Elbow Stiffness: Therapeutic Mgmt

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- [Fawn] Today's course is Elbow Stiffness: Therapeutic Management. Our presenter today is Paul Bonzani. He is an Assistant Clinical Professor in the Department of Occupational Therapy at the University of New Hampshire. He teaches the Human Movement and Adult Development courses in the required curricula and elective courses in Upper Extremity Rehabilitation Orthotic Fabrication and Physical Agent Modalities. Additionally, he co-teaches a course on the Psychobiological Manifestations in Management of the Human Stress Response. He obtained his Certified Hand Therapy credential in 1991, and continues to practice in addition to his educational responsibilities. Finally, Paul has authored multiple textbook chapters and review articles or varied upper extremity rehabilitation topics including functional anatomy, tendinopathy management, elbow rehabilitation, and mobilization orthosis. Welcome back Paul, so happy to have you.

- Thank you, Fawn. And hello everyone and thank you for coming today to listen to this presentation on therapeutic management of elbow stiffness. So let's get started right away. We have much to cover today. So my objectives for today is to cover the concepts of joint and soft tissue mobilization around the elbow to manage, for the management of stiffness. We're going to be talking about neurophysiological and proprioceptive occupation-based interventions to reducing the co-contraction phenomena, and exercise interventions that will assist with the co-contraction phenomena, and then we will of course finally review orthotic fabrication around the elbow. And use of orthotic management for mobilization and prevention of stiffness. So let's get started without any further delay. So the first thing to consider is what is our goal? If we have a stiff elbow, we need to understand the difference between the amount of motion that's available at the elbow, and the motion that's necessary for daily tasks and occupation performance. So let's start with the osteokinematic motion of the elbow, and you see that listed here. The osteokinematic motion is 145 degrees of elbow flexion to zero degrees of extension, and 85 supination to 80 of pronation. Now can human beings perform daily occupational tasks or daily occupations rather, with less than full motion? The accepted range of movement for occupation

performance is 30 degrees of extension to 130 degrees of flexion. And it's considered to be a hundred degree arc of motion. So from an orthopedic perspective, orthopedic surgeons would tell you that the minimum amount of movement that's acceptable in a rehabilitation outcome would be 30 to 130 and then 50 to 50 in supination and pronation. Now, notice I said to you that would be the perspective of an orthopedic surgeon. The question I would have for you, or for any other practitioner is, is that the perspective of your patient? Is that gonna be the perspective of your client? My experience is that clients do not tolerate this restriction in range of motion very well. They may tolerate it in terms of their ability to perform the task, but the method of their performance of the task is gonna change significantly. Further, there are some tasks that are significantly impaired by 30 degree elbow flexion contracture. For example, if you have a person who is athletically inclined or is a person who is, uses gym participation as a way of maintaining health, this may be someone who does Pilates or yoga, there are many poses and techniques that are not going to be able to be performed with lacking 30 degrees of elbow extension.

What I have found in my practice and what is in the literature for sports performance is that a person can perform pretty much any athletic activity if their elbow extends to 15 degrees of extension. I've always considered that my patients would be much happier and are much more satisfied with an elbow arc of motion of 15 to 135 degrees. And so I've always considered that to be my goal for a patient when I start a rehabilitation program for an elbow injury. I have found that the same thing is true in supination and pronation. The 50 degrees of pronation is actually quite well tolerated by most patients, because you can abduct the shoulder and position the forearm into pronation fairly effectively. But restrictions in supination of 50 degrees lead people to come into adducted positions and create a situation that is functionally impairing. So I always consider supination to be functional at approximately 70 degrees. So I said, the literature, the orthopedic literature supports these ranges, but if we think about our patients from an occupational performance perspective, we probably need a bit more. To get a bit more, we have to understand how the elbow moves, and while we

understand the osteokinematic movements of flexion extension and pronation and supination, there are accessory motions of the joint that we have to consider as we start to mobilize the soft tissue, the stiffness around the elbow. So one of the things to tell you is that the flexion extension axis, which is through the humeroulnar joint, and we're gonna look at this in just a second, has very little change in its instant center of rotation. Basically what this means is the elbow joint is stable. So the humeroulnar articulation is congruent and stable. And essentially, this motion is occurring with a little bit of translation, but not a significant amount of sliding or gliding translation. Therefore, distraction mobilizations are important at the humeroulnar articulation. And gliding motions, because of the convex, concave move, need to be in the same direction as the osteokinematic motion. So let's take a look at that for a moment, and look at the arthrology.

