Extremity Joint Mobilization Techniques
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-- [Calista] Our presenter today is Doctor Dawn Gulick. Doctor Gulick has been teaching orthopedics for over 20 years and she is the author of "Ortho Notes" and "Mobilization Notes" as well as an inventor of the device to teach and to quantify joint mobilizations. So we're so pleased to have her here with us today and she's presented for us several times on physicaltherapy.com and at this time, Doctor Gulick, I'm gonna turn the microphone over to you.

- [Dawn] Thank you very much, Calista, and it's my pleasure to present for physicaltherapy.com. So today's topic is joint mobilizations and we're gonna talk about it with respect to some of the techniques, the tips, the physiology behind it, and then share some innovative ways to begin to quantify. So all materials in this presentation are the property of Therapeutic Articulations. Using this material for any other reason without permission is prohibited. The learner outcomes for this course, I'd encourage you to just read along with me here, after the course, the participant will be able to: identify at least one clinician application for each of the four grades of joint mobilizations, identify at least three absolute and relative contraindications related to joint mobilizations, identify at least two advantages of being able to quantify joint mobilization techniques, and describe at least one mobilization for each of the joints presented in this presentation, will be emphasizing the shoulder, elbow, wrist, knee and ankle.

I'm gonna talk also about dosing mobilization and evaluating the effects of mobilization techniques using an algorithm provided in the presentation. As is expected in presentations like this, I wish to disclaim that or disclose I guess that I have a financial interest in some of the things that Calista mentioned earlier: iOrtho Mobile App, "OrthoNotes" "Mobilization Notes" and the device that we're going to be using today. I will do my best to handle this in a professional way and not turn this into a commercial. So joint mobilizations are defined as the skilled passive movement to a joint directed towards restoring accessory, also known as arthrokinematic motion. So it is the

movement obviously of two bone surfaces on one another with the idea that we are attempting to improve arthrokinematic motion to be able to then impact osteokinematic motion, which is what we measure with a goniometer. So many years ago, the concept of the Concave-Convex Rule was applied to the arthrokinematics and although there are some minor deviations to this with respect to the way that we mobilize in order to achieve centering of joints, I'll discuss that in a little bit, the Concave-Convex Rule actually does still apply.

What you see here on this picture is a description of the movement of a concave surface on a convex, and then we'll talk about a convex on a concave as well, but the direction of glide is opposite when it's convex on concave and is in the same direction when it's concave on convex. So in this particular slide you see the image on the right, the concave surface, moving on the image on the left, which is the convex surface. So in this particular instance when we're saying that they move in the same direction, what I mean by movement is rolling and gliding. So in the concave-on-convex situation, rolling and gliding will both occur in the same direction. For example if you are moving a, let's see, let me just get you a good example here, if you are moving the tibia on the femur, the tibia moves anterior on the femur, that anterior rolling and gliding together give you the extension.

Whereas in the convex-on-concave rule or situation, when you have a wrist and you have the carpals moving on the radius, that's convex on concave. So when the carpals roll anterior, then they must have a concomitant glide posterior in order for you to get the wrist extension. I'm sorry, what did I say? Roll anterior, glide, posterior, that would be wrist flexion. So that's kinda the way this whole Convex-Concave Rule works and we'll apply that as we move through. The indications of joint mobilizations kinda span a pretty big gamut. It can improve accessory and physiologic motions. It can restore the normal articular relationships. They can provide symptom relief and help to mitigate some pain. It can enhance motor function and reduced muscle guarding. All of these

depend on which grade of joint mobilizations you choose for that given technique. There are also some contraindications. There's some absolute, and there are also some precautions. The absolute ones are listed here on this slide and are things that we should definitely pay attention to because of course the Hippocratic oath is always to do no harm. So we would never want to try to get range of motion through an arthrokinematic task but at the same time then do some kinda damage otherwise, so medically unstable joint hypermobility.

And to that end, if you have a person who has a connective tissue disorder, Ehlers-Danlos, something like that, a positive Beighton score, then you're gonna be really careful on looking at their mobility and trying to assess, do they need to be mobilized? Are they already kinda loose and maybe they would benefit more from stabilization? So again that's a part of your clinical judgment on what needs to be done at that time. Of course none of the joint mobilization techniques from Grades I to IV are incredibly aggressive and they're not going to be doing any damage to the tissue. Other contraindications would be ligamentous laxity, malignancy is simply because we don't know if there's any issues with that so we err on the conservative side, cauda equina lesions, bowel and bladder dysfunctions, vertebral basilar insufficiency, and that's certainly to the area involved and there wouldn't be a problem in doing an ankle mobilization in a situation of VBI.

Bone disease, post joint fusion, obviously you don't wanna disrupt that fusion with a mobe, a central nervous system pathology that is deteriorating, acute inflammation and joint effusion. The precautions are things like joint replacements, which often I wonder why we would wanna do that anyway from the perspective that the joint surfaces are brand new. There's really not a problem of those joint surfaces moving well on one another, but there may be a way that you can help to maybe abate some pain, or just get a person used to that internal movement of that new joint. Pregnancy-postpartum, recent trauma, early connective tissue healing, long-term use of steroids, osteopenia or

osteoporosis, other connective tissue disorders that are systemic in nature, unfused joint plates, so we're talking about it particularly in children who have open growth plates, open wounds, communication or cognitive disorders where feedback might be a challenge, or psychogenic patients exhibiting a symptom magnification. So again taking into mind their current status there.

So I developed a movement impairment algorithm with my colleague, Doctor Christopher Wise, when we wrote "Mobilization Notes" We looked at this from the perspective of when we do an examination, what is it that we're trying to answer and what makes us think that joint mobilizations would be the right way to go? I say this to students all the time, we have to assess joint mobility. We can't just decide that because someone has a deficit in range of motion that the problem is the accessory motion. It may not be, we need to assess accessory motion to make sure that we're treating the right thing and we're not treating the passenger instead of the driver. So we're looking for reproducible signs, what causes the symptoms, looking for the region of origin, where are the symptoms, and we're looking for reactivity, how symptomatic are they? And then from there we're gonna decide, is this a hypermobile situation or is this a situation of instability?

