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*Review Article*

# Musculoskeletal ultrasound: Is it underutilised?

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A good history is the most cost effective component of the clinical evaluation. Clinicians must sift through and analyze the extraneous information that inevitably accompanies the patient presenting for the first time. When the diagnosis is unclear, proper selection of imaging modality becomes paramount in today's health care system.

The musculoskeletal system can be subject to acute injuries including contusions, strains, or sprains, tearing of soft tissues, dislocations, fractures or any combination of these. Systemic diseases including rheumatologic, endocrine, vascular and so forth can lead to alteration of musculoskeletal biomechanics, which ultimately can change one's function. Infection, tumours are other conditions that can lead to the musculo-skeletal morbidity of varied severity.

Like most subdisciplines in diagnostic imaging, musculo-skeletal radiology has been affected by the explosive technological developments that have taken place during the last few decades. But the order of testing should be (1) from inexpensive to costly, (2) from less to more risky, (3) from simple to more complex. Unfortunately, despite the dramatic advances in CT and MR imaging, they do carry a high expense and they are performed at fixed facilities. Thus, the ideal initial imaging device, after plain radiograph is ultrasound because it provides economic and noninvasive imaging of tissue.

Significant advances in gray-scale and colour flow ultrasound imaging have resulted in an expanded role of US in the evaluation of musculo-skeletal pathology [1,2]. High resolution imaging afforded by the current generation of high frequency linear transducers has been shown to produce exquisite gray-scale images of tendons, muscles, nerves and so forth. Likewise, improvements in colour flow sensitivity allow the demonstration of alterations in blood flow associated with a variety of inflammatory, neoplastic, and posttraumatic status [2,3]. These improvements along with economic factors and availability have resulted in renewed interest in using ultrasound as a diagnostic tool. As such, the efficacy of US has been compared with other modalities, in particular MR imaging, as a cost effective imaging alternative. US has the ability to characterize changes in the cortical surface of bone, or of the adjacent periosteum, has extended its applications to the diagnosis of fractures, osteomyelitis, and characterization of some neoplastic processes [1]. The presence of metallic hardware often precludes evaluation of the involved bones and soft-tissues with CT and MR, in such situation US can be the best alternative imaging modality.

**Trauma**

In traumatic injury plain radiographs remain crucial. There are a number of scenarios, however, radiographs alone are insufficient for management and US may have a major clinical role to play. Chronic repetitive trauma can result in localized swellings, such as enlarged bursae or ganglia, or produce focal injury to tendons, ligaments, muscles, cartilage and even bone, which are frequently occult to or only partially visualized with radiographic examination. US can clarify the nature of such swelling, depict superficial tendon, ligament or muscle injury, and in some cases demonstrate joint loose bodies, and associated bony erosions [4,5]. In acute trauma US may be used to see the soft tissue injury (tendon or ligament injury), haemarthrosis, effusion, when radiographs are negative [6]. In addition associated vascular complications like pseudoaneurysm, AV fistula, colour Doppler is quite useful to confirm. In children US can show fractures, deformities and displacements of non-ossified cartilages. In sport injuries, US examination of the soft tissue can be done quickly and with good accuracy, as well as it becomes apparent that one can help return athlete back to his or her sport in a very efficient manner.

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Many musculoskeletal injuries are demonstrated with specific types of motion. US is an outstanding tool in this dilemma, because it can image tissues in both static and dynamic motion. In addition US is excellent method for detection and extraction of non-opaque foreign bodies.

US, by its ability to visualize developing callus before radiographic changes are evident, can be used to assess the changes of bone healing. It can be applied to measure the distraction gap and assess the formation of new bone following the Ilizarov procedure or other limb lengthening operations [7,8].

**Joint**

Apart from trauma US has been used for the assessment of acute and chronic joint infection, rheumatoid arthritis, pigmented villonodular synovitis and crystal deposition arthropathies, such as gout. The finding can be nonspecific like synovial thickening or masses, echogenic debris, bone or cartilage erosions, but are still useful for clinical staging, guiding percutaneous joint aspiration and even synovial biopsy [6].

Movement related joint pain is very common and is the usual presenting symptoms in the rotator cuff tear of the shoulder. US is very useful to depict tendon or bursal impingement that usually accompanies the pain, and also help distinguishing between impingement and tear [6] .

