Recommended musculoskeletal and sports ultrasound terminology: a Delphi-based consensus statement

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The following societies have endorsed this statement: American Institute of Ultrasound in Medicine, American Medical Society for Sports Medicine, American Orthopaedic Society for Sports Medicine, American Society of Regional Anesthesia and Pain Medicine, Canadian Academy of Sport and Exercise Medicine, European Society of Musculoskeletal Radiology, Society of Interventional Radiology and Society of Skeletal Radiology. The American Academy of Physical Medicine and Rehabilitation has affirmed the value of the statement.

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ABSTRACT
The current lack of agreement regarding standardised terminology in musculoskeletal and sports ultrasound presents challenges in education, clinical practice and research. This consensus was developed to provide a reference to improve clarity and consistency in communication. A multidisciplinary expert panel was convened consisting of 18 members representing multiple specialty societies identified as key stakeholders in musculoskeletal and sports ultrasound. A Delphi process was used to reach consensus, which was defined as group level agreement of >80%. Content was organised into seven general topics including: (1) general definitions, (2) equipment and transducer manipulation, (3) anatomical and descriptive terminology, (4) pathology, (5) procedural terminology, (6) image labelling and (7) documentation. Terms and definitions which reached consensus agreement are presented herein. The historic use of multiple similar terms in the absence of precise definitions has led to confusion when conveying information between colleagues, patients and third-party payers. This multidisciplinary expert consensus addresses multiple areas of variability in diagnostic ultrasound imaging and ultrasound-guided procedures related to musculoskeletal and sports medicine.

INTRODUCTION
The use of ultrasound for diagnostic imaging and procedural guidance in musculoskeletal and sports medicine has increased dramatically and involves multiple disciplines and subspecialties. A lack of consensus regarding standardised terminology can lead to confusion when conveying information between colleagues for clinical and research purposes. Our learners often struggle as different terms are used to describe simple actions such as transducer movement and imaging planes. Furthermore, communication with our patients, third-party payers and the public also faces these same challenges.

The primary purpose of this consensus is to provide a clear and useable reference for anyone using musculoskeletal and sports ultrasound. We aim to improve the clarity of communication in clinical practice and improve consistency in the literature. While other terminology references are

Box 1 Musculoskeletal and sports ultrasound terms and definitions outline

1. General.
2. Equipment and tansducer manipulation.
3. Anatomical and descriptive.
4. Pathology.
5. Procedural.
6. Image labelling.
7. Documentation.

Table 1 General definitions

Term	Definition
Musculoskeletal ultrasound	The use of ultrasound to diagnose and/or guide treatment of conditions involving bones, joints, tendons, muscles, bursae, ligaments, cartilage, nerves, fascia and related soft tissue structures. Indications and specifications are outlined in the AIUM Practice Parameter for the Performance of a Musculoskeletal Ultrasound Examination,[6] the AIUM Practice Parameter for the Performance of Selected Ultrasound-Guided Procedures[7] and the ESSR Musculoskeletal Ultrasound Technical Guidelines.[8]
Sports ultrasound	The use of ultrasound by a qualified medical professional to diagnose and/or guide treatment for injuries and medical conditions associated with sport and exercise. This may involve both clinical and in-the-field applications. Sports ultrasound evaluations are most often performed to answer a specific clinical question, and the need for further imaging or involvement of other medical imaging experts should be considered.

AIUM, American Institute of Ultrasound in Medicine; ESSR, European Society of Musculoskeletal Radiology; SSR, Society of Skeletal Radiology.

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Table 2 Equipment and transducer manipulation

Term	Definition
Equipment	
Transducer	The hand-held device with which one obtains ultrasound images
Cord	The connection of the hand-held ultrasound device to the machine or viewing device (if not wireless)
Transducer manipulation	
Slide	Motion of the transducer across the body surface in any direction
Heel–toe	Motion in the long axis of the transducer along a fixed point changing the angle of insonation away from 90° to the skin surface while maintaining contact with the skin surface, often used to achieve an angle of insonation at 90° to the target structure to optimise visualisation and eliminate anisotropy
Tilt	Motion in the short axis of the transducer along a fixed point changing the angle of insonation away from 90° to the skin surface while maintaining contact with the skin surface, often used to achieve an angle of insonation at 90° to the target structure to optimise visualisation and eliminate anisotropy
Compression	Force is applied by the sonographer or sonologist on the transducer towards the patient's body.
Rotation	Motion along a fixed centre axis point of the transducer in the clockwise or counterclockwise direction
Pivot	Motion along a fixed axis point at the end of the transducer in the clockwise or counterclockwise direction
Stand off	The transducer does not touch the skin surface but rests on a layer of acoustic coupling gel or other acoustic medium with angle of insonation at 90° to the skin surface.
Oblique stand off	The transducer does not touch the skin surfacebut rests on a layer of acoustic coupling gel or other acoustic medium with angle of insonation away from 90° to the skin surface.
Sonopalpation	Force is applied on the transducer towards the patient's body to elicit symptom provocation (eg, pain).

available, our focus was on clinically relevant topics in the context of musculoskeletal medicine, where we identified frequent variations in terminology used in everyday practice, scientific presentations and the literature. Our goal was to present a user-friendly reference of the most common terminology encountered in musculoskeletal and sports ultrasound.

