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Thoracic Outlet Syndrome Considerations Recorded April 23, 2020

Presenter: Marie Pace, M.H.S., OTR/L, CHT
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- [Fawn] Today's course is Thoracic Outlet Syndrome Considerations. Our presenter today is Marie Pace. She is the facility director for the UPMC Centers for Rehab Services hand therapy clinic in Pittsburgh, Pennsylvania. She has been an occupational therapist since 1994, earned a post-professional master's degree in 2001 and earned a certified hand therapy certification in 2002. Welcome, Marie, so glad to have you back.

- Thank you so much, I appreciate the introduction. It's nice to have all of you here today. This topic has been one that's been really helpful to me in my practice in hand therapy, because it is one of those things that explains some of the strange things that are going on with people's arms. So I hope that you're able to benefit from learning from this today, so let's get started. So just to start with, I just like to say that these are my disclosures. You can read through those. And we're gonna go over learning objectives so you can kind of focus on what we're gonna study today. The first learning objective is we're going to be able to discuss the types of thoracic outlet syndrome and describe them. We're gonna be able to identify the special tests, which would indicate the need to treat for thoracic outlet syndrome. And we're gonna be able to list the treatments some of the treatments to relieve the symptoms of thoracic outlet syndrome by the end of this course.

So to start with, I think having a good definition of what is thoracic outlet syndrome would be helpful. First of all, the thoracic outlet is from the scalenes in the neck down through underneath your pectoralis minor and your coracoid process. So it's compression neurovascular, so nerves and vascular structures within that thoracic outlet. Diagnosis is made primarily through clinical signs as opposed to like an Xray or MRI study. Onset is insidious, so meaning that there's no blunt trauma normally when we're talking about the thoracic outlet syndrome. It is usually related to posture, body structure, and repetitive strain, so causing irritation to the nerves or the blood vessels within the thoracic outlets and the thoracic outlet. The main complaint that people have

is pain or heaviness in their shoulder, neck, and arm radiating down usually especially to the ring and the small fingers. So anatomy zones of thoracic outlet syndrome, there are three zones that we can refer to within the thoracic outlet. There's the scalene triangle, so related to your scalenes in the triangle, your costo, meaning your ribs, clavicular, clavicle space, so right in this part, and your subcoracoid space. So we're gonna look at some pictures here so we can visualize what a subcoracoid space is.

So scalene triangle, let's start with that. We're gonna point out a couple of things about the scalene muscles. So in this case, we're talking about the anterior, so the one that's in the front and the middle scalenes. You notice that they originate from the vertebra and the insert on the rib, so first or second rib that come off, you can see, we get the pointer out here so you can see where I'm pointing. Okay, green pointer, there it is. Okay, so you could see the origin and the insertion of your scalenes. And then you can see how the nerves at the different levels of nerve roots are coming out to start the brachial plexus and they emerge through these scalenes. And then at the bottom of the scalene triangle is the subclavian artery and vein. So here is typically as pictured red is the artery and blue is the vein. I wanna do a hands on thing here, so if you're, I can't see you all obviously, don't have your cameras on but just follow what I'm doing and try this yourself. So I want you to find where your sternum is, sternum in the middle and then over to your clavicle, and there's a space right underneath your clavicle where you can appreciate a rib. So I want you to put your finger on that rib and kind of push down on that. And I want you to turn your head and pull. Okay, that's more than middle scalene, and then to get your anterior scalenes, you're pushing down on your ribs, you might feel it rise slightly, you're gonna turn your head, that's your anterior scalene toward the ceiling. So you're going toward the side that you're palpating on, and that stretches your scalene, we'll go over that 'cause that's part of a special test later. All right, that's a scalene triangle.

All right, next we're gonna move on to the costoclavicular space. So we have highlighted in the small breakout box what we're looking at here. So, costo meaning rib and then the clavicular space, so the coming emerging from the neck through the scalenes are the artery and the vein and your brachial plexus and they come right underneath the clavicle, and below that is the first rib. And so in this picture, it's showing how the trunks of the brachial plexus and the subclavian artery, but especially the subclavian vein, are at risk of dislocation because the subclavian vein is more medial and can get the greatest pressure from the rib with the clavicle, especially when a clavicle is depressed, so we'll go over that again later, but I'm just pointing that out here. So here's the clavicle as it comes off the sternum with the vein and the artery here in the blowout. You can see that a little more closely, so that's costoclavicular space. The subcoracoid space, I'm gonna explain that a little bit more because I know a lot of people are a little rusty on their anatomy. The coracoid process is an extension of bone that comes off of the shoulder blade. So as we're looking at the picture that you see in front of you, we're gonna pick up this arrow and point to, this right here is the acromion process.

