AIUM Practice Parameter for the Performance of a

Musculoskeletal Ultrasound Examination

Parameter developed in conjunction with the American College of Radiology (ACR), the Society for Pediatric Radiology (SPR), and the Society of Radiologists in Ultrasound (SRU).

© 2012 by the American Institute of Ultrasound in Medicine
The American Institute of Ultrasound in Medicine (AIUM) is a multidisciplinary association dedicated to advancing the safe and effective use of ultrasound in medicine through professional and public education, research, development of parameters, and accreditation. To promote this mission, the AIUM is pleased to publish, in conjunction with the American College of Radiology (ACR), the Society for Pediatric Radiology (SPR), and the Society of Radiologists in Ultrasound (SRU), this AIUM Practice Parameter for the Performance of a Musculoskeletal Ultrasound Examination. We are indebted to the many volunteers who contributed their time, knowledge, and energy to bringing this document to completion.

The AIUM represents the entire range of clinical and basic science interests in medical diagnostic ultrasound, and, with hundreds of volunteers, the AIUM has promoted the safe and effective use of ultrasound in clinical medicine for more than 50 years. This document and others like it will continue to advance this mission.

Practice parameters of the AIUM are intended to provide the medical ultrasound community with parameters for the performance and recording of high-quality ultrasound examinations. The parameters reflect what the AIUM considers the minimum criteria for a complete examination in each area but are not intended to establish a legal standard of care. AIUM-accredited practices are expected to generally follow the parameters with recognition that deviations from these parameters will be needed in some cases, depending on patient needs and available equipment. Practices are encouraged to go beyond the parameters to provide additional service and information as needed.
I. Introduction

The clinical aspects contained in specific sections of this parameter (Introduction, Supervision and Interpretation of Ultrasound Examinations, Specifications for Individual Examinations, and Equipment Specifications) were developed collaboratively by the American Institute of Ultrasound in Medicine (AIUM), the American College of Radiology (ACR), the Society for Pediatric Radiology (SPR), and the Society of Radiologists in Ultrasound (SRU). Qualifications and Responsibilities of Personnel, Written Request for the Examination, Documentation, and Quality Control and Improvement, Safety, Infection Control, and Patient Education vary among the organizations and are addressed by each separately.

This parameter has been developed to assist practitioners performing a musculoskeletal (MSK) ultrasound examination. Although it is not possible to detect every abnormality, adherence to the following parameter will maximize the probability of detecting most abnormalities that occur.

II. Qualifications and Responsibilities of Personnel


III. Indications

Indications for MSK ultrasound include but are not limited to:

A. Pain or dysfunction.
B. Soft tissue or bone injury.
C. Tendon or ligament pathology.
D. Arthritis, synovitis, or crystal deposition disease.
E. Intra-articular bodies.
F. Joint effusion.
G. Nerve entrapment, injury, neuropathy, masses, or subluxation.
H. Evaluation of soft tissue masses, swelling, or fluid collections.
I. Detection of foreign bodies in the superficial soft tissues.
J. Planning and guiding an invasive procedure.
K. Congenital or developmental anomalies.
L. Postoperative or postprocedural evaluation.

An MSK ultrasound examination should be performed when there is a valid medical reason. There are no absolute contraindications.
IV. Written Request for the Examination

The written or electronic request for an ultrasound examination should provide sufficient information to allow for the appropriate performance and interpretation of the examination.

The request for the examination must be originated by a physician or another appropriately licensed health care provider or under the physician’s or provider’s direction. The accompanying clinical information should be provided by a physician or other appropriate health care provider familiar with the patient’s clinical situation and should be consistent with relevant legal and local health care facility requirements.

V. Supervision and Interpretation of Ultrasound Examinations

A physician must be available for consultation with the sonographer on a case-by-case basis. Ideally, the physician should be on-site and available to participate actively in the ultrasound examination when required. It is recognized, however, that geographic realities may not permit the presence of an on-site physician in all locations. In this case, a supervising physician should be available for quality assurance and sonographer supervision via a picture archiving and communication system.

