■ ASPECTS OF CURRENT MANAGEMENT

The use of ultrasound in the assessment and treatment of Achilles tendinosis

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The use of ultrasound in the diagnosis and management of disorders of the tendo Achillis is discussed. Some of the pathological processes which occur in Achilles tendinopathy can be identified by ultrasound, which may also be used to direct local treatment.

Pain in the hindfoot and heel is common. In a number of patients it may be difficult to make an accurate clinical diagnosis based on the history and examination alone. One of the most common causes of pain around the heel is a disorder of the tendo Achillis including tendinosis and paratendinitis.

Ultrasound examination plays a key role in establishing the diagnosis, enabling the clinician to consider the appropriate treatment. Moreover, in certain patients where the complaint is refractory to standard regimes of treatment, ultrasound-directed intervention can offer an alternative to surgical management.

There is considerable debate in the literature regarding the specific terminology of abnormalities of the tendo Achillis.¹⁻⁴ The terms tendinosis, tendonitis, partial tear and tendinopathy have been used simultaneously for apparently overlapping clinical and imaging abnormalities. There is now a general consensus that these lesions should not be called tendonitis because of a lack of histopathologically identifiable inflammatory cells.^{1,4,5} Current terminology would suggest that the term tendinosis be used for a thickened tendon with abnormal signal/echogenicity present when imaged by ultrasound or MRI. However, inflammatory change is present in the paratenon, and the term paratendonitis is appropriate.⁶

Normal structure of the tendon. Tendons comprise cells (tenocytes) surrounded by collagen and ground substance. The collagen molecules are formed from polypeptide chains and are arranged in a triple helix pattern. With the cross-linkage of proteoglycan molecules, a regular three-dimensional structure is formed. These fibrils are grouped to form fibres, bundles and fascicles. The tendon is covered by epitenon, which is a loose connective tissue layer containing the neurovascular supply. The

superficial surface of the tendon may or may not have a further lining known as the paratenon.⁷ Yet again, there remains some debate regarding the location of the paratenon; O'Brien⁸ indicated that the tendo Achillis was enclosed by paratenon, whereas Sharma and Maffulli⁷ suggested that the paratenon was a superficial structure. More often than not, tendons that course around bony surfaces, passing through fascial slings, tend to have a sheath lined by synovium, as exemplified by the flexor hallucis longus tendon. However, the tendo Achillis lacks such a sheath and is therefore encompassed by the paratenon,^{7,8} which allows limited movement of the tendon within the subcutaneous tissues and Kager's fat pad.

The average turnover for collagen production is slow, between 50 and 100 days, which is important to appreciate as the healing process may in some instances take up to three times longer.

Sonographic technique. The ideal way to examine the tendo Achillis is with the patient in the prone position. A high-frequency probe (7 MHz to 12 MHz) is necessary and the ultrasound machine should be equipped for both colour and power Doppler imaging. Importantly, it should be recognised that the interpretation of the scans is operator dependent.

In normal individuals the tendo Achillis exhibits a homogeneous fibrillar structure on the sagittal images, with approximately six to eight characteristic undulating lines of internal echoes that reflect the acoustic border between the collagen fibrils and the loose connective tissue between the fascicles.⁹ The oval shape of the tendon is demonstrated on the axial series. There is a superficial convexity and a deep concavity (Fig. 1). Occasionally the tendon is divided by a hyperechogenic septum. The

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Fig. 1

Axial ultrasound image demonstrating normal appearance of the tendo Achillis (arrowheads) in cross-section. The hypoechoic paratenon is identified posteriorly.

Fig. 2

Sagittal sonogram of the normal tendo Achillis (TA). The arrows point out the echogenic paratenon lying on the anterior and posterior surfaces of the tendon.

tendon is well demonstrated bordering its subcutaneous fatty tissue by the paratenon, which is a visible hyperechogenic line situated on the anterior and posterior border (Fig. 2).