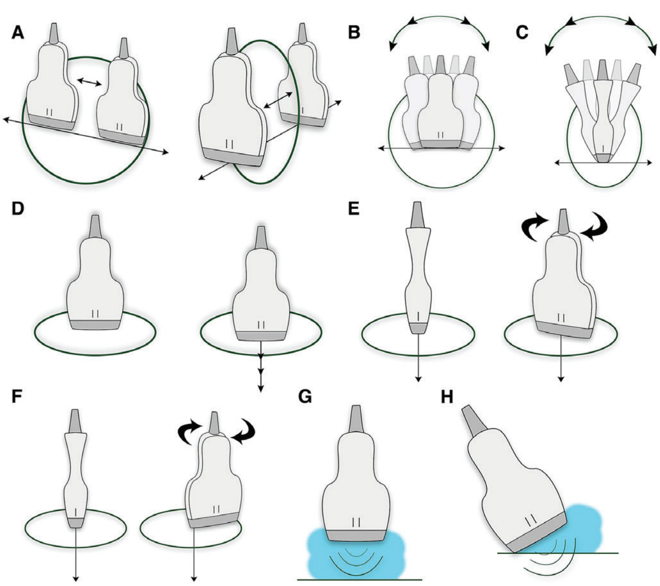

Figure 1 (A) Slide, (B) heel–toe, (C) tilt, (D) compression, (E) rotation, (F) pivot, (G) stand-off and (H) oblique stand-off.

Table 3 Anatomical and descriptive terms*

Term	Definition
Body planes	
Transverse	Anatomical region (eg, knee) when displayed in cross-section to the region
Longitudinal	Anatomical region (eg, knee) when displayed parallel to the region lengthwise; when used to refer to an anatomical region, may refer to either the coronal or sagittal plane
Coronal (frontal) image plane[5]	Any plane perpendicular to a sagittal plane and parallel to the long axis of the body; each coronal image plane extends from left to right through the body.
Sagittal image plane[5]	The anteroposterior plane parallel to the long axis of the body and passing through the midline; anteroposterior planes not passing through the centre of the body are frequently called parasagittal planes.
Transverse image plane[5]	A plane perpendicular to the long axis of the body or structure of interest; with respect to the body, a transverse plane extends from left to right and divides the body into superior and inferior regions.
Axes	
Short axis or transverse	Target structure (eg, Achilles tendon) when displayed in cross-section perpendicular to the structure's length
Long axis or longitudinal	Target structure (eg, Achilles tendon) when displayed parallel to the structure's length
Directional terms	
Proximal/distal	Describes a position that is closer (proximal) or farther (distal) from the centre of the body
Anterior/posterior	Direction toward (anterior) or away from (posterior) the front of the trunk or limb (excluding the forearm, hand and foot)
Superior/inferior	Direction above or towards (superior) or below or away from (inferior) the head
Medial/lateral	Direction toward the tibia (medial) or toward the fibula (lateral) when describing structures below the knee
Ulnar/radial	Direction toward the ulna (ulnar) or toward the radius (radial) when describing structures in the forearm, wrist and hand
Volar/dorsal	Anterior (volar) or posterior (dorsal) surface of the forearm
Palmar/dorsal	Anterior (palmar) or posterior (dorsal) surface of the hand and wrist
Plantar/dorsal	Sole (plantar) or top (dorsal) surface of the foot

*All anatomical terms are defined with the body in the anatomical position.

METHODS

Expert group selection and demographics

The project was approved by the board of directors of the American Institute of Ultrasound in Medicine (AIUM) and the American Medical Society for Sports Medicine (AMSSM) who served as the lead societies for this article. Members were invited to represent a diverse group of physicians with experience in the musculoskeletal and sports medicine applications of ultrasound. The AIUM and AMSSM reached out to multiple societies identified to be key stakeholders with the following societies contributing members: American Academy of Orthopaedic Surgeons, American Academy of Physical Medicine & Rehabilitation, American Orthopaedic Society for Sports Medicine, American Society of Regional Anaesthesia and Pain Medicine, European Society of Musculoskeletal Radiology, Society of Interventional Radiology and Society of Skeletal Radiology. Primary specialties represented include anaesthesia, emergency medicine, family medicine, physical medicine and rehabilitation, orthopaedic surgery and radiology.

