■ *Original Article*

Ultrasound evaluation of muscle and tendon

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Abstract

Background: Ultrasound has been shown to be effective in the diagnosis of musculoskeletal pathology, and its use continues to increase. **Objective**: To evaluate the role of ultrasound in detection of pathology of muscle and tendon, where the facility of advanced imaging modality is not available. **Methods**: Ultrasound evaluation of muscle and tendon was done in referred 550 patients with clinical history of localized pain or trauma. A detailed clinical history was taken before sonography. The clinical findings and provisional diagnosis were recorded. A routine ultrasound examination included imaging of the affected muscle and tendon. The findings were compared with contralateral limb. **Results**: Ultrasound showed ailment in 130 patients and was useful to detect lateral epicondylitis in 37 patients, tenosynovitis in 26, tear of muscle or tendon in 23, cystic lesions in 9, abscess in 17, myocysticercosis in 4, radiolucent foreign bodies in 3, muscle hernia in 2 and intramuscular hemangioma in 9 patients. **Conclusion**: High resolution ultrasound is a rapid and inexpensive technique.It can be used as a first line imaging modality for the musculoskeletal pathology particularly in developing countries with limited imaging facilities.

Keywords: ultrasound, musculoskeletal, muscle, tendon

Background

Ultrasound has been shown to be effective in the diagnosis of musculoskeletal pathology, and its use continues to increase. In the past low kilovoltage radiography and Xero-radiography had been used for radiological evaluation of the tendons for many decades.[1,2,3] These methods can silhouette the tendons, particularly when these are surrounded by fat. Radiograph could be useful to detect tendon calcification. CT can be useful technique for injury of muscle and tendons, but the limitation can be only axial scans. It has been rarely used in tendon imaging. It has also the disadvantages of high cost and hazards of radiation.[4] MRI is ideal method of imaging of muscle and tendons, but the technique is costly with less availability. According to some research workers, the results of ultrasound are more sensitive and accurate than MRI in detection of some injuries, like ankle tendon tear.[3,5]

The recent advance in high frequency ultrasonography has markedly improved the rate of correct diagnosis of musculoskeletal pathologies. So, ultrasound may be the investigation of choice for detecting the pathology of muscle and tendon, especially in our country for its relatively easier availability and low cost. Superficial tendons are specially suited for ultrasound evaluation.

Methods

In 550 patients ultrasound of muscle and tendon were performed in radiology department, B & B teaching hospital. Scanning was performed using a linear high frequency transducer (6.2-10 MHZ) (Siemens Sonoline G40).

A detailed clinical history was taken before sonography, clinical findings and provisional diagnosis were recorded. At the time of ultrasound

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examination, the patient was asked to indicate a focal point of discomfort or trauma or tenderness.

A routine ultrasound examination included imaging of the affected muscle and tendon, and the findings were compared with contralateral limb.

The criterion of observation was thickness of the muscle and tendon, thickness of the tendon/tendon sheath, presence of fluid within the tendon sheath, the continuity as well as echotexture of the muscle fiber and tendon, any focal lesion or collection within the muscle and tendon. A focused examination included a more thorough interrogation of the area under the indicated point of discomfort, including the use of Doppler imaging, dynamic imaging if applicable.

Results

Table 1: Tenosynovitis

Site	No. of cases
Quadriceps tendon	2
Extensor tendon wrist	3
Flexor digitorum wrist	6
Posterior tibialis tendon	3
Achilles tendon	4
Rotator cuff	1
Extensor pollicis tendon	1
Common flexor tendon elbow	1
Flexor tendon index finger	1
Peroneal tendon	1
Flexor tendon middle finger	1
Plantar fascia	2

Table 2: Tear of muscle and tendon

Muscles and tendon	No. of cases
Achilles tendon	2
Quadriceps tendon	3
Medial gastrocnemius muscle	3
Biceps brachi muscle	1
Common extensor tendon	1
Biceps femoris muscle	1
Vastus lateralis muscle	3
Anterior tibialis muscle	2
Flexor digitorum tendon	1
Adductor muscle of thigh	1
Rotator cuff	1
Vastus medialis muscle	1
Triceps tendon	1
Common peroneal tendon	1
Hamstring muscle	1