Okay, so that is the most lateral portion of the shoulder blade, and the rest of it, of course, is on the back, but coming, projecting forward is the coracoid process, which is pictured here. Let me drag the green arrow down. Coracoid process is right here. You can see the pectoralis minor muscles coming off of that coracoid process and attaching to the ribs and here's the coracoid. So if you look at your shoulder, so the dent between your clavicle and where your deltoids start, there is a hard bump where you come off the clavicle and you can feel that hard bump, that is the coracoid process and it is projecting forward from your shoulder blade. So the pectoralis minor pulls down on that coracoid process causing your shoulder blade to go medially at the bottom but also tilt forward so that you would get a winging if that was unopposed by some other muscles. Notice also that in this picture, the subcoracoid space has the blood vessels, it has both the subclavian artery and vein and the brachial plexus as it

goes underneath the pectoralis minor, just inferior to the coracoid process, and it exits through into the axilla. So the contents just to be clear, the contents of the thoracic outlet are the subclavian vein, the subclavian artery, and the brachial plexus. This is another picture that has some nice descriptions of what's happening here. If there is compression of the brachial plexus between the scalene muscles or if there is compression underneath the clavicle, let me show you that, okay, and I like this picture also because it shows the muscle, muscle that goes between the rib and the clavicle.

So we're gonna do a little experiment here so that you can appreciate this muscle 'cause this one is actually a really important muscle for like if you were gonna weight bear on your elbows, through your elbows, the muscle underneath the clavicle is important for supporting and holding the clavicle down. So I want you to try to find where the clavicle attaches to the sternum and then walk your fingers below the clavicle until they're touching that rib again. So instead of moving our head this time, we're gonna move the arm. So I want you to push down on that rib, so you're pushing down towards your toes, not in but down, and I want you to raise your arm out to the side, abduct your arm and see how that feels. You're really stretching and holding back or pinning down the beginning of the muscle, and so you're gonna reach out to the side. Okay, now go ahead and release that, and now I just want you to reach out to the side without pushing down on that, so you can feel the difference. Your ribs are being allowed to elevate, the insertion or I'm sorry, the origin of the muscle that goes beneath the clavicle is being free to move as your arm moves. So your clavicle is elevating as your arm elevates, it's going from here to here as you go up. So this pinning move helps you to stretch that muscle, okay? I just wanted to point that out why we're looking at this anatomy picture because it helps us to understand that little muscle.

Also in this picture, I'm gonna move the green arrow down to, we're showing here this white part is the coracoid process and how the pectoralis minor tendon comes up to that and underneath there, showing the red mark, which indicates where there's

pressure, okay, on the brachial plexus. It could be also on the subclavian vein and artery. Okay, so let's get a little more detailed, dig in a little deeper to the scalene triangle. So the borders or the edges of the scalene triangle are the anterior scalene and posterior would be the middle scalene, and then clavicle inferiorly. The purpose of the scalenes are for head lateral motion and as an accessory to breathing, which is important for later. So the scalene muscles help to elevate, I'm showing you with my shoulders because you can't really see the ribs going up, but they elevate the ribs to breathe. I don't know if you can appreciate my neck but, so as we inspire a breathe in, the ribs come up, so in order to draw air into the lungs, the muscles lift the ribs up, which brings the air into the lungs. So the attachment of the scalene muscles to the ribs is significant because it helps in breathing in when you're breathing from the top, breathing from your neck, as I like to say.

So defining a costoclavicular space, so this is a space that's central, that you have the clavicle on top, the costocoracoid ligament and the subclavius muscles. So the subclavius muscle's the one that I was talking about earlier that if I hold the ribs down and then try and elevate the clavicle by abducting my arm, I can really feel that stretch. And then the first rib predisposes a person to thoracic outlet syndrome. So some people can have an abnormal first rib that makes that space really small, this costoclavicular space really small. So, that is a abnormality that your orthopedic surgeon may have seen in an Xray that says, okay, well, this person has an abnormally small costoclavicular space. So this is the area the central area, costoclavicular, that is under pressure when you see someone, when you look at their posture and they have drooping shoulders, and that can be from just their natural posture, or from carrying heavy things, or from having, I'm just gonna turn to the side here so you can see, or from having a rounded thoracic spine or a kyphotic thoracic spine.

So the costoclavicular space has a problem that if someone can develop something called Paget-Schroetter syndrome, is a result of a thoracic outlet syndrome from the

costoclavicular space where a thrombosis or blood clot is formed in the subclavian vein, so this is a serious problem, and we would want to identify it if we see it. It can lead to pulmonary embolism and death which would be the ultimate problem. So look for, what you would look for as the clinician, obviously we can't do the the angiogram, but you can look for upper extremity edema and a dusky color, bluish color in the arm especially when you look at their arm, there hasn't been any problem with the lymph nodes, there's no trauma that we know of, we just know that there are measures that's more larger and is not having a gray color. They have pretty good pulses like you can feel that the artery is coming in but the arm just has a strange color. So for any of you who are studying for the CHT exam and I'm working with surgeons, orthopedic surgeons and vascular surgeons, it's good to know the names of these things. So Patrick Schroetter's one of those things you can tuck under your hat.