VI. Specifications for Individual Examinations

Depending on the clinical request and the patient’s presentation, the ultrasound examination can involve a complete assessment of a joint or anatomic region, or it can be focused on a specific structure of interest. If a focused study is performed, it is essential to have a full understanding of the relevant abnormalities, including those that may correspond to the patient’s symptoms.

General ultrasound scanning principles apply. Transverse and longitudinal views should always be obtained with the transducer parallel (that is, ultrasound beam perpendicular) to the axis of the region of interest to minimize artifacts. Abnormalities should be measured in orthogonal planes. Patient positioning for specific examinations may vary depending on the indication, clinical condition, and patient’s age.

A. Specifications for a Shoulder Examination

Patients should be examined in the sitting position when possible, preferably on a rotating seat. Examination of the shoulder should be tailored to the patient’s clinical circumstances and range of motion. Color and power Doppler imaging may be useful in detecting hyperemia within the joint or surrounding structures.

The long head of the biceps tendon should be examined with the forearm in supination and resting on the thigh or with the arm in slight external rotation. The tendon is examined in a transverse plane (short axis), where it emerges from under the acromion, to the musculotendinous junction distally. Longitudinal views (long axis) should also be obtained. These
views should be used to detect fluid or intra-articular loose bodies within the bicipital tendon sheath and to determine whether the tendon is properly positioned within the bicipital groove, subluxated, dislocated, or torn.

The rotator cuff should be examined for signs of a tear, tendinosis, and/or calcification. Both long- and short-axis views of each tendon should be obtained. To examine the subscapularis tendon, the elbow remains at the side while the arm is placed in external rotation. The subscapularis is imaged from the musculotendinous junction to the insertion on the lesser tuberosity of the humerus. Dynamic evaluation as the patient moves from internal to external rotation may be helpful.

To examine the supraspinatus tendon, the arm can be extended posteriorly, and the palmar aspect of the hand can be placed against the superior aspect of the iliac wing with the elbow flexed and directed toward the midline (instruct the patient to place the hand in the back pocket). Other positioning techniques also may be helpful.

To scan the supraspinatus and infraspinatus tendons along their long axis, it is important to orient the transducer approximately 45° between the sagittal and coronal planes to obtain a longitudinal view. The transducer then should be moved anteriorly and posteriorly to completely visualize the tendons.

Short-axis views of the tendons should be obtained by rotating the probe 90° to the long axis. The tendons are visualized by sweeping medially to the acromion and laterally to their insertions on the greater tuberosity of the humerus. The more posterior aspect of the infraspinatus and teres minor tendons should be examined by placing the transducer at the level of the glenohumeral joint below the scapular spine while the forearm rests on the thigh with the hand supinated. Internal and external rotation of the arm is helpful in identifying the infraspinatus muscle and its tendon and in detecting small joint effusions. To visualize the teres minor tendon, the medial edge of the probe should be angled slightly inferiorly.

Throughout the examination of the rotator cuff, the cuff should be compressed with the transducer to detect nonretracted tears. In evaluating rotator cuff tears, comparison with the contralateral side may be useful. Dynamic evaluation of the rotator cuff also is useful: for example, to evaluate the rotator cuff for impingement or to assess the cuff tear extent. In patients with a rotator cuff tear, the supraspinatus, infraspinatus, and teres minor muscles should be examined for atrophy, which may alter surgical management.