Table 3: Tenosynovial ganglion

Site	No. of cases
Wrist	4
Ankle	2
Elbow	1
finger	2

Table 4: Intramuscular abscesses

Site	No. of cases
Thigh	6
Calf muscle	4
Gluteal muscle	4
Heel	1
Shoulder	1
Foot	1

Table 5: Myocysticercosis

Site	No. of cases
Palm	1
Calf	2
Forearm	1

Table 6: Intramuscular hemangioma

Site	No. of cases
Shoulder	3
Gluteal	1
Thigh	2
Calf	2
Leg	1

A total of 550 patients underwent ultrasound evaluation of muscles and tendon. Ultrasound showed abnormalities in 130 patients. The patient's age ranged from 17 years to 55 years. In our series the abnormalities detected by ultrasound did correspond to focal symptoms and cause of muscular or tendon ailment.

A variety of causes of lateral epicondylitis have been presented, but the most accepted theory is cumulative microtrauma that results from repetitive wrist extension and alternating forearm supination and pronation.[6,7,8] Scar tissue develops from the healing process, which is then vulnerable to further tearing with repeated trauma.[9,10,7] Subsequently, as the cycle of injury and repair repeats, the patient becomes symptomatic. Examination of the elbow for lateral epicondylitis (tennis elbow) was the most frequent US examination performed in our study. The abnormality in ultrasound could be seen in 37 patients.

There was asymmetric thickening of the tendon in the affected elbow compared to that of contralateral side in all the patients (Fig1a,b). In addition the tendon was slightly hypoechoic with heterogeneity of the fiber margin. Thickening of the tendon sheath was found in 4 patients with acute tendonitis. Patients with history of recent injection of steroid and trauma were excluded in this category. Most of the affected patients were female (M-11, F-26). Associated focal partial tear of the tendon was found in two patients with lateral epincondylitis. Tiny intrasubstance calcification of the tendon was seen in three patients (Fig1c).

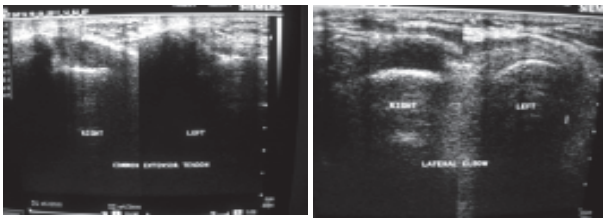

Fig. 1a,b: Lateral epicondylitis showing thickening of the right common extensor tendon and decreased echogenicity. Significant difference in the thickness and echotexture of the tendon is observed compared to contralateral side.

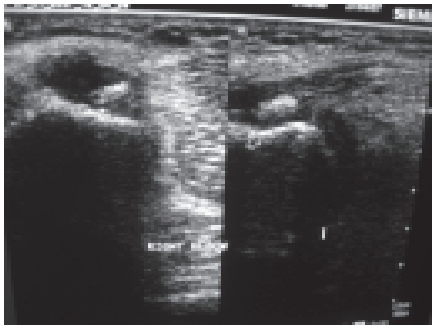

Fig 1c. Chronic calcific tendonitis of common extensor tendon in a patient with lateral epincondylitis.

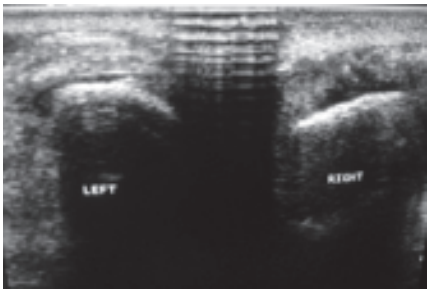

Fig 1d. Focal partial tear of the common extensor tendon in a case of chronic lateral epicondylitis.