So here's, what I'm gonna ask you to do is on this slide, if you can, take this little arrow here, and if you can ignore this yellow arrow. This yellow arrow is pointing to a part, a part of the ulna, and I'm not really using that in any significant way in this presentation. We're gonna look at the two purple arrows. So if I look at this arrow here as the representation of osteokinematic movement, with the movement of the ulna moving towards the humerus, I'm going to see a concave on convex surface at the joint. And therefore the accessory movement is going to occur in the same direction as the osteokinematic movement, based on the concave, the convex concave rule. When we look at this humeral radial joint, we're gonna look at that a little independently, because this joint does not articulate directly with the capitellum, and is not really considered significant for restrictions in flexion and extension. We look more at the radial head for problems in rotation. So when I am going to move a patient who's stiff into extension, I have to consider that I'm gonna see an opposite movement of these arrows, and I'm gonna see osteokinematic extension happening here, and glide happening in the same direction into extension. When I look at the superior radioulnar joint, I am looking at rotational movements that are stiff, so I'm gonna start over here a little bit more because it's a little clearer. So when I'm on the lateral side of the elbow, this is a view

of the lateral side of the elbow, and when I look at the lateral side of the elbow, the radial head is much more prominent. You notice here on the medial side of the elbow it's difficult to see the radial head. So when I look over here on the lateral side, I can see that there's quite a bit of distance between the radial head and the capitellum. And this is what I was talking about in the previous slide. This joint lacks congruity in elbow flexion and extension. However, it's quite congruent in rotation. This is a pivot joint. Its primary osteokinematic motion is spinning. So it spins in this area to create the rotation. But anything that spins also has a bit of slide and glide in it. And this again works in the same direction as this is a convex, a concave, rather, on convex surface. So it's governed by the same rule that governs flexion and extension. So in this case, what is going to happen is as this spins in the direction of, in one direction, it's going to glide in the same direction.

So that's the important thing to consider here. And so our mobilizations are going to be in the same direction as the osteokinematic movement. And we'll say the same thing here. On the medial side, meaning I'm going to move the radial head in a medial to lateral direction, or anterior to posterior, depending on how we position the arm. So let's take a look at some of the conditions to set up some review of the joint mobilization videos. So the first thing about mobilization of these joints is that we have to get them into their open pack positions, and we have to understand where they close and where they open. So let's go through those terms for people who may not be familiar with them. A closed pack position is when the, when the joint surfaces are in maximum contact. They're in their most congruent position. They're in their most stable position. The soft tissues are under their most constraint. So therefore the soft tissues are actually at length. The closed pack position here, as you can see here, is in the humeroulnar joint is full extension. Humeroradial joint is 90 degrees of flexion with the five degrees of supination. And the proximal radioulnar joint in five degrees of supination. However, mobilization has to occur in these open pack positions. And the open pack positions that we're gonna work in are predominately, are these two. 70 degrees of flexion, and 10 degrees of supination, and proximal radioulnar, which is 70

degrees of flexion, and 35 degrees of supination. These are the positions that open the superior radioulnar joint, as you see here on the bottom, and open the humeroulnar join to their maximum abilities. So these are the positions that we're going to put the patient in when we start mobilization techniques. Let's go through those techniques. So the way I thought about doing this is I thought I would explain each of the mobilization techniques, and then show you a short video that will demonstrate the technique. So here we have, the first technique is the humeroulnar distraction scoop technique for flexion. And this technique improves, as you see here, you can see, let me point this to you. You can see that I have an assistant here holding the humorous stable. So that's one of the things I wanna point out to you is that this is a mobilization you can do with one person, but works better with two. Right, so let's run this little video.

So if you can, can we run this video? So the first, we're gonna start with the joint mobilizations, and the first one is going to be the scoop mobilization for flexion. We start her in the open pack position. So we're gonna start here in about 10 degrees of supination. This is in the, this mobilization is to gain flexion. So we're gonna start her in 10 degrees of supination, and about 70 degrees or so of elbow flexion, open pack position. We're gonna rest her lightly on my shoulder here. And I'm gonna place my hands at the joint crease, and I'm going to place my hands in sort of a, just a little bit of an interlock. I like to use a little bit of an interlock technique with this. And what I'm really gonna be doing here is gonna make a move like this with my hands. So I'm gonna be doing distraction, and a bit of roll into the flexion position. So as we call this a scoop. So let's see how this works. While my friend here is going to hold on so that she's stabilized on the humorous, it's a much more effective technique if you do this with two people. So if you have a tech available, or if you have a student or if you have someone to help you, stabilization of the humorous makes this a little bit more effective. All right, so here we are. We're in open position. And I'm going to distract her. And then scoop that. And I can do this as a static hold, or I can do this as a hold and oscillation. And I can oscillate the joint. Scoop mobilization for flexion. All right, if

we can come back to the slides. Okay, so as you saw in that video, there's two approaches that can be taken to the accessory mobilization. You can take a distraction, and then a slight hold, and hold it in that distracted scoop position. You'll notice that I'm pivoting off the ulna fingers in that mobilization video. And that is what creates the movement here. So I want you, if you're trying this technique, make sure that you try the technique at the closest component, the closest finger presentation to the joint line crease in the anterior elbow. So you'd be using your ulna fingers of your ring and small fingers, predominantly to do the scoop technique. You can use oscillations, the oscillations can be using, if you use the Maitland system, the oscillations can be graded a one through four. Typically, for stiffness, I'll be using predominately grade three and grade four oscillations. And those have to do with the size and wavelength of the oscillation.

