INVITED ARTICLE

Minimally Invasive Stripping for Achilles Tendon: A Novel Option to Treat the Tendinopathy of the Main Body?

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Abstract

Achilles tendinopathy (AT) is commonly defined as failed healing response characterized by an increase in non-collagenous matrix and proliferation of altered tenocytes and degradation of collagen fibers. Diagnosis is made by clinical evaluation, and magnetic resonance imaging (MRI) or ultrasonography (US) imaging is used for differential diagnosis or is not a clear case. The first line of management is conservative, while open or minimally invasive techniques are considered in the second line. Generally, after 6 months of non-operative management, surgery is indicated. Minimally invasive stripping of the Achilles tendon in case of tendinopathy of the main body is effective, inexpensive, and technically simple. However, randomized controlled trials (RCTs) with a control group and more patients are needed to confirm clinical outcomes.

Keywords: Achilles tendinopathy, Ankle joint, Minimally invasive, Stripping.

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Introduction

The main characteristics of Achilles tendinopathy (AT) are pain, swelling, and reduction in performance quality.[1] Generally, it is distinct and described in insertional and non-insertional, which are two different disorders with treatment options. As synonymous of non-insertional of AT, of common use, are "tendinopathy of the main body" and "mid-portion AT".

Based on the most recent available scientific literature, it is considered as a consequence of a failed healing response, with modifications in tendon structure fibers after overuse or metabolic impairment.[2–5] However, pain generation remains controversial[6–8] characterized by abnormal neoinnervation that accompanies neovascularization.[9,10]

In the beginning, cell-matrix changes, between these different types of AT, cannot be differentiated, but specific exercises for insertional or mid-tendon AT may provide better results, probably due to the different loading profiles and activities in a different portion of the tendon.[11]

In the athletes' population, AT is very common [6–17% of all running injuries[12]], but the true incidence in the other type of populations remain unclear, even though it has been associated with seronegative arthropathies.[13] Several pieces of evidence showed how aberrant changes in various genes expression of matrix proteins lead to tendon degeneration impairing the healing process.[14]

The natural history of AT is not clear, however, a high association of tendinopathy and tendon rupture has been reported, and pain represents a late symptom of tendon degeneration, indeed, most patients are asymptomatic.[15,16]

The etiopathogenesis remains unclear but its multifactorial nature due to the interaction of intrinsic and extrinsic factors has been hypothesized.[4] Poor technique, previous injuries, and environmental factors, such as training on hard, slippery, or slanting surfaces, are extrinsic factors[4] but also dysfunction of the gastrocnemius soleus, age, body weight and height, pes cavus, marked forefoot varus, and lateral instability of the ankle have been reported as risk factors.[4] Fluoroquinolones (such as ciprofloxacin) and corticosteroids have been associated with the risk of developing tendinopathy,[17,18] several studies on a large population-based case-control demonstrated a rate of a single rupture case every 5,958 patients managed with fluoroquinolones.[19]

Furthermore, imbalance in MMP activity in response to injury and mechanical strain,[20–24] metabolic diseases,[5,25–27] and a genetic component seem to play a key role in developing tendinopathies of the Achilles.[28–30]

Histologically, tendinopathic samples show a modification in collagen fibers with an increase in type III (reparative) collagen[1] and irregular crimping, loosening, and increased waviness, however, hypoxic and hyaline degeneration, mucoid, myxoid, fibrinoid, or

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lipoid materials, calcification, fibrocartilaginous and metaplasia can all coexist.[1]

Clinical Diagnosis and Imaging

Pain is the main symptom despite its generation is not completely understood[1] being able to originate from mechanical and biochemical stress.[31] Commonly, it occurs at the beginning and at the end of the training, and with the progression of the pathology, it occurs during the entire session interfering with daily activities.[5]

Clinical examination remains the best diagnostic tool with patients who commonly report pain 2–6 cm above the distal insertion of the Achilles tendon, and palpation is a reliable and accurate test for diagnosis.[32] Other used and reliable clinical diagnostic tests are the painful arc sign, and the Royal London Hospital test.[33]

Diagnostic imaging, such as plain radiography, ultrasonography (US), and magnetic resonance imaging (MRI), may be useful to verify the clinical hypothesis and exclude other musculoskeletal diseases.[34] Radiographs may be useful in case of associated or incidental osseous alteration or for intratendinous calcific deposits and ossification, especially in the posterior aspect of the calcaneus (posterior heel spur) which is diagnostic for insertional AT.