As I said earlier, in the case of instability, this is where we go and we do a lot of Therex, maybe some PNF techniques, maybe some isometrics, maybe some joint perturbations to be able to get those side joints to firing and be able to stabilize and strengthen around the joint. Whereas if we have a hypermobile situation or the lack of mobility, hypomobile syndrome, then that's where we may benefit from doing joint mobilization techniques. The grades that we're gonna discuss today are from Grades I to IV. Now recognize that there is a Grade V, and we often call those thrust, but that's not going to be the focus of this course. We're gonna look at the Grade Is and IIs for the purposes of firing the articulum mechanoreceptors and the proprioceptors, finding the cutaneous and muscular receptors, and attempting to address pain with altered

nociception. When we get into Grade IIIs and IVs, we're looking at stretching of joint restrictions where we're getting into the end range, often times the capsule range, so looking at getting to the end range to be able to impart an increase in range of motion, breaking of adhesions, altering the positional relationships, this will be really important when we talk about anterior and posterior glides of the shoulder, and diminish or eliminate barriers to normal motion. Typically when we talk about joint mobilizations, we almost always add an element of distraction to any mobilization technique that we do.

Of course you can do distraction in and by itself with the idea that that is your technique for separating two joint surfaces, but if you're going to do any type of mobilization technique that is perpendicular to the joint surfaces, you wanna create a little bit of distraction. In other words, taking up the slack in the joint, taking up that soft tissue slack so that you don't have two bony surfaces rubbing on one another. So a distraction is always going to be something you're going to do as part of your joint mobilization techniques.

Our Grade I mobes are small amplitudes at the beginning of range, Grade II, larger amplitudes at the beginning of range, kinda just going into the mid range, Grade III, from mid range to end range in larger amplitudes, and Grade IV, small amplitudes at the end range. This chart kinda depicts what we just discussed there with A being the starting point on our left and B being the anatomic limits of movement on our right. So you see the smaller amplitudes going part way into the range for Grade I, Grade II, going larger amplitudes mid way, Grade III larger amplitudes to the anatomic limit, and Grade IV, shorter, smaller amplitudes at the anatomic limit. So what's our clinical problem with doing joint mobilizations? I think there's one main clinical problem that we really should address before we actually go through the joint mobilization techniques. Clinical application of joint mobilization techniques have been reported by Gorgos and many other authors. Gorgos actually did a systematic review, looking at

many other articles, and reported that they're quite variable, and that this lack of consistency has a significant effect on patient recovery. So if we're not able to reproduce our joint mobilizations, not only within ourselves but between clinicians, then there's gonna be inconsistent treatments. If we're not able to teach these techniques properly to our students, then they're not going to be able to have a good appreciation for what a capsular end feel is or are they truly at the end range to be able to do a Grade IV?

I've experienced this so often in the classroom with students where they say to me, "Hey, am I doing this technique correctly?" and the only way that I can answer that question is to actually either do the technique on them or have them do the technique on me, and then I give them feedback. If they do it on me, I can tell them what I'm feeling in their hand placement, their grip, and the degree of mobility. On the other hand, if they do it on somebody else, I have to rely on that third person being able to give that student feedback when they attempt to reproduce the technique on them. There's just a lot of disconnects here that make this really challenging. So what I've been doing with my life for the past two-and-a-half three years is actually working on trying to quantify it.

So I'm just gonna share the use of this device with you as we go through the mobes, but certainly we're going to address the mobes as they're classically taught. The device that I'm referring to here is called the Mobil-Aider and what it does is allow us to have an actual quantitative value on our joint mobilization techniques. So now, although you can still say, I'm going to do a Grade IV joint mobilization to increase range of motion of the shoulder, you can also add to that that that Grade IV anatomic endpoint occurred at eight millimeters, and then if someone else treats that patient the next day, they'll be able to know that, well, you got to eight millimeters, they're only getting to six, maybe they should be pushing a little harder to make that an efficacious treatment, and then being able to document that serial measurements allows you to

also see that progress. So can we camp that first video please? So what you're seeing here is the movement of the device and you're seeing a read out. So you can see that linear translation that corresponds to the movement that will occur when we do the joint mobilization technique. So I'm just doing that little glide and you're seeing it showing up in millimeters, and that's when it's in the A Mode.

So it's giving us our maximum movement there. I'm gonna go back again and show you this. So we're moving downward and you're seeing that display and it pauses at the maximum value and it holds that for a couple seconds regardless of what I do, and then it resets. If I move it to the B Mode, it gives me real-time values. You see it constantly changing there, real-time values moving in the B Mode. So as you're doing a Grade IV if you determine that the end range is eight millimeters, then you can see it go six, seven, eight, six, seven, eight, six, seven, eight, and you can keep doing that joint mobe in that small oscillation range there. If you wanna do a Grade III, maybe you go five, six, seven, eight, five, six, seven, eight, and that way you're be able to quantify exactly what's going on within that particular mobe.

Let's go back to our slides please. So this is the actual device and all of the parts and I'm showing this to you so that you'll be able to appreciate the donning and doffing of each of these parts as we go through the techniques. We'll always do the original classic technique first, and then I'll show you how to do it with the device. So as I indicated, we're going to go in Mode A first Where we actually assess the end feel. So we're gonna take this all the way down, as the green arrow indicates, all the way down to end range of the accessory motion. That will allow us to get a value and say, okay, this is what our starting point is, and this is what we're going to use as our baseline, and then when we go into the B Mode, can we key up that video so we can see how this works please, when we go into the B Mode, we put the device right on the joint line, stabilize proximal, and then we mobilize. You can actually see the device sliding and you can see the joint moving. Line up with the joint line, stabilize proximal, and

then do a posterior glide. Okay, thank you. Please feel free, folks, if anybody has any questions as we go along, feel free to ask them at any point. So if you could key up this one, what you saw before was a surface movement. Now what I'd like you to be able to see is actually put the device on an E model just so you can see the mode that it's in and you can actually see the movements of the bones there. You actually see the end range, and then you move it and now I can do the join oscillations and you can actually see the real-time movements.

Remember there's not a ton to see here 'cause we're only talking about millimeters of motion. You're seeing six, seven, six, seven, and they're like going more towards end range there. You're getting into the 12-millimeter range. Okay, thank you. So the point is that it's really difficult when we're holding onto a joint, making sure that we have a good grip, attending to the patient's position, attending to our alignment, and then also being able to grade a movement in something as small as millimeters. I'd like to show you one more thing that is helpful about the device, and then we're gonna get into the actual modes. Because I indicated that we have an alignment issue with the device, you see if I did not align the device with the joint line, then I'm not getting any movement. You can see that it's gonna be totally ineffective. So it almost helps you not mess up, if you know what I mean.