So I would refer you to Maitland's schematics for further information regarding that. And if you use more of, the name I mentioned was Kaltenborn, which was more of a distraction hold technique. A little bit less than the oscillation component. So think those are the two classic ways we think of, the ways we think of the intervention. Or we think of mobilization interventions. All right, let's look at a ventral glide. This is gonna be an interesting mobilization. This is the mobilization that allows us to get joint accessory movement to help us with extension of the elbow. Much more significant problem than flexion. What we do here is we stabilize the ulna, and the movement occurs predominately through the, through the humorous, rather. So therefore, let's run this video now, and then I'll give you a bit more detail. So now I'm gonna look at the, now I'm gonna have a demonstration of the extension. of the mobilization we use to gain extension. This is pretty effective when restrictions, in extension creating flexion contraction in the much more common stiffness of the elbow. In this case we're dealing with a different type of mobilization. I have a concave surface on a convex surface. What I'm gonna be doing here is stabilizing the proximal part of the extremity. I have, again my hands here for my assistant. She gonna be holding the radius and the ulna stable in form. And I'm gonna be holding again proximally here. And what I'm

gonna do here, is I'm gonna do a slight distraction. So you can see I'm gonna do a slight distraction here. And I'm going to do a proximal, a posterior rather, to anterior mobilization, the humerus on the ulna. And that's gonna look like this. So we come out. And I'm gonna move that humerus into that anterior direction. I can also use a wedge here sometimes. So, I'm gonna have you put your hands here like this as a wedge. And if I didn't have an assistant I could use a wedge here, and I could bring my hand underneath this way. Give myself a little bit more distraction that way. And then I can bring that surface from anterior to posterior on the humerus. And then I can follow that of course, with a more extension movement as she gains movement. So to clarify. When I was speaking on the video I wanted to clarify one point. When I was saying the hold is proximal I mean the proximal end of the ulna, just to clarify that. So, for example, one might think I was talking about this component, the proximal component of the humerus, I was not. I was speaking about holding proximally on the ulna and stabilizing the proximal end of the ulna.

So this is the extension mobilization. Again, we start that in that open pack position. You'd want to be able to get your person to about 70 degrees. We can bring them out into a bit more extension as they move along, and as the person gains range. And I hope you saw the integration of the osteokinematic and accessory at the very end of the video when I fully brought the elbow into a bit more extension osteokinematically. So let's look at the pronation, let's look at pronation. What we're gonna do here is, what I want you to see here is we're gonna be doing a dorsal glide here, I'm gonna be doing a dorsal mobilization, moving the radial head from an anterior to posterior position. So we're gonna show this video please. By looking at the pronation, stiffness into pronation. And to do that I'm going to be doing a glide from the ventral, or anterior surface to the posterior surface. So this is a posterior glide, a radial head. Again, I find my radial head in a similar fashion. I'll find it here on the lateral side like I typically do. It's easier to find it. And then I'll meet that by coming here on the ventral side. So now that I've sort of scooped the radial head, I'm gonna go on both sides. I'm gonna put my thumb across, and I'm gonna do a ventral glide in this direction, in that open pack

position. Slight supine, about 35 supination, 70 flexion, and there's my ventral glide. Moving from anterior to, or my dorsal line rather, moving from anterior to posterior. And we use that for gaining pronation. Okay, so when we saw it, what you saw in the video there was my two thumbs together. I wanted to give you a little something to consider. Please notice that I found the radial head with my right hand, and I used my right thumb to position over the radial head. But I did force application with my left thumb, over the right thumb. Sometimes this is referred to as using, using what's called the dummy, or the dummy thumb, meaning I have it in place. But I'm actually providing the force with another part of the body. So I put the right thumb in place, but the mobilization forces came from my left thumb. And we do this because boney prominences like the radial head require high forces. So, it's important that you don't directly push with the mobilizing hand, you're using intervening, you're using intervening part of your body.

So in this case the dummy thumb works perfectly. Let's take a look at this next slide. And in this slide we're gonna look at mobilization of the radial head into supination, for supination loss. And, the stabilization is at the humerus. And the movement is from posterior to anterior. And what I really want you to see here, is the examination of radio head. So if you're someone who's not familiar with how to identify the radial head this will be helpful with some steps to help you do that. So could we show this video, please? So now I'm gonna look at the proximal radial on the joint and the superior radial on the joint. And we're gonna do a mobilization to gain supination. And to gain supination, to deal with stiffness in supination, one of the things we had to do is again start in the open pack position. And so we're gonna start with her elbow at about 70 degrees of flexion. And she's gonna start at about 35 degrees of supination. That's open pack position for the superior radial ulna joint. Now what we're going to do is we're gonna be doing a ventral glide, so we're, or a posterior to anterior glide to gain supination. So I'm gonna come down on my, and if you can come in close here, let's follow me. Here is her lateral epicondyle. I'm going to come from the lateral epicondyle distally until I feel a joint space which would be right here. I'm gonna bring the skin a