So the subcoracoid space, so below the coracoid process, the borders are gonna be the pectoralis minor and the coracoid process and the ribs are underneath that, deep to the structures. So the neurovascular bundle is under pressure, in hyperabduction of the upper extremity also the neurovascular bundle is stretched and repetitive overhead reaching. So this is when you're taking the neurovascular bundle so both your plate brachial plexus and your subclavian artery and your subclavian vein and you're stretching it around the corner. So if I put my finger where my coracoid process is and I abduct my arm especially overhead, hyperabduction, meaning going back like that behind the plane of the body, that really takes the vessels and the brachial plexus and stretches it around the hard corner of the bone of the coracoid process. So someone who is repetitively, we turn this way, reaching back like this, reaching up like to hold drywall on the ceiling, for example, if you got a drywall or doing, lifting a drill and putting screws in the drywall overhead, especially if they're hyperabducted, that could be a problem.

So classifications of thoracic outlet syndrome, you'll see this when you're reading about thoracic outlet syndrome that I think is worth mentioning. So you can have either arterial thoracic outlet syndrome, you can have venous thoracic, or neurogenic, so coming from irritation of the nerves. So arterial symptoms, what does that look like? So you have compression of the subclavian artery and that will be general pain in the neck and the arm and the shoulder. There'll be a diminished pulse. So if you were taking a radial pulse in the radial artery, that would be diminished. There'll be numbness and tingling and the reason that there's numbness and tingling is if the artery or the blood flow is not good to the hand especially with repetitive positioning, then the whole hand will be numb. Anything that's innervated skin-wise distal to the thoracic outlet syndrome will get numb and it'll be intermittent. It will come and go depending on how much pressure is on there. You'll also have a sense of heaviness and fatigue in the arm. This is actually the most serious and least common form of thoracic outlet syndrome, and can cause permanent ischemic injury to the upper extremity.

So venous symptoms is compression of the subclavian or arterial vein in the costoclavicular space. It can be intermittent with upper extremity edema. There's heaviness and weakness in the upper extremity. And if there is a thrombosis, if there is a blood clot in the vein, then the swelling will be more steady and unchanging, and there will be cyanosis, there will be a blueness in the arm from lack of clearing of the used blood. A thrombosis is a serious complication, and if suspected, the referring physician should be informed immediately. So if you feel that, say, the swelling has increased or has become more steady, and they've been diagnosed with thoracic outlet syndrome in the past and it's recurrent, and you see a change, you just refer them back to the surgeon for that. So neurogenic symptoms can be categorized in two different ways, either true neurogenic or disputed neurogenic symptoms. In a true neurogenic, they call it true because it can be corroborated with electrodiagnostic testing that confirms that it's definitely from the nerves. Also called Gilliatt-Sumner Hand, they can show motor deficits in the hand in both median and ulnar innervated

muscles. There can be sensory deficits that are also present. So if the nerve is compressed, then you get a pattern of compression throughout the whole hand, so the muscles, the distal muscles in the hand can show that compression. So in disputed neurogenic, where there really isn't a diagnostic electrode, diagnostic test showing that this is a problem and that the pressure is in the thoracic outlet syndrome, then there's still complaints of weakness, periodic numbness and tingling, but not in the same pattern that you would see just a cubital tunnel or just a carpal tunnel, you would see that throughout. And that there is oftentimes with disputed neurogenic, there's also headaches, vision impairments, and facial pain.

So this is all just nerve compression-related issues that's intermittent, but the nerve is clearly irritated. So special tests, this is a really important part. There are some special tests, and we're gonna go over a couple of them today for thoracic outlet syndrome. So special tests are if you get a positive outcome, it points to thoracic outlet syndrome, so the Wright's test, we're gonna go through first and I have some pictures here. So Wright's test is essentially feeling the radial pulse, putting the arm in abduction, and I'm gonna stop feeling the pulse 'cause I can't feel my own pulse, putting the arm in abduction, external rotation, and continuing, I'm gonna turn this way, continuing in abduction. So you'd have the person seated and then you would have them, you're feeling the pulse still and you would have them move into hyperextension and abduction. And a positive Wright's test is when the radial pulse is obliterated. So you feel the pulse well in this position, and then as they abduct, hyperabduct the arms, then that pulse would diminish, so you can hardly feel it.

Okay, so Adson's test, this is a test for compression in the scalene triangle. So again, you would feel the radial pulse, you're palpating the patient's radial pulse, you're gonna extend their arm, let me come back here so you can see it, you're gonna extend their arm, and then you're gonna have them look toward the extremity and then up, so that they're stretching their anterior scalene. And if that obliterates the pulse, that's a

positive Adson's test. The Roos test is the one that I generally use the most. It covers the whole brachial plexus, sorry, the whole thoracic outlet from the pectoralis minor all the way up into the scalene. So what you're gonna have the patient do is to put their arms and it doesn't depend on you feeling the radial artery. Yeah, they put their hands up like this so that you can have observe the color of their hands, and then you're gonna start the timer. And you're gonna have them open and close and you're trying to have them pull their elbows back behind the plane of their body, so they're really horizontally abducting, so open and close, open and close. Now three minutes is a really long time, and it's normal to have some weakness in opening and closing your hand like that, but you will notice a color change especially if the complaints are in one hand. So a positive Roos test is when one hand starts to droop and they slow down, and they just can't do it anymore. So that would be a positive Roos test.