Table 4 Pathology

Term	Definition	Ultrasound appearance	Caveat
(A) Tendon			
Tendinopathy[9–12]	A clinical term used to describe painful conditions of the tendon or tendon sheath including tendinosis, tendinitis and tendon tear		The use of a more precise term is recommended when describing imaging findings if possible.
Tendinosis[9 11–14]	A chronic tendon condition characterised histologically as collagen degeneration (predominantly mucoid) with other variable features such as collagen disorganisation, fibrocartilaginous metaplasia, calcification and possible neovascularity; primarily an overused and degenerative process with absence of an acute inflammatory infiltrate, but inflammatory mediators may be present	Abnormally hypoechoic tendon without tendon fibre disruption, with possible increase in tendon diameter, with or without flow on Doppler imaging (figure 2A)	
Tendinitis[9 11 12]	Tendon inflammation.	Abnormally hypoechoic tendon occasionally associated with possible increased flow on Doppler imaging	Imaging features of tendinosis and tendinitis are similar and may be difficult to differentiate. Features of tendinosis and tendinitis may be present concurrently. Hyperaemia, as seen in tendinosis, is due to neovascularity and should not be equated with acute inflammation. Clinical features (such as history of inflammatory disease) may be required to determine the most likely histological diagnosis.
Calcific tendinopathy[15 16]	Calcium deposition within a tendon; if calcium hydroxyapatite, this may be termed calcific tendinosis. Use calcific tendinitis when in the resorptive or inflammatory stage.	Calcium hydroxyapatite appears as a globular well-defined hyperechoic focus within a tendon with variable shadowing. Overlap with other forms of calcification and crystal deposition are possible. Small punctate or linear tendon calcifications may also be due to calcium pyrophosphate dihydrate deposition disease or degenerative calcification. Amorphous echogenicity with variable shadowing can be seen with monosodium urate deposition in gout (figure 2B).	
Tenosynovitis[9 12]	Inflammation of the tendon synovial sheath	Distention of a tendon sheath from fluid of variable echogenicity with or without synovial hypertrophy and possible increased flow on Doppler imaging (figure 2C)	Some tendon sheaths normally communicate with joints (ie, long head of the biceps brachii tendon sheath and glenohumeral joint, flexor hallucis longus tendon sheath and tibiotalar joint). Simple fluid within the tendon sheath may be secondary to intra-articular pathology rather than tenosynovitis.
Stenosing tenosynovitis[9 12 17 18]	A subtype of tenosynovitis that affects tendons that course through osteofibrous tunnels composed of bone covered by a pulley or retinaculum. The hallmark is thickening of the pulley or retinaculum that causes constriction. Examples include trigger finger and de Quervain tenosynovitis.	Hypoechoic thickening of pulley or retinaculum with possible hyperaemia on Doppler imaging with possible additional findings of tendinosis and tenosynovitis (figure 2D)	
Paratenonitis[9 19–21]	Inflammation and fibrosis of the paratenon surrounding a tendon that does not have a tenosynovial sheath (ie, the Achilles tendon)	Focal or diffuse abnormal hypoechogenicity surrounding a tendon with possible increased flow on Doppler imaging (figure 2E)	Several related terms have been described in the literature, including paratendonitis, peritenonitis and peritendinitis, paratenopathy, among others.
Tear[22–25]	Disruption of tendon, categorised as partial thickness (interstitial/intrasubstance, bursal or articular (if relevant)) or full thickness (focal or full width/complete); a longitudinal split tear may also be described, typically when involving a tubular tendon.	Hypoechoic or anechoic tendon fibre disruption with an extent defined by the categories listed in the definition column. With longitudinal tears, the hypoechoic or anechoic abnormality is parallel to the long axis of the tendon (figure 2F).	
Avulsion	Tendon tear at its bony attachment or a fracture at a tendon attachment	Variable depending on specific pathology (see other more precise terms)	Due to a traction mechanism (as opposed to direct trauma)
(B) Muscle			
Strain[26]	A clinical/biomechanical term which is not well defined and used inconsistently for different muscle injuries		Generally, refers to an elongation or stretch type of injury
Tear[26–31]	Injury to muscle fibres or internal aponeuroses	Variable, depending on degree of injury ranging from increased echogenicity of intact muscle to muscle or musculotendinous disruption (partial or complete) with possible haemorrhage of variable echogenicity. Possible increased flow on Doppler imaging (figure 3A.1,A.2)	Numerous clinical and imaging-based classification and grading systems for muscle injury exist.
Contusion[27–29]	Muscle injury with or without haematoma most commonly as a result of blunt trauma	Mixed echogenicity area of muscle fibre disruption ranging from hyperechoic when acute to anechoic when chronic with possible mass effect from haematoma, possible increased flow on Doppler imaging (figure 3B)	
Myositis ossificans[27 32 33]	A subtype of heterotopic ossification located within muscle most commonly occurring after trauma, often preceded by haematoma	Hyperechoic in early phase followed by a hypoechoic mass-like area within muscle, with hyperechoic foci maturing into an echogenic peripheral rim with possible acoustic shadowing. Possible increased flow on Doppler imaging (figure 3C)	Radiograph or CT scan may be required to confirm the peripheral mineralisation when shadowing does not allow accurate characterisation

