The ABCs of Musculoskeletal Ultrasound: 8 Foot Ankle Transcript

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Overview of ankle and foot ultrasound

In this portion of the series, I will review with you the ultrasound evaluation of ankle and foot. I'll discuss the technique for patient positioning and for scanning.

Also, review some of basic anatomy and show you pictures you should be able to identify using the Ultrasound. At the end of this series I review the clinical correlations when evaluating ankle-foot pathology.

As usual, one of key things for doing ultrasound scanning is patient position. For looking at ankle and foot structures, it is best to use a transducer of at least 12 megahertz.

The patient is placed supine on an examination table for the dorsal scans, with the examiner seated at the patient's feet. And for planter scans it's best have the patients examined prone.

When obtaining images of the ankle or the foot, its best first start proximally and scan distantly on the ultrasound. Let's now review some of the anatomy.

This is an image showing you the basic bony structures of ankle and foot. You're familiar with the tibula and the fibula. But we want to pay more detailed attention to the bones of an ankle, and of a feet.

Here you can see in greater detail the talar and navicular bones. And actually coming more distally you may look at and identify the cuneiform bones, Remember there are three of them, starting on the medial most aspect, the media, there's an intermediate, and there is a lateral cuneiform bone.

Basic anatomy and scan approach

And lateral to that, you will see that you also have the cuboids. You can visualize here the metatarsal joints and also the portions of the meta-tarsals phalangeal joint.

An image looking at the lateral ankle can identify the major tendon structures that we will look at. You can see the bands of tissue that help to stabilize the ankle.

Part of these comprise the deltoid ligament. Wrapping right around the lateral malleolus, you will see two tendons that we will identify. The peroneus brevis and the peronius longus.

You also have some vascular structures here where they're not as of significant concern when looking at ankle pathology. Looking at the medial anatomy of the angle, You will several key structures.

You definitely see the huge retinaculum that helps to stabilize the ankle. And then posterior to the medial malleolus, you will see several tendons and other neurovascular structures.

We will identify the tibialis posterior, the flexopolisis longus and you'll also be able to identify flexahalysis longas. Before reaching the flexahalysis longus, you will also see a neurovascular bundle.

This is the portion that comprises the tarsal tunnel. And looking at the basic anatomy from the posterior aspect, the biggest thing that we will focus on will be the Achilles tendon, looking its site of assertion into the calcaneal bone, and then we'll scan distally to look at plantar fascia.

There are several scans that are usually performed to evaluate both the ankle and for the foot, and they were outlined here. The anterior longitudinal scan, the anterior transverse scan.

And then we will actually look at the different parts of the ankles, as far as the malleolar regions. You have the medial aspect, both of longitudinal transverses, then the lateral aspect.

Again, looking at longitudinal and trans versa orientation. Posterior scans we'll look also at in the longitudinal transfer aspects. The plantar scans we'll see there are two quick and easy scans obtained.

And then also we look at the dorsal longitudinal transverse scans. When evaluating the small joints of the feet, for example, the MTPs, we usually look the first and the fifth, because this is where you will see most of pathology, and especially in people with inflammatory conditions.

Let's first start off by looking at the anterior longitudinal scan.

Anterior ankle scans

This slide demonstrates the location of the transducer and in the view you should be able to pick up the tibula and also should see the tailored joint.

Let us obtain these structures on the ultrasound. Let's first show you how I usually position my patients. Even though the patients may be lying down when doing the evaluation, I like to have the patient sitting up.

The knee is slightly flexed. I use a small pillow under the knee so as not to any tension on the ankle or the foot so that the food is not into a plantar or a dorsiflex position.

You want to a very neutral position as you look at the medial aspect and the lateral aspects here. To obtain the first image, we'll actually look the anterior longitudinal image to identify our two bony structures.

Again remember there are several curves and tendons and boney structures around the ankle so you want to compensate for any anisotropy by using excess gel.

Also remember to make sure you maximize your focal points in the area of interest and in this case I want the focus on the bones. So the two bony structures we will see here, remember the left side of the screen is going to be medial.