little tighter here, so you can see the boney structures perhaps. So here's the lateral epicondyle, here's the joint space, here's the radial head. If you're a new examiner it's easy to find the radial head, because you can leave your finger on the radial head. And you can supinate and pronate the forearm slightly, and you'll feel the radial head rolling. So now that I've located my radial head, I know she's in the right position, I know I'm on the right place. I'm gonna take my thumb and use this as a dummy. I'm gonna use, by putting pressure through this thumb here, I'm going to use my fingers where to support the humerus. I'm gonna come with my other thumb over the top. And I'm gonna perform a posterior to anterior glide of the radial head. And I can mobilize that with oscillation, or I can use a full push and hold, Kaltenborn technique of pushing and holding. Ventral glide of the radial head. Okay, so there we saw the radial head and the use of the radial head for mobilization for supination, and you saw the dummy thumb in examination. You can always, if you're ever lost the important thing to do is to rotate the forearm through a brief arch of motion is the supination to pronation. And if you do not feel the spinning and rolling movement of the radial head you're in the wrong place.

So you can always reconfigure your hand to find the radial head. So those are the four mobilizations, the standard mobilizations that we do around the radial head and the humeroulnar articulation. For pronation, supination, flexion and extension. I do think they are only part of the picture, one of the, I think a comprehensive management of stiffness begins with this joint arthrology, and joint techniques. But then we need to bring into the soft tissue techniques. So I think we need to look at the muscular assessment, or the muscle tissue and how it impacts the movement around the elbow. When we look at soft tissue management, we have to think about systems of examination for the soft tissues. So the first system is how do I actually palpate the soft tissue, how do I palpate muscle. And one way I palpate muscle is I use a flat assessment, which means I lay my fingertips across, this is perpendicular to the longitude orientation of the muscle. So if the muscle is approximal to distal muscle, I'm going to put my fingers perpendicular on that muscle, and come across it. You'll see

this in demonstration when I show you the videos in the tricep and the bicep. Pincer assessment is actually when I pick up the muscle. I literally take it between my index finger and my middle finger and my thumb, and I roll the muscle fibers through in a three point pincher grasp. With most muscles I can use three point per prehension. With some of the smaller muscles you might only need, be able to do two point prehension for assessment. Length assessment is an assessment that tells you whether the muscle's actually contracted or stiff in itself. And not just parts of it, but actually you could see a loss of the movement through fibers. It's really an assessment of things like looking at the passive insufficiency of the muscle. Meaning can I move both joints at the same time, or is one joint dependent upon the other for movement? So I always think about length assessment. That brings us into concepts of what's called intrinsic and extrinsic tightness around the hand.

Or concepts of passive/inactive insufficiency around the larger joints. Our treatment is going to be either a stroking massage, we're gonna use sometimes breathing techniques. But what we're gonna talk about today is we're gonna be looking at anchor and mobilization techniques and contract-relax. Let's look at these two videos. We're gonna start with the video on the left, which is an assessment of the tricep. This is for problems in flexion. This is actually helpful for when we have problems related to the tricep tendon. Some of the clinical conditions that we'd be thinking about for this would be things like an olecranon fractures. Anterior dislocations, instead of posterior dislocations. So let's take a look at the tricep assessment. All right, so now we're gonna take a look at the soft tissue of the lateral elbow, so we're gonna be looking at the neo head of the tricep, the lateral head of the tricep. And we're gonna look at the relationship of soft tissue to stiffness and flexion. This is gonna be to assess for people with stiffness inflection. Couple of orientation points. Medial epicondyle, olecranon, lateral epicondyl. Your tricep tendon is here. It's right, just proximal to the olecranon, rather. And then of course I can palpate into the olecranon fascia. One of the areas that I like to make sure that we're clear, I don't have any feeling for any osteophytes or any type of skeletal restriction in movement. What I want to do my soft tissue assessment

I'm gonna start with the medial side, rather. And I'm always gonna start with the medial side because most times I want to see if there's a component in the medial head of the tricep. Because it's important for gaining terminal extension. When I fully extend an elbow, the medial head it tightens over the last 30 to 40 degrees of extension. And so when I have someone with a flexion contracture I always want to look at the medial head of the elbow. When I have someone with tightness into flexion, I want to look at the lateral head. And I want to look a little more at the tendon itself, to see if the tendon itself has any fibrosis in it. So when I come to the medial head I put the person about maybe 35 to 40 degrees of extension. I will do a what's called a pincher. I'll come and I'll bring the medial head off out on its own, and I'll roll into the fibers like so. And I'm looking for a taut band in the fibers.