During the rotator cuff examination, the subacromial-subdeltoid bursa should be examined for the presence of bursal thickening or fluid. It is also important to evaluate the glenohumeral joint with the probe placed in the transverse plane from a posterior approach to evaluate for effusions, intra-articular loose bodies, synovitis, or bony abnormalities. If symptoms warrant, the suprascapular notch and spinoglenoid notch also may be evaluated. The acromioclavicular joint should be evaluated with the probe placed at the apex of the shoulder, bridging the acromion and distal clavicle.
Ultrasound is very useful in evaluating infants with glenohumeral dysplasia. These infants are examined in a decubitus position, and older children are examined seated. The shoulder is scanned from a posterior approach to evaluate the relationship between the humeral head and glenoid, as well as the shape of the posterior glenoid. Both static and dynamic images are obtained. The shoulder is scanned through the full range of internal to external rotation. Posterior subluxation is assessed visually and by measuring the $\alpha$ angle, which is the angle between the posterior margin of the scapula and the line drawn tangentially to the humeral head and posterior edge of the glenoid. The normal value of the $\alpha$ angle is 30° or less. The clavicle and proximal humerus are also evaluated for fracture.

B. Specifications for an Elbow Examination

The patient is seated with the arm extended and the hand in supination, resting on a table, and the examiner sitting in front of the patient. The elbow may also be examined with the patient supine and the examiner on the same side as the elbow of interest. The examination is divided into 4 quadrants: anterior, medial, lateral, and posterior. The examination may involve a complete assessment of 1 or more of the 4 quadrants or may be focused on a specific structure depending on the clinical presentation. Color and power Doppler imaging may be useful in detecting hyperemia within the joint or surrounding structures.

1. Anterior

The anterior joint space and other recesses of the elbow are assessed for effusion, synovial proliferation, and loose bodies. Longitudinal and transverse scanning of the anterior humeroradial and humeroulnar joints and coronoid and radial fossae is performed to assess the articular cartilage and cortical bone. The annular recess of the neck of the radius is scanned dynamically with the patient alternatively supinating and pronating the forearm. The same dynamic assessment can be made for the biceps tendon and its attachment to the radial bicipital tuberosity. Evaluation of the brachialis muscle, the adjacent radial and brachial vessels, and the median and radial nerves can also be performed as clinically warranted.

2. Lateral

The patient extends the arm and places both palms together, or if the patient is supine, the forearm is placed across the abdomen. This position allows assessment of the lateral epicondyle and the attachments of the common extensor tendon as well as the more proximal attachments of the extensor carpi radialis longus and brachioradialis. The hand is then pronated with the transducer on the posterolateral aspect of the elbow to scan the radial collateral ligament.

3. Medial

The hand is placed in supination, or if the patient is supine, the upper limb is placed in abduction and external rotation to expose the medial side of the elbow. The medial epicondyle, common flexor tendon, and ulnar collateral ligament are scanned in both planes. The ulnar nerve is visualized in the cubital tunnel between the olecranon process and medial epicondyle. Static examination of the ulnar nerve may be facilitated by placing
the elbow in an extended position. Dynamic subluxation of the ulnar nerve is assessed by imaging with flexion and extension of the elbow. Dynamic examination with valgus stress is performed to assess the integrity of the ulnar collateral ligament. During stress testing, the elbow must be slightly flexed to disengage the olecranon from the olecranon fossa.

4. Posterior

   The palm is placed down on the table, or if the patient is supine, the forearm is placed across the abdomen, with the elbow flexed to 90°. The posterior joint space, triceps tendon, olecranon process, and olecranon bursa are assessed.

C. Specifications for a Wrist and Hand Examination

   The patient sits with hands resting on a table placed anteriorly or on a pillow placed on the patient’s thighs. Alternatively, the examination can be performed with the patient supine. The volar examination requires the wrists to be placed flat or in mild dorsiflexion with the palm up and during both ulnar and radial deviation to delineate all the necessary anatomy. The dorsal scan requires the wrist to be placed palm down with mild volar flexion. The examination may involve a complete assessment of 1 or more of the 3 anatomic regions described below or may be focused on a specific structure depending on the clinical presentation. Color and power Doppler imaging may be useful in detecting hyperemia within the joint or surrounding structures.

