# Diagnostic Ultrasound for the Assessment of Joint Pathology

Use this valuable tool to assess disease status.

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## Objectives

After completing this CME, the reader should be able to:

1) Identify and list how diagnostic ultrasound compares to other imaging modalities in assessing joints of the foot and ankle.

2) Describe the general approach to utilizing diagnostic ultrasound in assessing joint pathology.

3) Identify the key sonographic findings in inflammatory arthritis.

4) Identify the key findings in osteoarthritis.

5) Identify the key findings in crystalline arthritis.

6) Understand the benefits of ultrasound guided injections over blind injections.

7) Describe the basic approach to doing ultrasound guided injections.

8) List the codes used in billing for diagnostic ultrasound assessment and intervention in the office setting.



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*Following this article, an answer sheet and full set of instructions are provided (pg. 136).—**Editor***

### Introduction

Diagnostic ultrasound has come a long way since its use was first explored in the 1940s. Its safety is evidenced in its use in obstetrics. It has an impressive list of benefits, which include the following:

**Diagnostic ultrasound has come a long way since its use was first explored in the 1940s.**

1) No patient limitations such as pacemakers, claustrophobia, and spinal implants;

2) Patient convenience, with the scan being able to be done in-office;

3) Dynamic scanning allowing for structure movement which can aid in assessment;

4) Bilateral comparison;

5) Imaging able to be done in

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presence of metallic hardware;

6) Doppler which enables assessment of an inflammatory condition;

7) Ability to visualize when palpating;

**Scanning is done in 2 planes, the short axis and the long axis.**

8) Ability to use ultrasound for needle guidance;

9) Portable units that provide optimum lateral and axial resolution. Simply put—a great image from which to make an assessment.

Although this article will be focusing on clinical application, specifically rheumatologic assessment, a few things need to be discussed regarding technical factors. Listed are those factors which are deemed to be the most critical to ensure that the best image is obtained on which to base assessment.

1) Make sure the probe is perpendicular to the structure being imaged to avoid what is called anisotropy. This is an artifact, which will decrease the image quality and can be confused with pathology.

2) Scanning is done in 2 planes—the short axis, which is cross sectional, and the long axis, which is the longitudinal view.

3) Use lots of gel to eliminate any air between the probe and the skin, which will ruin the image.

4) Use high frequency that will improve resolution of the superficial structures inherent in podiatry. 12-18 megahertz is highly recommended.

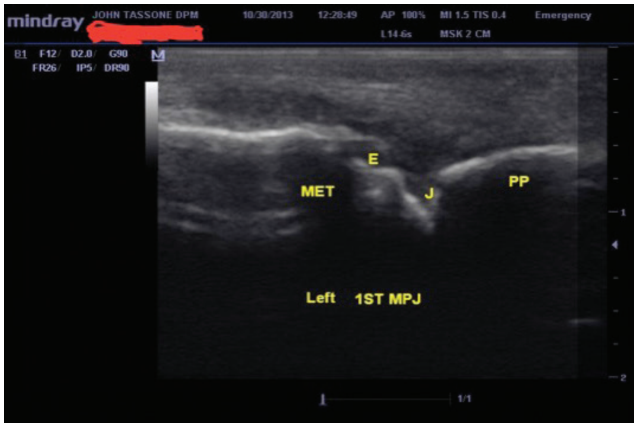


Figure 1: Erosive change (E) as seen on this sagittal view of the 1st MPJ. You can see the disruption of the normal hyperechoic bone of the metatarsal head. (MET) PP—proximal phalanx.

**12-18 megahertz is recommended to use in imaging the foot and ankle .**

5) Make sure you are at a proper depth. A range of 0.5cm–6 cm can be chosen, depending on how deep the structure is.

6) Make sure you are at the proper focus, which improves lateral resolution. This is a one-button adjustment that greatly helps with obtaining a clear image.

7) Use gain, which increases energy of the ultrasound. This needs to be used judiciously, should not be over-utilized, and may not be needed at all.

8) Scan in ambient light.

9) Scan slowly and deliberately.

Although a proven imaging modality, diagnostic ultrasound is still in many minds relegated to an ancillary status. The reasons for this are multifactorial and beyond the scope of this article. However, one factor that is pertinent is the lack of under-

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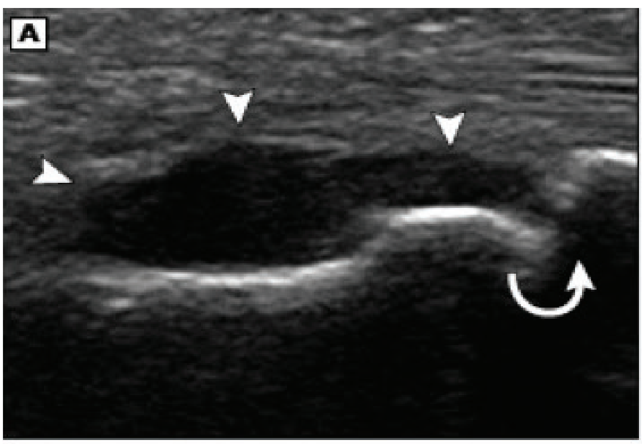


Figure 2: Effusion (arrowheads) seen as anechoic signal at IPJ (curved arrow).