The Military Brace Test is when you have, you're feeling the pulse in the person's arm and you're gonna have them adduct or retract their scapula, depress their scapula, extend the shoulders, and then they look up. So they're stretching the scalene, all right? And so you would have them do that and if they have reproduction of symptoms, numbness and tingling or the radial pulse decreases. That's positive Military Brace and the Military Brace Test is testing for compression of the clavicle on the subclavian artery and vein at the medial part of the clavicle. So this is me trying to do this on, I should have had him sit down, but I'm feeling the radial pulse and I'm hyperabducting and my hand right here is blocking. I find that a lot of people when I'm testing them, they just kind of lean backwards when I do that. So if I put my hand back there, that just keeps them upright, keeps them from flexing their trunk. And then you can have them breathe in deeply when they do that as well. That's the Wright's test, and the Roos test, open and close, open and close, and the Military Brace Test, I'm feeling the radial artery at the wrist and then getting into the position and extending the head and neck.

Okay, differential diagnosis, so it's important to just sort of touch on this. With thoracic outlet syndrome, it is often that I get someone who comes to me for some other problem. And cervical disc disease that is affecting the muscles in the hand is one that's pretty common. So you can have double crush so that there is a problem at the cubital tunnel and a problem with the cervical disc or a problem in the thoracic outlet, and they also have carpal tunnel syndrome. So one of the common differential diagnosis is that I'm doing my activity and then my hand gets numb. So carpal tunnel syndrome is one of those differential diagnosis that happens a lot. But carpal tunnel is very specific. Carpal tunnel syndrome is numbness and tingling in the thumb index, middle, and half of the ring finger, and it's very specific, so that is carpal tunnel. So when you have a thoracic outlet syndrome kind of compression, then it's gonna be more general, like my whole arm gets numb, all my fingers, front and back. Everything just sort of gets numb and heavy and hurts. Another issue would be peripheral neuropathy. Now generally, with the peripheral neuropathy, you'll have both hands, feet also involved. There's a diagnosis of diabetes or some other thing that might indicate that they could get peripheral neuropathy. Also just shoulder pain, shoulder-related injuries. So do your full range of motion testing, do your special tests for shoulder tendinitis, biceps tendinitis, things like that. But it's important to think of what the differential diagnosis can be. Is this with thoracic outlet syndrome or is this on top or is it separate from thoracic outlet syndrome?

Okay, so ergonomic considerations. This is actually, as an occupational therapist and an upper extremity rehab person, I do hand therapy primarily. So it is very often that someone comes to me with a shoulder diagnosis or an arm pain diagnosis and it is sort of left up to me to have help this person to feel better. So applying reasonable ergonomic considerations for everyone, whether the diagnosis is given to you or not, you could still do this special test, you still document the outcome of the special tests, but these ergonomic considerations help to address thoracic outlet problems. So, is there a repetitive lifting? So you're asking about history. Is there a repetitive lifting,

heavy lifting? Either, I'm gonna move this down so you can see, so someone who is gonna be lifting something heavy like this, I watched my son's do the deadlift, they go down like this and they lift that deadlift and if their shoulders significantly depress, okay, that's heavy lifting that's gonna affect the thoracic outlet syndrome. I see many people carrying heavy bags on their shoulder. So I work in place where there's a bunch of colleges nearby and people carry their backpacks, extremely heavy backpacks around that depress the clavicle and can put pressure both medially and laterally on that thoracic outlet.

The forward head posture from driving, so if someone is got their hands on the steering wheel out here, it's pulling the shoulder blades forward, but then if their head is also forward, that that further tightens, if they especially if they sit like that a lot, it tightens that pectoralis minor muscle, I once heard a physical therapist describing their myofascial treatment, and he said he's found correlation between thoracic kyphosis and a shortened pectoralis minor muscle, which makes sense, because if your back is round, then your shoulder blades your scapulas are forward and the coracoid process would be forward and that shortens, further shortens the pectoralis minor especially if you sit like that a lot for work or if you drive for a living. Repetitive overhead reaching tasks, if you are observing that someone has obesity as a problem or they have large breasts which pull down on the clavicle, so you have a lot of tissue mass, and you know bra straps that cut right, move this over right over where the coracoid process is, you can feel that that bra strap or you can see that that bra strap goes right by where the deltoids are coming through. And if someone has large breasts, that bra strap might be pulling down on that clavicle at that location.

Okay, so the ergonomic consideration was heavy lifting or weight training or carrying a heavy bag on the shoulder. You'll see the depressed clavicular angle from weak or fatigued trapezius. So the trapezius lifting the shoulder up, the clavicle up can be, if you get stretched down over there, that muscle is weak or fatigued, you can have

problem with that. You could have hypertrophy of the scalenes from breath holding. So when someone is lifting heavy weights, they could be, you know how they do that, and they're breathing from their chest, they're breathing from the top, and they do that a lot, and they hold their breath a lot, and that could hypertrophy or cause the scalenes to get bigger, and that alone just a big neck, a big scalene neck can put pressure on the nerves, the nerve vascular bundle as it comes through, that is called the scalene triangle. If there's an imbalance between the chest and the back muscles. So someone who loves to do the bench press and they're really working hard on getting their pecs really big, so they have this kind of pulled forward look but they never work on their back. That could be a problem 'cause you could have large muscles that are putting pressure on the structures of thoracic outlet.