The right side is gonna be proximal distal. We see the hyperchoric region of tibula. And then to the right of that we see hyper-choric region. Of the talus.

In this patient you actually see that the articular cartilage surface is there. In between the joint, the tibula tala joint there is a recess, and this is the site where you might see fluid accumulation in patients who have inflammatory arthritis or in some cases in patient who has things like gout.

So the anterior longitudinal scan. The next, we will look at the anterotransfer scan, keeping your orientation correct, will essentially rotate the transducer 90 degrees.

And again, because we're over regions where we have the extensor tendons here, I will compensate by using some excess gel to get rid of any anisotropy.

And the joint that we're seeing the most here is what we saw in the longitudinal scan is looking at the talar joint. Here you can see the articular surface of it, and this would be the area of the recess there.

There's some other superficial tendons and blood vessels that are there, but not a significant area interest when dealing with musculoskeletal pathology.

Medial ankle and tarsal tunnel

The next image we will obtain will be looking at the medial aspect of the ankles. We will focus on those areas

around the malleolus. I will first start with the longitudinal orientation.

It actually is not a true longitudinal because to identify the tendinous structures of interest, the transducer should be held more at an oblique angle.

Again, remember because of bony landmarks and sharp drop-offs of this region, you can compensate for any anisotropy by using excess gel. So as we look at the images on the screen here, first identify the hyperchoric signal for the medial malleolus.

The anisotropy that is seen here on left, because there's areas that are not in contact with the skin, and we can compensate that by slightly moving the transducer.

We want to focus on the middle of the screen because here we will see the medial malleolus, and above that we're going to see, closely abutted to each other, two tendinous structures.

If we lift the transducer slightly back and forth, the most superficial will be the tibialis posterior, And right underneath that will the flexopolisis longus.

So again, mediamalleolis, tibiolis, posterior and the Flexopolysis longas. Next, we'll obtain the transverse image of the medial malleolus. In this case, I'm going to change the orientation of my transducer, and again, take advantage of some excess gel to compensate for any anisotropy.

The reason I wanted to change the transducer, so the left part of the screen is going to be the most distal structure, which we will first identify is gonna be tibialis posterior.

So if you look at this slide here, it shows the first structure will be to tibiolus posterior, next to that would be flexopolisis longus, and then posterior to we have the flexor holusus longas.

That tendon is preceded by a neurovascular bundle and nerve that comprises the tarsal tunnel. And let's identify those structures. So first, identifying your bony landmarks, which is the medial malleolus.

The first tendon that we encounter is going to be the Tibialis posterior. Next to that, we will see a cross section here, the flexopolisis longus, And then if I scan posteriorly, and again shift into the transducer to compensate for any anisotropy, we see a region where in most patients you would have an artery and two veins.

And as you can see here, I can compress the vein, whereas the artery continues to pulsate. Slightly inferior to those vessels, you actually can identify the tibial nerve.

Again, this is a reason where you have the truscle tunnel. And if we shift slightly posterior to that, this will be the region, the fibular pattern that you will identify for the flexaholisis longus.

So again, going for more anterior to posterior, here you can see your medial malleolus, tibialis posterior.

Lateral ankle tendons

Flexapolisus longis. The neurovascular bundle that comprises the tarsal tunnel. And then the fibrillar pattern, of the flexor hollis's longus in this region here.

Let's now look at the lateral maleolar region and transverse orientation. In this case, again, keeping the transducer oriented so that the lateral maleolus is going to be your brightest region, which you can see right at tip of arrow.

The areas of interest will be the two tendinous structures that we will see in cross-section, the peroneus brevis which is gonna butt the latteral malolius and the proneous longis which will overlay that.

And again, that area's where we want to focus on. And as I focus back and forth, making sure we can see all those

fibrils in cross-sections, and making they are not dispersed, which would represent tendinosis.

If they had an increased signal on the Doppler, it would recommend represent tendonitis. Those are actually fine. There's a common sheath that surrounds those, we actually see that in this region.