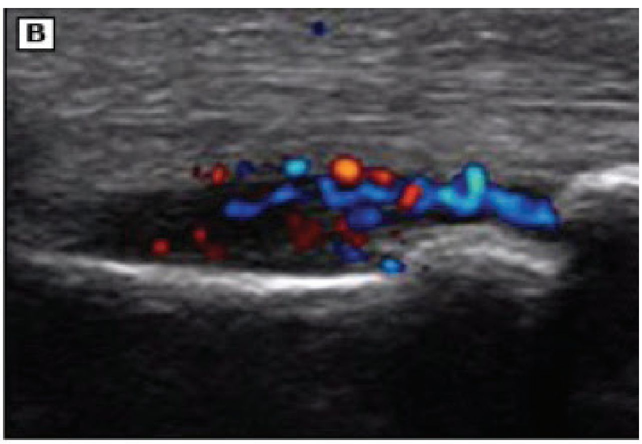


Figure 2b: Hyperemia as seen on power Doppler of effusion and synovitis of IPJ.

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standing of how diverse ultrasound is in assessing clinical pathology. Most clinicians know of its ability to image basic soft tissue structures such as tendons and ligaments, but do not understand how much more it can do in the clinic. One of the areas in which it's extremely useful is assessment of joints and associated structures. This will be the focus of this article.

**Gain needs to be used judiciously, should not be over-utilized, and may not be needed at all.**

**Comparison to Other Imaging Modalities**

Ultrasound, as compared to plain film, will detect erosions earlier than when they present on radiographs. Studies show that diagnostic ultrasound has three times greater sensitivity than plain films in detecting erosions.[1] It will also detect stress fractures earlier and also occult stress fractures. Studies also show that small joint changes seen in psoriatic arthritis are detected sooner than when changes can be appreciated on radiographs.[2] Compared to MRI, ultrasound is highly comparable, both regarding sensitivity and specificity for assessing large joints and to a lesser—but still respectable—extent, assessing small joints.[3] For soft tissue assessment enthesitis is comparable to MRI.[4] The resolution of high frequency ultrasound in assessing tendon pathology compares to 3T MRI. The resolution of the 3T MRI is only slightly better than that of high resolution diagnostic ultrasound.[5] This comparable resolution combined with the ultrasound's advantages of dynamic capability, low cost, portability, and patient convenience make it favored by radiologists who are adept at both the MRI and diagnostic ultrasound. Subtle collagen fiber derangement seen in tendonosis can be appreciated on ultrasound, and subtle tears can be better seen when the tendon can be moved while assessing in real time, which is only possible with ultrasound.

**The Rheumatological Assessment**

There are three basic protocols that are utilized when assessing joint pathology.[6] The first and by far the most common protocol that is employed is the complaint-driven image selection. This protocol is based on the clinical assessment and the most likely differential diagnosis. The most useful images and the order in which they are obtained are then chosen to support or exclude the likely causes of the given pathology, and can lead to a definitive diagnosis. The second protocol used in the rheumatologic assessment is standardized scanning. This type is time-consuming. It is typically relegated to clinical trials and training sessions. An ultrasound technician would obtain the images and a radiologist would then interpret them. The third type is disease-specific imaging, and the images obtained are on specific regions of the body that tend to be specific to a disease. An example would be imaging the hip and knee in someone who may have polymyalgia rheumatica.

**The most common protocol that is employed is the complaint-driven image selection.**

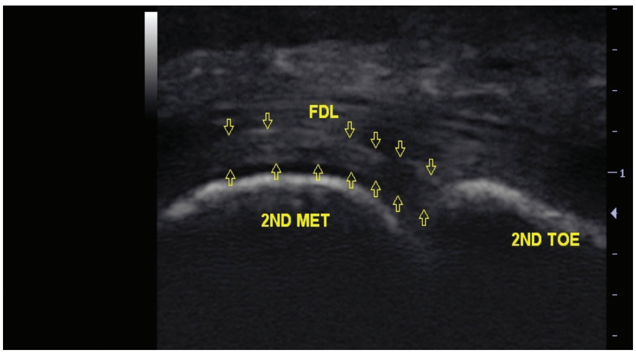


Figure 3: Hyaline cartilage appearing as anechoic band above the hyperechoic surface of the metatarsal head.

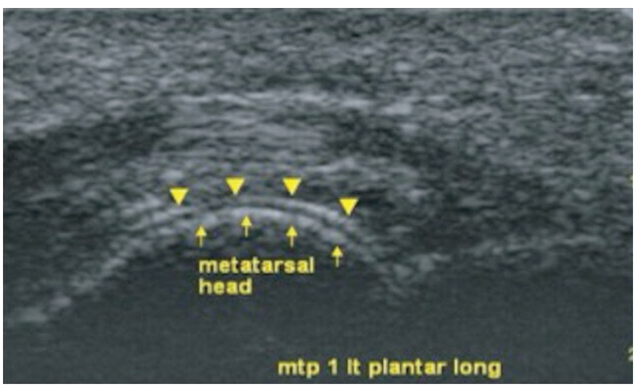


Figure 4: Double contour sign as seen as hyperechoic band (arrowheads) following the contour of the hyperechoic osseous contour of the metatarsal head. (Arrows).