Ultrasonography, despite its operator-dependent nature, showed a good correlation with histopathologic findings, indeed, its grayscale is commonly associated with color or power Doppler to detect neovascularity.

Only if US remains unclear an MRI can be required, providing extensive information regarding tendon, bone, and soft tissue morphology. It allows differentiating between tendinopathy and paratendinopathy of the Achilles tendon. Magnetic resonance imaging data should be interpreted with caution, providing a complete patient examination, before making any decisions.[35]

Management of AT

Treatment of AT lacks evidence-based support, and tendinopathic patients are at risk for long-term morbidity with no predictable results.[36] Treatments are primarily conservative, reporting good clinical findings. However, if conservative management fails, surgery is recommended,[37,38] but the adequate moment to switch to operative management remains not clear. Moreover, a prospective study, show a favorable prognosis at 8-year follow-up in patients with AT, but 29% of these samples required surgical intervention.[39]

The initial management for AT includes eccentric exercise, NSAIDs, corticosteroid injection, or PRP, as monotherapy or in combination, to accelerate recovery. If no responses are found, shock wave therapy or nitric oxide patches might be used but results are limited. Lastly, peritendinous injections or between the Achilles tendon and Kager's triangle should be considered but, at the best of our knowledge, no gold standard with a clear clinical outcome has been defined in the last few years. More level I studies are needed to prove the outcomes of these management options. In general, conservative management could be considered for a minimum of 3–6 months before giving surgical indication.[40,41]

Minimally Invasive Stripping of the AT

Surgical treatment of AT lack of trials and the reported success rate by several studies needs to be well evaluated. The most commonly used surgical options are simple percutaneous tenotomy (that can be performed with the ultrasound guide),[42–44] open procedures (debridement with re-attachment of the tendon or transfer), and minimally invasive stripping of the tendon.[45–47]

Regarding open procedures, if >50% of tendon body is debrided, augmentation or transfer need to be considered, and several authors have shown excellent or good results in >85% of cases,[48] but these results are not always observed in clinical practice, indeed, articles reporting success rates up than 70% are characterized by poorer methods scores.[49]

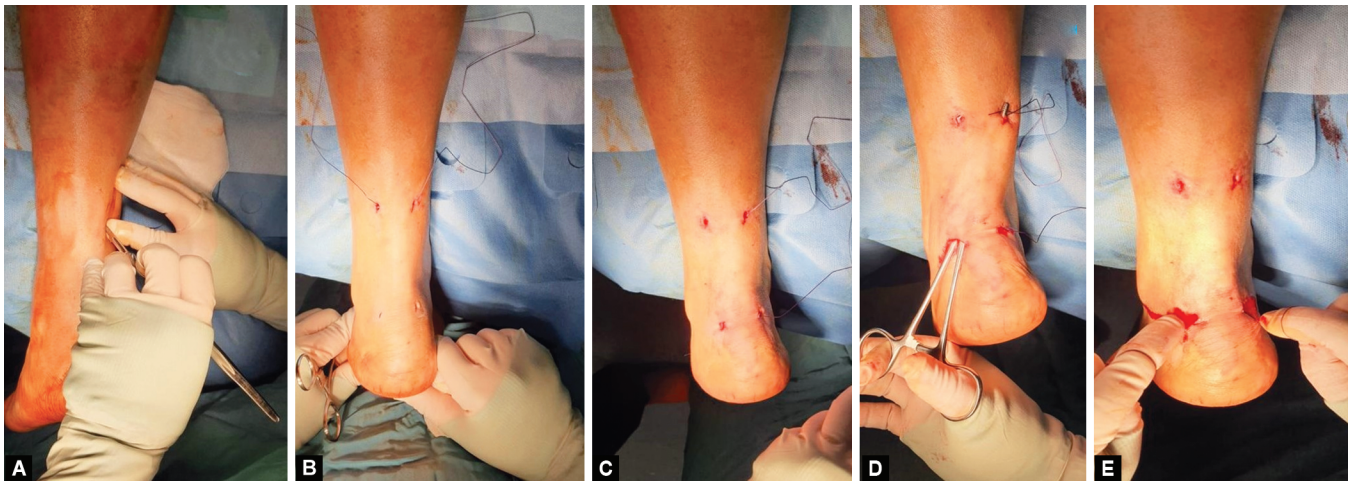
Several minimally invasive surgical techniques, to remove neural tissue around the Achilles tendon have been developed, resulting in denervation.[45,50] The surgical technique consists of four small (0.5 cm) longitudinal skin incisions, in line with the Achilles tendon, two proximally, medially, and laterally to the origin of the tendon and two distally at the level of the calcaneal insertion of the tendon, were made using a no. 11 scalpel blade. Surgery was performed with the patient in the prone position and under local anesthesia by direct injection. A mosquito clamp was inserted through the proximal incisions and a no. 1 unmounted Ethibond (Ethicon, Somerville, NJ) suture was doubled up and passed transversely through the proximal incisions, ensuring that it was anterior to the Achilles tendon, between the tendon and the Kager fat pad. Then, the suture thread was retrieved distally, posteriorly to the Achilles tendon, to form an X fashion. In the end, the unmounted Ethibond suture had been retrieved from the distal medial and lateral stab wounds, and a gentle seesaw motion was applied, advancing it over the interface between the Achilles tendon and the Kager fat pad (Fig. 1).