1. Volar

   Transverse and longitudinal images should be obtained from the volar wrist crease to the thenar muscles. The transducer will require angulation to compensate for the normal contour of the wrist. The flexor retinaculum, flexor digitorum profundus and superficialis tendons, and adjacent flexor pollicis longus tendon should be identified within the carpal tunnel. Dynamic imaging with flexion and extension of the fingers will demonstrate normal motion of these tendons. The median nerve lies superficial to these tendons and deep to the flexor retinaculum, and it moves with the tendons but with less amplitude on dynamic imaging. The distal end of the median nerve is tapered and divides into multiple divisions for the hand. The palmaris longus tendon lies superficial to the retinaculum. On the radial side of the wrist, the flexor carpi radialis longus tendon lies within its own canal. It is important to evaluate the region of the flexor carpi radialis and the radial artery for occult ganglion cysts, which typically originate from the radiocarpal joint capsule. On the ulnar side, branches of the ulnar nerve and artery lie within the Guyon canal. The flexor carpi ulnaris tendon and pisiform bone border the ulnar aspect of the Guyon canal. All of the tendons can be followed to their sites of insertion if clinically indicated.

2. Ulnar

   Placing the transducer transversely on the ulnar styloid and moving distally will allow visualization of the triangular fibrocartilage complex (TFCC) in its long axis. The transducer is then moved 90° to view the short axis of the TFCC. The ulnomeniscal homologue may be seen just deep to the extensor carpi ulnaris tendon. This tendon should be viewed in supination and pronation to assess for subluxation.
3. **Dorsal**

Dorsal structures are very superficial on the dorsal surface, and a high-frequency transducer is required with or without the use of a standoff pad. The extensor retinaculum divides the dorsal aspect of the wrist into 6 compartments, which accommodate 9 tendons. These tendons are examined in their short axes initially and then in their long axes in static and dynamic modes, the latter being performed with flexion and extension of the fingers. The tendons can be followed to their sites of insertion when clinically indicated. Moving the transducer transversely distal to the Lister tubercle identifies the dorsal aspect of the scapholunate ligament, a site of symptomatic ligament tears and ganglion cysts. The remaining intercarpal ligaments are not routinely assessed. In patients with suspected inflammatory arthritis, the dorsal radiocarpal, midcarpal, metacarpophalangeal, and, if symptomatic, proximal interphalangeal joints are evaluated from the volar and dorsal aspects in both the longitudinal and transverse planes for effusion, synovial hypertrophy, and bony erosions. Other joints of the wrist and hand are similarly evaluated as clinically indicated.\(^8,^9\)

---

### D. Specifications for a Hip Examination

Depending on the patient’s habitus, a lower-frequency transducer may be required to scan the hip. However, the operator should use the highest possible frequency that provides adequate penetration. The patient is placed supine to examine the anterior hip and turned as necessary to visualize the posterior, medial, and/or lateral hip. The examination may involve a complete assessment of 1 or more of the 4 anatomic regions of the hip described below or may be focused on a specific structure depending on the clinical presentation. Color and power Doppler imaging may be useful in detecting hyperemia within the joint or surrounding structures.

1. **Anterior**

   A sagittal oblique plane parallel to the long axis of the femoral neck is used for evaluating the femoral head, neck, joint effusion, and synovitis. The sagittal plane is used for the labrum, iliopsoas tendon and bursa, femoral vessels, and sartorius and rectus femoris muscles. The above structures are then scanned in the transverse plane, perpendicular to the original scan plane. When a “snapping hip” is suspected, dynamic scanning is performed over the region of interest using the same movement that the patient describes as precipitating the complaint. The snapping hip is usually related to the iliopsoas tendon as it passes anteriorly over the superior pubic bone or laterally where the iliotibial tract crosses the greater trochanter.\(^10\)

2. **Lateral**

   In the lateral decubitus position, with the symptomatic side up, transverse and longitudinal scans of the greater trochanter, greater trochanteric bursa, gluteus medius, gluteus maximus, gluteus minimus, and tensor fascia lata should be performed. An iliotibial tract that snaps over the greater trochanter can be assessed in this position using dynamic flexion-extension.
3. Medial
The hip is placed in external rotation with 45° knee flexion (frog leg position). The distal iliopsoas tendon, due to its oblique course, may be better seen in this position. The adductor muscles are imaged in their long axis with the probe in a sagittal oblique orientation, with short-axis images obtained perpendicular to this plane. In addition, the pubic bone and symphysis and the distal rectus abdominis insertion should be evaluated.