So again, lateral malleolus, peroneus brevis, and perroneus longus. The next image we retain will be the posterior scans of the ankles. And in this case, we're going to reposition the patient so that we look at the postural portion of ankle.

So now we will look at the series of posterior scans when looking at foot and ankle. In this case we have the patient who is now lying prone so that we can expose the areas of the Achilles tendon and looking the plantar surface of foot.

Again I like to use a pillow to elevate the leg so they are not cutting into the bony surface the examination table.

Posterior ankle and Achilles tendon

The two simple posterior scans that we'll look at will first be the longitudinal scan where we really want to focus on the Achilles tendon and pay most attention where it begins to insert onto the calcaneal bone.

Again because this is a sharp bony surface I've taken advantage of using some excess gel to compensate for any areas of anisotropy. This is one of the best areas to begin to obtain scans, particularly when looking at ultrasound images for beginners, because it shows all of these structures that you want to identify on a typical ultrasound image.

We'll first look at the hyperacoric region of skin, the hyperecoric or isoacoric region, of a subcutaneous tissue, and then you will see the Achilles tendon here as it comes down and attaches to the calcaneal bone.

One of the things you want to do is take advantage of is rotating the probe left and right, back and forth to make sure that there is no areas of anechoic regions inside the Achilles tendon.

Now you will see right in this region here, as those fibers come down and then dive at a 90 degree angle to the calcaneal bone, you'll lose those tendons.

So what you can do is essentially just tilt the probe transducer so you begin to pick those up. Doing this kind of motion with the transducers, if you look in that region, now you're beginning to see those tendsons as they attach to calcanial bone.

This is going to be skin, the Achilles tendon as it attaches in the The other area of interest in this part of the ankle is gonna be the area where there's a retrocalcaneal bursa.

Remember that the borsa is a potential space, so in normal individuals like the model, you will not see any fluid. But if a patient had gout or inflammatory arthritis, this would be area that you would see a compressible region of hypochordic signal.

The next scan we will obtain will be transverse orientation, looking at this region And you should be able to identify essentially two things. I will first use some more gel.

The most medial and lateral aspects of the screen will be off of image because there's no contact with any of this of a skin or of body. What we will identify though is the Achilles tendon that we would see in cross section as it abuts over the calcaneal bone.

So as I scan up further with that we see the nice fibula pattern of the Achilles tendon looking at those fibers on long view and you can see it just as it abuts into the calcaneal bone.

Scanning back and forth around that and making sure there's no fluid that has accumulated into Achille's tendon itself. Again, the areas on the left and the right of the screen are unavoidable in many patients because the transducer would not make contact with the body.

For the next image we will obtain will be the longitudinal view looking at the plantar aspect of a foot. The patient is in the same position and a probe is oriented so that the proximal portion is pointing toward the calcaneus.

The biggest things to identify in this particular image we will see, for example, our first focus on the big tendon structure, which is going to be the flexor hollis's longus.

It actually can manipulate the large digit and actually could see that tendon move. Underneath that in some patients you will have, as she has, the sesamoid bone, Which is a hyperchoric structure in the middle of the screen.

Now as I focus the first MTP joint, and we can identify several bony structures here.

Plantar foot and first MTP

So again, this will be the flexohalus as long as tendon, and this is going to be that metatarsal phalangeal joint of the first joint. Let's go back to a live image to obtain that.

and better detail. To make sure we get the best image I am putting some pressure contacting the probe tightly to the skin so you can identify the margins of the bony surfaces there.

A very nice image looking at the flexohalus as long as tendon, the metatarsal head, here's the phalanx, and in this region began to identify the nice, articular structures that you see, particularly the cartilage that coats that joint, in hers is normal.

The next image we would like to obtain will be the transfer scan of the plantar aspect of foot. In this case, you would just take your transducer at 90 degrees and keep it oriented so that the left side of this screen will medial and the right side will lateral.

The bony landmarks you will see will the hypercorp regions of metatarsal bone. Again, we see the tendons and cross section here. And I'm precisely over her second and first MTP joints.