Like if you aren't on the joint line, you could continue to try to wiggle that joint and it's not gonna move, so you're not gonna actually be effective at all. Whereas once you find the joint line, if you take the device and you put it somewhere else, it's not gonna move and now you know, hey, I'm not on the joint line. I'm not feeling any movement. Let me check my position. It's kinda like doing CPR. If you don't get that moment you expect, you always assume human error and you always change that positioning and try to fix what you're doing. Okay, thank you. To that end, there's a lot of likenesses to using a device like this for feedback to CPR. As a matter of fact, the American Heart Association has recently said that if you don't get trained using a device that gives you

feedback, then they're no longer going to certify you in CPR beginning January of 2019, and this is because they recognize the importance of feedback. Go ahead, Kathleen. Let's take a look at that one. It's just a different angle of what we saw before. So now you can see it lining up with the joint line, lining up the device back there where you don't get any movement. So before what you saw, it was from the side. Now you're seeing it from the top, indicating that clearly it's not registering. Now we get right on the joint line and now we see some really nice arthrokinematic motion there. Thank you.

So does anyone have any questions on the mobilization theories, the physiology, the contraindications? Those are all things that you're gonna wanna know for your quiz after the lessons, some of the things about the theories and indications and contraindications. Now let's move on to the actual joint mobilizations. So we're gonna start with the shoulder and we're gonna talk about what motions might be effective here. We're gonna talk about inferior glide to improve shoulder elevation, and by elevation I'm assuming flexion, abduction and scaptional under that umbrella, anterior and posterior glides to improve rotation and we're gonna talk about not just improving the motion, but also improving the position of the humeral head in the glenoid socket and I'm going to discuss some deviations in the Concave-Convex Rule there.

So typically glenohumeral inferior glides involve stabilizing, I'm gonna turn on my arrow here so you can see where I am, stabilizing here by putting your hand in a towel and stabilizing in the axilla here, so my palm is facing the arm and the back of my hand is up against the patient's rib cage. So what I'm attempting to do here is bring this arm outward. So I'm kinda pushing into the rib cage with my forearm to leverage the upper arm away from the socket. So I'm leveraging the ball away from the socket to create a little bit of distraction, and then I am pulling, longitudinally, with my left hand here to create an inferior glide. So the humeral head is gliding inferior in the socket, and that's an important component of elevation of the shoulder. Typically we only get probably a

net of about two to four millimeters of movement as we actively elevate our arm. So we don't need a ton, but we really do need to make sure that we do get an inferior glide with elevation, otherwise we're going to be creating an impingement situation of the supraspinatus tendon or the subacromial bursa. There's another way to also do the glenohumeral inferior glides and this is from the superior aspect where you stabilize proximally, you kind of envelop the top of the shoulder here and you drive longitudinally down your forearm. I wanna make sure that you pay attention to the alignment of my forearm through all of these techniques.

Again, just like CPR, you wanna get your shoulders over the chest as you're doing a compression. You wanna get your body weight behind this mobilization. That's easiest on your body to shift your weight into these mobes and it requires less gripping and less force onto that patient's extremity here, which ultimately makes it more comfortable. So let's key up that video please. So what you see is kinda creating this cupping of that shoulder. The webspace of my hand is coming down the arm and the thenar and hypothenar eminence is in contact with the superior aspect of the humeral head, and that creates a big surface area. That's an important factor also because I liken this to the idea of mobilizing comparisons to walking with sneakers versus stiletto heels. If I'm walking in sneakers, I have a great deal of surface area in contact with the floor. That means that basically no area is getting too much pressure.

The forces are distributed across a wide area and that allows it to minimize the force per unit area. Whereas if I am talking about applying my force through a pinpoint area, like stiletto heels, now all of my force is concentrated and that can be very uncomfortable for the patient, so the point being, I wanna be able to dissipate the forces so that my contact is comfortable. Okay. So we just saw the inferior glide and now I'm gonna show you how to do that inferior glide with the Mobil-Aider device. Here, there's an attachment here. It's this green attachment here and that's known as an H-E attachment. All the attachments have an H when they're on this side and a

letter, and on this side, they have an H with a number. So this is an H-E, and there's the standard H2 on this side. What I'm gonna do is stabilize proximally, and then drive distally with the device, and our video please. So here's our H device right there, H-E. So we put on the green H-E, and now I'm lining it up, driving, stabilize proximally, and now you can see the movement distally on that humeral head and how I can actually create my oscillations. I'm just gonna move forward here on this, just see that again. Set in the B Mode to mobilize, assess in the A Mode, treat in the B mode, and again this inferior glide is important in helping to elevate the arm: flexion, abduction, scaption, okay.

That picture is just showing you a different view. Now we talked about the Concave-Convex Rule earlier about how rolling and gliding occur in the same direction when it's concave on convex and they occur in the opposite direction when it's convex on concave. For quite some time, there was some discussion about the fact that the Concave-Convex Rule was violated for internal and external rotation of the shoulder. To be perfectly honest with you, those of us that've been in academia for a while kind of bought into that and we taught it that way and we taught that you do a posterior glide for external rotation and an anterior glide for internal rotation because that's what we saw clinically with respect to what got people better, but to be honest we were teaching it wrong and we were missing a very important concept that both Herriman and Neumann articulated in the literature about a decade ago.

What they reported was that there's a point at which the humeral head may actually be anterior in the socket and because we do all these activities in our everyday life with our hands in front of our chest, we don't do things behind our back for the most part, we run into the issue of our muscles in the anterior aspect of our chest being tight and the muscles on the posterior aspect being elongated. So what that means is that our humeral head translates anteriorly. We have kyphotic position of our T spine and our shoulders. So with our humeral head being translated anterior, if the humeral head

needs to go anterior for external rotation, it has very little running room. So what we did clinically was mobilize posterior to facilitate external rotation, but we didn't know was we weren't actually facilitating external rotation. We were putting the humeral head in a better, more optimal position to be able to externally rotate. So if you can imagine making a fist with your right hand, making a socket with your left hand and having your fist further away from you, like out anterior, and then expecting it to be able to move forward, it can't really do that if it's already at its end range so it stops the anterior glide, which doesn't allow the external rotation to happen.

But if through a posterior glide, I can center that humeral head, bring it back posterior towards the middle of the socket, now I have an equidistant ability for it to move anterior for external rotation and posterior for internal rotation. So this position right here is one that we use to center the humeral head. I'm not committing to internal or external rotation. I'm simply saying centering the humeral head to allow anterior and posterior gliding of that humeral head in the socket, hoping that was clear to everyone. It can be very challenging to explain. So let's look at video number eight here. So here again we have the green device which is our H-E attachment, and then we put that, looks like proximal. Okay, that's inferior glide.