Ultrasound and MRI of the origin of the common extensor tendons are valuable in diagnosing lateral epicondylitis.[9,11,12,13] Levin et al have found a statistically significant relationship between clinical symptoms of lateral epincondylitis and ultrasound findings of intratindinous calcification, tendon thickening, bone irregularity, focal hypoechgenicity, and diffuse heterogeneity, which resulted in sensitivity and specificity of 72-88% and 36-48.5%.[11]

Acute tenosynovitis of the tendons may be detected with increase in diameter with surrounding hypoechoic area, when compared with normal contralateral side. Fluid in the sheath, even in minimal quantity can be seen in suppurative synovitis.[14] Chronic tenosynovitis is characterized by a hypoechoic thickening of the synovium, most often with little or no fluid.

Tenosynovitis of the flexor carpi ulnaris at the level of the wrist is particularly common and occurs in up to 50% of involved wrists in rheumatoid arthritis.[15] Loss of the normal fibriller echotexture consistent with tendinitis may be seen in 55% to 60%of cases.[16] In our study the tenosynovitis were detected in 26 patients (Table 1). The focused ultrasound showed thickening of the tendon and sheath, correlating the clinical finding of soft tissue swelling and tenderness (Fig 2a,c). The tenosynovitis were seen in different parts of the limbs, the most frequent site being flexor digitorum tendon of the wrist in 6 cases . There was increased vascularity on color Doppler in some of the cases indicating acute inflammation (Fig2b). Chronic calcific tendinosis was found in rotator cuff and Achilles tendon in two cases. Diffuse thickening of the Achilles tendon due to chronic tendinosis was found in one patient. In two patients of plantar fasciitis showed hypoechoic thickening of the plantaris brevis muscle at the insertion (Fig 4)

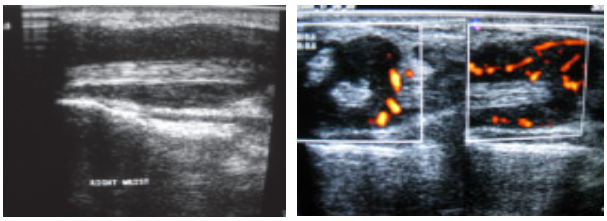

Fig2 a,b. Acute tenosynovitis of the extensor tendon of the wrist showing hypoechoic thickening of the tendon sheath. On color Doppler there is significant increase in the vascularity.

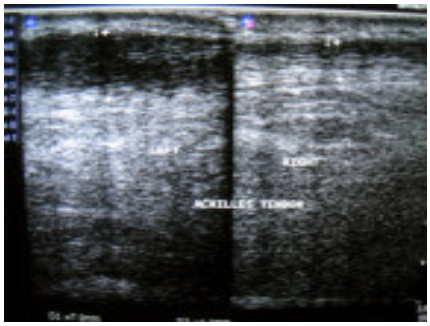

Fig2c. Acute tendinitis of the Achille's tendon. The tendon in thickened tendon with decreased echogenicity compared to contralateral side.

Complete tears of the tendon are visible as complete disruption of fibers i.e. a full thickness discontinuity with variable amount of retraction of fragments from one another. [17] The interval between the fragments is filled up with hematoma, which has a variable echopattern. There may be an echogenic fibrous scar at the injured site in case of an old tear. Hematoma may calcify. Partial tears are difficult to diagnose clinically and to differentiate it from focal tendonitis. They appear as focal hypoechoic defects within the tendon or at the insertion due to disruption of fibers and presence of edema. Calcification may be present. A ultrasound finding of tendon rupture correlates well with those appearances found at time of surgery, there being accurate correlation in over 90% of cases.[18]

Twenty-three patients showed tear of the muscles and tendon (Table 2). Partial tear of the muscle was common, which showed small areas of hypoechogenicity and discontinuity in the muscle & tendon with loss of fiber margin (Fig 4,8). Associated small collection was seen within the muscle as well as intermuscular fascia in acute tear. Complete tear of the tendon with retraction were seen involving Achilles tendon, quadriceps tendon and triceps tendon (Fig 3, 5,6,7,9).

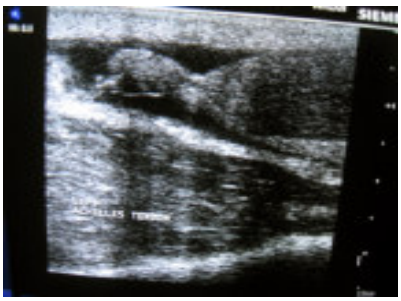

Fig 3a.Complete rupture of Achille's tendon with hematoma.

