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Dystonia and Neuroplasticity: Evaluation and Treatment Recorded March 11, 2020

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PhysicalTherapy.com Course #3654

- [Calista] Our course title is Dystonia and Neuroplasticity: Evaluation and Treatment. It is my pleasure to welcome to PhysicalTherapy.com, Dr. Julie Hershberg. Dr. Hershberg is a neurologic physical therapist with a passion for movement disorders. She founded Re+Active Physical Therapy and Wellness, a neurologic physical therapy and wellness studio, with two locations in southern California. She developed the first neurologic-based physical therapy fellowship, the Schmidt Movement Disorders Fellowship, now in its fourth year. And she has presented courses and published articles on neurologic physical therapy, including topics of stroke, neurologic assessment, differential diagnosis, dystonia, and movement disorders. In addition, Dr. Hershberg is a clinical faculty at the University of Southern California, the Division of Biokinesiology and Physical Therapy, with the main roles of directing the neuropathology for the last seven years, and teaching and mentoring in clinical neuroanatomy and neurologic screening. So at this time, I'm gonna turn the microphone over to you, Dr. Hershberg, and thank you so much for being part of our virtual conference week.

- [Dr. Hershberg] Thank you so much for having me, and thank you to Mike Suter for putting together our group, we actually have worked together quite well on a lot of these topics that have this overlying theme of neuroplasticity potentially gone awry, and that's something that I think of with dystonia. So I'm really excited to share this with you today. I'm very interactive, it's a little odd for me to not have a video here, because I use my hands a ton, and so I'll try to describe what I'm talking about in a little more detail without having that video. But I also would love the interaction, so please ask questions as we go, and I will get to them as we go as well. So thanks again, and I do want to give a shout-out to the team that I have at Re+Active, and in particular, Ali Elder, who's been a colleague of mine for awhile, she and I have put together a lot of what you see here on dystonia, and we've done many courses together with it, so I just have to really thank her for this input. So, let's dive in here,

what are we going to do today? So, after this course, I hope that you feel very comfortable with dystonia, that you can identify some of the common features of dystonia, identify at least two of the clinical assessment tools for the sensory problem in dystonia, and we're gonna dive into some detail there. And identify the steps for a treatment approach that's very neuroplasticity-driven, and this is where I'll get really excited about the opportunities for us, to help people recover with dystonia. And then, outline at least one learning-based sensorimotor retraining strategy for a patient case. So we are gonna all go through a patient case together, and then have a more open-ended case to apply these principles to, so that you can take that right into your practice, and really help people with dystonia improve their quality of life.

And here is exactly how we'll do it over the next couple of hours, we have this introduction to dystonia, talk about the diagnosis and review the pathophysiology, the stuff that's happening in the brain with this diagnosis, review some of the key assessments, and then take this neuroplasticity approach through learning-based sensorimotor training. And we're gonna talk about these three steps of preparing the brain, retraining the brain, and treating some of the underlying factors. And we'll end with applying this to cases in a very interactive way. So let's start with the big broad umbrella of what is dystonia?

And dystonia falls under the realm of neurology, it falls under the realm of movement disorder neurology, so if somebody is unknown with a diagnosis, they should be seeing a movement disorder specialist, as a neurologist. And the definition is that it is a sustained or intermittent muscle contractions, causing abnormal, often repetitive movements or postures. And I put this lovely diagram from the Dystonia Foundation, great organization by the way, that outlines some of the most common types of dystonia, and I just wanna hit on a few of these, because some of them are much less known. So there's spasmodic dysphonia, or laryngeal dystonia, and this is affecting the muscles of the vocal cords, making it difficult to speak, or changing the voice quality. I

actually worked with a woman yesterday with this, and this is a really nice co-treat with speech therapy. Oromandibular dystonia is a dystonia that's affecting the face, jaw, tongue, it might cause abnormal facial movements, like grimacing. It might cause tongue protrusion, difficulty opening or closing or coordinating the jaw, and that can also affect speech, but most definitely chewing can be a big problem for people as well. Each of these types of dystonias, by the way, will have different techniques and ways that we might incorporate this learning-based sensorimotor training. We're gonna apply it to two cases today, of focal dystonia and cervical dystonia, but those techniques really can apply to all of these types. Let's talk going down a little further, limb dystonia, so this may affect the hand, the arm, the foot, the leg, we're going to talk about a few cases today, musician's dystonia, writer's dystonia, a drummer where it was in his foot.

And what you can see is abnormal muscle activation, so the toes are curling, the muscles begin to cramp, things like that. Over on the right side of the body, some other types of dystonia, blepharospasm, so this affects the eyelids, causing them to blink uncontrollably, or even remain closed, which you can imagine, is quite concerning and can cause a lot of disability. Cervical dystonia, a very common type of dystonia, also can be called spasmodic torticollis, this affects the neck and the shoulder muscles, where you might get a turning, an involuntary turning of the head to one side. It can also present as a tremor, if you get on and off of those muscles.