And I really don't feel one right now. I'll come across that taut band, again with a flat top patient, looking for taut structures. When if find a taut band, or twitch response I'll add soft tissue mobilization into the intervention as part of treatment. I'll do the same for the lateral head. You can see the lateral head over here. Lateral head is an important extensor. It's the most powerful part in elbow extension. The lateral head is right here. And you can see I can do the same thing here. I can roll and pinch. Again, looking for any types of taut band or twitch responses, or palpable nodules. I can also then do a flat palpation. I could come across looking, this is a little bit of a strum kind of a move. Or I could also take a couple of fingers and strum. Again, looking for a taut band and reactive tissue. And then if those tissues become reactive we can do an intervention technique, which I'll demonstrate in the next video. So now I'm gonna do a little bit of mobilization, I'm gonna demonstrate it on the lateral head of the tricep. And what we're gonna do is we're gonna do a pin and trap mobilization. Which is taking the tissue in a softened position, or a lengthened, or shortened position, rather. And I'm gonna hold it at a shortened position while I then lengthen it over the lever arm. Now when you're lengthening the tricep what's important is to recognize that the tendons are confluence tendon. So you need to stabilize both the medial and lateral heads. But you can see the technique well just from the lateral side. I'm going to make a little

cradle here out of my thumb. We'll keep her at about 20 to 30 degrees of extension. I'm going to mobilize the muscle bellies back. And from distal to proximal. And what I'm gonna have her do is stretch into flexion position. I'm gonna have this close to her ear in sagittal plane, while I maintain pressure on the muscle bellies. Now the important thing to consider here about the tricep, there's one other feature that wasn't readily available, or readily, that I didn't address actually in the videos. And that's remembering that it's called triceps, it's a third head here. The third head is the long head of the tricep. And you'll notice that at the end of the second video, I sort of brought the body into sagittal plane, sort of closer to the ear. I brought the arm, rather, closer to the ear, closer to sagittal plane. That's incorporation of the long head, and that's to gain tension through the long heads. And you'll also notice that you bring the humerus into a flex position, again, because that lengthens the long head of tricep. Long head of tricep is secondary humeral extensor. So it'll be lengthened in the overhead flexion position.

So that is a couple of technical details that you might want to think about if you're employing these techniques. When I look at the bicep assessment, I do have two heads of a bicep. I have long head and I have a short head, and you can see that here. The bicep assessment is more important for terminal, regaining terminal extension. It is in fact the more common of the soft tissue techniques that you'll use. The problem is going to be this tendon, which is almost always tight. You see here in the red area. Now the tendon and the bicep is also a confluence tendon. It's one distal tendon to proximal tendons. We're gonna see the mobilization technique, and the assessment technique in this video for the bicep. So could we run this bicep video now, please? Soft tissue examinations starts by taking the muscle belly itself, rolling the bicep muscle belly in a pincher technique. And then following with a flat technique. And we can use both in the bicep muscle belly. Now the important thing about the bicep muscle is this. The bicep muscle is very susceptible to co-contraction phenomena. And therefore, in flexion contraction problems, the bicep muscle tends to tighten and sit in this position. Can you give me a little bit of a flexion in your arm? There you go,

okay. And you can see, if you come in real tight here, you can see the bicep tendon often sits very tight like this in a flexion contractor patient. One of the things we need to do when we had that problem is we can do a little bit of over pressure to that tendon. And we can hold overpressure on that tendon to get that tendon to relax. Another technique we can do is we can employ the soft tissue and mobilization technique of the bicep. Which is again, to take again my thumb as a little bit of a bar, use my thumb as a bar. And I'm gonna shorten that bicep muscle belly. Approximately, what I'm doing is I'm putting my fingers behind the humerus here. And I'm bringing the thumb in a wide, make a wide wedge space and bring the bicep muscle proximally. So you can see how much I can mobilize it. If I start that patient around 90 degrees or so, most people with flexion contracture easily get to 90 degrees. I can shorten the bicep muscle belly, and then as I lengthen, you can see the soft tissue begin to lengthen underneath the pin and trap mobilization. So basic soft tissue mobilization, lengthening of the bicep.

And so you can see that we have a pin and trap mobilization. Also, if you think about another technique you can employ here, with the elbow flexed at about 90 degrees, it's reasonable to think, to ask for a contract-relax as a technique. The PNF contract-relax technique. So we'd have the person aggressively flex their elbow. And then after a 10 to 15 second hold, you can release the contraction. You could have them take a deep breath, release the contraction, and then ask for extension. So that is a way of addressing the, one of the ways that we address bicep skull contraction. In our final soft tissue video, one of the secondary muscles that we need to assess is the pronator teres. The pronator teres is a strong secondary flexor of the elbow. And I think what we'll do is we'll just take a look at the video right here. So if we can have that video right now? So now we're going to examine the pronator teres muscle. And the pronator teres muscle's involved in restrictions in gaining, by regaining supination, or gaining extension. The pronator teres is involved as a secondary elbow flexor, because it crosses from the medial epicondyle and inserts to the radial, to its tuberosity here, the radius of the radius. So we see this sort of oblique line of pull, and that sort of of

course allows it to pronate. So the pronator teres we assess in more of a pronated position, 'cause that shortens and slackens the muscle belly. And I'm gonna take that muscle belly and I'm gonna do a flat palpation here, not a pincher. And I'm gonna come across those two heads of that muscle. You'll notice I'm crossing in an oblique pattern here. So, I'm crossing perpendicular to this obliquely running muscle. So here is my palpation and assessment of the pronator. And you can feel, she's got a little band right there in her pronator. You can see in my strong palpation, see how I kind of snap over that little band? If you come in close on that you can get a little bit of a look on that, okay. And that's a little bit of what a restriction may look like. When I see a, or feel a taut band like that, I'm gonna do what's called a pronator release. And in a pronator release I'm gonna take the olecranon here. I'm gonna put it in between my two fingers like so.