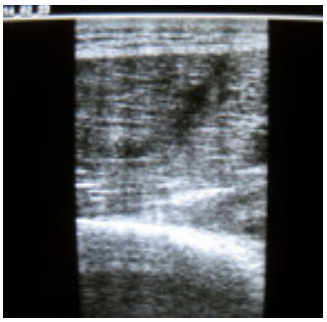

Fig 3b. Partial tear of the muscle of calf. The continuity of the muscle fiber is disrupted with minimal collection.

Fig 3c. Rupture of triceps tendon with retraction

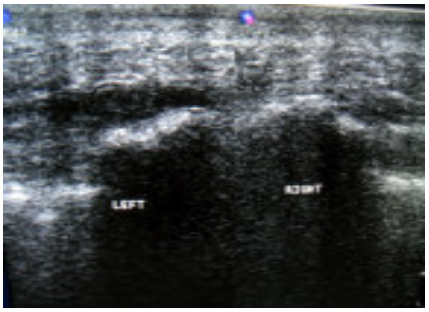

Fig 4 Plantar fascitis showing hypoechoic thickening of the left plantaris brevis muscle at insertion. Comparison was made with right sided plantar fascia, which showed normal thickness of the muscle and fiber margin.

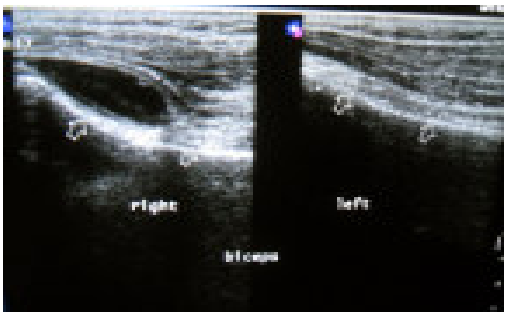

Fig 5 : Acute tear of biceps tendon with hematoma. Comparison made with contralateral side.

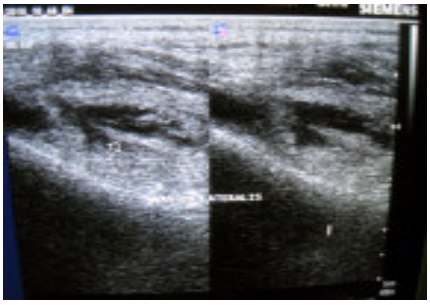

Fig 6: Partial tear of the vastus lataralis muscle

Fig 7: Tear of the medial gastrocnemius muscle with retraction and small collection

Fig 8: Partial tear of the supraspinatous tenon

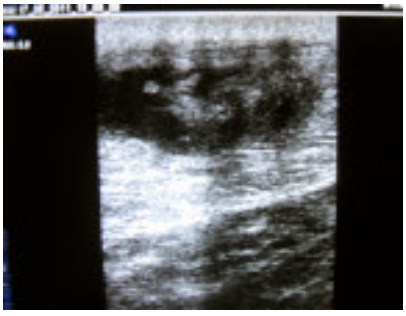

Fig 9: Acute tear of rectus muscle with hematoma in a soccer player

In most cases pre-existing degenerative changes and recurrent microtraumas predispose tendons to rupture, and damaged tendons may also rupture as a result of relatively minor trauma or functional overload. In this field, it has been reported that 90% to 95% of patients with rupture of the Achilles tendon also exhibit US changes of tendon disease in the contralateral tendons. [18,19] High frequency of ultrasound can identify degenerative changes, differentiate partial from complete tears, and determine whether the patient has to be treated surgically or conservatively. Power Doppler interrogation should be performed to look for neovascularization within an abnormal tendon. The importance of this finding is not fully understood, but normal tendons do not exhibit neovascularity. Results of some studies have suggested that neovascularity initially correlates with pain severity, but a consistent relation to poorer outcome has not been found. All of the sonographic findings of tendinopathy be seen at an asymptomatic stage, but prominent tendon swelling, loss of fibrillar structure, and neovascularity usually are associated with severe symptoms.[20]