Let's go back please. Okay, there's our posterior glide. Can we bring up video nine please? Okay. So here we go. We're putting in our H-D, our blue attachment. We find our joint line. We hold that, proximal side stable. Here you can see doing a posterior glide of the humerus. Now Reynold actually did a really nice video one time, we should let that play a second, regarding the angle at which we are pushing down posteriorly for this glide. Remember that the humeral head is not at a 90-degree angle to our body. So it's a little challenging to see, but I am pushing posterior and lateral. My upper body is at a slight angle, pushing posterior and lateral, go ahead, we can go back, if you could please, because we don't wanna hit the posterior rim of the socket. So it's important that we push posterior lateral to be able to clear that. You can see, when I

bring this arrow here, you can see that this arm is coming both posterior and lateral. Okay, again, now here we go with 10. You'll see this from a different angle. So whether you're doing this with or without the device, the point is that we want to create that angle of movement so that my arms are coming out and back, back in and out to the side to be able to get that motion. Okay, and let's move on. Again refreshing our thoughts on the use of these glides, we're looking at proprioceptive input, nociceptive pain management and in the early kinda one-two glides, and then looking at getting into end range. These are wonderful techniques for getting to the posterior capsule and that allows us to be able to increase rotation, and then ultimately rotation helps us to increase elevation because we can't elevate our arm unless we have external rotation.

The mantra that I always use when I teach orthopedics and discuss shoulder pathology is the order is always: scapular stabilization, external rotation, and then elevation. So I'm going to work on my joint mobes, my joint mobes are going to always begin to assess the alignment of the humeral head first. Is that humeral head in the center of the glenoid fossa? And if not, then I wanna start with posterior glides, and then once I get my posterior glide and get that humeral head centered, then my emphasis is gonna be on inferior glides. It doesn't mean that I can't be doing them both within one session. Simply means it's where I'm gonna place my emphasis. In anterior glide, you can see there is a wedge here that is underneath this anterior aspect of the shoulder to give us some running room if you will for the mobe and this allows us to push anterior medial.

Again notice the angulation of the arm to accommodate that somewhat anteriorly-tipped glenoid fossa. Anterior glides, according to the Concave-Convex Rule, will actually facilitate external rotation, but if we are already too far anterior, then we wanna do a posterior glide at the center of the humeral head. If we're already too far anterior, the answer is not to push more anterior or try to create more anterior mobility because that could risk creating instability. Okay, and video 11 please. So here you see a towel there as a wedge, perfectly fine. Don't need quite as much of a wedge

for male patients, as you do female sometimes, but just wanna make sure you have movement. You have room to move into the glide. You can see that happening right here. There's that humeral head, translates anterior, again, angle of the mobe, anterior medial. Another point here as I play this video is that I want you to also see the wide space that I talked about or the wide contact area that you see all along here and I also want you to see how close my hand placement is for all of these techniques. It's critical that you are as close to the joint one as you possibly can be. That's extremely valuable in maintaining control over the joint as you're mobilizing it.

Okay, and back to the slides please. If we do an anterior glide with a Mobil-Aider, we're now talking about again the H-D device. So let's take a look at that one here please. Again, putting on the blue device, again looking at this wedge here to create running room, getting right on that joint surface, and then gliding anterior. You can see the arm alignment, anterior medial. We're getting a readout here in millimeters as we mobilize. Okay, thank you. I just like to touch on a couple of other mobes and the sternoclavicular glides. This is a challenging mobilization to do because it's not real comfortable and you have to be very conscious of your position of your hands here. Especially when you're dealing with a female, you wanna make sure that you curl your fingers under.

You notice that I'm coming from a side position and I've curled my fingers this way. You could do this technique from a superior position, and then you need, again, make sure that your fingers are curled so that you don't actually come down onto the chest in any way whatsoever. The other thing that's unique about this particular mobilization technique is using what's known as a dummy thumb. This thumb underneath is simply a palpation thumb. This thumb goes right on the spot that you are looking to mobilize. In this particular case, we're right over that anterior proximal aspect of the clavicle, and then our mobilization hand, the thumb that goes on top is the one that's imparting the force downward. So the dummy thumb simply stays still and holds your mark and the

mobilization thumb then does the actual work. This is going to help improve horizontal abduction. Okay, and our video please. So we're gonna don a device that accommodates there to the sternum. Palpate that sternoclavicular joint, get right on top of that and we mobilize down. Again we'll be able to actually see the movement and read the reading off of the device, okay. So any questions on shoulder mobilizations? All right-y, then we're gonna move on, okay. So we had inferior glides for elevation. We had sternoclavicular posterior glides for horizontal abduction and we had anterior and posterior glides for rotation, posterior glide if you wanna center the humeral head, and then anterior glides are consistent with the Concave-Convex Rule of rolling posterior gliding anterior and for external rotation, and for internal rotation, keep rolling anterior gliding posterior.

Let's move on to elbow. There are a couple of elbow glides that we're gonna do here and they're to facilitate elbow flexion and elbow extension. So for flexion, we're going to do a medial glide because with elbow flexion, the angulation that we have of our elbow, of our ulnar and radius articulating with our humerus requires that we mobilize on some angles in order to accommodate that carrying angle of the elbow. So what I mean by that is that the ulnar protrudes or projects further proximally on the medial side, so it creates kinda that angulation of the elbow, just like we have angulation of the knee, and of course we call that varus and valgus. So our carrying angle of the elbow is in a little bit of valgus. It varies across individuals, but if you simply bend your elbow in an open kinetic chain position, you'll notice that with flexion the forearm comes medial as you flex and moves lateral as you extend.

So it's moving on a slight diagonal. So in order to achieve the appropriate arthrokinematic motions, we wanna do a medial glide to the ulna on the humerus, the ulna articulating with the humerus at the elbow. So achieving flexion will involve a medial glide. So in this particular case here, we're gonna stabilize, actually let me go back to, sorry, we're gonna stabilize proximally here on the humerus, and then we're

going to use our thenar and hypothenar eminence with our forearm in alignment with our direction of force being medial. Forearm's just supported across the person's body, and then we're going to capture that ulna with a lumbrical grip and drive down through the thenar and hypothenar eminence as it's always desirable to push on a mobilization as opposed to pull. It's easier on everybody. So this alignment here of this arrow showing you the direction of force allows the clinician to push. So let's look at that actual movement with the device here aligned on the humerus, and then pushing straight down here in a medial direction, elbow supported here, arm across the body as we move into a medial glide.