And I'm going to take my thumb, and I'm gonna bring my thumb from a lengthened position with a wide web space, and I'm gonna really bring it back proximally. And contract that pronator and hold the muscle short. Then what I'm going to do, since the pronator lengthens in supination, the mobilization position then becomes supination. But it's also an elbow flexor. So it's going to require elbow extension. So one more time I'll repeat that and let it happen all at one time. I shorten it, I supinate. And I come to full extension. And that works on the, right over that top band to release it. So those three techniques are sort of basic techniques that help us mobilize the soft tissues around the elbow at the same time that we concern ourselves with the joint. So I think it's really important for therapists to maintain a balance. We have have to think about the soft and skeletal tissues for proper mobilization of stiffness around the elbow. Now, once we finish with our manual assessment and techniques it's reasonable to think about exercise interventions. And exercise interventions are pretty standard. The standard intervention that we use in early mobilization of the elbow after any type, most types of injuries really, is the overhead motion protocol. First described by Aviva Wolf and Robert Hotchkiss in 2006, and has been studied again more recently in 2015, in unstable elbow patients. The technique is basically to begin in supine. And so first,

you try to begin immediately after injury. And the whole idea of the overhead motion protocol is to prevent the stiffness development in the elbow. So we don't want to hold a patient still for a long period of time. There's a joke among people who treat elbows, that the best way to treat an elbow flexion contracture is to not get one. And so, what we're going to be looking at now, is technique that helps us think about the concepts of prevention of elbow stiffness. We will begin supine, and the patient will work in supine for approximately three to four weeks. This is because after elbow injury there's an element of instability. So we want to get the patient mobilizing, but we don't want to overstress the elbow, particularly in varus. And we'll come back to that in a minute. And the basic exercise is elbow extension, against gravity with the forearm in pronation, 10 to 15 reps, followed by elbow extension with the elbow in pronate and supination for 10 to 15 reps. And the person does this four to five sessions per day. At approximately somewhere between three and four weeks, the person can be progressed to a sitting position.

And in the sitting position, I always suggest that my patients keep the humerus in a scapula plane position. And you'll see that here that the humerus is in scapula plane. And the person is doing active assisted exercises now. In this case he is in neutral. But he can be in pronation or supination depending upon the injury. And he mobilizes using gravity assistance with the arm in a scapula plane. And that's for flexion. And one of the things that people run into is they begin to develop stiffness quite quickly in extension. And so therefore one of the ways to improve the extension angle and the extension exercises is to create what's called the axilla block. And we add the axilla block here at about the third to fourth week post operatively. And we add active, assisted range of motion into extension. The idea of the axilla block is that it improves the extension angle and the mechanics at the distal mobilizing part of the exercise. And it also creates improved proximal control, which is often compromised by the biceps co-contraction phenomena. Let's look at a case now. I'm gonna show you a case of a person who, we progressed at about three to four weeks. So here we see a significant injury. This is a person who had developed a, has a significant elbow fracture, multiple

trauma. Has what's called the Monteggia fracture. In addition to a both bones forearm fracture. And the point of this first x-ray was really to show you that this is a stable wrist. And you can see the reason this is a stable wrist is because this scaphoid angle here is less than 60 degrees. And that indicates that the wrist is stable. You also don't see the distal ulna here at the proximal, at the distal radial ulna joint right there. Therefore, by not seeing the distal ulna in the lateral, you know that the wrist is stable. So the patient is able to mobilize without being concerned about the wrist function is the point of the first x-ray. The point of the second x-ray is to show you the severity of the injury. The elbow, this is a distal humerus fracture, and not a Monteggia fracture, I beg your pardon. This is a humerus fracture bi-columner in nature. Fairly good articular surface, however.

An interarticular component from the trochlea. But good articular surface on the humerus right here. So let's have a look at this gentleman mobilizing. Could we show this video, please? All right in this video what you see here is a person, he's out about three weeks. And you can tell that he's out at about three weeks, because you can see that he has stable soft tissues. He's got a little skin graft here. And you can see that he has, we're using the axilla blocking technique, for him to gain extension. And this is the active assisted component of addressing elbow stiffness into extension. So you can see in this position we have his axilla quite well controlled. He's able to reverse his hand and mobilize it from flexion, from extension into flexion. And then reverse mobilize from, from flexion into extension, by shifting hand position. There's multiple issues going on with this case. He's obviously in a wheelchair, he's had significant multiple trauma. But you can see how a pretty severe elbow injury three weeks out, and yet we have him mobilizing quite well. Okay, can we return please? Now, as you saw from the previous case, in this case we have a lady who is trying to mobilize and begin from active assisted to active range of motion. And I want to point out a couple of discrepancies in her movement. So let's show this video and I'll do the voiceover with this video. So here I have her trying to do an active assisted range of motion, and you can see she's failing miserably. And what she's doing here is rocking her forearm,

her trunk back and forth. So I realized, and you can see I'm cuing here. And I realize I want to see her mobilize her arm actively. So I have her doing this in this position, because she's gravity eliminated. She is so weak and deconditioned, unlike the other gentleman who's younger, stronger. In this older lady, she's a little more deconditioned and her musculature is quite a bit weaker. So I'm trying to employ a gravity eliminated, so that we can activate her muscles independently. And I want you to watch the difficulty she has in movement. So she's gonna move independently now. And notice how she struggles for extension. She's substitutes with her finger, and she really moves her trunk to try to gain extension. But however, did you notice how quickly and how readily that flexion occurred? Watch her extension, you could see tremendous amounts of substitution. And yet when flexion occurs, it happens quite readily. But yet, she continues to have difficulty with extension.