Myositis may be less readily demonstrated sonographically. Usually, there is a diffuse increase in muscle bulk and subtle decrease in muscle echogenicity but these changes may be difficult to quantify particularly if, as is often the case, the inflammatory myositis is bilateral so that comparison with contralateral side is not possible. Occasionally, in cases of myositis the muscle is hyperechoic and is more easily differentiated from normal muscle. In cases of acute pyomyositis there may be central areas of compressible fluid sonographically consistent with intramuscular abscess formation and the muscle generally may be markedly swollen and hypoechoic. Ultrasound was quite useful to detect intramuscular abscess in 17 patients (table 4). The common site included thigh, calf and gluteal region. The lesions showed localized and illdefined collection with internal echoes. Associated inflammatory change was present in the adjacent muscles, which showed increased echogenicity of the muscle and poorly defined margin of the fibers.

Ultrasound is being increasingly used in the diagnosis of the soft tissue foreign bodies, in particular for the non-radiopaque materials that may not be visualized with conventional radiography.[21,22] High resolution US is capable of detecting superficial foreign bodies with sensitivity of 94% and a specificity of 99%.[23] There were three cases of radiolucent intramuscular foreign bodies in our series, one each in the thigh, forearm and in the palm. All the foreign bodies were wooden log. There was surrounding abscess and sinus formation in the lesion of thigh and forearm (Fig:11).

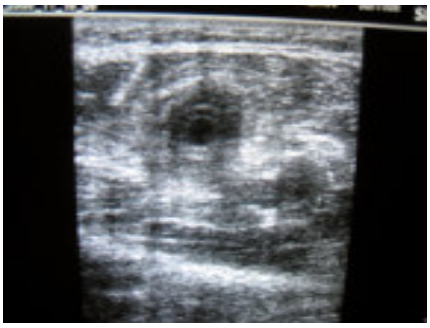

Fig 10a: Intramuscular cysticercosis with peripheral inflammation.

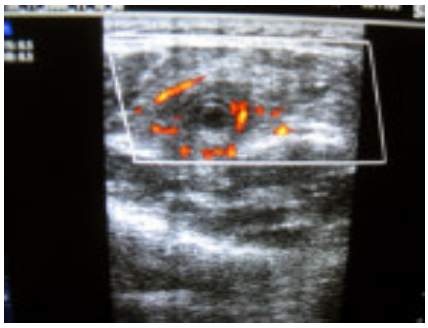

Fig 10b: Intramuscular cysticercosis with peripheral inflammation. Color doppler showing increased vascularity

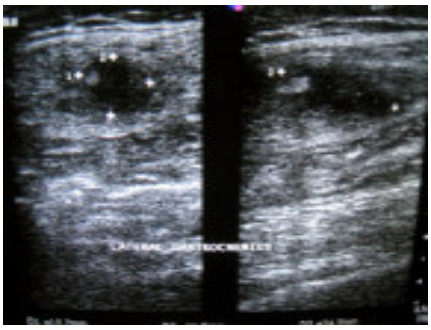

Fig 10c: Intramuscular cysticercosis. An echogenic nodule within the cyst representing scolex.

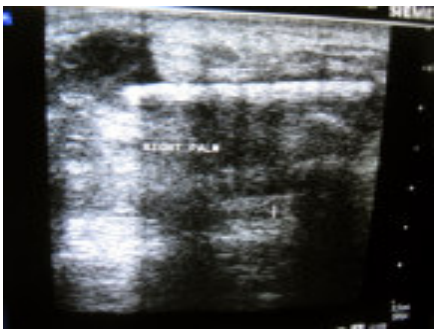

Fig 11: Foreign body in the palm (wooden log). A linear echogenic lesion present beneath the superficial flexor tendons.