Ahead, please, next slide. Okay. So here, putting on the H-E, the green device. You see him laying across, stabilizing proximal and I'm doing a medial glide. That will be, as I said, what facilitates flexion. Now you can also do this technique in sitting. You don't have to be supine to do it. You would simply put this shoulder at 90 degrees, and then you would put a towel or a wedge underneath this humerus so that you have running room underneath the most proximal part of the ulna to be able to do your translation. All right-y, thank you. So that's our medial glide. Our lateral glide is one of the few techniques where we almost have to pull. We don't really have much other choice. There's not really a good way to kinda lay the outside part of your arm on a table without really stressing your shoulder. You could do it, but it's not the best of techniques. It would require you to take this, I lost my arrow here. I lost my arrow.

This would require you to actually flip the arm out to the side and lay this most posterior aspect of the humerus, thank you, most posterior aspect of the humerus here on the table, and then mobilize by going in this direction laterally. So given that the arm is not a really large appendage to hold on to, most people will be able to grasp this relatively easily. You're using like I said a lumbrical grip with your fingers wrapped under. The thing you have to be careful of here when you're gripping and pulling up is compression on the ulnar nerve. So just make sure that your finger placement on the

medial border or the medial aspect of the ulna is not compressing the ulnar nerve. So here we're looking at doing a lateral glide. So now again we have the device, all we basically did was flip the device around here. So it's the same attachment, but we just did was we flipped, which was the moving part? So the device is built such that this side over here or the X always goes down. So by virtue of flipping this, I can now take this side with the screen and be able to pull up. So why don't we take a look at that. That lateral glide of the ulna on the humerus is consistent with moving into that carrying angle of valgus as we go into elbow extension.

Okay, now we move on. Other joint mobilization techniques that are associated with the elbow is a radiohumeral or humero-radial glide. This glide is described as going either anterior or posterior. You typically do this with a grip that involves a three-jaw chuck. So you see kinda that pincer grasp and you're grabbing that radius. The thing that people do most often that is incorrect here is they don't actually get deep enough to get the radius. They tend to grip rather superficially and they just get the forearm extensor muscles. They don't actually go in and grab the radius. So when you get in there, you should actually be able to feel the radius, the head of it anyway, rotating underneath your fingers, and that's really what you wanna be able to grab. This is a technique which when we grab we're gonna be able to go in either direction, anterior or posterior. We align our forearm with that direction of pull. The anterior glide is actually taking the radius and having it roll forward and anterior in order to achieve flexion and pronation.

Now I recognize that most of the pronation of the forearm occurs by the radius rolling over the ulna distally at the wrist, but we need it to be able to spin at the radial head on the humerus where it articulates with the capitulum. So it's important that we get this anterior glide proximally in order to achieve distal pronation and flexion also. Here's your posterior glide. It's pretty much the same picture, but we just changed the target, which is to improve extension and supination. So now the glide will be going from here

to here, posterior. So you're pushing down and moving with your index finger and long finger as opposed to an anterior glide where you're movement is from from thumb to anterior. Questions on the elbow? I'm acknowledging that we're not addressing radioulnar glides. Although they are apparent in some textbooks, there's really not a lot of physiologic motion to deal with there. Your radiohumeral pretty much covers those kinda motions. The wrist and hand, that's our next stop, and they're going to be four mobilizations that we're gonna do here. Radiocarpal where you actually have the carpal bones which are convex moving on concave radius.

So we'll do both a dorsal and a volar glider there, and that'll be in the sagittal plane to facilitate flexion and extension, respectively, and then we'll do medial and lateral glides, which will facilitate radial and ulnar deviation. So let's first look at the radiocarpal glide, and as I said the carpal bones are convex moving on the concavity of the radius. So here what we see is a dorsal glide where we'll be pushing downward. So I'd be pushing longitudinally, towards the dorsal the hand. So a dorsal glide will facilitate flexion. The reason that it does that is because we have convex on concave, so the carpals will actually roll anterior and glide posterior. Convex on concave means they move in opposite, roll anterior and glide posterior. So this posterior or dorsal glide will facilitate flexion, moving downward. Now we can leave the hand in this very same position and pull upward to do a volar glide where we would roll posterior and glide anterior or volar to get extension.

So we can stay in the same position or we could flip the arm over, put the arm on the table, instead of in supination, in pronation, and then push down through our glides. This is a situation here where we have the Mobil-Aider device being used to stabilize proximally here. So our white piece that we're using is our attachment here. This is our H-F attachment and that's gonna stabilize our radius and ulna. Now our attachment here is going to move posteriorly on the carpals to move them on that radius. Okay, and our video please. So here we're putting that white attachment, which is our H-F,

putting it into the dovetail. We stabilize proximally and we glide distally, real easy and kinda nice. Push straight down helps to facilitate, and I'll just play that again so you can actually see the motion. There is a dovetail there that slips in and kinda locks it into place, and we can go back now. I think we're gonna go right into another video if I recall. Yes, to do them as well. There's several other glides. So this is actually the technique I told you earlier where we're actually flipping the arm over now.

So now we can do our volar glide with the arm in supination and push straight down here. So you can do wrist glides in either supination or pronation. You just have to remember which direction is the desired motion, in other words whether you wanna push or pull in that position, and you can obviously do either. It's just a matter of the comfort of the patient of how hard you have to grip and we tend to have to grip harder when we pull than when we push. So that's something to consider. In this particular case, pushing straight down on the back of the hand here will be a volar glide or basically an anterior glide to facilitate extension. So here what we're seeing is again lining that device, lining the joint line, which is something we wanna do with or without the device. Make sure we have that joint line. Now we're pushing down anteriorly into the glide. So aligning up with the axis, and then this arm is driving straight down in the direction of pull anterior.

