Sonographic Assessment Of Achillodynia

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Aim of the study: To assess the usefulness of ultrasound in assessment and diagnosing pathologies of the painful Achilles tendon (achillodynia).

Methods: We conducted a prospective study of a consecutive series of 137 patients who referred to our radiology department from rheumatology clinic at Dallah hospital, Riyadh, Saudi Arabia from April 2015 to January 2018 with complaints of pain at and near the Achilles tendon.

Results: Sonography was used to evaluate 137 patients with achillodynia. This modality enabled the diagnoses of 59 abnormal tendons (42%). The mean diameter of the pathological tendons was 9.4±1.7 mm, while normal tendons measured 5.2±0.8 mm (P<0.001).

A complete rupture in 3 patients (2%); a partial rupture of the Achilles tendon in 2 (1%); various degrees of calcification of the tendon seen in 10 patients (7%); and peritendinous lesions discerned by the tendon's hypoechoic regions with disorganized arrangement of collagen fibrils in 5 patients (4%). Other lesions included tendonitis (5 patients, 4%), retrocalcaneal bursitis (11 patients, 7%) and xanthoma in 1 patient (2%). Ultrasound findings were found to be normal in 41 cases (30%).

Conclusion: Ultrasonography has provided important information about Achilles tendon and it is a useful tool in the evaluation of the underlying pathology in patients presenting with painful Achilles tendon (achillodynia).
INTRODUCTION:

Tendo Achilles is the toughest tendon in the body (1) and it forces equaling 12 times the body weight (2). The Achilles tendon spans two joints and connects the gastrocnemius and soleus muscles to the calcaneus, comprising the biggest and toughest muscle complex in the calf. It is prone to injury because of its limited blood vessels that supply it, especially when subjected to strong forces (3). The blood supply to the tendon is provided by longitudinal arteries that run the length of the muscle complex. The area of the tendon with the poorest blood supply is approximately 2 to 6 cm above the insertion into the calcaneus (4). Chronic and acute pain of the Achilles tendon and its surrounding tissues are usually seen in orthopedic practice, and patients with achillodynia are also seen and treated by rheumatologists, physiotherapists, sports specialists and podiatrists (5).

Tendinosis, called chronic tendinopathy, chronic tendinitis, or chronic tendon injury, is damage to a tendon at a cellular level (the suffix "osis" implies a pathology of chronic degeneration without inflammation). It is thought to be caused by microtears in the connective tissue in and around the tendon, leading to an increase in tendon repair cells (6). It is common clinical practice to use the collective term tendinitis when referring to chronic achilles tendon disorders, although the true pathology is often related to abnormal fluid collection, foreign body lesions, soft tissue injury, or soft tissue masses (7). An inclusive history and thorough physical examination are the keys to making the proper diagnosis and suitable treatment plan (3). Three imaging modalities are used in the diagnosis of pathology in the Achilles tendon, i.e. diagnostic ultrasound US, magnetic resonance imaging (MRI), and plain film radiography (XR). US is the method commonly used, and it is a non-invasive and harmless method to examine the human body. It is now possible to examine muscle fibres, tendons, and even ligaments, with good reliability (8-9).

The structure and the thickness of the Achilles tendon as well as the attachment to the muscles and the calcaneal bone can be visualized with both US and MRI. It is also possible to examine the surrounding structures to the Achilles tendon, in order to diagnose other conditions responsible for pain in the Achilles tendon region using these methods (10).

When comparing MRI and US, MRI is more sensitive to little changes of signals in the tendon (11), but US shows more details in the tendon structure and has a higher sensitivity to diagnose small intratendinous calculi (12). On the other hand, MRI can show bone pathology, which is not possible with US (Karjalainen. et al. 2000) (13). An MRI examination is more expensive and more time consuming than an US examination. It is also not possible to perform a dynamic examination with MRI, which is possible with US (9). Tendo Achilles disorders can be viewed by high frequency ultrasonography. It allows for an exact diagnostic examination of soft tissue conditions related to the Achilles tendon area. A recent study comparing ultrasonographic pre-operative evaluation to surgical findings of Achilles tendon disorders showed sonography to be highly specific and sensitive in the diagnosis of Achilles tendon tears and invaluable in elucidating many elusive cases of tendinosis and tendinitis (14-15-16). The present study summarizes our experience to assess the usefulness of ultrasound in diagnosing pathologies of the painful Achilles tendon in our institution.

