury. Shorter hospitalisation time and average time to return to working activities was also showed. But the main finding of the study was indications were grossly comparable and functional outcomes were not significantly different between minimally invasive and open surgery. Although sural nerve injury has been reported as a potential complication of this kind of surgery[29], new techniques have minimised the risk of sural nerve damage[38].

Figure 15: A 9 cm Mayo needle (BL059N, #B00 round-point spring eye, B Braun, Aesculap, Tuttlingen, Germany) is threaded with 2 double loops of number 1 Maxon (Tyco Healthcare, Norwalk, CT), and is passed transversely between the proximal stab incisions through the bulk of the tendon.

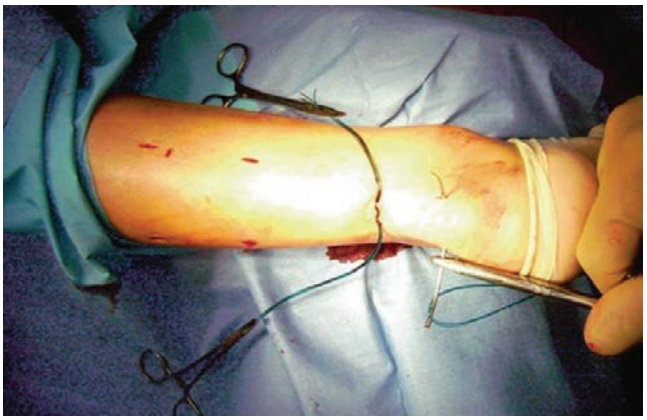

Figure 16: Another double loop of Maxon is passed between the distal stab incisions through the tendon.

Percutaneous Achilles Tendon Repair: surgical technique

A 1 cm transvers incision is made over the defect using a size 11 blade. Four longitudinal stab incisions are made lateral and medial to the tendon 6 cm proximal to the palpable defect. Two further longitudinal incisions on either side of the tendon are made 4–6 cm distal to the palpable defect. Forceps are then used to mobilise the tendon from beneath the subcutaneous tissues. A 9 cm Mayo needle (BL059N, #B00 round point spring eye, Braun, Aesculap, Tuttlingen, Germany) is threaded with two double loops of Number 1 Maxon (Tyco Healthcare, Norwalk, CT, USA), and this is passed transversely between the proximal stab incisions through the bulk of the tendon (Figure 15). The bulk of the tendon is surprisingly superficial. The loose ends are held with a clip. In turn, each of the ends is then passed distally from just proximal to the transverse Maxon passage through the bulk of the tendon to pass out of the diagonally opposing stab incision. A subsequent diagonal pass is then made to the transverse incision over the ruptured tendon. To prevent entanglement, both ends of the Maxon are held in separate clips. This suture is then tested for security by pulling with both ends of the Maxon distally. Another double loop of Maxon is then passed between the distal stab incisions through the tendon (Figure 16), and in turn through the tendon and out of the transverse incision starting distal to the transverse passage (Figure 17). The ankle is held in full plantar flexion, and in turn opposing ends of the Maxon thread are tied together with a double throw knot, and then three further throws before being buried using the forceps. A clip is used to hold the first throw of the lateral side to maintain the tension of the suture. We use 3-0 Vicryl (Ethicon) suture to close the transverse incision and Steri-strips (3M Health Care, St Paul, MN, USA) to close the stab incisions. A non-adherent dressing is applied. Apply a full plaster-of-Paris cast in the operating room with the ankle in physiologic equinus. Split the cast on both medial and lateral sides to allow for swelling. Patients are discharged on the same day of the operation.

We reported excellent results in 17 elite athletes after percutaneous surgical repair of Achilles tendon rupture[39]. All patients came back to competing at high level and the average time to return to full sport participation was 4.8 ± 0.9 months (range 3.2 to 6.5).