Okay, thank you. Medial and lateral glides, I don't know about you guys, but these aren't glides that I do a lot of. I typically don't have a lot of problems with radial and ulnar deviation with patients that I see. Of those two, radial deviation is even less of a problem. Typically ulnar deviation is needed to go into extension and when we're gripping with our wrist and hand, as we grip, we tend to extend, and extension is often accompanied by ulnar deviation. So of these two, radial deviation is even less of an issue. So we're going into medial glide. Okay, medial glide, oh, and this isn't, oh, this is an ulnar deviation, I'm sorry. Please make a note of that that this is an ulnar deviation. Medial glide is ulnar. Medial glide is ulnar, again here, my apologies. We camp this one

please. So we put a small attachment on there so we can get good alignment, or radial deviation, or ulnar deviation, excuse me, I did it again, or ulnar deviation, you can tell that. You know anatomically. You don't need me to correct that, you know it. You're moving into an ulnar deviation here. You're moving towards the ulna. You're moving pinky side. So let's just take a look at that again so we make sure that I didn't confuse anyone. My apologies for that. I'm gonna stabilize proximal and I'm going to glide medially. Remember, we're always referring to anatomic position here. It's a medial glide and we're going towards the ulna, so that's ulnar deviation, ulnar deviation. Okay, great, let's go back.

So I'm imagining you might need to make that correction on the next one, yes. So I have these backwards on the slide, so please make a note of that. I apologize again. Now we're gonna look at the video for lateral deviation. This can be done in one of two ways. You can either have the person flip their arm, so their arm down. Here we go and we're just gliding down or you could flip this device around or flip your hands around in the way that you do this, and then just pull up, and that pulling up would also with your thumb up. So this position can be somewhat challenging for a patient to get into. If they don't have the shoulder motion to do this, this could be a challenge. So that being said, you might want to, if we could go back please, I just wanna show this slide, we would simply do this motion in this position with the device.

So here you would be doing it, again, this would be an ulnar glide. If you did this motion, instead of pushing down into an ulnar glide, if you pulled up it could be a radial glide and radio would be a lateral glide and down would be a medial or ulnar glide. There are a number of intercarpal glides that you can do. All of these carpal bones all have ligaments that attach to them and they're very important in terms of maintaining stability, particularly if you do anything that is close chain or anything that you're weight-bearing through your arm. The most important ligament, which I'm at right here, is your scapholunate ligament. This ligament is known as the ACL of the wrist and it is

really critical to have stability of the wrist. So one of the things you might wanna do is assess that, particularly when you've a fall on a outstretched hand. That's not so much with the idea of doing joint mobilizations. It's the idea to see, was that ligament disrupted and could you actually have a dislocated lunate or sprain to the scapholunate ligament.

So in doing joint mobilizations of these carpal bones, you would simply hold one of them still, and then move the other, and then perhaps move to a different location, hold another bone still and move the other. We're always looking at creating movements of the carpal bones such that they go in opposite directions of the radius and ulna. So if the radius and ulna is going anterior, then the carpal bones are gonna go posterior. If the proximal row's posterior, then the distal row's gonna go anterior. It's sorta set up, if you have ever seen what's known as a Jacob's Ladder, it's sorta set up to move in that way. So the challenging part about the carpal bones is the significantly irregular orientation of those bones. They're not really clearly concave or convex. They have irregular shapes to them.

So it depends on which part of the bone is articulating with which surface of its adjacent bone that's gonna dictate that, and that can become very challenging, but you're just looking for consistent mobility when you're assessing those bones. The thumb is a particular challenge. As we're talking about surfaces, we refer to the movement of the thumb relative to the third ray. So when the thumb comes out to the side, it would be abduction. When it goes forward or anterior diagonal, that would be flexion. Posterior diagonal, posterior diagonal here would be extension, and then towards the second ray or the index finger, that would be adduction.

The point here is what you need to remember when you're thinking about movement of the thumb is think about the nail and the collaterals. When we find the collaterals, they're always on the side of a joint and the collateral is always defined ab and

adduction, whereas the posterior and anterior surface, the nail bed being on the posterior surface defines flexion and extension. This can be somewhat tricky because of the curvature of that proximal row of carpals. So here we see a medial glide coming across this way would be for flexion. A lateral glide coming up and out would be for extension. A posterior glide would be going out that direction, would be for abduction and an anterior glide would be for adduction.

Now if you remember, the thumb is a saddle joint, so it is basically moving concave on convex for flexion and extension, but it's moving convex on concave for ab and adduction. That's why we speak about moving posterior with abduction because we're gonna be going out this way, but the joint itself is actually moving back. It's gliding back as it rolls anterior and glides posterior for abduction, and that's A-B I'm saying, A-B duction. Whereas when we talk about flexion-extension, we're rolling and gliding medially and that gives us increased flexion and we're rolling and gliding laterally for extension. When we speak about the digits two through five, we always refer to the middle digit as our center of the hand. So moving this second ray towards the thumb is abduction, A-B duction. Moving it towards the third digit is A-D duction. Likewise moving rays four and five away from the third digit is abduction and moving it towards the third digit is adduction. So we are moving and these particular cases we're moving concave on convex, so rolling and gliding occur in the same direction. Flexion occurs anterior, extension occurs posterior.

So these are a little more like kinda straight planed, kinda a little bit more in the sagittal plane. Even though there is a curvature of the distal carpal arch there, it's much more in the sagittal plane than the thumb is. So here you see an image of moving the MCP and you can see that you can go dorsal or posterior for extension, and then anterior or volar for flexion and thumbs, again, or, excuse me, fingers again you wanna get very, very close. So you get really tight into that joint line so you have really, really good control. Moving down to the IPs, it is the same as the MCPs. So it's really straightforward:

dorsal extension, volar flexion. Again, there's not a whole lot of motion here, but you'll certainly be able to feel if it doesn't move. So that wraps up the upper extremity, and again my apologies for the confusion on the radial and ulnar glides of the wrist. If you need me to review that at all, I'm happy to do that. I wanna make sure that everyone gets that correct.

As we move into the lower extremity, we're gonna address the knee and the ankle. So our knee mobes are again pretty straightforward. They're basically anterior and posterior glides. So here we're looking at an anterior glide, can be done in either supine or prone. It's always as I said biomechanically better to push than to pull. So when you can, push. That's your best technique. Here you're seeing the technique done in supine where we're actually pulling. I'm demonstrating this here simply because a lot of people are used to doing this in doing a Lachman's test for the knee. So they're used to doing this technique in testing an anterior glide. Certainly you can do that, but here we're talking about facilitating extension of the knee, so anterior moving the tibia, anterior on the femur. In this particular case, again using the device, we're looking at putting some straps around to make it easy. One of the challenging things about doing an anterior glide is trying to kinda grip that lower extremity. So the device can actually help you to do that by wrapping your hands behind it and the straps securing the device to the body. Many of you may be familiar with the device out there that's called a KT-1000 or a KT-2000 which was used to anteriorly translate the tibia on the femur to assess ACL injuries. Although that device is no longer available, it actually was a very interesting predicate for the development of the Mobil-Aider. You can see that the Mobil-Aider device will allow you to stress the knee anteriorly to be able to assess that anterior cruciate ligament.