So, this is a picture of a drooping shoulder or carrying your backpack on one shoulder. That can cause the arm to feel numb or heavy and decrease the blood flow because of the pressure, both at the scalenes and at the costoclavicular area. If the backpack is sitting well across the shoulders and tightened, you still have to consider if the backpack is too heavy or too tight. Just from having the weight on the shoulders, it could be causing pressure through the thoracic outlet. So sleep position, if someone is having issue and they come in they're telling me about and I see that they have some thoracic outlet issues, I'm gonna talk to them about the position that they sleep in. The ideal position for sleeping is supine with both arms supported with hands on the abdomen, because they're minimizing the pull on the clavicle and ideally position the head and neck to minimize the pull of the nerves. I'll show you a picture of that. So lying flat with pillows, let me drag this arrow out here, sorry, pillows underneath each elbow, hands on the abdomen and then the head. Ideally, this head is pushed a little too far forward, but we would flatten those pillows out a little bit more so that the head, sorry, dragging that arrow, so that the head and neck are a little flatter. And that would minimize the pressure on the nerve so that if someone is having pain from an irritated nerve, they would be able to sleep better. Or a sideline position, so if the arm that's up

is the one that hurts, you do a neutral spine alignment to the neck, and you support the arm with a pillow in front of the body. That can be helpful in improving that. Things that hurt, sleeping positions that hurt.

Sleeping, and I hear that people say this a lot of time. "I sleep on my stomach with my head turned like this "and my arms up like that." Okay, well, that's almost the Wright's test right there, so you're getting a lot of pressure and stress on the thoracic outlet, and a couple of different places from doing that. If a person sleeps on their back with their arms over the head is the same thing, very stressful to the thoracic outlet. So you try and encourage people to try to get themselves when they wake up with a problem, get themselves back into this position. So head forward position from driving or sitting at a computer.

So this is not a course on ergonomics of sitting but I'm just gonna mention that pelvic position, pelvic tilt is really important. So you got the 90-90-90 rule, so the hips are at 90, the ankles are at 90, the knees are at 90. You have to start with that base so that the pelvis is tilted, so you have the proper lordosis of your lower spine, proper kyphosis of your upper spine in order to keep your arms from having to reach out too far for typing. You wanna monitor the height or change the height of the monitor and the glasses. So I'm getting to that age where I've got bifocals, and I'm starting to do this to look through the bottom. Oh, I can see so much better when I do that, yeah. So you have to sort of be aware of that when when you are assessing someone's computer situation, you wanna say, "Okay now put something up on the screen "and let me see you read it." And it's important to ask them to read it 'cause you could have a good monitor height, but if their glasses are wrong, and then, I don't know if you can see me do this, all the sudden their head tips up, so they can see out of the bottom of their bifocals so they can see their screen, this is a problem. So something to talk to people about, about getting the eyeglasses for reading the computer monitor, especially if you do that a lot.

Another place that I have seen people have thoracic outlet problems has to do with their mouse and the angle of their their shoulder. So I'm gonna lower this down so you might see my arm. So if my mouse is in the center of my computer situation, that's nice, but if I have to externally rotate and reach out, then I'm stressing like this, I'm stressing, I'm putting more downward pressure on the clavicle, especially medially, and it's maybe putting some thoracic outlet pressure in this costoclavicular space. The driver's seat position to the steering wheel. So if the steering wheel is too far away, and they're really reaching, then and maybe the steering wheel is too high, then they're getting a little bit flexed and the heaviness of their arms is pushing down, the nerve is bending around the coracoid process and perhaps the clavicle is pushing down. So you wanna bring that in a little bit to a safe position, so that it's a little closer, and the angle of the humerus is not as high.

So repetitive overhead reaching. So the solutions for repetitive overhead reaching is to try and teach people about being like this is different than being like this, to reach something behind them. So this is gonna be easier on someone than being back like that. But ideally, if really, if the thoracic outlet syndrome is progressing, they're having constant problems and really significant pain, which is usually where I see people because they don't come to therapy until they've got a serious problem. But if you can have people bring frequently used items down in the workplace, so say you have someone in an industrial setting, and they have to constantly reach up, especially on their tiptoes to get something to bring it down, reach up, and get it down, then that's an issue. Those items need to be brought down to a level so they're not having to reach, or if it's like I'm thinking of people who carry a load of shingles on their shoulder and then climb the ladder with this heavy load of shingles on their shoulder, and then they gotta push it up onto the roof. So having the mechanical lift on the ladder can really save people a lot of wear and tear.

So when it comes to obesity or large-breasted, you might think about even for males who don't have the mammary tissue, they can still have heavy load of the obese tissue on the front of their body. They might consider some kind of supportive, wide strap tank or something to hold like a jog bra, kind of situation to hold that load up. Some women may consider a strapless bra if that bra strap is really digging in or just getting the extensions that you can buy to slide onto a bra strap that makes it wider and spreads out the pressure. And you can always talk about weight loss, I know that sounds easy but that is a consideration if a person is having significant pain in their arms, that can be a consideration. So exercises to manage thoracic outlet syndrome. So there are several different authors that have stated that exercise is a great thing. It is very useful to improve both radiographic signs of thoracic outlet syndrome and the symptoms over the long term for the majority of cases. Most people with thoracic outlet syndrome are treated conservatively and rib resection and scalenectomies and surgical intervention can be done and can certainly be needed especially if there's a problem like an aneurysm or a tumor is pressing on the structures, but for the majority of people, exercise is what needs to be done.