Now, the problem, what you're seeing here is not just the co-contraction phenomena, but you're also seeing here what's been shown neuro-physiologically to occur in animal models by beset, that it's difficult to recruit the motor points rather of the triceps, after injury. It's one of the consistencies that you see in clinical practice, we've never been able to demonstrate it in human models simply because you need to be able to do active craniotomies to be able to locate motor points in the brain. And so basically only animal research can show us this. But nonetheless, it's very difficult to activate the parts of the brain related to the triceps. So the early switch from active assisted to independent active motion, often brings in a great deal of substitution patterns. Let's look at the next slide. So can I have the movie, please? Thank you. With can see this phenomena if we don't address this phenomena readily, we can see this phenomena developing into a significant motor learning planning problem, which is associated with that co-contraction phenomena in the difficulty in recruiting the tricep motor point. Let's run this video. And watch what happens when these patterns of movement become incorporated into reaching. And what you can see here is that the person really has virtually no ability to initiate extension in a reaching task, from the tricep. They initiate from the shoulder. So the purpose here is early active motion in a

good movement pattern, can we come back to the video, or to the slides? Early active motion in movement patterns that control that biceps co-contraction, support the axilla and give us appropriate recruitment of the triceps, actually helps us prevent contracture development over time. Once the patient develops, so before we go further, just one point to consider. I would rather a person move with less of an arc of motion, where the recruitment patterns are more normal. And the person is moving with better quality of movement in a restricted range, than I would for a person who's trying to gain a larger amount of range, using poor quality of movement. So it's an important component for therapists. And it's really critical in that three, four, five week period of time, when you're starting to re-mobilize the patient after a period of protected mobilization.

At the end of the range, once we get into the... Once we get to the end of the program at the eight to 12 week mark, we now have patient moving nicely. We can incorporate plyometrics, we can incorporate tossing activities. And we can look at this little video right here on the left. Actually that's a person doing an extension exercise. And you can see the nice quality of motion in this video. And this is a person who had a very severe injury. This person had a radial head dislocation and fracture. Had has a radial head replacement, lateral ligament reconstruction. And humeroulnar dislocation. This was quite a severe injury. And here he is about 10 weeks out, tossing a basketball using a beautiful movement pattern of extension and pronation. And certainly you can see his limitation in movement. But his movement pattern is excellent. You see virtually no shoulder substitution of that protraction retraction that we've seen previously. And our next slide deals with what happens if your patient gets stuck. So when did we start thinking about orthoses, and how do we use orthoses for prevention? And how do we deal with them when a person gets stuck? So, when a person gets stuck, we need to be thinking about what kinds of mobilization orthoses. When we really want to get into the evidence of it, every one of us has a preference. And my preference is static-progressive orthoses. But I have to admit honestly, when I look at the literature, there seems to be no difference in the outcomes between dynamic and static-progressive

orthoses. And this has been discovered in a number of studies. But I use the Muller study, because the Muller study is an meta-analysis, and incorporates the previous studies that have demonstrated a similar phenomena. So, whatever you are using in your practice, a dynamic process or a static-progressive, or a serial static, you're likely to gain motion. And you're likely to gain motion, pretty much no matter what you do. However, I would tell you this. There's a few things that I think create orthotics that work in a more principally sound manner. And one of those is the three point rule of fixation. Orthoses that do not have three points of fixation, in my mind do not adequately transport forces, whether they're dynamic, static-progressive or serial static to the stiff tissue.

Further, splints, or orthoses that do not have adequate forearm length, or forearm control, or humeral control around the elbow, that means they're too short and they can't transmit forces effectively to the stiff tissue. And a third principle that's always important is the mobilization force that should occur directly to the areas of the stiffness. So if the stiff tissue is the anterior capsule, it's reasonable to consider the mobilization forces to being on the anterior surface of the elbow. Dosing means how often, how much should I wear the splint? And therefore, what you have to think about is, we have to consider four variables. How strong is the stretch, how often do I want them to wear the stretch for how long? And what's likely going to be their compliance? So therefore, dosage is gonna be a factor of these four variables. Therefore, optimum dosing, is unknown. The current literature does not suggest what optimum dosing is. Now we know what optimum dosing is for stiffness of tissue, but we don't know that directly resulting, we don't know that directly to stiff elbows. Glasgow's study showed us that six hours per day of what we call TERT, or total end range time, at the end of the range. Total end range time at the end of the range, needs to be six hours. However, at the elbow we know that optimum dosing is unknown and therefore Muller's conclusion is that current literature, and current use of the 30 minute, three time per day protocol, gets satisfactory results as any other dosing protocol. So let's look at a couple of orthoses, and put them the apart, and we will make some