Anterior to the tendo Achillis lies the retrocalcaneal fat pad (Kager's triangle) which together with the tendo Achillis, fills the distal part of the triceps surae compartment of the calf. This structure typically shows a mottled echo pattern sonographically, but there is marked variability between individuals. The normal thickness of the tendon ranges between 4 mm and 7 mm, with a mean of 5.2 mm.⁹

Fig. 3

Sagittal sonogram of the normal tendo Achillis insertion. The arrow points to the normal physiological retrocalcaneal bursa (TA, tendo Achilles).

The sonographic findings at the insertion of the tendo Achillis are demonstrated as a strong echogenic border against the bone (Fig. 3). The tendon flattens and covers the calcaneum. Moreover, in children a broad layer of hyaline cartilage covers the posterior aspect of the calcaneum, which can be demonstrated using a high-resolution probe. Between the tendo Achillis and the superoposterior aspect of the calcaneum there may be a small crescent-shaped bursa, the retrocalcaneal bursa, which is not always demonstrable in normal individuals and is only regarded as pathological in the presence of symptoms.

Sonographic findings in tendinosis. Excluding the signal returned by the paratenon, there are four typical sonographic findings in patients with clinical signs and symptoms arising from the tendo Achillis. These include normal tendons, enlarged tendons showing spindle shape/fusiform thickening, hypoechoic lesions within the tendons, and Doppler-proven neovascularisation (Fig. 4).

Archambault et al¹⁰ demonstrated a statistical difference in the recovery time between normal tendons and those that were enlarged, and those with hypoechoic lesions where the recovery time was extended. Additionally, Nehrer et al¹¹ demonstrated that patients without sonographic changes had a significantly better outcome after conservative treatment. Most importantly, high rates of spontaneous rupture were documented in patients with tendon thickening and circumscribed lesions.¹¹

The typical sites for Achilles tendinosis are within the middle third. Gibbon, Cooper and Radcliffe¹² demonstrated small microtears (tendinosis) in approximately 28% of normal individuals. Conversely, only 18% of athletes with chronic Achilles tendinosis were without microtears. Moreover, those with partial tendon rupture were associated with microtears in the middle third of the tendon. This study concluded that the increase in frequency of microtears had a significant association with rupture of the tendo Achillis.

Identification of neovascularisation of the tendo Achillis has promoted a number of publications.^{13,14} The general consensus indicates that neovascularisation is specifically

Fig. 4a

Fig. 4b

Sagittal sonogram demonstrating a) diffuse fusiform swelling of the tendo Achillis (block arrows). Colour Doppler box demonstrates branching new vessel formation within the tendon (thin arrows) and b) focal tendinopathy (arrowheads) principally affecting the posterior surface of the tendo Achillis. The long arrows demonstrate the anterior margin of the slightly expanded tendon.

related to the pain experienced by the patient, but does not indicate an unfavourable outcome. Conversely, tendon inhomogeneity is associated with an unfavourable outcome.¹⁴ Power Doppler imaging generally demonstrates significantly greater microvascularity than does colour Doppler imaging. Usually the vascularity appears to arise from the anterior aspect of tendo Achillis, but there is a non-linear relationship between tendinopathy, tendon size and the extent of the microvascularity.

Symptoms of Achilles tendinosis may be indistinguishable from those of paratendinosis, in which the typical sonographic findings are of a circumferential hypoechoic halo around the tendon (Fig. 5). Doppler imaging may reveal hypervascularity within the paratenon. Ultrasound has been superseded by contrast-enhanced MRI in the detection of

Fig. 5

Axial sonogram demonstrating a thickened hypoechoic paratenon (arrowheads) covering the medial side of a normal tendo Achillis (TA).

Achilles paratendinosis. However, the two conditions may coexist.

Clinical assessment of pain in the tendo Achillis remains difficult, and there are a number of complaints that can produce similar symptoms. Accurate and early diagnosis provides a rational management programme and allows a prognosis to be made. Typical conditions that produce pain in this region include rupture of the plantaris tendon, calcific tendinosis, fat pad impingement, paratendinosis and hypertrophy of accessory muscles (Fig. 6). Systemic inflammatory conditions such as rheumatoid arthritis can also produce similar findings.