So that you'll see, Mark Walsh is the author in "Rehab of the Hand" for the therapy side of it, and I thought he had, I wanted to make this point, education of the patient is key to success with the program. So you wanna talk about mechanism of injury, what you think might have caused this, ergonomics that would help improve and decrease the pressure on the neurovascular bundles that comes through the thoracic outlet, and posture and sleeping but also, and not to forget exercises to support those changes. So let's talk about a few things, especially if someone is extremely painful and you know by looking at them that they're breathing through their shoulders and neck. You wanna teach someone diaphragmatic breathing so they're supine with their head and neck supported, they have their hand on their belly and they learn to expand their belly, singers learn this and instrument players, you expand your belly and apply your breathing from the diaphragm, which is down here, and apply the breathing from down

there, rather than from up here. And that breathing can be done for short periods of time with the shoulders flexed, and they can get a little bit of stretch from the movement of their ribs. So I would limit the overarm so lying down posture, 10 reps of diaphragmatic breathing to stretch the muscular structures that attach the ribs and move up caudally.

Okay, so the another exercise and I use actually that the, I should have said cephalically. Anyway, you know, up towards your head. Corner stretch, so stretching the pectoralis minor is really important, and it's interesting for a person to be able to do their own pec minor stretch, this corner stretch, I think, would be the best one. Also it's very important to combine with deep breathing, so moving into the corner, and stretching and then inspiration, expiration try not to move the shoulders up. inspiration, expiration with no forward head posture. So someone gets in the corner, and their head is like this 'cause they're trying to touch their head to the corner. You say, "Okay, that's not right. "Let's keep that head vertical. "We really just wanna stretch the shoulders back." Okay, and that stretches it. So I think that we're gonna watch this video from Physiotech, and I'll turn that over. So this is a one-handed corner stretch or doorway stretch that you can do to stretch, to begin to stretch your external rotators and your pecs. So I'm gonna demonstrate a corner stretch, so I'm gonna move on to the next slide. And then I'm gonna demonstrate corner stretch for you 'cause I think, I actually have a corner right behind me. And it's usually, to find a corner in someone's house, you find a doorway, and then the wall next to it. Otherwise, it's kind of hard to find a corner.

So I'm gonna come over here, I'm gonna put my hand up like that and my other hand like this. So what you saw the person do in the video is the first step, they have to be able to do that. Then gradually, they bring their hands up higher and do both arms at the same time 'cause you do both arms at the same time because you're anchoring one side ribs, so that the other side moves, your pec minor gets a good stretch. So

your scapula are coming together, you're getting that tip downward. My head is not going toward the corner, but I lean my chest in toward the corner, and then you breathe in and breathe out. Breathe in and breathe out. I encourage you to try that because I want you to feel how that feels and you're gonna be able, the patient is gonna be able to stretch their pec minor on their own. Now you can also stretch someone's pec minor by having them lie down on the mat table and you put a towel just medial to their scapula and they're lying flat and their head is back and you would push on the scapula, you're mobilizing the collarbone and the scapula posteriorly so that you're bringing the shoulder back. Now it is also helpful to stabilize a rib cage but you might not have a place to press. So you might just press down on the top of the ribs as you're mobilizing that shoulder backward. I find that's a really nice manual way to give that a stretch. I also remember the connection between thoracic spine curvature and pectoralis minor.

So I have had people that have a significantly kyphotic spine, just from lifelong large breasts or sitting in front of a computer. So you do the mobilization where you have a rolled up towel in between their shoulder blades and they lie down on that towel and they are gently extending the thoracic spine and wonders that that does to help with a pec minor. So you just gently have them actively, we're not doing spinal mobilizations here. That's a different venue but just actively extending the thoracic spine, taking the ribs and separating them. Let's look at it this way, you're separating the ribs and bending the ribs backwards to help get the pec minor stretched out. Okay, that's enough for the corner stretch. All right, the next one is exercises to manage the shoulder extension with your hands joined behind your back. This stretches all the structures of the anterior shoulder and gives you shoulder extension and is a good bilateral stretch for the subclavius. Remember, you could do the pinning and the arm extension, but really, practically, you have someone hold their hands behind their back, so I'm gonna click over to this bilateral shoulder extension and have you watch this Physiotec video of this exercise.

Now, I personally can't hold my hands together like that. I have to have a towel between my hands, I'm just not flexible enough, and so having a towel between my hands and getting that extension and then breathe in, you need that inspiration because, remember, the muscles of the subclavius, your scalenes, your pectoralis minor are all attached to your ribs. So get that back and do a breath in, okay. You don't wanna breathe up but you breathing in through your ribcage expanding that ribcage, really important for the best stretch. So let's move on to the next one. Okay, so we've got the bilateral adduction, shoulder extension, I like to hold the towel between the hands but you can, if they're flexible enough, you can do a hands together. Another one would be supine thoracic extension with shoulder flexion and abduction. So you can do this one with a pool noodle and lie down. We're gonna watch the video in a second, but lie down and then stretch your arms out to the side, so you get, I've described that before, you get that stretch to the anterior chest and arm. So let's go ahead and watch that video.