conclusions about orthotic management. Here's a serial static three point splint. And this uses, this is an anterior elbow approach. And you'll notice that it gives us our three points of fixation, by having one point here, one point here, and these are balanced by the third point over the olecranon. And the advantage of serial static, is as you can see in this case. Since it doesn't have an aggressive mobilizing force, I can apply these very early post-operatively. And in this case I'm applying an extension splint for night use at two weeks. Which is much more likely to be preventative in nature. So I use serial static as a preventative approach when a person's developing early onset stiffness. Once stiffness has been established, in my mind, the most effective technique is the three point static-progressive splint. And I use a turnbuckle orthoses. I tend to fabricate my own. This is one of the ones I used on a child. And you can see I use a standard turnbuckle, hinged elbow splint, three points of fixation, with olecranon stabilization. Here's another example of that splint in adult. And you can see I'm using a different turnbuckle here.

Again, I'm using a three point of fixation mobilization. Good length in the forearms, so it meets all our orthotic fabrication criteria. Let's look at some other types of orthoses that are used in management of elbow problems. These are not for stiffness, but they're management of the elbow instability. And so in simple dislocations, like we had in this patient, this is a patient of mine who's had a reduction of a simple dislocation. Then we can use a posterior elbow splint here. Again, using three points of fixation. But in this case, the third point is being fabricated by two straps bordering both sides of the anterior surface of the elbow, instead of the posterior surface. So my three points are here and here. And again, adequate length. So we're using this as a stabilization orthoses at the elbow. When we have complex injury with dislocation, one of the ways that we have been always taught to treat these particular patients is that hinge elbow splints are the appropriate technique. However, in a very recent study, Manocha showed us in 2018 that the hinged elbow splint, even though we think it helps protect from varus it does not. And so it's not as adequate as we thought it was. So this standard brace with positioning of the forearm in slight pronation, for injuries of the

lateral collateral ligament, is not as stable as we thought it was. So therefore there's a move away from these hinged elbow braces when we have lateral collateral injury with elbow instability. And so we need to protect in varus. So, surgeons are using a more advanced technique these days. And that's called a hinged elbow fixator. And this is an x-ray of a patient of mine from hinged elbow fixator. And you can see instead of a hinged elbow brace, they're using this orthopedic device. You can see this is a quite complex injury with a radial head replacement, lateral collateral ligament here. Basically the same injury as you saw in this case. So let's go back a second. This injury is essentially this injury, only treated in a different manner than the previous case. This is what that patient looks like in mobilization. Can we run this video please? And here you see an early mobilization, active assisted range of motion, hinged fixator. He's only about four or five days out from his injury. And notice he's already stiff. Notice that he's already fighting biceps co-contraction. He is already fighting the substitution pattern at the shoulder.

So even though I have him doing early onset active assisted range of motion, in a very stable external fixator, he is still exhibiting the soft tissue and motor learning difficulties that accompany elbow stiffness, and elbow injury. And you're gonna get a close up video of that hinged elbow fixator. Little picture right, should be right around there. Here you go, okay. And could we advance to the next slide, please? So one of the ways, and one of the final things to think about with this is, how can I help with motor learning if in fact the... Why don't we run this video right now and I'll do the voice over. So if you think about how can we address that early motor learning, so that we don't run into the substitution patterns that we saw before. And one of the ways that I like to do that in my practice is using a neuromuscular electrical stimulation technique, using reciprocal electrical stimulation of the tricep and the bicep. And the idea is to start addressing the activation of the tricep as independent of the bicep. And so you can see that's exactly what I have here. I have the patient participating in an electrical stimulation program for muscle re-education. That's quite effective in early management of the biceps co-contraction phenomena. Okay, and we can move on

from this video. So in summary, management of the stiff elbow requires the therapist to have multiple tools in their armamentarium. They need to be able to incorporate principles of joint mobilization, soft tissue mobilization, orthotic intervention and even bringing in physical age modalities to manage the elbow to regain optimum function in occupational performance. And I want to thank you for attending my presentation today. Oh there's one more little slide here, I forgot, I'm so sorry. This is to show you that I can add, this is a little creative orthoses that I made, where I add a dynamic traction at night. So you can see that I'm adding the full compliment of intervention in this one case. Stabilization, mobilization with an elbow orthoses, electrical stimulation and active assisted, early active assisted range of motion. This kind of case kind of summarizes how we use all our tools in one case to prevent stiffness. And to mobilize the stiffness that's already there. Thank you for participating.

- [Fawn] Thank you so much for a great presentation today, Paul. I am going to hold off on questions, so that I can be mindful of everyone's time. But he has provided his email there, as well, as I did pull a few questions out that I will get answered for you. Hope everyone has a great rest of the day. Join us again on continued and occupationaltherapy.com. Thanks everyone.