Continued

Table 4 Continued

Term	Definition	Ultrasound appearance	Caveat
Myositis[34]	Muscle inflammation including idiopathic, autoimmune, and infectious aetiologies with possible superimposed abscess in the latter (see pyomyositis)	Increased muscle echogenicity and possible distortion of the muscle architecture with increased muscle size when acute and variable increased flow on Doppler imaging; other conditions such as rhabdomyolysis may have a similar appearance.	
Pyomyositis[35 36]	Muscle abscess	Circumscribed heterogeneous fluid collection ranging from anechoic to hyperechoic with increased through transmission and commonly peripheral increased flow on Doppler imaging	Clinical features may help in differentiating from other causes of fluid collection within a muscle.
Fatty Infiltration[34]	Fat infiltration of muscle from disuse, dysfunction, injury or denervation, among other causes, with the term atrophy used when muscle is also decreased in size.	Diffuse increased muscle echogenicity with possible decrease in muscle size when atrophic (figure 3D)	
(C) Ligament			
Sprain[37 38]	A clinical/biomechanical term, which is not well defined and used inconsistently for different ligament injuries	Depends on severity of injury	Generally, refers to an elongation or stretch type of injury
Tear[37 38]	Injury to ligament fibres which may include partial or complete ligament disruption	Partial or complete ligament disruption with variable degrees of laxity on stress imaging based on severity of injury; echogenicity and ligament thickness are variable; possible increased flow on Doppler imaging (figure 4A,B)	Numerous clinical and imaging-based classification and grading systems for specific ligament injuries exist.
Avulsion	Ligament tear at its bony attachment or a fracture at a ligament attachment.	Variable, depending on specific pathology (see other more precise terms)	Due to a traction mechanism (as opposed to direct trauma)
(D) Joint recess, bursa and tendon sheath			
Term	Definition	Ultrasound appearance	
Effusion[39–42]	Distention of a synovial space with fluid from several possible aetiologies, including but not limited to, mechanical, reactive, and inflammatory mechanisms, among others	Fluid distention of a synovial space of variable echogenicity depending on composition (figure 5A)	
Synovial hypertrophy[39–41]	Thickened synovium characteristic of several aetiologies, including, but not limited to, mechanical, reactive, and inflammatory (infection or inflammatory arthritis) mechanisms.	Variable echogenicity (most commonly hypoechoic) non-compressible or minimally compressible tissue with variable flow on Doppler imaging; increased blood flow could indicate active inflammation (termed synovitis as described below).	
Synovial proliferation[43]	Thickened synovium due to several non-inflammatory etiologies, such as pigmented villonodular synovitis, lipoma arborescens and synovial chondromatosis (which is often mineralised).	Variable echogenicity non-compressible or minimally compressible synovial thickening or mass-like appearance with variable flow on Doppler imaging (figure 5B)	
Synovitis[39–41 44]	Inflammation of the synovium within a joint recess, tendon sheath or anatomic bursa; use a more specific term (eg, tenosynovitis) whenever possible.	Variable echogenicity (most commonly hypoechoic) synovial tissue that is not displaceable and minimally compressible with possible increased flow on Doppler imaging (figure 5C)	
Bursitis[45]	Inflammation of bursa	Variable, depending on the underlying pathology, which can include effusion, synovial hypertrophy, synovial proliferation and synovitis with possible increased flow on Doppler imaging	
(E) Nerve			
Neuropathy	A term that encompasses several nerve conditions	Variable, depending on specific pathological process	The use of a more precise term is recommended when describing imaging findings if possible.
Compression neuropathy[46–48]	Disorder characterised by nerve dysfunction as a result of nerve entrapment or extrinsic impingement	Hypoechoic appearance of nerve from epineural oedema with possible fascicular enlargement typically proximal and sometimes distal to the compression site (figure 6A)	Nerve compression first results in oedema followed by demyelination and then ischaemic axonal damage when the compression is severe and chronic
Transection[49]	Partial or complete discontinuity of a nerve due to disruption of some or all the nerve fascicles	Discontinuity of some or all nerve fascicles with possible retraction of the discontinuous nerve and focal or mass-like thickening at the retracted end (see neuroma) (figure 6B)	
Neuroma[49 50]	The focal enlargement of an injured nerve or fascicle, which may be associated with nerve or fascicular retraction if due to transection	Hypoechoic focal nerve or fascicle enlargement at the site of injury with possible retraction (figure 6C)	
Neuritis[51]	Nerve inflammation as seen with inflammatory, infectious or autoimmune conditions	Abnormally hypoechoic nerve with possible increased flow on Doppler imaging	
(F) Fascia			
Fasciopathy[52 53]	A term that encompasses several fascial conditions	Variable, depending on the specific pathological process	The use of a more precise term is recommended when describing imaging findings if possible.
Fasciosis[52 53]	A chronic condition characterised histologically as degeneration, collagen necrosis, angiofibrotic hyperplasia, chondroid metaplasia and fibrosis; although primarily a degenerative process from mechanical overload with absence of an acute inflammatory infiltrate, inflammatory mediators may be present.	Hypoechoic thickening of the fascia with possible calcification and possible increased flow on Doppler imaging (figure 7)	

Continued

Table 4 Continued

Term	Definition	Ultrasound appearance	Caveat
Fasciitis[54]	Inflammation of fascia	Hypoechoic thickening of the fascia with possible increased flow on Doppler imaging	
Tear	Injury to fascial fibres which may include partial or complete disruption	Partial or complete disruption with variable echogenicity and thickness and possible haemorrhage of variable echogenicity; there may be loss of tension with complete disruption; possible increased flow on Doppler imaging	
(G) Bone			
Osteophyte	A bony excrescence at the margin of a synovial articulation as a manifestation of osteoarthritis (or osteoarthrosis)	Hyperechoic bony excrescence typically at the margin of a synovial articulation	
Enthesophyte	A bony excrescence at a tendon, ligament or fascia attachment, typically as a manifestation of overuse, tension, prior injury or adjacent tendinosis (when well defined) or inflammation (when ill-defined with possible erosions termed enthesitis or inflammatory enthesopathy)	Hyperechoic bony excrescence at a tendon, ligament or fascia attachment; may be well defined or ill-defined with possible associated erosions and possible increased flow on Doppler imaging	
Erosion[40]	Cortical discontinuity in a subsynovial or enthesis location, a manifestation of inflammation (infection or inflammatory arthritis) with possible associated synovial hypertrophy	Discontinuity of the hyperechoic cortical bone surface in a subsynovial or enthesis location confirmed in two planes, may have associated synovial hypertrophy (see previously mentioned definition) and possible increased flow on Doppler imaging	There are many causes for cortical irregularity, and the finding of adjacent synovitis adds specificity to the diagnosis of cortical erosion.
(H) Miscellaneous			
Term	Definition		
Hyperaemia	Increased blood flow due to neovascularity (as seen in tendinosis and tumours) and/or vasodilation due to inflammation (as in inflammatory synovitis or infection).		
Subluxation	When a structure is partially displaced from its normal anatomical location, possibly only occurring with dynamic manoeuvres (ie, dynamic subluxation); the word ‘sublux’ and ‘subluxed’ do not exist in the English dictionary and should be avoided in favour of subluxate and subluxation.		
Dislocation	When a structure is completely displaced from its normal anatomical location, including those occurring with dynamic manoeuvres (ie, dynamic dislocation)		