Sonography-based treatment

Local anti-inflammatory injections. Local corticosteroid injections are commonly employed in the treatment of chronic lesions of the tendo Achillis. The role of inflammation in chronic tendinopathy is unclear, and the rationale for the use of corticosteroids in this manner is controversial. Moreover, anecdotal and accepted practice suggests that there is a potential risk of tendon rupture related to intra-tendon injection, although we could identify no studies that have specifically shown an adverse outcome from injection of steroid around the paratenon.

Ultrasound has been used to direct the placement of the injection. In one report recurrences were noted when the tumour necrosis factor- α blocker adalimumab and the interleukin-1 receptor antagonist were used for percutaneous peritendon injections.¹⁵ Both these drugs improved pain and the dimensions of the tendon, which led authors to postulate the presence of an inflammatory component.¹⁵ Additionally, the hyperaemia demonstrated was perceived to be part of an inflammatory reaction rather than a reparative process.

Obliteration of new vessels. On the basis of this original work further studies have been performed on methods to obliterate the neovascularisation (Fig. 6). Of these studies, Ohberg and Alfredson^{16,17} targeted the neovascularisation

Fig. 6a

Fig. 7

Axial sonogram demonstrating dry needling of Achilles tendinopathy. The needle (arrows) is passed repeatedly through the tendinopathy under ultrasound guidance.

Fig. 6b

Axial sonogram of a 28-year-old amateur footballer with chronic non-insertional Achilles tendinopathy. a) Straight arrows denote areas of cystic degeneration. Curved arrow demonstrates the origin of new vessel formation on the deep surface of the tendon. b) Axial sonogram of the same patient taken during sclerotherapy of intratendinous neovascularisation. Needle passed from medial side of tendon (block arrows) into source of vascularity (curved arrow).

using polidocanol, a local anaesthetic and sclerosing agent. A two-year follow-up indicated that a number of patients had an excellent result.¹⁸ Electrocoagulation of neovessels is based on the same rationale as sclerotherapy, but is potentially more destructive.¹⁹

High-volume injections. Chan et al,²⁰ hypothesised that high-volume injections of normal saline into the tendo Achillis would produce local mechanical effects causing neovessels to rupture or occlude. A local anaesthetic and

steroid combination was injected into the fat pad, followed by 40 ml of injectable saline. Their study indicated that the injection significantly reduced pain and improved function.

Stimulation of healing response

Intra-tendonous injection of hyperosmolar dextrose. Hyperosmolar dextrose is a proliferant and has been used as part of prolotherapy regimens since the early 1940s. It initiates a local inflammatory response, inducing fibroblast and subsequently collagen proliferation. Maxwell et al,²¹ in a pilot study, injected into the lesions within the tendo Achillis and demonstrated a significant reduction in pain at rest and during tendon loading activities.

Dry needling and autologous blood injection. Dry needling (barbotage) is the technique of repeated lancing of the site of abnormal signal in order to cause intra-tendonous bleeding (Fig. 7). Similarly, autologous blood injections have been used for tendinopathy, with the aim of providing cellular and humoral mediators promoting healing.

Percutaneous tenotomy. Testa et al²² evaluated ultrasound-guided percutaneous longitudinal tenotomy in a number of athletes and confirmed that their results were comparable to those reported in more extensive open surgical procedures.

Other treatments. Ultrasound guidance has also been applied in volume adhesiotomy or paratenon stripping, also known as brisement. However, the evidence for its effectiveness is relatively anecdotal.²³ There is also considerable and promising interest in intratendinous and intraligamentous injection of autologous platelet-rich plasma.²⁴

The treatment and management of Achilles tendinosis remain controversial, which is compounded by the absence of uniformly applied diagnostic criteria. Although some of the treatments have been reported with persuasive evidence

of their effectiveness, there have been no randomised controlled trials.

Ultrasound imaging can provide clear evidence of some of the pathological processes occurring in Achilles tendonopathy, and help to provide a rational approach to treatment and monitoring of the outcome of any intervention.

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