The podiatric assessment, by far, would employ the complaint-driven protocol. The clinician would determine, by the exam, a differential diagnosis and the ultrasound would be used to assess any structures that are part of the differential. In joint pain, that would entail a survey of the structures of that joint. When working a disease state such as any of the arthritides, the disease-specific proto-

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col would be utilized. A podiatric joint survey to rule out a generalized process includes the ankle, talonavicular joint, 1st, 2nd and 5th metatarsophalangeal joints, and the 1st and 2nd interphalangeal joints.[7] The 2nd MPJ is common for early synovitis and the 5th is most common for early inflammatory arthritis.

Diagnostic ultrasound can provide visualization of various components of a joint including the capsule, joint recesses, the joint cartilage, and the contour of the subchondral bone and adjacent bone. Joint recesses such as seen in the ankle and subtalar joint can be visualized when they are fluid-filled. The contour of the bone can be assessed for any irregularities such as stress fractures or occult fractures.

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**Inflammatory Arthritis**

The hallmark of inflammatory arthritis, such as rheumatoid arthritis, is bone erosion. The standard imaging to detect erosions has long been plain film radiography. Ultrasound is able to appreciate erosions in the early phase of the disease process with sensitivities that are far greater than plain film *radiography* (Figure 1). Greater sensitivity of US over conventional radiography in the detection of bone erosions in metacarpophalangeal joints of RA patients was corroborated in a study in which sonography detected 6.5-fold more erosions than radiography in early rheumatoid arthritis and 3.4-fold more erosions in late diseases.[8] Moreover, the sonographic erosions corresponded to MRI bone abnormalities. Joint effusions are easily captured on diagnostic ultrasound (Figure 2a). The fluid will be seen as hypoechoic (dark) on the monitor. Clinically differentiating between a thickened synovial membrane and joint effusion is, at times, problematic. Synovitis is depicted as a hypoechoic area in relation to the isoechogenicity of connective tissue.

The use of power Doppler can help to differentiate between active and inactive synovitis (Figure 2b).

**Joint effusions will be seen on ultrasound as hypoechoic.**

Several studies suggest that US is superior to clinical examination in detecting synovitis.[9,10-12] In a study that utilized both gray scale imaging and power Doppler ultrasound, but did not utilize MRI or arthros-

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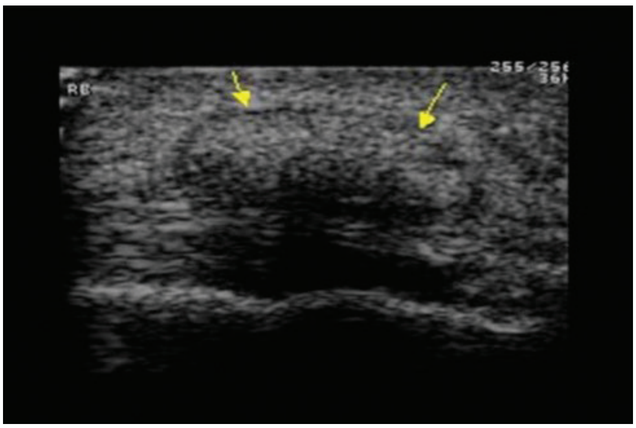

Figure 5: Tophaceous mass (hyperechoic stippled mass) seen on sagittal view.

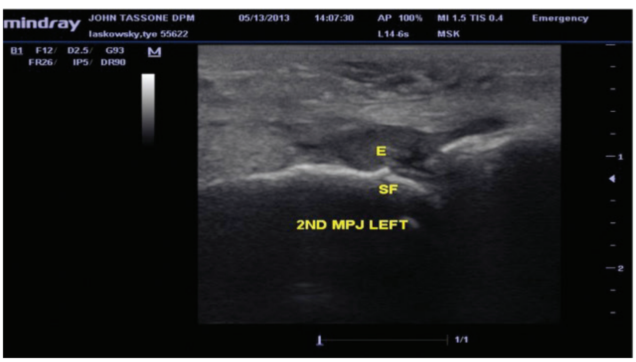


Figure 6: Stress fracture (SF) seen as hyperechoic raised disruption coming off the metatarsal head on sagittal view. E-hyperechoic chronic synovial thickening.


Figure 7: EDL tendon on long axis showing anechoic fluid surrounding tendon typical of tendonitis.


Figure 8: Anisotropy on the sagittal view of the Achilles tendon. The anechoic area seen where the arrow is pointing is where the tendon inserts on the calcaneus.

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copy as gold standards, diagnostic ultrasound detected more synovitis in finger and toe joints in patients with rheumatoid arthritis than did clinical examination.[13] Thickening of the synovial membrane does not always correlate to an inflammatory process, whether detected by clinical examination or by diagnostic ultrasound. Power Doppler ultrasound proved to be a more reliable imaging modality when compared to MRI for appreciating active synovitis. This is especially useful when monitoring for response to biologic treatment of inflammation.[9] Diagnostic ultrasound is able to adequately visualize joint cartilage. Normal hyaline cartilage appears as a homogeneously anechoic band delineated by hyperechoic margins (Figure 3).