So you can use something as small as a pool noodle or you can use a rolled up towel, you don't need any fancy equipment. But just to lie down, this is not a huge mobilization so you kind of move side to side. Depends on how kyphotic the spine is, you can reach up overhead, that's a wonderful stretch. That really gets the pec minor stretched and thoracic extension, so she's rolling down to the bottom of the shoulder blades a little bit, and then mobilize a little bit more, and then go forward again. You can also abduct your arms, so straight out to the side. You want your patient to be comfortable. Some of these are more advanced and you have to, this lady's obviously super flexible, you're gonna work your way up to doing this so that you can improve extension. She's working farther down on the shoulder blades, mostly this is farther up on the shoulder blades. So the noodle isn't so far down the back. So it's a pretty mild stretch, very safe, you're not gonna hurt anything or sprain anything by trying to do this.

Okay, let's move on to the next one. Okay, so nerve glides, nerve glides without increased pain. So I won't spend too much time on this. Nerve glides is gonna take a little more time to go over. But essentially, want you to look up nerve glides because when you have a swollen brachial plexus or an irritated brachial plexus you're trying to improve it. You can start with holding your hands in and just doing your lateral side bend. So this is the arm as a problem, you just do your lateral bends away from the arm. Okay, you can move into your extension in front and out to the side for your neural glides. And that's a neural tension but you're gonna move through the glide of your nerve tensions. There's essentially three different levels of nerve glide. I teach people this one 'cause this is a good carpal tunnel one. So you're doing, your arms forward flexion, supination, wrist extension, and reach out in front of you. And then to get a little more pull on the median nerve trunk, you reach out to the side, and I can really feel that as it goes through my elbow. And ulnar nerve tension, so I'm gonna look at tension first. Ulnar nerve tension is pronation, elbow flexion, abduction of the shoulder, wrist extension. The way we remember this for the therapy exam is the Junior Birdmen, I guess, this is a Junior Birdmen position, see my glasses? Okay, so this is the ulnar nerve tension, lower trunk tension. And so in order to do a glide, you do part of that. So you can do elbow flexion and pronation without wrist. So you do part of that this way.

Okay, you're gonna do the other part, wrist extension without elbow flexion. And if you wanna do these non-painful five repetitions, go up to the point where they feel the tension and then back off. So if we get tension, tension, tension, then you don't have to move on to the next part, which is more tension. We already have symptoms of nerve, then we wanna back off. Okay, so we did this one, okay, then we did this one. And then the last one, I'm gonna lower my camera a little bit. The last one is for the radial nerve, which is, get a little higher, elbow extension, pronation, wrist flexion, elbow extension, and then shoulder extension. Okay, so you could do the first part of that and

only go as far as you can without aggravating the symptoms. So you begin to feel a little stretch, then you stop, you don't need to go quite as far. All right, let's see, where are we?

Next, so the sternocleidomastoid stretch, you can sit on your hand just to anchor everything down and turn away, stretch that part, look up to the ceiling. Stretch yourself, only go as far as you can to get a stretch without pain. Okay, so I've got some case studies here. So someone with an anomalous first thoracic rib, they will have a kind of a bluish arm, more sensitivity to pressure on their shoulder. So someone comes to you with a little more swelling, they've already been tested that they don't have a thrombosis, but comes and goes, it's a little bluish, they have large breasts, they're wearing the bra strap that presses down, and they've had some injury to the AC joint. So you have the history of the AC joint injury, which can aggravate or traumatize the muscle, the subclavicular muscle, and so doing some stretching, person who comes to has those complaints are doing some stretching of that subclavicular muscle. Remember, I'm pinning down the ribs, the origin of the subclavicular muscle and we're stretching out to the side this abduction to keep my collarbone from rising. I'm gonna stretch that, okay.

Then we're going to have the ergonomic considerations so let's make sure we don't carry heavy things on the side that hurts. We wanna make sure that we're doing some scalene stretches and the shoulder extension stretch so that when the pressure is off, then the clavicles are free to move up and down. We wanna make sure we have good scapular thoracic motion and the sleep position is really important with this, to have the arms up and so that they're not back too hard or pulling down too hard. So I think that with the first thoracic rib, those kind of ergonomic considerations make the biggest impact in pain level. And what I tell people, you have someone comes in with this first thoracic rib problem, I say that, "It's gonna take a while "for your arm to completely resolve "and you'll probably always be prone to this." So you have to be careful about

carrying too much work. You're also gonna wanna work on making sure that we have good ability to move the whole scapula, okay? You have forward pro, retract, protraction of the shoulder blades, so getting them to go around in a way, so we'll make sure we have a good stretch of the shoulder blades in that way, and that we're not trying to stand up too straight. That's the other thing that I see with this first rib is that you get people who are like, "Oh, I'm really trying to have good posture "and I really pull that back a little bit too much." You know, just relax that posture a little bit so that you're not putting so much pressure on that first rib between your clavicle and the first rib pinching on your subclavian artery and vein, okay. I put that in, yeah.