MATERIALS AND METHODS;

A total number of 137 patients referred to our radiology department, from rheumatology clinic at Dallah hospital, Riyadh, Saudi Arabia, from April 2015 to January 2018 with complaints of pain at and near the Achilles tendon included in our study. Human ethics committee approval for this study was obtained from the institutional review board. All patients were bilaterally examined by ultrasound using an ultrasound machine (HD II XE Ultrasound 2006, Philips medical system, Nederland B.V). A linear transducer (L12-5) was used for all the patients (B-Mode) to assess Achilles tendon. Color Doppler Mode also used in all cases. Dynamic ultrasonography done in some cases. Patient history were included, the exact location of pain, aggravated factors, the duration of symptoms, modes of treatment, and the degree of functional limitation.
Normal anatomy of Achilles tendon

The Achilles tendon is a part of the gastrocnemius-soleus complex. The aponeuroses from the three muscle bellies of the gastrocnemius and soleus muscles join and form the Achilles tendon. The fibres in the tendon spiral up to 90 degrees from the proximal to the distal end at the insertion on the calcaneal tuberosity. So the fibres originally positioned posterior in the proximal part of the tendon become lateral, lateral fibres become anterior, the anterior fibres medial, and medial fibres posterior, at the distal end of the tendon (1).

The distal portion of the Achilles tendon attaches to the mid-posterior calcaneus by a stiff fibrocartilaginous expansion. Close to the insertion of the tendon are the subcutaneous calcaneal and retrocalcaneal bursae. The Achilles tendon is surrounded by a peritendinous sheet (paratenon), with thin gliding membranes that decrease friction and allow free movement of the tendon against surrounding tissues (1).

Sonographic Anatomy of the normal Achilles tendon

The Achilles tendon is composed of parallel running fibers that are reflective by US (17). The resolution of the fiber pattern is increased with increased frequency of the US probe (18-19-20-21-22). For optimal ultrasonographic evaluation, tendons should be interrogated/scanned along both their long and short axes, orientating the ultrasound probe so that the ultrasonic waves reach the tendon perpendicularly. The highly ordered pattern of parallel collagen tendon fibers shows the highest echogenicity when examined perpendicular to the ultrasound beam.

In the longitudinal section (Figure 1.A), the normal Achilles tendon is equally thick or slightly thickened distally, with successively diminishing thickness proximally, where the Achilles tendon becomes a thin aponeurosis between the soleus and the gastrocnemius muscles (19). The maximum thickness of the tendon has been estimated to 6.3 mm ± 0.5 mm in adults 18 – 30 years, and 6.9 ± 1.0 mm in adults older than 30 years (23-24). In the transversal section the Achilles tendon is ovoid in shape (Figure 1.b).

*Figure 1.A- Longitudinal ultrasonographic image of a normal Achilles tendon. Note the echogenic, parallel fibrillar pattern (between arrow).*
highly reflective skin and subcutaneous fat identified. The Kager’s fat pad is seen ventral to the Achilles tendon and seen as a moderately echogenic irregular, structure. At ultrasound imaging, the pre-Achilles fat pad shows low mottled echogenicity relative to the normally echogenic tendon. With colour Doppler study no vessels could be seen in the normal Achilles tendon, however a few small vessels can be seen in the fatty tissue in Kager’s fat pad (9).