4. Posterior
The patient is prone with the legs extended. Transverse and longitudinal views of the glutei, hamstrings, and sciatic nerve are obtained. The glutei are imaged obliquely from origin to greater trochanter (gluteus medius and minimus) and linea aspera (gluteus maximus). The sciatic nerve is scanned in its short axis from its exit at the greater sciatic foramen, deep to the gluteus maximus. It can be followed distally, midway between the ischial tuberosity and greater trochanter, lying superficial to the quadratus femoris muscle.

For information on the neonatal hip, see the AIUM Practice Parameter for the Performance of an Ultrasound Examination for Detection and Assessment of Developmental Dysplasia of the Hip.

E. Specifications for a Prosthetic Hip Examination
The hip is assessed for joint effusions and extra-articular fluid collections, often as part of an ultrasound-guided procedure for fluid aspiration in the clinical scenario of possible prosthetic joint infection. The regions of the greater trochanter and iliopsoas are evaluated for fluid collections or tendon abnormalities such as tendinosis or tears of the iliopsoas, gluteus medius, and gluteus minimus tendons.

F. Specifications for a Knee Examination
An ultrasound examination of the knee is divided into 4 quadrants. The examination may involve a complete assessment of 1 or more of the 4 quadrants of the knee described below or may be focused on a specific structure depending on the clinical presentation. Color and power Doppler imaging may be useful in detecting hyperemia within the joint or surrounding structures.

1. Anterior
The patient is supine with the knee flexed to 30°. Longitudinal and transverse scans of the quadriceps and patellar tendons, patellar retinacula, and suprapatellar recess are obtained. The distal femoral trochlear cartilage can be assessed with the probe placed in the suprapatellar space in the transverse plane and with the knee in maximal flexion. Longitudinal views of the cartilage over the medial and lateral femoral condyles are added as indicated. The prepatellar, superficial, and deep infra-patellar bursae are also evaluated.
2. Medial

The patient remains supine with slight flexion of the knee and hip and with slight external rotation of the hip. Alternatively, the patient may be placed in the lateral decubitus position. The medial joint space is examined. The medial collateral ligament, pes anserine tendons and bursa, and medial patellar retinaculum are scanned in both planes. The anterior horn and body of the medial meniscus may be identified in this position, particularly with valgus stress. If meniscal pathology is suspected either clinically or by ultrasound, further imaging with magnetic resonance imaging (MRI) or computed tomographic arthrography if there are contraindications to MRI is advised.

3. Lateral

The patient remains supine with the ipsilateral leg internally rotated or in a lateral decubitus position. A pillow may be placed between the knees for comfort. From posterior to anterior, the popliteus tendon, biceps femoris tendon, fibular collateral ligament, and iliotibial band are scanned. The lateral patellar retinaculum can also be assessed in this position (as well as in the anterior position). The joint line is scanned for lateral meniscal pathology, with varus stress applied as needed.

4. Posterior

The patient lies prone with the leg extended. The popliteal fossa, semimembranosus, medial, and lateral gastrocnemius muscles, tendons, and bursae are assessed. To confirm the diagnosis of a popliteal cyst, the comma-shaped extension toward the posterior joint has to be visualized sonographically in the posterior transverse scan between the medial head of the gastrocnemius and semimembranosus tendon. In addition, the posterior horns of both menisci can be evaluated. The posterior cruciate ligament may be identifiable in a sagittal oblique plane in this position.14,15

G. Specifications for an Ankle and Foot Examination

An ultrasound examination of the ankle is divided into 4 quadrants (anterior, medial, lateral, and posterior). The examination may involve a complete assessment of 1 of the 4 quadrants described below or may be focused on a specific structure depending on the clinical presentation. Examination of the foot is most often focused on a particular structure to answer the clinical question (for example, plantar fasciitis, Morton neuroma, or a ganglion cyst). Color and power Doppler imaging may be useful in detecting hyperemia within the joint or surrounding structures.