**The double contour sign is indicative of gout.**

### Crystal Induced Joint Disease

Diagnostic ultrasound is an excellent imaging choice for gout. It can also aid in monitoring therapy.[14-18] Important diagnostic features include a hyperechoic linear density that follows the contour of the hyaline cartilage. This is known as the double contour sign (Figure 4). Also, tophaceous-appearing deposits in joints or within tendons can be visualized.[16] These deposits will appear as ovoid stippled signals that will be hyperechoic cloudy areas surrounded by a hypoechoic border (Figure 5). Several studies support the effectiveness of the use of diagnostic ultrasound in diagnosing and monitoring gout. In one study, the ultrasound finding of hyperechoic cloudy areas had a sensitivity and specificity for gout of 79 and 95 percent,[17] while the double contour sign had a sensitivity and specificity of 44 and 99 percent.[18] In a subsequent report in which "atypical" (punctuate) forms of the double contour sign were described in calcium pyrophosphate deposition (CPPD) arthropathy. In typical gout, the double contour sign is more linear and not punctate.

**Hyaline cartilage on diagnostic ultrasound is normally seen as an anechoic band with hyperechoic margins.**

### Osteoarthritis

Joint hypertrophy is easily visualized on ultrasound. Hyperechoic proliferation, seen as bright white on the screen representing increased echo, will be seen. Osseous hypertrophy such as spurring and lipping can be easily imaged.[19] The contour of the bone can also be imaged assessing for stress fractures, subchondral changes, and defects (Figure 6). The joint space can be assessed and measured using digital calipers. Joint debris and any calcifications can also be readily appreciated appearing as hyperechoic signals on the monitor.

### Soft Tissue Structures

Diagnostic ultrasound is excellent in assessing associated soft tis-

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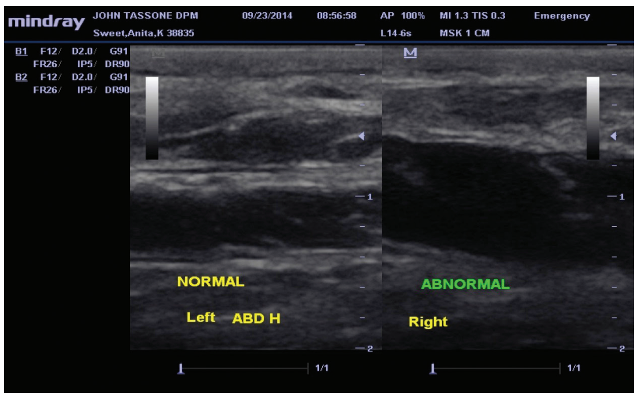


Figure 9: Normal abductor hallucis muscle belly on the left image. The right Figure shows the anechoic loss of the normal muscle architecture the represents injury.

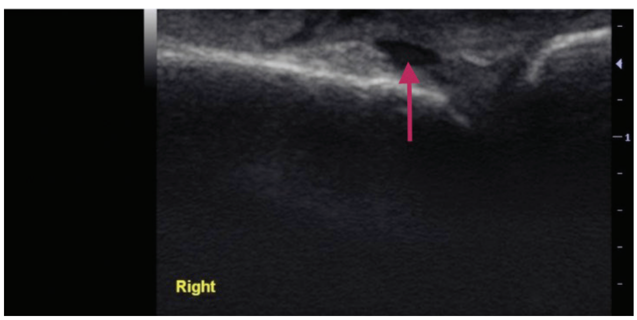


Figure 10: Anechoic area at arrow shows capsule tear on sagittal view of the cuneo navicular joint.

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sue structures such as tendons, ligaments, and bursa. Inflammatory arthritides can involve the synovial sheath and/or the tendon proper (Figure 7). Although tendons are poorly vascularized, they can become inflamed. Thus, the tendon may undergo neovascularization.[20] In sheathed tendons, the nutrient vessels enter the tendon at specific sites called mesotendons (or vincula in the fingers), whereas in unsheathed tendons, blood vessels enter the tendon at randomly distributed sites. Sheathed tendons have a wide distribution as seen in all the flexor and extensor tendons around the ankle joint. Tendons, either sheathed or unsheathed, lie adjacent to bursae and joints, structures that are lined with synovial cells. Thus, tendons may become involved in the inflammatory process as innocent bystanders. This mechanism probably plays a predominant role in inflammation of unsheathed tendons, including the rotator cuff tendons, which lie adjacent to the shoulder joint and the subacromial-subdeltoid bursa; another example is inflammation of the Achilles tendon, which is adjacent to the retrocalcaneal bursa.