Okay, could we take a look at that video please? This is doing an anterior glide. So we'll put the device in the B Mode. Remember now here, right forearm, forearm is in alignment, pulling straight up. The arm's kinda blocking the reading, but you can see

the oscillations, do that again, you can actually see the screen oscillations as you go because it's giving you changes in values as it's moving, but you're pretty much pushing straight down here. You're stabilizing with that proximal hand and you're pulling straight up. That wedge helps to give you the ability to get underneath. As I indicated, it's more desirable to push if you're able to. So in this particular case, here you see distal hands stabilizing the lower leg, proximal hand here pushing straight down as close to the joint line as possible to be able to facilitate extension.

So you're doing an anterior glide of the tibia on the femur and driving down to facilitate extension. Concave on convex, rolling and gliding anterior in the prone position to facilitate extension. Here we have a video to demonstrate that. This is first without any device at all, pushing straight down. You're looking at getting an anterior glide, and then oscillating. So the proximal hand here is stabilizing the thigh. The patient's leg is on your thigh, and then you're driving straight down here with this hand, going parallel to the joint surface. So going straight down, and then you can oscillate at end range for a Grade III or Grade IV mobilization.

One key point I'd like to make here is that there's a towel underneath the femur for a reason. What you wanna do is always make sure that that patella is off of the table, that it's out of the way, that you're not pushing down into the patella where the patella's hitting the table and creating a nasty compression for us that might be very comfortable for the patient. So your glide here needs to have that patella free to move or at least not get impinged, thank you. You can also use an H-C or this yellow adapter on this posterior part of the femur, and then drive straight down here to create an anterior glide, again in prone, facilitating extension of the tibia on the femur, and another video. Lock that in, find the joint line, align the joint line with the device and translate. End range oscillation's there. Now you can do unilateral glides of the knee, in other words, where you just grab either the posterior medial or the posterior lateral. Actually it would be posterior medial or anterior lateral aspects of the tibia and create a

rotatory force because as you know, the knee goes into external rotation as it reaches terminal extension, and that's known as the Screw-Home Mechanism. So there's also the possibility that you might be lacking those last couple degrees of extension of the knee and that might be because you don't have the appropriate amount of external rotation to quote screw home the tibia on the femur. Again that goes back to the fact that the medial condyle of the femur extends further distally than the lateral, creating that valgus angle and resulting in that angulation of our lower leg and the rotation of the knee. With the idea of doing a unilateral mobilization, what you're actually doing is just getting those last few degrees.

So that's just another option. It's being a bit more precise if you will into those last few degrees of motion. That's something that you could do if you wanted those last few. Our last joint or last region is the foot and ankle. So we're to look at a few things that we can do as far as effective joint mobilizations and talk about what motions that we want to improve. So the talocrural posterior glide and the talocrural anterior glide are used to enhance or improve dorsiflexion and plantar flexion respectively. So the talocrural posterior glide is for dorsiflexion, talocrural anterior for plantar flexion. We typically have more difficulty with getting dorsiflexion on people.

Typically plantar flexion isn't something that we have to actually work on them getting as far as a joint mobe goes or stretching into plantar flexion, so we'll address the posterior glide first. This gets a little tricky when you're talking about dorsiflexion 'cause of what we're stabilizing. So what I want you to take note of here, and I tried to articulate this on this slide so that you wouldn't have to take any notes on this, is you're moving the talus posterior on the tib/fib. So you're actually kinda holding the calcaneus here with your distal hand and you're sort of bringing that up a little bit as you drive down through the talus. The weight of the lower leg pretty much stabilizes the tib/fib. By virtue of pushing down on the talus, you're creating that dorsiflexion moment at the talocrural joint. So that posterior glide of the talus, pushing down on the calcaneus. Let

me say that again just to be clear. So you're moving the talus posterior on that tib/fib to create dorsiflexion. To do this with the device, we're gonna use the H-E attachment. This is the green one. If we could put up the video please. When you don't have enough hands with this technique to stabilize everything and grab the talus, like on the other one, but here we're driving the talus posterior on the tib/fib. We don't really have the ability using the device to bring the foot back into dorsiflexion as you do this, but you could still create a very good posterior glide of the talus on the tib/fib to create dorsiflexion of the talocrural joint, okay.

Our next one is an anterior glide. The talocrural anterior glide is used to facilitate plantar flexion. In this particular case, as we do an anterior glide, we want the foot over the edge of the table and we're just going to kinda hold the tib/fib in contact with the table there to stabilize the distal lower leg, and then what we're gonna do is impart an anterior force to the talus through the calcaneus, so an anterior force through the talus taking the calcaneus with it. So this kind of grip that you're using with this distal hand kind of envelops both the talus and the calcaneus in the webspace of your hand and you're simply driving anterior. We create that similar situation here. Ideally I would like this person to be down a little further. We still have enough room to move here because our force is coming down this way, but getting that foot off the table a little bit more might be helpful. Holding the device on to the tibia, posterior tibia, and then driving anterior on the talus and taking the calcaneus with it gives us an anterior talocrural movement.

Okay, go ahead. Just here you see donning the device that attaches for posterior tib, and now driving anterior. So that's an anterior talocrural glide that we would use for dorsiflexion. Okay, thank you. We also have side-to-side motion that occurs at the ankle, an inversion and eversion motion, and that occurs at the subtalar joint, so occurring between the talus and the calcaneus as opposed to dorsiflexion occurring at the talocrural joint. So here we're looking at the position in which you would do a

medial glide. This medial glide here taking your thumbs on the lateral border of the calcaneus and driving it medially. Remember, this isn't a Talar Tilt. Like this isn't creating a test for the anterior talofib ligament. This is creating a glide. So your movement is a parallel one, not an angular one. The movement is straight down and this will help to facilitate eversion. To do this medial glide with the device we would use a screen attachment and stabilize proximal and we're moving distal. Again, remember, as you can see, it's a linear motion. It's not a tilting motion. This movement is straight down this way, not an angle, not an arch, okay. That's for eversion. So now if we wanted to move on and do inversion, then we have to do a lateral glide, and that involves translating the distal calcaneus on the talus moving in a lateral direction, distal calcaneus on the talus moving in a lateral direction, and that's the subtalar joint moving into inversion.