1. Anterior

The patient lies supine with the knee flexed and the plantar aspect of the foot flat on the table. The anterior tendons are assessed in long- and short-axis planes from their musculotendinous junctions to their distal insertions. From medial to lateral, this tendon group includes the tibialis anterior, extensor hallucis longus, extensor digitorum longus, and peroneus tertius tendons (the latter being congenitally absent in some patients). The anterior joint recess is scanned for effusion, loose bodies, and synovial thickening. The anterior joint capsule is attached to the anterior tibial margin and the neck of the talus, and the hyaline cartilage of the talus appears as a thin hypoechoic line. The anterior inferior tibiofibular ligament of the syndesmotic complex is assessed by moving the transducer proximally over the distal tibia and fibula, superior and medial to the lateral malleolus, and scanning in an oblique plane.
2. Medial

The patient is placed in a lateral decubitus position with the medial ankle facing upward. The posterior tibial, flexor digitorum longus, and flexor hallucis longus tendons (located in this order from anterior to posterior) are initially scanned in the short-axis plane proximal to the medial malleolus to identify each tendon. They are then assessed in long- and short-axis planes from their proximal musculotendinous junctions in the supramalleolar region to their distal insertions. To avoid anisotropy, the angulation of the transducer must be adjusted continuously for the ultrasound beam to remain perpendicular to the tendons as they curve under the medial malleolus. The same holds true when assessing the lateral aspect of the ankle, as described below. The tibial nerve can be scanned by identifying it between the flexor digitorum tendon anteriorly and the flexor hallucis longus tendon posteriorly, at the level of the malleolus. The nerve can then be followed proximally and distally. The flexor hallucis longus may also be scanned in the posterior position, medial to the Achilles tendon. The deltoid ligament is scanned longitudinally from its attachment to the medial malleolus to the navicular, talus, and calcaneus.

3. Lateral

The patient is placed in a lateral decubitus position with the lateral ankle facing upward. The peroneus brevis and longus tendons are identified proximal to the lateral malleolus in their short-axis planes, and they can then be assessed in long- and short-axis planes from their proximal (supramalleolar) musculotendinous junctions to their distal insertions. The peroneus longus can be followed in this manner to the cuboid groove where it turns to course medially along the plantar aspect of the foot to insert on the base of the first metatarsal and medial cuneiform. This latter aspect of the tendon can be scanned in the prone position as clinically indicated. The peroneus brevis tendon is followed to its insertion on the base of the fifth metatarsal. The peroneus brevis and longus tendons are assessed for subluxation using real-time images with dorsiflexion and eversion. Circumduction of the ankle can also be a helpful maneuver. The lateral ligament complex is examined by placing the transducer on the tip of the lateral malleolus in the following orientations: anterior and posterior horizontal oblique for the anterior and posterior talofibular ligaments and posterior vertical oblique for the calcaneofibular ligament.