The choice of the type of management should take into account the age, occupation, and level of sporting activity of each patient. In elderly or a few selected patients, conservative

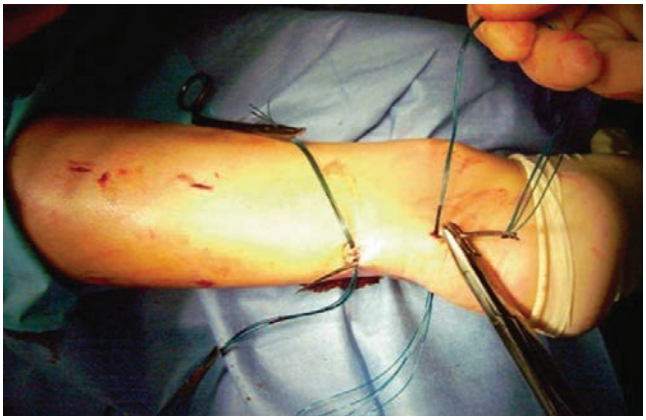

Figure 17: The needle is passed in turn through the tendon and out of the transverse incision starting distal to the transverse passage.

management and early mobilisation achieves excellent results but the associated re-rupture rate is not acceptable in young individuals. Open surgery is frequently associated with higher risk of superficial skin breakdown and wound problems, which can be prevented by performing percutaneous repair. Percutaneous repair followed by early functional rehabilitation, is becoming increasingly common, and may be considered in selected patients.

"Patients with chronic painful tendinopathy of the main body of Achilles tendon (AT) often present neovascularisation outside and inside the ventral part of the tendinopathic area. However, neovascularity in absence of pain is not necessarily pathological, and, in athletes, it can just indicate a physiological response to physical training."

Plantaris tendon injury

Injuries of the plantaris muscle and tendon, also known as "Tennis leg", was first described in 1883 by Powell[40]. The plantaris muscle arises from the supracondylar ridge of the lateral femoral condyle and courses medially as it progresses down the leg to its insertion on the calcaneus, just medial to the Achilles tendon. It runs between the overlying gastrocnemius and the deeper soleus. The plantaris muscle is an accessory plantar flexor of the foot. It has been proposed to assist the larger plantar flexors of the foot with proprioception due to its high density of muscle spindles and it is absent in approximately 7–10% of the population[41].

Controversy exists regarding the existence of plantaris tears. Early descriptions of plantaris tears were later disputed, with several investigators questioning their existence[42]. The advent of modern imaging technology along with surgically documented lesions confirmed these entities[41]. More recently, most investigators have implicated a rupture of the medial head of the gastrocnemius muscle at the musculotendinous junction in the pathogenesis of injury. Actually "Tennis leg" is a clinical entity that is variably attributed to a partial tear or rupture of the gastrocnemius, a rupture of the plantaris tendon or at the musculotendinous junction, or of the soleus muscle, where gastrocnemius muscle is the most frequently involved[43]. A series of 141 patients referred for ultrasound examination after calf strain revealed that 67% had gastrocnemius tears, 21% had hematoma and fluid accumulation but no clear muscle tear, 1.4% had plantaris rupture, and 0.7% had isolated soleus tear[44]. Plantaris injuries may occur after ankle dorsiflexion while the knee is extended[45]. Injuries to the plantaris or soleus have been described during running, tennis and volleyball[46]. Clinically, it may be difficult to distinguish among soleus, plantaris, and gastrocnemius injuries. US and MRI are useful imaging techniques for diagnosis[43]. Even if an isolated tear of the plantaris tendon or muscle is an uncommon condition, its importance lies in the fact that its rupture cans mimic different conditions, such as a proximal Achilles tendon tear or deep vein thrombosis (DVT)[47,48]. DVT can occur in 9.9% cases of so called Tennis leg[44]. For this reason, some authors use US and Doppler US to rule out differential symptoms, such as DVT[46]. Furthermore, plantaris tendon can provide plantar flexion of the ankle after AT rupture presenting a confusing picture.

Treatment is mostly conservative. Rest, ice, compression and elevate of the affected leg showed significant reduction in pain and swelling. Unfortunately there is a paucity of good quality data on these uncommon injuries, so firm evidence-based recommendations are not yet available.

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References, as indicated within the article, are available at sma.org.au/publications/sport-health