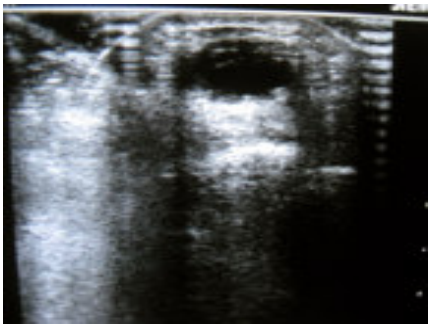

Fig 12: Ganglion in the dorsal aspect of the wrist.

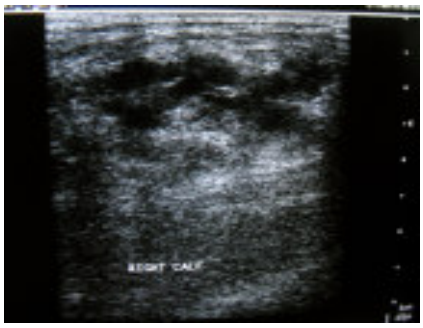

Fig 13a: A compressible mass in the calf showing small cystic spacs with vascularity. Intramuscular hemangioma

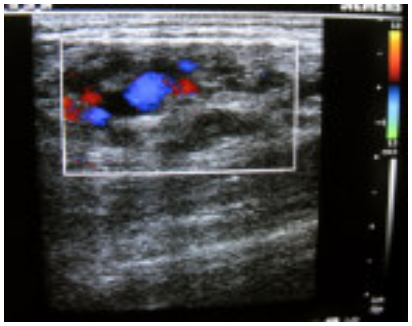

Fig 13b: A compressible mass in the calf showing small cystic spacs with vascularity. Intramuscular hemangioma.

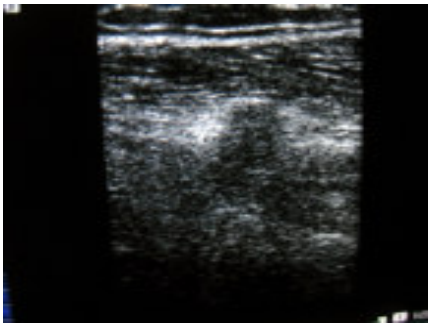

Fig 14: 25 years male presenting with localised pain in the calf. US shows small reducible iso-hypoechoic lesion protruding through the fascia in calf. Muscle hernia.

Cystic lesions in the muscle and tendon could be of various etiology, either tenosynovitis or post traumatic cyst or parasitic infestations. In our study tenosynovial ganglion were seen in 9 cases (Table 3), the common site being the wrist in 4 patients (Fig12:). Small intramuscular cystic lesions were found in 4 patients, which were confirmed as myocysticercosis (Fig: 10a,c). Small echogenic nodule could be seen within the cyst, which represent scolex of the Taenia solium. In two cases there was inflammatory change in the adjacent muscle in cases of cysticercosis, which showed fuzzy margin of the muscle fibers and increased vascularity on color Doppler interrogation (Fig 10b).

The sonographic features of muscle hernias are characteristic and exclude alternative clinical diagnosis such as tumors and muscle tears.[24] There were two cases of muscle hernia, who had localized pain and tenderness (Fig: 14). The focused ultrasound at the point of tenderness showed isoechoic small mass through adjacent fascia contiguous with the muscle, and disappeared on probe compression.

US assists in determining the size and consistency of a soft tissue masses. Additional to conventional gray scale images, Color Doppler offers flow information. In 9 patients there was compressible soft tissue mass, which were confirmed as intramuscular hemangioma (Table 6). The common location was shoulder in 3 patients (Table 6). US showed illdefined hypoechoic intramuscular mass with small cystic spaces. Sluggish venous flow was seen in these lesions on color Doppler (Fig 13). These patients presented with pain and swelling at the site of the hemangioma. The ultrasound was useful to rule out any underlying infection and tear of the muscles.

Conclusion

Significant advances in gray scale and color flow ultrasound imaging have resulted in an expanded role of ultrasound in the evaluation of musculoskeletal pathology. High resolution ultrasound is a useful tool for the evaluation of muscle and tendon pathology. It is a rapid, inexpensive technique with adequate equipment, training and expertise makes it compelling for use as a first line imaging modality for the musculoskeletal pathology particularly in the underdeveloped country with limited imaging facilities.

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