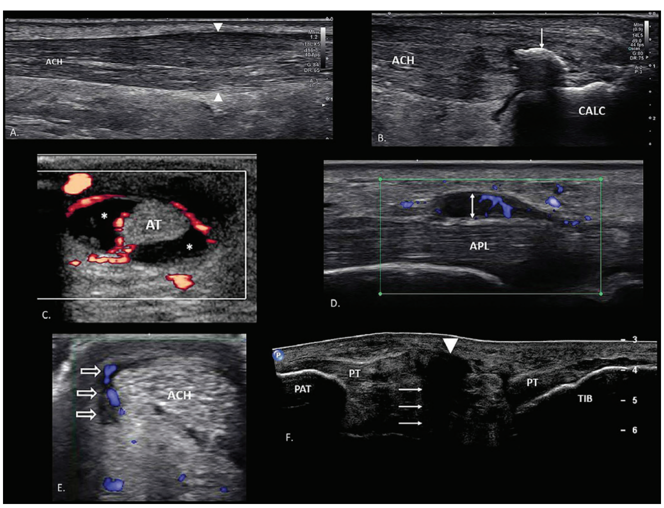

Figure 2 (A) Tendinosis: long-axis image of midportion Achilles tendinosis. Note fusiform thickening (arrowheads) without fibre disruption. (B) Calcific tendinopathy: long-axis image of calcific tendinosis of the ACH insertion. The well-defined hyperechoic focus (arrow) demonstrates intermediate posterior acoustic shadowing. (C) Tenosynovitis: short-axis image of the AT demonstrating distension of the tendon sheath (asterisks) with increased Doppler flow. (D) Stenosing tenosynovitis: long-axis view of the first dorsal compartment of the wrist. The retinaculum (double arrow) is hypoechoic and significantly thickened with hyperaemia on Doppler. (E) Paratenonitis: short axis image of the ACH. There is focal hypoechoic thickening of the lateral aspect of the paratenon (open arrows) with hyperaemia on Doppler. (F) Tendon tear: long-axis extended field of view image of acute PT complete tear. There is loss of tension with a hypoechoic region of tendon fibre disruption (arrowhead). Edge shadowing artefact (arrows) is noted deep to the proximal tendon stump. ACH, Achilles tendon; APL, abductor pollicis longus tendon; AT, anterior tibialis tendon; CALC, calcaneus; PAT, patella; PT, patellar tendon; TIB, tibia.

Preliminary work

A list of general topics to be included was discussed among the group and organised as presented in box 1. Each section was then assigned to a small working group who was responsible for identifying key references and creating the initial list of terms to be defined. This was circulated among the group until agreement was reached on final terms to be included. Each small group was

Figure 3 (A) Muscle tear: (1) long-axis image of the RF demonstrating an acute disruption of the central aponeurosis and surrounding muscle (callipers); there is anechoic haemorrhagic fluid (asterisks) at the site of tear; (2) corresponding short-axis image. (B) Muscle contusion: long-axis extended field of view image of an acute quadriceps contusion. Muscle fibre disruption of the VI is noted with a large anechoic haematoma (asterisks) resulting in mass effect. (C) Myositis ossificans: long-axis image of the quadriceps. This follow-up image of the muscle contusion (B) demonstrates resolution of haematoma with formation of hyperechoic regions of myositis ossificans (arrows). (D) Muscle fatty infiltration: short-axis extended field of view image of the rotator cuff musculature in setting of chronic complete rotator cuff tear. The SS and IS are diffusely hyperechoic with loss of internal muscle fibre definition. FEM, femur; IS, infraspinatus; RF, rectus femoris; SS, supraspinatus; TM, teres minor; TRAP, trapezius; VI, vastus intermedius.