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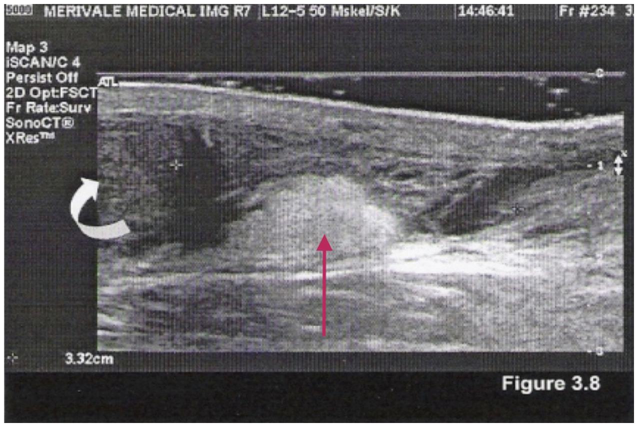


Figure 11: Achilles full rupture on sagittal view. Curved arrow shows retracted end. Red straight arrow shows hyperechoic late hematoma formation in the gap of the rupture.

Sonography usually depicts a normal tendon as hyperechoic and fibrillar. However, a normal tendon may demonstrate the phenomenon of anisotropy which is an artifact that must be corrected for (i.e., areas of decreased echogenicity due to oblique beam artifact). (image 8) Normal muscle is characterized as being predominantly hypoechoic with interspersed hyperechoic connective tissue on sonography and as having an intermediate signal on MRI. The transverse US scan of muscle is featured as a "starry night."

Abnormal tendon or muscle is characterized by hypoechoic areas on sonography and by a fluid, which is seen as an anechoic or dark signal (Figure 9). Full-thickness tears are characterized by complete tendon absence or muscle disruption with retraction. The presence of an accompanying hematoma is characterized by anechoic (early stages) or hypoechoic areas (later stages) or by heterogeneous abnormal mixed echogenicity with a mass effect on sonography.

An essential part of US examination of tendons is dynamically moving the joint or extremity (e.g., toe tendons should be examined while bending and stretching the toes, and the ankle tendons should be examined while plantarflexing, dorsiflexing, inverting, and everting the ankle and foot.). During dynamic examination, tendon movement and anatomical integrity may be assessed. Anatomic integrity is defined as continuity of the parallel aligned tendon fibers, without interruption, along with a crisp outer tendon border. Examples of pathologic features that may be observed include the snapping phenomenon accompanying peroneal subluxation and any bulging of tendons. Capsular injuries can also be appreciated (Figure 10).

**Abnormal tendon or muscle is characterized by hypoechoic areas on sonography and by a fluid, which is seen as an anechoic or dark signal.**

The unsheathed Achilles tendon is the longest of the human body. It connects the calf muscles (i.e., the gastrocnemius and the soleus) with the calcaneal bone. It can best be examined using a probe with a frequency between 12-18 MHz. Longitudinal sonography permits measuring the length and the sagittal diameter. The mean length in adults is about 15 cm, and the sagittal diameter is about 4.3 mm. A bursa lies deep to the tendon at the enthesis, which is sonographically not visible when it is not inflamed.

Both partial and complete ruptures of the Achilles tendon may be assessed with ultrasound (Figure 11). Partial tears are more common than complete tears and are more difficult to diagnose clinically. Dynamic scanning is critical in assessing partial tears in that the tear may be more evident when moving the tendon. Sonographic examination of artificial cuts in cadaveric tendons

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shows 81 percent accuracy between the size of the tear and the sonographic diagnosis.[21]

In patients with Achilles tendon injuries, full thickness rupture is suggested by absence of tendon at the site of injury, by proximal tendon migration or retraction, and by posterior acoustic shadowing.[22] A common site of complete tears is about 5 cm proximal to the insertion onto the calcaneus. Furthermore, the Achilles tendon and its enthesis are frequently involved in the spondyloarthropathies, characterized by increased thickness, loss of fibrillar architecture hypoechogenicity, and inflammation and neovascularity as seen on power Doppler (Figure 12).

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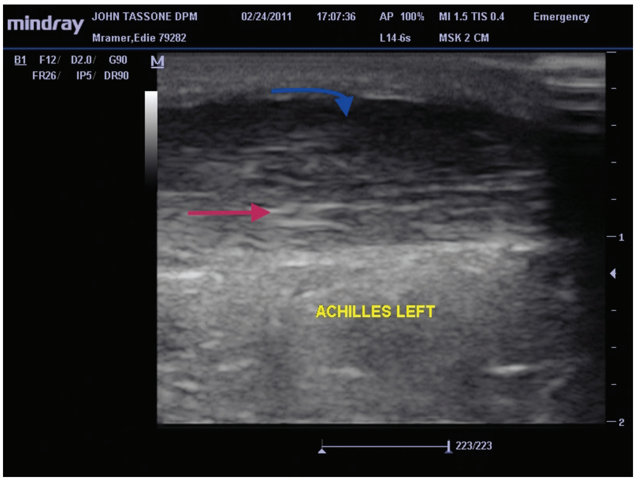


Figure 12: Achilles tendinosis on sagittal view. Blue curved arrow shows hypoechoic loss of architecture and distension typical of pathology on ultrasound. Straight white arrow shows the tendon proper.