Okay, video please. The small attachment, now we're looking to do a lateral glide so now we're on the inside, stabilizing proximal and pushing straight down. This can be a challenging mobe to do. Again the good think about it is that when we're talking about lateral glides we often don't have to worry about people needing assistance in going into inversion. They often get there by virtue of an ankle sprain and have way too much inversion, so we don't have to work on giving them any more, if you know what I mean. As we move distally to the torso metatarsal joints, these are basically looking at facilitating both dorsiflexion, plantar flexion inversion and eversion. So these are kinda combination motions so these midtarsal kinda glides are creating pronation and supinations so we've got lots of movements going in in lots of different directions. When we're looking at doing, in this particular case, doing a glide of the TMT, if we push dorsal, then we're looking at improving dorsiflexion and inversion. If we go plantar and inversion, when we go plantar, we're looking at getting plantar flexion and eversion. So dorsiflexion and inversion, the motion would be dorsal. Plantar flexion and eversion, the movement would be plantar. As we move down to the MTPs, doing glides here can facilitate motions in a lot of different directions. Again you're seeing flexion

would be plantar, extension would be dorsal. The first ray is probably the one that you would be most involved in mobilizing. It's probably the one that has the most amount pathology if you will. There are actually a couple of different things you can do here. There's another technique that allows you to also distract this joint. So here you're seeing the glides in the anterior and posterior directions, but what you can also do, instead of pushing down through your thumb here, you can actually grip the thumb between digits two and three and it's like a hooking kinda grip. So you hook your fingers and you put the toe in between digits two and three, your index finger and your long finger, and you grip that toe, and then you pull longitudinally. That creates a great distraction force.

Any questions on the ankle motions or the foot mobilizations? All right, then let's talk a little bit about dosing. I think it's important to recognize how long you do joint mobilization techniques. I mean first you're gonna obviously determine the location of the problem and you're going to assess the mobility of that particular structure. If it's diminished and you decide that they could benefit from a mobilization technique, either hypomobile, then you're gonna then decide on what is the goal of this? Do we want to achieve pain management or do we want to actually increase mobility? So we're looking at more of Grades I and II or Grades III and IV. I hope that it's intuitive to you that this is not a linear progression, that you don't have to start with a Grade I, and then go to a Grade II, and then a III, before you can finally do a Grade IV. That's not the case at all. You can do a Grade I and a Grade IV in the same session. You start with a Grade I to begin to abate some pain, get them used to your touch, get them used to the feel of the motion, give them some proprioceptive input, and then go to a Grade IV to actually get to the capsular end feel or get to the anatomic limit, and then mobilize at the end of the range.

So that's sort of first picking out your location, and then your goal, and then from there you're going to decide on what is the speed or the rhythm of that movement and you

wanna be very controlled and deliberate with these moments. You don't want to be abrupt or irregular. They should be consistent. Every mode should be the same as the one before within a given grade. Again that's where the device comes in in helping you to give you that feedback. The amplitude of the motions should be consistent with the grade. I and IV, very small amplitudes, II and III, a bit larger amplitude, but still staying within the relative available range of the joint. If you think about the problems that we encounter here is because ever joint is different and we might only have two or three millimeters of motion in the DIP of our finger, but we may have 14, 13 or 14 millimeters of motion in our shoulder.

So a Grade III oscillation for a finger is gonna still have a much smaller amplitude than a Grade IV of a shoulder. It's all relative with respect to available range within that joint. Hopefully, if your mobilizations are successful, then that available range will continue to increase and you'll adjust the amplitude of your mobilization accordingly. How about the frequency and duration? Sets, reps, frequency of treatment, what do we wanna do there? Well, part of this comes from a trial intervention. So one of the things that you want to do is do a trial intervention of maybe six to eight mobilizations of a given grade, and then you assess. Different people use different amounts. Maybe you wanna only do one to five as your trial intervention. I mean, that's fine too.

There's no absolute answer here, but what you wanna do is do a small number. I mean it's not like you wanna do 30 or 40 of these before you determine whether it was effective. So let's just say here we do five reps of a given trial intervention, and then you reassess. Did they gain more motion? How's their pain, not just their arthrokinematic motion, was there a change in osteokinematic motion? If it's worse, then you need to change one of the variables, and that could mean that you either change the grade, which impacts the amplitude, or maybe you change the number of repetitions. Those are things that may produce a different result. You do another one to five repetitions, and then you reassess again. If they're still having a difficult time, if

they are getting worse, then perhaps this isn't the treatment technique for them. That's okay because you have other tools in your toolbox that can be very valuable in achieving increases in range of motion. This isn't the only thing that you have to do, but let's go back to our initial five repetitions and let's just say that they don't have any change at all. Well, again, then we wanna change something: We change the grade. We change the amplitude. We change the number of repetitions, and then we repeat and reassess. If it gets better with that change, then you continue to treat with whatever just was successful. You may find that you get a good result right from the beginning. You do your five reps. They respond very well.

They get a little bit better or a lot better, and so you continue to render that treatment, and then maybe, again, as they improve, you increase reps or you change your grade in order to perhaps achieve a different goal. So we haven't had any questions so we've been able to move along fairly well here, but these are the references that were used for this presentation. They're all peer-reviewed references. If anyone is interested in reading any of those, I'm happy to secure those for you, get them to you. To that end, I'm supplying you my email address and the website to my company if you would like to learn more.

The videos that were used in this course are not available to you through the handouts. I mean the handouts are obviously a paper handout. You can't activate the videos like what were done through the course, so I'm giving you an opportunity, a place where you can actually get those videos if you wanna see them again, or any of the videos for the joint mobilization techniques. So you can do that by going to my website and using this discount code to be able to acquire the iOrtho Mobile App, which has all of the joint mobilizations not just for what we covered in this course, but for the hip and the spine as well. So you are going to need to take a 10-question quiz after this and I'm very certain that we covered all of the things that you will need to address there. If anybody again has any questions, I'm happy to answer those for you.

- [Calista] All right, just as a reminder, if anybody has any questions, kindly use the question-and-answer pod in the classroom and if you have any questions, like Dawn said, if you have any questions about the quiz, now's the time to ask. Is there anything else you want to go over Doctor Gulick before we go ahead and close out today?

- [Dawn] Not at the moment, Calista, very much.

- [Calista] Okay. All right, well I'm gonna--

- All right-y.

- [Calista] Go ahead and close out today. Have a great Friday, everyone.

- [Dawn] Thanks for participating, folks. Bye now.

- [Calista] Have a great day, everyone. I'll officially close out the classroom.