There is wide range of tendon pathology, with varied appearance. Full-thickness tears may appear as transverse gaps in the fibre bundles, or as focal contour deformities. Tendon dislocation is another entity that can be detected with high resolution US. Tendon calcification appears as a focal brightly hyperechoic area with variable degrees of posterior acoustic shadowing. Focal tendon swelling may be due to overuse syndromes, such as Achilles or patellar tendinosis, which often has internal focal areas of decreased echogenicity, or to intrasubstance deposition, such as tendon xanthomas. Tenosynovitis may manifest as thickening of the tendon sheath or a hypoechoic rim around the tendon due to fluid or replaced by hypoechoic granulation tissue.

US is accepted method of primary investigation of the congenital dysplasia of hip. The image is obtained with the child on his/her side with the hip slightly flexed, the transducer is parallel to the ilium and the image obtained is in the coronal plane. The measurement of Graf angle may be made in the assessment of hip dysplasia to determine the degree of dysplasia and plan management [9].

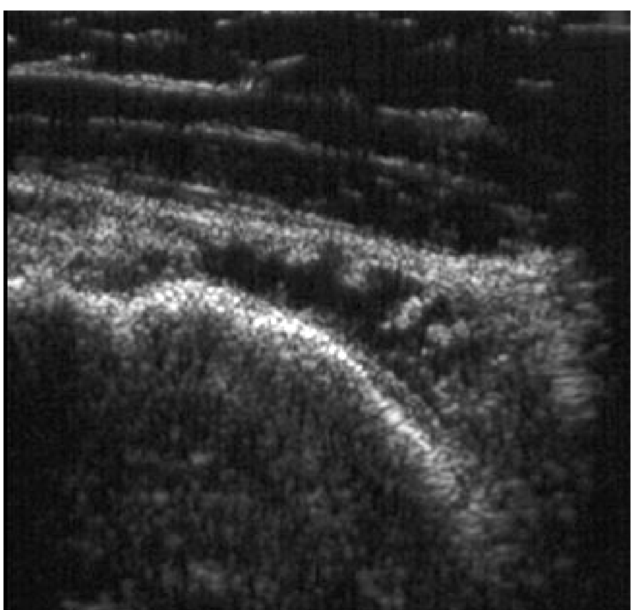

**Fig 1:** Ultrasound shows full thickness supraspinatous tear

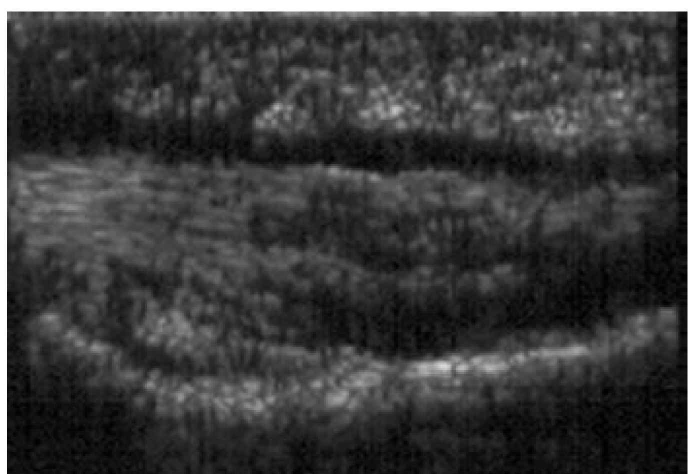

**Fig 2:** Thickened tendon with hypoechoic halo-tenosynovitis

**Infection**

US can be best used to diagnose bone and soft tissue infection and to localize and aspirate infected fluid. In early osteomyelitis, plain radiograph usually does not show any change, where as a spectrum of US findings can be demonstrated, e.g. soft tissue swelling, subperiosteal fluid collection, periosteal elevation, cortical breach or destruction [10,11]. In septic arthritis US is useful to localize the soft tissue swelling accurately and characterize the collection, demonstrate articular erosion and periarticular effusion. US can be used to diagnose infection around loosened hip prostheses or infected orthopaedic metalware [12].

**Cartilage imaging**

US can detect gross changes in the articular cartilage [13], but the main limiting factor is acoustic access. However alternatively intraarticular US may provide the earliest imaging evidence of changes in the articular cartilage. Surface fibrillary change is an early manifestation of the osteoarthritis. MR is the best modality for global assessment of the articular cartilage so far.