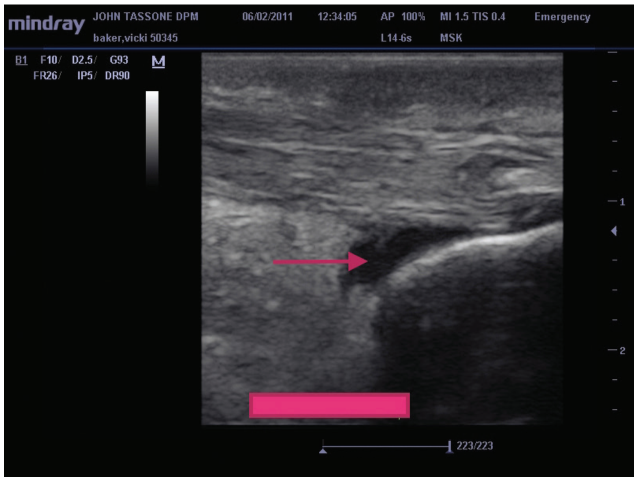


Figure 13: Sagittal view of the Achilles tendon. Arrow is pointing to inflamed bursa.

Tendons, ligaments, and joint capsules attach at the bone interface at an area called the enthesis. The enthesis consists of an area of fibrocartilage. To underpin the significance of this anatomical complex, the term enthesis organ complex has been coined to include not only the portion of the attachment between tendon and bone but also adjacent structures including bone, bone marrow, bursae, and adipose tissue.[23] Enthesitis is one of the hallmarks of all of the spondyloarthritides (e.g., undifferentiated spondyloarthritis, ankylosing spondylitis, psoriatic arthritis, and reactive arthritis). Sonographic findings of enthesitis include thickening or intratendinous focal changes of the tendon insertion, inflammation, and swelling of the tendon insertion, calcification at the tendon insertion, spurring, erosions, new bone formation, or periosteal changes. In addition, adjacent bursitis is considered a sign of enthesitis. A positive power Doppler US signal consistent with increased vascularity may be found in active enthesitis.[24]

Normal bursae consist of two layers within only a very thin fluid between them; sonography usually depicts a bursa as a hypoechoic cleft between two hyperechoic lines. The hypoechoic cleft corresponds to the actual bursal sac, and the two hyperechoic lines correspond to the interfaces of the bursal sac with the surrounding tissues. On sonography, a dark semicircular line of 1 mm surrounds the rotator cuff in transverse view. Bursae may become inflamed in inflammatory and degenerative rheumatic disease (Figure 13).

**Power Doppler**

Power Doppler differs from color Doppler. Color Doppler is used to assess flow. Power Doppler is used to assess the intensity of the flow.[25] Thus, it is more sensitive in detecting increased flow as seen in inflammation. It will detect neovascularization seen in synovitis, tendonitis, and any inflammatory process that may be occurring. Color Doppler can be utilized to locate vessels. This can be very useful when planning an injection so as to avoid vessels. Diagnostically, it is extremely useful when assessing soft tissue masses and ruling out vascular lesions or components of the mass.

**Ultrasound-guided Injections**

Blind injections based upon external landmarks alone are often inaccurate.[26] A study of 109 patients who received "blind" intra-articular injections of the shoulder or the knee showed that the accuracy was

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only 25 and 70 percent, respectively.[27] Another study, which examined the accuracy of blind glenohumeral (GH) joint and subacromial bursal injections into 38 shoulders found 42 and 29 percent accuracy, respectively.[27] The use of US may improve the accuracy of needle placement. A study compared US-guided and blind needle placement in a total of 63 joints, including the shoulder, knee, ankle, and small joints.[28] Successful aspirations were more frequent using US guidance (97 versus 32 percent), although interpretation of the study data is limited by the fact that patients referred for US-guided aspiration who subsequently failed to show fluid were excluded from the study.

**When determining if a thickened synovial membrane represents an inflammatory process use a power Doppler.**

Accuracy of small joint aspiration from metacarpophalangeal or proximal interphalangeal joints is also greater with US-guidance than using a palpation-guided approach (96 versus 59 percent).[29,30] Other studies have found comparable accuracy for US in comparison with computerized tomography (CT) or magnetic resonance imaging (MRI) for the aspiration of joints, including the hips or soft tissue masses at various skeletal sites.[31,32]

Other benefits besides increased accuracy include less post-injection pain; and with guided nerve blocks, less local anesthesia required, faster onset of anesthesia, and avoidance of nerve trauma. US potentially reduces the likelihood of "dry taps" from the needle missing a small or sequestered fluid collection.[33,34] US is able to detect volumes of synovial fluid in cadaver knees as small as 7.4 mL, but modern devices visualize fluid collections in ankle joints as small as 2 mL.[34]

Ultrasound is excellent for soft tissue imaging. Improved clinical outcomes for peritendinous anatomical structures, bursal, or intra-articular injections have been cited in the literature.[35-39] A randomized trial compared US guidance and conventional palpation guidance for arthrocentesis and glucocorticoid injection in a variety of joints in 148 patients with osteoarthritis, rheumatoid arthritis, and other conditions. US guidance resulted in significant reductions in procedural pain and pain scores at two weeks (by 43 and 59 percent, respectively) and increased the rate of response (reduction in pain score of at least 50 percent) by 26 percent.