Figure 1.B - Transverse ultrasonographic image of a normal Achilles tendon showing echogenic ovoid shape (arrows)

Figure 2.A Left ankle

Figure 2.C Left Ankle

Figure 2. (A, B, C and D):

(A) Normal transverse ultrasonographic image of the left Achilles tendon (single arrow).
(B) Transverse ultrasonographic image of an Achilles tendinopathy on right side. The tendon is thickened, heterogeneous, and hypoechoic (double arrows).
(C) Normal longitudinal ultrasonographic image of the left Achilles tendon. (single arrow).
(D) Longitudinal ultrasonographic image of an Achilles tendinopathy in right side. (double arrows).
Figure 3 Longitudinal extended field of view ultrasonographic image of a complete tendon tear showing discontinuity and disruption of the tendon, retraction & thickening of the tendon fragments, heterogeneous echogenicity of the gap in the tendon (star) and fusing of the torn tendon ends (arrows).

Figure 4. A. Longitudinal view ultrasonographic image of an insertional chronic calcific Achilles tendinosis showing multiple intratendinous echogenic (bright) foci of calcifications (arrow) in the thickened hypoechoic distal Achilles tendon with fluid in retrocalcaneal bursa (star).

Figure 4. B. Multiple calcifications seen within distal part of tendon in another patient with no associated retrocalcaneal bursitis (arrow).
Figure 5. A.

Figure 5. B.

**Figure 5(A & B).**

A. Longitudinal ultrasound image of acute retrocalcaneal bursitis, demonstrating enlarged hypoechoic retrocalcaneal bursa.

B. With Power Doppler, detected vascularity within the bursa.

Figure 6. A.
**Statistical analysis**

Data was evaluated by using statistical package for social sciences (SPSS) software version 10 for calculating percentages and frequencies.

**RESULTS:**

In our study, all patients (137 patients) presented with achillodynia or tenderness around the Achilles tendon, predominant in the left side (91 patients, 66%). The mean age of the patients was 16±35 years, Females to males’ ratio was 4:1. Associated complaints in included pain in other regions of the leg such as the knee and thigh (21%), soft masses (14%), and swelling (2%). We found that, the point of maximal tenderness in our patients was located over the calcaneal tuberosity in 26 cases (19 %), at the bone- tendon junction (0±2 cm proximal to the calcaneus) in 16 cases (12 %), along the tendon (2±6 cm from calcaneus) in 46 cases (34 %), at the musculo-tendinous area in 12 cases (8%), in the retrocalcaneal bursa in 23 cases (17%), and in the posterior ankle in 14 cases (10%).

The duration of symptoms until presentation was less than 2 months (acute) in 90 cases (66 %) and more than 2 months (chronic) in 47 cases (34 %). Ultrasound findings were found to be normal in 41 cases (30%). This group of patients was young age at symptoms presentation (3±19 years). Sonography revealed abnormalities in 96 cases (70%) including 59 patients with abnormal tendons (42%). The mean diameter of the pathological tendons was 9.4±1.7 mm, while normal tendons measured 5.2±0.8 mm (P<0.001).Sonography also revealed structural differences between the pathological Achilles tendons and normal tendons. The normal tendon (Figure 2.A & C) displays a parallel layering of fibers extending along the longitudinal tendon axis, while in the abnormal tendon this ordered fibrillar arrangement is absent (Figure 2.B & D). A complete rupture of Achilles tendon (Figure.3) found in 3 patients (2%); a partial rupture of the Achilles tendon in 2 (1%);
various degrees of calcification of the tendon seen in 10 patients (7%) noted as hyperechoic zones within the tendon structure and acoustic shadows behind them; and peritendinous lesions discerned by the tendon's hypoechoic regions with disorganized arrangement of collagen fibrils in 5 patients (4%).

Other lesions included tendonitis (Figure 4.A & B ) seen in 5 patients, 4%, retrocalcaneal bursitis (Figure 4.A ) found in 11 patients 7%, one of the 11 patient showing acute retrocalcaneal bursitis ( figure 5 A & B) and xanthoma (Figure 6. A & B) in 1 patient, 2%.