**Nerve compression and tumours**

Nerve involvement from extrinsic causes may occur anywhere in the body, commonly at anatomic sites, where the nerves passes in unextensible osteofibrosis tunnels or beneath a prominent or abnormal band of muscles, connective tissue or bony ridge that tether the nerve. US is increasingly proposed as an efficient and low-cost alternative to MR imaging for detection of compressive lesions. US can detect changes in both nerve shape and echotexture. Diffuse flattening or localized constriction of the nerve and associated swelling of the nerve portion proximal to the level of compression are the main findings. The most common sites of nerve entrapment that are amenable to US study include the carpal tunnel for the median nerve and the cubital and Guyon's canals for the ulnar nerve in the upper limb, the proximal fibula for the common peroneal nerve, the tarsal tunnel for the posterior tibial nerve, and the metatarsal heads for the interdigital nerves in the lower limb[14].

The most important contribution of the US related to trauma is demonstration of interruption of nerve continuity. In these cases US is able to image the defect in the nerve, to predict the level of nerve section preoperatively, as well as to assess its integrity and to identify early complications after reconstructive surgery.

The diagnosis of a nerve tumour is based on detection of a mass along the course of a nerve in association with clinical and neurologic signs. US can be reliable tool to detect a mass along its course. Nerve tumours appear as solid hypoechoic mass [15].

**Musculo-skeletal tumours**

US allows visualization of musculoskeletal masses that are not confined to the intraosseus compartment. It assists in determining the size and consistency of a soft tissue mass. In particular, it allows differentiation between cystic and solid masses. US may also be used to differentiate between a localized mass and diffuse oedema. Colour Doppler flow imaging (CDFI) allows visualization of blood flow within solid soft tissue masses, however CDFI features do not assist in differentiation between malignant and benign tumours [16,17]. Colour Doppler has proved to be a useful tool to monitor regression of tumour neovascularity induced by therapy in patients with musculoskeletal sarcomas [18]. US can also be used to guide percutaneous biopsy after confirmation of a suspected lesion.

**Bone density**

Broad based acoustic attenuation and sound velocity have been shown to display a quantum relation to mineralization. These methods correlate well with other existing techniques to determine bone mineral content. Qualitative assessment of callus formation across fractures and corticotomy defects has been demonstrated using gray-scale imaging, indicating the potential value of combining imaging with quantitative assessment of mineralization [19].

**Intervention**

US provides easy real-time guidance for arthrocentesis and other diagnostic aspiration procedures. It is also useful when performing diagnostic local anaesthetic injections of large joints. US has also been used to direct biopsy needles into erosions and inflamed enthesal sites as well as musculoskeletal tumours. US guidance may be used for local steroid injection of bursae and the tendon sheaths in patients with a chronic inflammatory arthropathy [20]. Over 90% of patients with local heel pain due to one of the varied causes related to chronic inflammatory arthritis (e.g. retrocalcaneal bursitis, plantar fascitis) have full resolution of this heel pain following US-guided cortico-steroid injection therapy [21].

**Ultrasound Vs. MRI**

MR imaging is essentially the standard of care for the evaluation of the musculoskeletal system. However, sonography has recently experienced an increase in popularity for several reasons. This includes its relative low cost, portability, and in most cases improved accessibility. Evaluation of a soft tissue lesion with metallic prostheses is possible with US without artifact that limits MR imaging. US guided intervention procedures, dynamic evaluation of joints, improved resolution of superficial structures are other advantages.

There exist several advantages of MR imaging over US. These are less operator dependence, global evaluation of the area of interest including deep soft tissue, bone marrow and joint cartilage with high sensitivity. US has demonstrated that it can produce results at least equal to MR imaging if performed by an experienced radiologist. Van Holsbeeck et al have shown that US can diagnose partial-thickness rotator cuff tears with 93% sensitivity and 94% specificity, demonstrating the potential effectiveness of rotator cuff sonography[22]. Waitches et al demonstrated 93% accuracy and 100% sensitivity in diagnosing tendon tears of the posterior tibial, peroneal, and flexor digitorum longus tendons using surgery as a gold standard [23]. Astrom et al demonstrated that US and MR imaging provide similar information in the evaluation of chronic Achilles tendinopathy [24]. In the evaluation of development dysplasia of the hip, US is the study of choice considering its availability, low cost, lack of general anaesthesia and proven success rates. Although MR imaging is capable of demonstrating unossified cartilage as well, it is generally reserved for problematic cases. It has also been used after operative treatment for hip dysplasia to confirm hip reduction and to evaluate for avascular necrosis [25].