The rationale for the use of the described technique is to improve pain by removing neoinnervation from the pathologic tendon through the sliding of the Ethibond suture, reducing damage to soft tissue due to surgery, and allowing quick rehabilitation.[1,5] A recent study showed a significant functional improvement, in all patients, using VISA-A score resulting in 87% of return to sports, of which 75% at the same level before surgery in a 3.5-month follow-up[46] reporting lower rates of wound complication if compared to open surgery.[46,51]

Similar results for other minimally invasive approaches are reported, e.g., in case of percutaneous longitudinal tenotomy with good to excellent outcomes for the 77% of patients at a 17-year follow-up (17 years) in 39 runners,[52] with one half of them able to run; or in case of endoscopic approach (with paratenon debridement and longitudinal tenotomy)[53,54] showing high success rate in 27 patients after 7 years, with the resolution of the symptom and improve in VISA-A scores in 96% of case. However, the complication rate was reported in 7.4% of patients.[53] Compared with these techniques, minimally invasive stripping of the Achilles tendon is less expensive, not requiring special instruments or specialized endoscopy skills.

Two systematic reviews[55,56] were reported similar outcomes between minimally invasive and open surgery for AT, but for the first one, lower complication rates were reported.

These studies had several limitations such as the absence of a direct comparison with the other studies, standardization of patients, degree and/or stage of tendinopathy which can vary. More studies and randomized controlled trials (RCTs) are needed to better understand and enlighten the role and long-term effects on the patient treated with minimally invasive techniques for AT.



Figs 1A to E: Patient in the prone position with a calf tourniquet. Four skin incisions are made (A and B). The first two incisions are longitudinal the proximal origin of the Achilles tendon, the other two incisions are 1 cm distal to the distal end of the tendon insertion on the calcaneus. A Number 1 unmounted Ethibond (Ethicon, Somerville, NJ, USA) suture thread is inserted proximally, passing through the two proximal incisions (B). The Ethibond is retrieved from the proximal incisions in an X-fashion (C and D). Using a gentle see-saw motion, similar to using a Gigli saw, the Ethibond suture thread is made to distally to the tendon (E), the same steps are repeated for the posterior aspect of the Achilles tendon which is stripped and freed from the fat of Kager's triangle

Conclusion

During the last years, several minimally invasive techniques have been developed to manage the pain of the AT, and open techniques for sedentary patients with advanced tendinopathy, which can require tissue resection and/or tendon transfer. In conclusion, stripping of the Achilles tendon for the management of AT of the main body is a low-morbidity and inexpensive technique with good outcomes and fast functional recovery in athletic patients, however, attention should be taken to the risk of sural nerve injury.

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