So I have a link for you. The article, I thought was very good from the Journal of Hand on this first rib. That was pretty diagnostic. Now this article was about resection. So how would they do surgery on a rib that was abnormal, and they take it out. So it's actually kind of interesting to see what could be done. But really, I find that in my first rib compression cases, there can be a lot of benefit from some education. And for them, understanding what mechanisms put pressure on the problem that they're having, so that it's not as much diaphragmatic breathing. We're working on the trapezius muscle and we're making sure that we have good scapular motion.

Okay, the next one. So, scalene compression on the brachial plexus, it goes to the neck from hypertrophy. I wanna teach people about not holding their breath and again, practicing that diaphragmatic breathing so they're not, while they do their leg squats or their lifting their weights. This way, we wanna make sure that we're breathing through it using the diaphragm, using the abdomen to breathe so we're not overly tensing the neck and making sure that we're not lifting up to breathe. So we see the numbness and tingling in the hand. So in the case study, there's numbness and tingling in the hand, and we're observing this person as like a weight lifter, weight trainer, but their symptoms are not specifically carpal tunnel, not specifically cubital tunnel, like my whole hand goes numb, like especially in my middle finger. Oh, the middle finger is

really painful. That is indicative of some problem that's more proximal like thoracic outlet syndrome, so you're gonna do your special tests. You're gonna do your Adson's test where we're testing for compression of the scalenes on the brachial plexus. If that replicates the problem that you're having, you're like, "Okay, this is what we need to do. "We need to stretch your scalenes, "we need to not do the breathing with the scalenes "and use a diaphragmatic breathing instead. "We wanna make sure that we're not putting too much pressure "on the way that we move our head and neck." Okay, and bed position, sleep position's also important. So the arms are supported, then they'll find that they have fewer of those symptoms.

Okay, so a case study, there's a guy that I was working with that just started working in the post office, and so he's a pretty young guy, but since he's young, and he's strong, they're having him move the bags of mail up over a barrier wall. So we've got picking up the bags and we've gotta hoist them up over the barrier wall. That's just the way it's always been done and you gotta do it that way, so he's going like this, picking it up. And instead of turning around, he's kind of going, let me see if you can see me, he's going backward like this to get it to go up over the barrier wall. And so he's developing numbness and tingling in his arm and it just gets so tired. He just can't seem to keep going after he's done this work for, 30 minutes, an hour, he just gets really tired, and that's not like him. He's really strong. So you analyze what activity you're doing when this happens. He's like, "Oh, it's when I'm working." So you see how he does it, he's hyperabducting in order to get that so you change ergonomically how he's doing it. Like do you have to throw it over this wall or could it be like put in a bin and wheeled around the corner? You wanna turn around and use both hands to set things up over the wall. So just problem solving why someone has this problem goes a long way to solving the problem.

So you've done the special tests and shown that it's thoracic outlet syndrome, and you're helping the person understand how they got there and then how it can go away.

Still need to look asleep position, still need to talk about diaphragmatic breathing, and avoiding carrying heavy things, pulling that arm down, and they can really resolve those issues and get better. And it's important to understand that thoracic outlet is a real problem. They might not be called thoracic outlet syndrome, but some of these pressure's understanding the pec minor, understanding the subclavian muscle, understanding the scalenes and where they attach and how they work can make a difference in how you approach someone who's having these symptoms in their arm. Okay, that's my references and questions. Okay, so we can go to the questions now.

- All righty.

- If we have time. Thank you so much for your attention.

- [Fawn] Sure, the first question we have is, can a small costoclavicular space come from breaking the clavicle?

- Do I need to repeat that question? I think, that if someone breaks their clav, okay, great, okay, if someone breaks their clavicle, certainly that could cause a small costoclavicular space. A lot of times, clavicles are not repaired, but instead they get a large callus on that and you could certainly have that. That would be important to know and to talk to the patient and the doctor about. Thank you for the question.

- [Fawn] Alrighty, when doing the corner stretch, how many reps and how long do you hold the stretch?

- That's a really good question, thank you for asking that. It really depends on how severe someone's symptoms are. If they have, they're very symptomatic, and you don't wanna aggravate it, okay? You say, "It's important that you do this stretch, "but we're gonna start with two to five seconds, "and we're only gonna do it three times,

"but I want you to do three times a day." And then once they are feeling better, and they can hold it longer without aggravating their symptoms, then you can hold it up to 10 seconds and you can do five to 10 repetitions, up to 10 repetitions with the deep breathing. So you're ramping it up, you're having them hold it longer, do more reps with the deep breathing. So I would say up to 10 reps three times a day.

- [Fawn] Okay, I think we're gonna wrap. I wanna be mindful of everyone's time. We do have some questions that came in that we are going to copy and I will get written answers out to those people. But I thank you so much for your time today, Marie. It was a great presentation.

- Thank you, I appreciate everybody's time listening to this. Hope they got something out of it.

- [Fawn] Hope everyone has a great rest of the day. You join us again on continued and occupationaltherapy.com. Thanks, everyone.