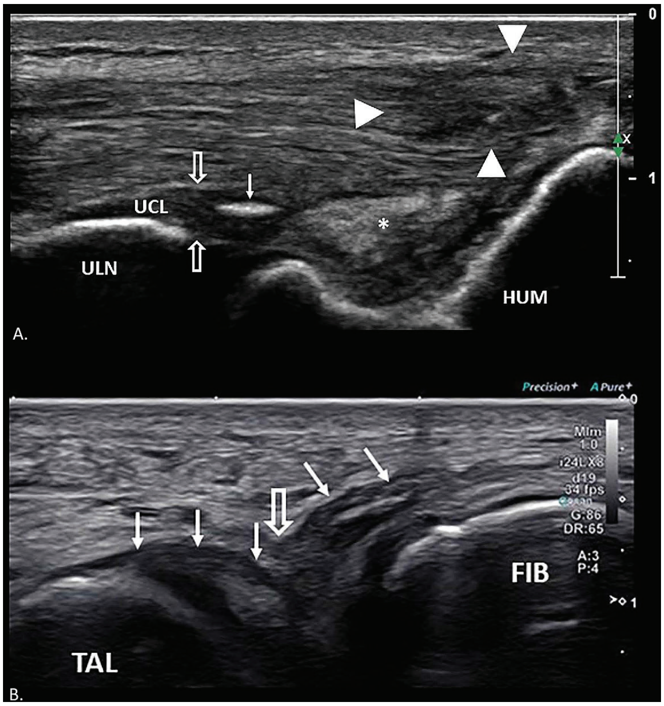

Figure 4 (A) Ligament tear: long-axis image of an acute UCL tear. A hyperechoic region of fibre disruption and haematoma (asterisks) is noted proximal. The distal attachment is intact but thickened (open arrows) and a hyperechoic linear density (solid arrow) overlying the joint space represents chronic calcific changes. Also note an associated muscle injury of the flexor/pronator group (arrowheads). (B) Ligament tear: long-axis image of acute anterior talofibular ligament (arrows) tear. Loss of tension results in an atypical contour of the ligament (open arrow). This can be further confirmed with dynamic stress imaging. FIB, fibula; HUM, humerus; UCL, ulnar collateral ligament; ULN, ulna; TAL, talus.

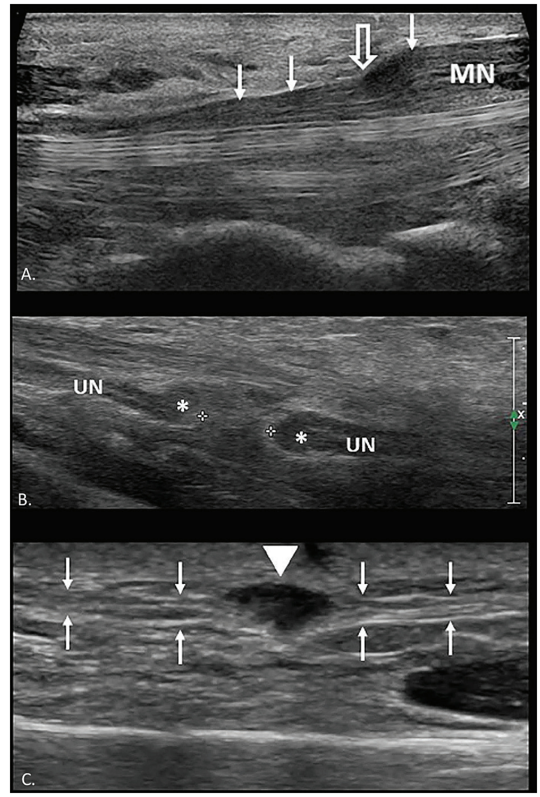

Figure 6 (A) Compression neuropathy: long-axis image of the median nerve (arrows) at the carpal tunnel. Significant swelling is noted proximal to the compression site (open arrow). (B) Nerve transection: long-axis image of complete ulnar nerve transection. Note discontinuity of nerve with retraction (callipers) and thickening at the ends representing stump neuromas (asterisks). (C) Neuroma: long-axis image of a partial transection of the lateral antebrachial cutaneous nerve (arrows). Focal hypoechoic enlargement (arrowhead) represents a neuroma at the site of injury. MN, median nerve; UN, ulnar nerve.

then responsible for drafting the working definitions. The list of terms, definitions and key references for each section was then made available to the group for review prior to the initiation of the Delphi procedure.

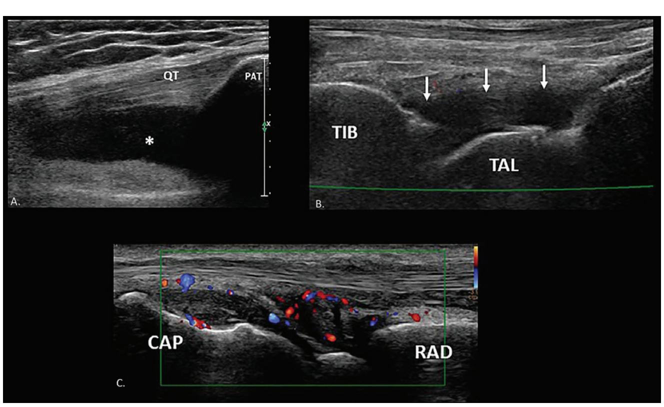

Figure 5 (A) Joint effusion: long-axis image of the suprapatellar recess with anechoic fluid distension (asterisk) representing a simple joint effusion. (B) Synovial proliferation: long-axis image of the anterior ankle with hypoechoic synovial tissue hypertrophy (arrows) without Doppler flow. (C) Synovitis: long-axis image of the dorsal wrist demonstrating hypoechoic synovial tissue with increased Doppler flow in the setting of rheumatoid arthritis. CAP, capitate; RAD, radius; PAT, patella; QT, quadriceps tendon; TAL, talus; TIB, tibia.

Delphi procedure

A Delphi method was used to reduce 'group think' bias by allowing anonymous voting and comments. The group leader (MMH) was responsible for developing and distributing all surveys and moderating discussion among the group. Qualtrics

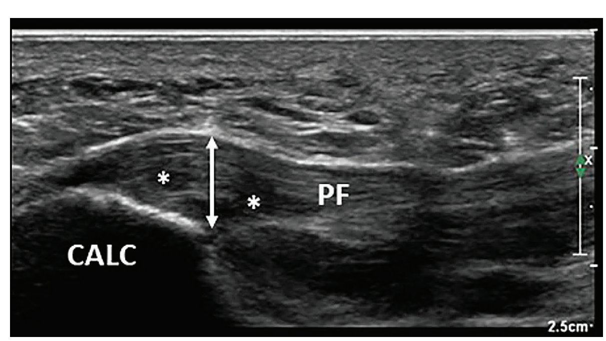

Figure 7 Fasciosis: long-axis image of the plantar fascia. Thickening of the origin is noted (double arrow) with focal hypoechoic regions (asterisks) representing degenerative changes. CALC, calcaneus; PF, plantar fascia.