**Conclusion**

MR imaging has been considered as the pre-eminent modality worldwide for the evaluation of musculoskeletal pathology. High resolution US with colour Doppler, although underutilized, is probably the imaging technique of choice for assessment of superficial musculo-skeletal lesions. US has the advantages of improved tissue and fluid characterization, easy availability, cheaper modality, real time imaging and performing interventional procedures.

**References**


1. Fornage BD: Musculoskeletal ultrasound. New York, Churchill Livingstone, 1995
2. Newman JS, Adler RS, Bude RO, Rubin JM: Detection of soft tissue hyperemia: value of power Doppler sonography. AJR 163: 385-389, 1994
3. Bouffard JA, Eyeler WR, Introcaso JH, van Holsbeeck M: Sonography of tendons. Ultrasound Quarterly 11: 259-286, 1993
4. Chhem RK, Kaplan PA, Dussault RG: Ultrasonography of the musculoskeletal system. Radiol clin North Am 32: 275-289, 1994
5. Alasaarela E, Takalo R, Tervonen O, et al: Sonography and MR in the evaluation of painful arthritic shoulder. Br J Rheumatol 36:996-1000, 1997
6. Shih-chang Wang, Rethy K Chhem, Etienne C: Joint sonography. Radiolo clin North Am 37: 653-668, 1999
7. Blane, CE, Herzenberg JE, Di Pietro MA: Radiographic imaging for Ilizarov limb lengthening in children. Pediatr Radiol 21:117, 1991
8. Young JWR, Kostribiak IS, Resnick CS, et al: Sonographic evaluation of bone production at the distraction site in Ilizarov limb-lengthening procedures. AJR 154: 125, 1990
9. David Sutton: Textbook of radiology and Imaging. Churchill Livingstone 7th Ed, Vol 2, 2003 Pge- 1109-10
10. Abiri MM, Kirpekar M, Ablow RC: Osteomyelitis: Detection with US. Radiology 172:509, 1989
11. Cleveland TJ, Peck RJ: Case report: chronic osteomyelitis demonstrated by high resolution ultrasonography. VClin Radiol 49: 429, 1994
12. Joseph G. Craig: Infection: Ultrasound-guided procedures. Radiolo clin North Am 37:669-678, 1999
13. Aisen A, Mc Cune WA, Martel WM: sonographic evaluation of the cartilage of knee. Radiology 153: 781-784, 1984
14. Hughes DG, Wison DJ: Ultrasound appearances of peripheral nerve tumours. Br J radiolo 59: 1041, 1986
15. Martinoli C, Bianchi S, Derchi LE: Tendon and nerve sonography. Radiol clin North Am 37: 691-711, 1999
16. Latiti HR, Siegel MJ: Colour Doppler flow imaging of pediatric soft tissue masses. J Ultrasound Med 13: 165, 1994
17. Taylor GA, Perlman EJ, Scherer LR, et al: Vascularity of tumours in children: Evaluation with colour Doppler imaging. AJR 157: 1267, 1991
18. Van der Woude HJ, Bloem JL, Van Oostayen JA et al: Treatment of high grade bone sarcomas with neoadjuvant chemotherapy: The utility of sequential colour Doppler sonography in predicting final histologic response. AJR 165:125, 1995

19. Ronald S: Future and new developments in musculoskeletal ultrasound. Radiol clin North Am: 37:627, 1999
20. Brophy DP, Cunnane G, Fitzgerald O, et al: Technical report: Ultrasound guidance for injection of soft tissue lesions around the heel in chronic inflammatory arthritis. Clin Radiol 50:120-122, 1995
21. Cunnane G, Brophy DP, Gibney RG, et al: Diagnosis and treatment of heel pain in chronic inflammatory arthritis using ultrasound. Semin Arthritis Rheum 25:383-389, 1996
22. van Holsebeeck MT, Kolowich PA, Eyler WE, et al: US depiction of partial-thickness tear of the rotator cuff. Radiology 197:443, 1995
23. Waitches GM, Rockett M, Brage M, et al: Ultrasonographic-surgical correlation of ankle tears. J Ultrasound Med 17:249, 1998
24. Astrom M, Carl-Fredrik G, Nilsson P, et al: Imaging in chronic Achilles tendinopathy: A comparison of ultrasonography, magnetic resonance imaging and surgical findings in 27 histologically verified cases. Skeletal Radiol 25:615, 1996
25. Gersovich EO: A radiologist's guide to the imaging in the diagnosis and treatment of developmental dysplasia of the hip: The role of sonography. Skeletal Radiol 26:386, 1997