DISCUSSION

The Achilles tendon, the largest & strongest tendon in the body, is vulnerable to injury because of its limited blood supply and the combination of forces to which it is subjected. Aging and increased activity (particularly velocity sports) increase the chance of injury to the Achilles tendon (25). Imaging plays a critical role in the diagnostic evaluation and assessment of patients with problems at and around the Achilles tendon; both in the documentation and differential assessment of disease as well as in the staging of the extent and severity of disease present (26). By ultrasonography, the normal tendon is visualized as a band comprised of parallel echogenic lines. In the presence of any pathology the Achilles tendon is often abnormally wide. Increased tendon diameter and zones of low echogenicity, often accompanied by peritendinous fluid, are typical findings associated with the various degenerative processes that can be depicted in the sonogram (27). Ultrasonography has many diagnostic advantages it can and should be applied in the primary clinic, dynamically and in real time (27-28). Compared to magnetic resonance imaging, which is static, ultrasonography has the capability of demonstrating physiological movement, and is simpler and more cost effective (29).

In our study, ultrasonography revealed structural differences between the normal & pathological Achilles tendons. The normal tendon displays a parallel layering of fibers extending along the longitudinal tendon axis, while in the abnormal tendon this ordered fibrillar arrangement is absent. We found Achilles tendon normal in 41 cases (30%), This group of patients was positively correlated with two clinical findings, relatively young age at presentation (3±19 years), and short duration of symptoms (<2 months). Ultrasonography is effective in detecting sings of inflammatory disease as tendinitis, paratendinitis and fluid accumulation in the retrocalcaneal bursa, in our study tendonitis seen in 5 patients (4%), and retrocalcaneal bursitis seen in 11 patients (7%). Peritendinous lesions are characterized by the presence of fluid around the tendon, similar to that seen in retrocalcaneal bursitis (14). Many authors (30- 31) reported that, calcification within the tendon is often seen in chronic tendinitis and is discernible by bright echoes with posterior shadowing. In our study, cases of tendonitis and tendon necrosis, an hypoechogenic zones and calcification were observed 2±5 cm above the calcaneal point of insertion.

Some investigators (32) showed that the baseline ultrasound appearance of the tendon, in the setting of chronic tendinopathy, was a poor predictor of subsequent clinical outcome. Conversely, other investigators have shown that tendon inhomogeneity can be used to predict clinical outcome in painful Achilles tendons (33 – 34). One observer (35) reported that patients with a clinical diagnosis of Achilles tendinopathy, with a normal ultrasound appearance of the Achilles tendon, had a significantly better clinical outcome, compared to individuals with abnormal findings at ultrasound. They also documented that patients with tendon thickening and focal hypoechoic areas had higher rates of subsequent spontaneous tendon rupture, which is supported by in our study by findings of foci of calcification in all patients with ruptured Achilles tendon (14- 36). Calcifications may also occur at the site of a prior tendon tear they are seen as hyperechoic areas casting acoustic shadowing (37-38): In our study, we used ultrasonography as a dynamic modality in the assessment of Achilles tendon tears, the torn edges are visualized during passive plantar flexion, and one investigator (39) reported that if good approximation is achieved with dynamic study the tear may be treated conservatively in a cast with a satisfactory outcome. We believe that partial tears should be viewed as advanced cases of tendinopathy and as such should be treated surgically with open debridement and suture. In our study
excellent result of surgery were found in our patient with partial tear of Achilles tendon.

Addition of color and power Doppler imaging to ultrasound has allowed for the noninvasive study of blood flow and vascularity within and surrounding the Achilles tendon. Zanetti et al. demonstrated that the presence of neovascularization is a relatively specific sign for a clinically painful tendon. However, the presence of neo-vascularization did not affect the patient’s outcome adversely (34). Finally, ultrasonography has many diagnostic advantages, it should be applied in the primary clinic, dynamically and in real time, as shown in our and other studies (19-28-39). It has the capability of demonstrating physiological movement, and is simpler and more cost effective than MRI.

CONCLUSION
In conclusion, the Achilles tendon is the most commonly injured tendon in the foot and ankle. Imaging modalities most commonly employed in the diagnostic assessment of the Achilles include conventional radiography, ultrasonography, and magnetic resonance imaging. Real time static and dynamic Ultrasound plays an important role in the documentation and staging of disease of the Achilles, and provides a noninvasive means of assessing patients presenting with painful Achilles tendon (achillodynia).

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