Table 5 Procedural

Term	Definition
Needle/device terminology	
In-plane[55]	Needle/device aligned with the long axis of the transducer
Out-of-plane[55]	Needle/device aligned perpendicular to the long axis of the transducer
Jiggling[55]	Rapid, low-amplitude movement of the needle/device in the plane of insertion to facilitate needle visualisation
Rotation[55]	Rotating the needle will result in the bevel alternately facing up and down, thus enabling identification of the needle tip.
Stylet movement[55]	Small movements of a stylet in and out of the tip of the needle to improve needle tip visualisation; the stylet should not be modified to allow it to advance beyond the needle tip when using this technique for visualisation.
Procedure technique descriptions	
Aponeurotomy[56 57]	Cutting an aponeurosis, either completely or incompletely, using a needle, scalpel or other device.
Aspiration	The act of removing fluid, calcification or other crystalline material, blood, pus or other substance from the body typically using a needle and syringe, catheter or another device
Barbotage[58]	Repeated injection and aspiration of fluid to break up and remove calcification, usually within a tendon
Brisement[59–61]	The injection of fluid into the space between a tendon and its paratenon or sheath; brisement has also been used to refer to injection of saline or other fluid into a joint to break down adhesions (eg, in treatment of adhesive capsulitis).
Debridement[62 63]	The removal of necrotic, degenerative or infected tissue from a region or given tissue of the body.
Dry needling[64]	A procedure, generally used as part of manual physical therapy, where a small gauge needle is inserted into a muscle or other soft tissue structure to treat myofascial pain
Fasciotomy[65 66]	Cutting fascia, either completely or incompletely, using a needle, scalpel or other device
Fenestration[64]	The act of repetitive puncture of a soft tissue structure with a needle or other device
Fragmentation[67]	The use of a needle or other device to break up calcified and/or bony tissue
Hydrodissection[68–70]	Technique by which saline or other sterile fluid is injected to separate tissues or tissue planes from each other
Injection	The act of delivering a fluid or other substance into the body, typically using a needle and syringe, catheter or another device.
Lavage[71]	Washing out using saline or other sterile solution; irrigation is an acceptable alternate term.
Neurolysis[69 70 72–74]	There are distinct definitions of neurolysis. An appropriate modifier is recommended to clearly describe the procedure performed.
Chemical neurolysis	The application of chemical agents to a nerve in order to cause temporary or permanent degeneration of targeted nerve fibres.
Hydroneurolysis	The injection of saline or other sterile fluid to free nerves from surrounding tissue/adhesion; the term 'nerve hydrodissection' is an acceptable alternate term.
Surgical neurolysis	The surgical freeing of nerves from surrounding tissue/adhesion
Physical neurolysis	The application of physical energy (eg, heat or cold) to a nerve in order to cause temporary or permanent degeneration of the targeted nerve fibres
Plantar fasciotomy[75 76]	Cutting the plantar fascia, either completely or incompletely, using a needle, scalpel or other device.
Tendon scraping[77 78]	The process of abrading the surface of a tendon or paratenon with a needle, scalpel, or other device, with the goal of separating the tendon from neovessels, neonerves and/or adjacent soft tissues.
Tenotomy[62 79–82]	Cutting tendon tissue, either completely or incompletely, using a needle, scalpel or other device
Trigger finger release[83 84]	Cutting the pulley and associated tendon sheath responsible for the stenosis using a needle, scalpel or other device
Terms to avoid	
Minimally invasive, ultraminimally invasive and microinvasive	These are relative and imprecise terms without formal definitions. Therefore, their use is not recommended. The exact procedure should be described including technique and tool(s) used.
Needling[85]	This is an inconsistent term that has been used to describe a range of procedures from dry needling of myofascial trigger points to tenotomy or fasciotomy procedures. The use of a more precise term is recommended. 'Needling' should only be used in conjunction with 'dry needling' as previously defined.
Peppering[85]	This term has been used to describe a type of fenestration procedure (often involving a tendon) alone or in conjunction with an injection. The use of more precise terms such as 'tenotomy', 'fasciotomy' or 'fenestration' is recommended.
Percutaneous	This term refers to a procedure performed through the skin. Due to lack of specificity associated with this term, its use in isolation is not recommended. Rather, the exact procedural technique should be described including tool(s) used and approach.

Box 2 Template for documenting a diagnostic US examination*

1. Patient's name and other identifying information.
2. Date and time of examination.
3. Ordering provider.
4. Location and contact information of facility in which the diagnostic US was performed.
5. Clinical history/indication.
6. Description of diagnostic US study performed.
   – Anatomical location.
   – Complete or limited exam.
7. Findings.
8. Impression/conclusion/summary.

*When reporting a diagnostic US, all structures evaluated should be specifically mentioned either in the 'findings' section or elsewhere in the report, even if within normal limits.
US, ultrasound.