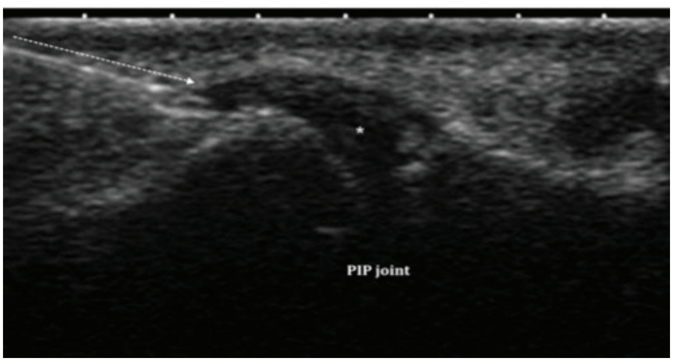


Figure 14: Broken arrow shows hyperechoic view of needle as seen on in-plane approach of injection in the IPJ.

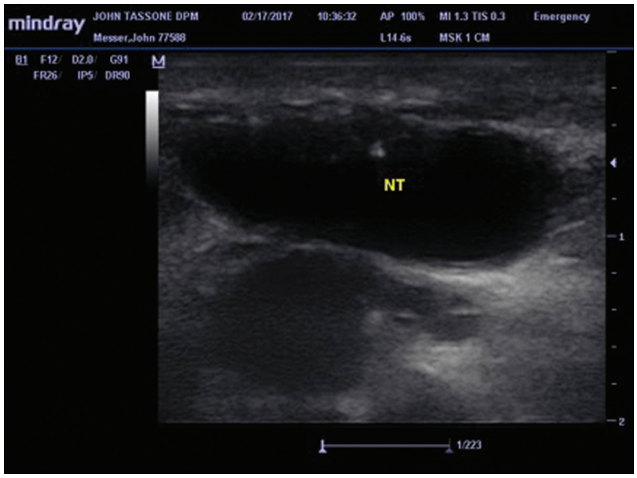


Figure 15: Needle tip (NT) seen entering ganglion cyst in out of plane injection technique.

A randomized trial of US-guided intratenosynovial glucocorticoid injection versus a blind intramuscular steroid injection in patients with rheumatoid arthritis and active tenosynovitis showed a significantly better response to the US-guided injection compared with intramuscular steroid injection, both at 4- and 12-weeks follow-up.[40] A retrospective study evaluating residents with carpal tunnel syndrome in Olmsted County, Minnesota showed that ultrasound-guided injections were associated with a reduced chance of retreatment compared with blind injections.[41]

**Injection Technique**

There are two approaches to needle visualization. With in-plane technique, where the long axis of the probe is longitudinal to the needle (Figure 14), the needle will be clearly visible. The out of plane technique is when the long axis of the probe is transverse to the needle. The needle tip, which will appear as a tiny hyperechoic dot will be visible (Figure 15). Both approaches are routinely used and depend on the clinician's preference. Small movements of the needle can make it more visible so that the progression of the needle course

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can be followed on the screen. Another technique for ensuring correct placement is to inject a small amount of air or a mix of air/glucocorticoid/saline into the joint through the needle. Air bubbles are clearly visible as a white line, white dots, or bright spheres.

There are also two overall approaches. The indirect approach technique is scanning the area prior to injection and planning your approach identifying any vessels and identifying the direction of the path. The clinician marks the skin in anticipation of the injection. The depth of the lesion should be measured to facilitate selection of a needle of sufficient length. The skin should be sterilized using standard techniques, and the needle should be inserted near the mark in the same direction as the probe was oriented. The direct approach scans while injecting, enabling the clinician to follow the needle to its destination. Aseptic technique should be employed. We prefer the use of sterile US transmission gel and cleaning the probe surface with alcohol rather than a sterile sleeve for the transducer probe when the direct approach is used. An alternative approach preferred by some clinicians, or in countries where sterile gel is not readily available, is to envelop the probe in a sterile glove filled with gel.

When the sterile-gel US approach is used, the skin is wiped with an alcohol swab and the probe surface is also cleaned with alcohol. Although iodinated solution can be used on the skin, the transducer surface may be affected by iodine, and cleaning with a 70 percent alcohol solution or chlorhexadine solution is used for the transducer probe. The sterile gel is then placed over the skin and the probe. Alternatives to the use of sterile gel are use of a gel-filled sterile transducer sleeve or sterile hand glove placed over the transducer. The needle is then placed under the probe and slowly advanced to the target. The use of sterile gel allows the needle to be inserted through the gel into the skin if it is overlying the preferred injection site.

**The in-plane technique allows for increased needle visualization.**

### Billing and Documentation

There are two main types of billing codes for utilization of ultrasound in the clinical setting. The first type are the diagnostic codes. The diagnostic codes consist of CPT 76881 and 76882. The 76882 code is defined as a survey of a joint. Ultrasound assessment would consist of examining all the structures associated with that joint, including any ligaments, tendons, joint structures, and the joint itself. Multiple images and a detailed note would need to accompany the chart and the exam would take longer. The reimbursement averages approximately $80-100. The other diagnostic code is CPT 76882. This is defined as a site-specific examination. The ultrasound assessment would be focusing on a structure (e.g. Achilles tendon) or a specific focal region. The exam would be faster and documentation briefer. Images still need to accompany documentation. Reimbursement is less, with national averages ranging approximately $30-60.