And those are the two hypercord regions that you're seeing. We get to a nice structure to identify the bone. So left is medial. This will be the first metatarsal.

Sessmoid bone is here, here's metatarsal, and here is the second. Metatorsal there more lateral. The flexaholus is longest, you can see that in cross section.

And then I get some more pressure and contact with the skin to identify those structures in greater detail. In this aspect of the foot you actually do the same thing in scanning along other aspects of metartarsals bones.

The biggest area you're looking for, for example, patients who have gout or rheumatoid arthritis, looking at erosions and looking any abnormalities in the bony structures.

So in this orientation, the transfer scan of the planter will look at the metatarsal joints, tendons and cross-sections to identify changes in those regions.

So for a large series of scans for the foot, we actually have the patient back so we can look at the dorsal aspects and our first look of the longitudinal scans.

Paying most attention to the larger joints, I will focus on the first MTP. This is a very nice image obtained showing you some of the bony landmarks. You can see here to the left will be the metatarsal head, this is the phalanx.

The antecorg region, or the black region here, is going to be articular cartilage.

Dorsal and lateral foot scans

And you can her's is nice and smooth, it's very homogeneous. you see a little bit of a fat pad that goes in and helps to kind of coat the joint. and then you'll see the the Phalanxes there.

If a patient had gout, you would see fluid accumulation, rheumatoid arthritis. You look for erosions and effusions. That you see above the joint space, You can actually see the extensor tendon of the first MTP.

A very simple and easy scan to obtain to identify structures in either normal or a pathologic joint. We will now go to a transfer scan looking at the same image.

I will keep my transducer so the left side of screen will be medial. And just like what we saw on the planter aspects of the foot, we begin to see the bony landmarks of MTP joints.

I will focus on those. So to the left side of screen is going to be the first M T P. If I slide over more lateral we pick up the second M And we can do the same thing.

Let's go through and pick up the third and so on. But this is the scans you want to look at. Patients who might have a neuroma, remember between the second and third MTP, you can identify those areas.

She has no structures. You're going to see some of her normal arteries pulsating between digits. That gives you that dorsal transverse scan. Very simple and easy scan to obtain.

And finally, for the lateral scans, to get the most lateral aspects of the joints, we focus on the later aspect of first MTP, and we do the same thing for fifth M. T. P.

As I've talked about already, the first m.t.p. is a site of a lot of pathology and a lots of discomfort for a number of patients. So again, using some excess gel because of curvatures of joint space, We actually will attain a very image that's very similar to the one obtained from the dorsal aspect, shifting back and forth to look at all the aspects of the joint.

To the left of screen is going to be the metatarsal joint and to the right is gonna be to phalanx.

Clinical correlations and pathology

And you can see that the articular cartilage in between that. The nice thing about the ultrasound you actually can scan almost the entire surface of joint going from darsals to lateral to plantar aspects.

And we do the same thing from the lateral scan of the first joint, and we can obtain a similar type of scan looking at the later aspects of fifth MTP joint.

And, we see here again. So, to the left of this screen is going to be the metatarsal head. To the right is gonna be phalanx. In between is a hypoechoid area, which represents the articular cartilage.

Now that we've obtained all of our standard images of ankle and foot, let me give you a few clinical correlations. Remember that the ultrasound is a very nice tool to identify areas of soft tissue swelling like sinusitis and effusions.

The ankle is often an area that's involved in patients with inflammatory arthritis such as rheumatoid arthritis or crystal disease such uric acid deposition in patient with gout.

So you can identify effusion and also bursitis. Remember one of the sites you could easily identify with the ultrasound is the region around the Achilles tendon, the retrocalcaneal borsa.

Like other joints in the body, the ankle and the foot can be involved in bony pathology. Patients with the erosive disease such as rheumatoid arthritis or psoriatic arthritis, or even patients who have spurs from osteoarthritis.

Calcifications, crystal deposition like uric acid or calcium pyrophosphate disease, those can identified. And also patients have prostheses. We see more patients now who will have ankle, and small joint surgeries and artificial joints that can also be evaluated with ultrasound because you cannot use MRI on those patients.