4. Posterior

The patient is prone with feet extending over the end of the table. The Achilles tendon is scanned in long- and short-axis planes from the musculotendinous junctions (medial and lateral heads of the gastrocnemius and soleus muscles) to the site of insertion on the posterior surface of the calcaneus. Dynamic scanning with plantar and dorsiflexion may aid in the evaluation of tears. The plantaris tendon lies along the medial aspect of the Achilles tendon and inserts on the posteromedial calcaneus. It should be noted that this tendon may be absent as a normal variant but is often intact in the setting of a full-thickness Achilles tendon tear. The retrocalcaneal bursa, between the Achilles and superior calcaneus, is also assessed. Assessment for a superficial retro Achilles bursa is facilitated by floating the transducer on ultrasound gel and evaluating for fluid within the subcutaneous tissues. The plantar fascia is scanned in both long- and short-axis planes from its proximal origin on the medial calcaneal tubercle distally where it divides and merges into the soft tissues.
5. **Digital**

In patients with suspected inflammatory arthritis, the metatarsophalangeal joints and, if symptomatic, proximal interphalangeal joints are evaluated from the plantar and dorsal aspects in both the longitudinal and transverse planes for effusion, synovial hypertrophy, synovial hyperemia, and bony erosions. Other joints of the foot are similarly evaluated as clinically indicated.

6. **Interdigital**

The patient is supine with the foot dorsiflexed 90° to the ankle. Either a dorsal or plantar approach can be used. The latter will be described here. The transducer is placed longitudinally on the plantar aspect of the first interdigital space, and the examiner applies digital pressure on the dorsal surface. The transducer is moved laterally with its center at the level of the metatarsal heads. The process is repeated for the remaining interspaces and then repeated in the transverse plane. When a Morton neuroma is clinically suspected, pressure can be applied to reproduce the patient’s symptoms. The intermetatarsal bursa lies on the dorsal aspect of the interdigital nerve, and care must be taken to correctly identify a neuroma and differentiate it from the bursa.  

H. **Specifications for a Peripheral Nerve Examination**

Nerves have a fascicular pattern with hypoechoic longitudinal neuronal fascicles interspersed with hyperechoic interfascicular epineurium. In addition, they have a hyperechoic superficial epineurium. As a nerve bifurcates, each fascicle enters one of the subdivisions without splitting. Nerves course adjacent to vessels and are readily distinguished from the surrounding tendons with a dynamic examination, during which the nerve demonstrates relatively little movement compared to the adjacent tendons. Nerves may become more hypoechoic as they pass through fibro-osseous tunnels, as the fascicles become more compact. Examination in the short-axis plane is usually preferred to assess the course of the nerve because it may be difficult to separate the nerve itself from the surrounding tendons and muscles on a longitudinal scan. Assessment at the level of fibro-osseous tunnels may require a dynamic examination. A statically dislocated nerve is readily identifiable on ultrasound imaging, but an intermittently subluxating nerve requires a dynamic examination. Perhaps the most commonly subluxating nerve is the ulnar nerve within the cubital tunnel (see Specifications for an Elbow Examination). Entrapment neuropathies also typically occur within fibro-osseous tunnels, (eg, cubital and Guyon tunnels for the ulnar nerve, carpal tunnel for the median nerve, fibular neck for the common peroneal nerve, and tarsal tunnel for the tibial nerve). Adjacent pathology of tendons, soft tissues, and bone can be readily evaluated to determine the potential underlying cause of the nerve dysfunction. In addition, congenital abnormalities, (eg, accessory muscles or vessels) can be assessed.

I. **Specifications for a Soft Tissue Mass Examination**

The mass should be scanned in both long- and short-axis planes. Ultrasound imaging is an excellent method for differentiating solid from cystic masses. The mass should be measured in 3 orthogonal dimensions, and its relationship with surrounding structures, particularly joints, neurovascular bundles, and tendons, should be determined. Compressibility of the lesion should be evaluated. A color or power Doppler evaluation may help delineate intralesional and extralesional vessels and vascularity of a mass.
J. Specifications for Interventional MSK Ultrasound

Ultrasound imaging is an ideal modality for image guidance of interventional procedures within the MSK system. The usual standards for interventional procedures apply (ie, review prior imaging, appropriate consent, local anesthetic, and sterile conditions). The use of a sterile drape that surrounds the prepared site, a sterile ultrasound probe cover, and sterile gloves will lower the risk of contamination and infection. Ultrasound provides direct visualization of the needle, monitors the needle pathway, and shows the position of the needle within the target area. Direct visualization of the needle allows the practitioner to avoid significant intratissueal and extralesional vessels, adjacent nerves, and other structures at risk.