The second type are the interventional codes, used when guided injections are done. There are two sub-categories within this. CPT 76942 is the classic code, and is used for all non-intra-articular guided injections. This code would be combined with the code for the injection (e.g. CPT 20550). Both codes would be billed. The intra-articular injections are combined codes. They are categorized depending on joint size. A small joint would billed as CPT 20604, an intermediate joint would be 20605, and a large joint would be 20606. These are bundled codes so they include the procedure and the injection code, so these codes are all that would be billed. Also, you cannot bill a diagnostic code (e.g. CPT 76882) and an injection code (CPT 76942) at the same visit. The injection codes assume that you did the assessment.

Ultrasound assessment documentation needs to include a brief description of the equipment being used and an overall description of the exam—making sure you mention both that the short and long axis was employed and the fact that the exam incorporated a dynamic component. Also, if power Doppler was utilized, this needs to be mentioned. Guided injection procedures need to describe the equipment used, the needle approach used (in-plane or out of plane), and a brief procedure of the encounter, including details of what was injected or aspirated. An image, showing the needle, needs to accompa-

**Ultrasound assessment documentation needs to include a brief description of the equipment being used and an overall description of the exam—making sure you mention both that the short and long axis was employed and the fact that the exam incorporated a dynamic component.**

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*Ultrasound (from page 133)*

ny the documentation. A clip is not needed but can be done and saved. PM

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## CME EXAMINATION

**SEE ANSWER SHEET ON PAGE 137.**

**1) Which frequency is best recommended to use in imaging the foot and ankle due to its excellent resolution?**
- A) 5-7 megahertz
- B) less than 5 megahertz
- C) 12-18 megahertz
- D) 7-12 megahertz

**2) Which of the following technical factors is recommended to adjust last, if needed at all?**
- A) Gain
- B) Depth
- C) Focus
- D) Frequency

**3) Which of the following is a true statement?**
- A) The ultrasound wave needs to encounter the structure at an oblique angle to maximize detail and resolution.
- B) Probe orientation needs to be in the cardinal planes when imaging.
- C) Minimum gel is needed between the probe and skin.
- D) Scanning is done in 2 planes, the short axis and the long axis.

**4) Which ultrasound exam protocol is mostly used in podiatric assessment?**
- A) Disease-specific
- B) Complaint-driven
- C) Standardized scanning
- D) None of the above

**5) Joint effusions will be seen on ultrasound as:**
- A) Hypoechoic
- B) Isoechoic
- C) Hyperechoic
- D) None of the above

**6) Hyaline cartilage on diagnostic ultrasound is normally seen as a(n):**
- A) hyperechoic band with hypoechoic margins
- B) anechoic band with isoechoic margins
- C) hyperechoic band with hyperechoic margins
- D) Anechoic band with hyperechoic margins

*Continued on page 136*

Continuing Medical Education

## CME EXAMINATION

**7) The double contour sign is indicative of:**

**A) Gout**
**B) Rheumatoid arthritis**
**C) Psoriatic arthritis**
**D) Osteoarthritis**

**8) Which of the following statements is true?**

**A) The in-plane technique allows for increased needle visualization**
**B) The out of plane technique allows for increased visualization of the needle**
**C) The indirect approach involves scanning while you are inserting the needle.**
**D) None of the above.**



**9) When determining if a thickened synovial membrane represents an inflammatory process, the following should be done:**

**A) Increase the gain while scanning.**
**B) Compress the membrane with ballistic movement of the probe.**
**C) Tilt the probe obliquely.**
**D) Use a power Doppler.**

**10) Which of the following is not part of a joint survey of the foot and ankle?**

**A) 3rd MPJ**
**B) 1st MPJ**
**C) talonavicular**
**D) ankle**

**SEE ANSWER SHEET ON PAGE 137.**

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## ENROLLMENT FORM & ANSWER SHEET *(continued)*

### EXAM #5/21
### Diagnostic Ultrasound for the Assessment of Joint Pathology (Tassone)

**Circle:**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | A | B | C | D | 6. | A | B | C | D |
| 2. | A | B | C | D | 7. | A | B | C | D |
| 3. | A | B | C | D | 8. | A | B | C | D |
| 4. | A | B | C | D | 9. | A | B | C | D |
| 5. | A | B | C | D | 10. | A | B | C | D |

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| Strongly agree [5] | Agree [4] | Neutral [3] | Disagree [2] | Strongly disagree [1] |
|---|---|---|---|---|

1) This CME lesson was helpful to my practice ____

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3) I will apply the knowledge I learned from this lesson ____

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6) What overall grade would you assign this lesson?

A B C D

7) This activity was balanced and free of commercial bias.

Yes _____ No _____

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A B C D

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_______________________________________________

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