XM (Qualtrics, LLC, Provo, Utah, USA), an online survey and data collection tool, was used to create and conduct all surveys. We set a minimum requirement of >80% group participation for each round of surveys to be considered valid. Consensus was defined as group level agreement >80%. Questions not resulting in consensus were revised based on group feedback and incorporated into subsequent surveys until consensus was reached. Each section was addressed separately and carried through completion prior to beginning the next section.

DISCUSSION

General

The term *musculoskeletal ultrasound* has been used extensively, but we were unable to identify a previously published formal definition. The term *sports ultrasound* has been more recently introduced by the AMSSM.[1 2] Although this term has begun to appear more frequently in the literature, a formal definition has yet to be assigned. Table 1 presents our recommended definitions for each term.

Equipment and transducer manipulation

When instructing or discussing ultrasound technique, consistency in terminology used to describe transducer movement and manipulation is critical to avoid confusion and to facilitate effective communication. Although prior authors have made recommendations, these have not been universally accepted.[3 4] Furthermore, we identified ongoing confusion regarding cardinal movements as well as additional terms relevant to musculoskeletal and sports medicine practice as listed in table 2. Of note, we concluded that using a single term, 'slide', to describe moving the transducer from point A to point B was most clear. Further directional or anatomical descriptors may need to be added to provide clarity. These terms are discussed as follows and demonstrated in figure 1.

Anatomical and descriptive terminology

Table 3 lists recommended anatomical and descriptive terms. There was agreement with the imaging plane definitions presented in the AIUM *Recommended Ultrasound Terminology* document.[5] When discussing body planes in relation to the anatomical region of interest, the group was unable to arrive at a consensus for a single term to describe parallel longitudinal planes. Either coronal/sagittal or longitudinal were proposed as appropriate terms. Similarly, when discussing axes of the target structure, we could not reach consensus on a single best term. Short axis and transverse can be used interchangeably as can long axis and longitudinal.

Pathology

Pathology terms have been divided into groups based on anatomical tissue type with consensus recommendations presented in table 4. Representative images demonstrating key terms can be found in figures 2–7. These terms are not meant to be prescriptive but rather represent the current best terms based on the literature and our expert opinion. We recognise that our understanding of pathophysiological processes is in constant evolution, and certain terms may require modifications based on future research. We focused on the accepted ultrasound appearance of common pathologies, recognising that pathognomonic ultrasound findings do not currently exist for all histopathological conditions. Furthermore, certain clinical conditions may be difficult to differentiate based on imaging features alone. Similarly, although Doppler flow is often considered a key imaging finding for some pathological conditions (eg, synovitis, tendinitis, etc), we agreed that, due to variability in both equipment and technique, the presence or absence of Doppler flow should not be an absolute requirement. Rather, we highlight when Doppler flow may be expected and further supports a specific diagnosis.

Procedural

Like the pathology section, the procedural terms and definitions presented in table 5 attempt to reconcile the historic use of multiple similar terms in the absence of precise definitions. This has resulted in difficulties interpreting clinical outcomes and conveying procedural techniques both to colleagues and third-party payers. Our goal is for these core terms to be used with appropriate technical descriptors bringing more consistency to procedural reporting.

Image labeling

There was consensus agreement that all ultrasound images should include labels identifying the target structure or region and laterality as appropriate. Other considerations which did not reach consensus but had majority agreement include (1) orientation of the image relative to the target structure or region (long axis, short axis, etc); (2) directional orientation (medial, lateral, proximal, distal, etc); (3) directional descriptors for cine loops (proximal to distal, medial to lateral, etc).

Box 3 Template for documenting a US-guided interventional procedure

1. Patient's name and other identifying information.
2. Date and time of intervention.
3. Ordering provider.
4. Location and contact information of facility in which the US-guided procedure was performed.
5. Clinical history/indication.
6. Technical.
   - Device.
   - Medications or other administered substances, including lot number, if applicable.
7. Procedure performed (eg, knee joint aspiration, carpal tunnel release, etc).
8. Injection/aspiration/procedure details.
   - Informed consent and time-out statements.
   - Description of preinjection images.
     - Target images.
     - At-risk structures.
   - Description of procedure.
     - Conditions under which procedure was performed (sterile, aseptic, etc).
     - Type of anaesthesia.
     - Description of approach—in-plane/out-of-plane, long axis or short axis to the target, medial or lateral to the target.
     - Description of the procedure performed including names and amounts of medications or other substances used if applicable. Describe any devices used.
     - Specimen description, type and amount removed if applicable.
   - Blood loss (if applicable).
   - Complications.
   - How the procedure was tolerated
9. Disposition and follow-up plans.

Documentation

The templates in boxes 2 and 3 include the key components which should be considered when documenting a diagnostic ultrasound or ultrasound-guided procedure. Notably, they are not meant to replace local institutional guidelines or policies regarding documentation of ultrasound-related services. These recommendations pertain to all billable ultrasound services performed in any setting. If studies are performed as a non-billable service (eg, in the athletic training room), then individual institutional guidelines and standards should be developed regarding documentation and image archiving. If any information populates the electronic medical record or images automatically, it does not need to be included separately in the report.

CONCLUSION

The historic use of multiple similar terms in the absence of precise definitions has led to confusion when conveying information between colleagues, patients and third-party payers. This multidisciplinary expert consensus addresses multiple areas of variability in diagnostic ultrasound imaging and ultrasound-guided procedures related to musculoskeletal and sports medicine. This concise reference should improve clarity and consistency of communication and reporting.

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