Before any procedure, an ultrasound examination to characterize the target area and its relationship to surrounding structures is performed. Color or power Doppler imaging is useful to delineate any vessels within the target zone. Ideally, the shortest pathway to the region of interest should be selected, with consideration given to regional neurovascular structures. The transducer is aligned in the same longitudinal plane as the needle. The needle can be attached directly to the transducer or held freehand. Either way, the needle is visualized throughout the procedure. Slight to-and-fro movement or injection of a small amount of sterile saline or air may be beneficial in visualizing the needle. In cases of biopsy, focal areas of vascularity indicate viable tissue for pathologic examination.

K. Specifications for an Ultrasound Examination for Detecting Foreign Bodies

Most foreign bodies are associated with an acoustic shadow or comet tail artifact. Foreign bodies also commonly have a surrounding soft tissue reaction. Once a foreign body is detected, ultrasound can be used to demonstrate its relationship to adjacent structures. In addition to a high-frequency linear array transducer, detection of foreign bodies in superficial subcutaneous tissues may require a standoff pad. Color and power Doppler imaging may be useful in detecting the tissue reaction that often surrounds a soft foreign body. When available, 3-dimensional imaging may be useful for localization.

VII. Documentation

Adequate documentation is essential for high-quality patient care. There should be a permanent record of the ultrasound examination and its interpretation. Images of all appropriate areas, both normal and abnormal, should be recorded. Variations from normal size should be accompanied by measurements. Images should be labeled with the patient identification, facility identification, examination date, and side (right or left) of the anatomic site imaged. An official interpretation (final report) of the ultrasound findings should be included in the patient’s medical record. Retention of the ultrasound examination should be consistent both with clinical needs and with relevant legal and local health care facility requirements.

Reporting should be in accordance with the AIUM Practice Parameter for Documentation of an Ultrasound Examination.
VIII. Equipment Specifications

Musculoskeletal ultrasound imaging should be performed with high-resolution linear array transducers with a broad bandwidth. Frequencies between 7.5 and 12 MHz are generally preferred, with frequencies lower and higher required for deep and very superficial structures, respectively. Transducers with a small footprint should be used in assessing smaller structures (eg, interphalangeal joints). Linear array transducers accentuate anisotropy due to the lack of divergent beam geometry. Color and power Doppler examinations are valuable in assessing hyperemia in inflammatory or reparative tissue, determining the vascularity of a soft tissue mass, differentiating cystic lesions from vessels, and assisting in ultrasound-guided biopsy and aspiration. Doppler frequencies should be set to optimize flow detection. Tissue harmonic imaging, compound imaging, and an extended field of view may all be useful in MSK ultrasound.

IX. Quality Control and Improvement, Safety, Infection Control, and Patient Education

Policies and procedures related to quality control, patient education, infection control, and safety should be developed and implemented in accordance with the AIUM Standards and Guidelines for the Accreditation of Ultrasound Practices.

Equipment performance monitoring should be in accordance with the AIUM Standards and Guidelines for the Accreditation of Ultrasound Practices.

X. ALARA Principle

The potential benefits and risks of each examination should be considered. The ALARA (as low as reasonably achievable) principle should be observed when adjusting controls that affect the acoustic output and by considering transducer dwell times. Further details on ALARA may be found in the AIUM publication Medical Ultrasound Safety, Third Edition.

Acknowledgments

This parameter was revised by the American Institute of Ultrasound in Medicine (AIUM) in collaboration with the American College of Radiology (ACR), the Society for Pediatric Radiology (SPR), and the Society of Radiologists in Ultrasound (SRU) according to the process described in the AIUM Clinical Standards Committee Manual.

Collaborative Committee: Members represent their societies in the initial and final revision of this parameter.
References