And then finally, a generalized dystonia, so there are some dystonias that might affect the whole body or half of the body, some of those are genetic syndromes, we're not gonna go into every type of dystonia today and the causes, but this is why a movement disorder specialist neurologist is so important to the management of dystonia, to get down to some of those underlying causes. So, as a brief background, as I mentioned, it can be inherited. It can be acquired through something like a brain injury, or stroke, even MS. Or it can be idiopathic, and the two cases that I'll present

today are the idiopathic cases. It is a clinical diagnosis, so there's not a blood test, unless you have a genetic version, there's not a blood test or an MRI finding, and it includes a whole clinical syndrome workup that a neurologist, a movement disorder specialist, is typically doing. And again, I'll sound like a broken record with the movement disorder specialist, but it's so important because when it comes to the medical management, there's a lot of fine-tuning that can take place as far as treatment with botulinum toxin, for example. This is an art, and I've really seen it gone bad, with somebody who's not experienced in treating dystonia, so this is why I highly recommend people to see somebody who does this regularly for dystonia. Some medications that can help include a Parkinsonian-type medication, like levodopa, or Sinemet, and there are types of dystonia that are dopamine-responsive types. So the physician will typically try a few medications, many many are not responsive to medication. In the most severe cases, deep brain stimulation might be an option, I've seen that helpful for several people with severe dystonia.

And that again, is a really important decision to make, excuse me, with a movement disorder specialist. And then some of the new and upcoming treatments include things like TMS, so trans-magnetic stimulation, this is not something that's done regularly, it's done in research at the moment, but I think this'll be an area that is really going to be on the forefront of treating dystonia because it directly addresses some of the pathophysiology, which is about the connections in the brain. Which is the next piece that we're talking about here.

So, in very general terms, what we know about dystonia, is that there seems to be a loss of inhibition at all levels in the central nervous system, meaning, in the cortex, basal ganglia, even in the cerebellum, so a lot of areas involved in this functional connectivity. And there's just a little more excitement happening, so there's a loss of inhibition, and this can lead to impaired sensorimotor integration. And the nice thing about this, is that this is where we actually come into treatment, is improving this

integration, whether that's temporal, spatial, or just overall organization. And why dystonia is part of this series here, is because it appears to be this maladaptive neuroplasticity so the connections are overly adapted. So I have this picture here in the slide, because it symbolizes one of the pieces that I think about, and I talk about with people that I see with dystonia, and it's this smudging. So if you can see in this image here, it's kind of a little fuzzy on one side, if you think of the homunculus in the brain, the sensory map and how we have distinct areas very clearly, every digit, every joint, distinctly mapped from a sensorimotor standpoint, with this maladaptive neuroplasticity, we get a smudging.

So instead of five distinct fingers, you get kind of a smudged hand, and you can imagine then, if you're going to right, and your sensory cortex is smudged like that, the incoming information is not accurately processed, and many muscles contract instead of fine-tuned, one muscle at a time. So I find that image very helpful, when we are talking about this with people with dystonia, because then that leads directly into what we test, so why we test the sensory discrimination, and what we treat, so why we treat it from a sensory standpoint as well. And this is another really nice analogy that I use in education. So this idea that dystonia is a software problem, versus a hardware problem, and I find this very helpful for us as therapists as well, because I think we're used to hardware problems.

So I know, I teach neuropathology at USC, and we talk a lot about hardware, like you have a stroke in the motor cortex, and you have a lesion there, and it's a clear lesion, and it shows up on an MRI. And that is not the case in dystonia. So, there's not a clear lesion in one area, but it's more about that motor cortex talking to the sensory cortex, talking to the basal ganglia, so it's a software, it's the connection piece that is the problem. And I think from a physical therapy standpoint, another way to think about this, is we tend to think in terms of hardware, also as like muscles, ligaments, joints, and how those impact movement. And the software problem here is actually very

important, because if we only address muscle length, we actually never get to the underlying cause of the person's movement pattern and that software problem. So we're gonna talk about this a lot. Sometimes those hardware problems, actually can predispose people to a software problem, and we wanna address those, and we'll talk about a case where we address those with runner's dystonia. But very important to think about the software problem, that's where neuroplasticity comes into play, and that's where it gets exciting. So I created this diagram based on a lot of the work by Nancy Byl. So Nancy Byl has been one of my mentors, she's a leader in the field of dystonia, has published a lot of the research in this area, especially in focal dystonia. And I love how she describes what's happening in the pathophysiology. So, what we see in the people that present to us with dystonia, we see these involuntary muscle contractions.

So that's down in the bottom, in the red circle. And what we understand and what we look for then, are what are some changes in the sensory input? So, are there some abnormal sensory inputs, like, we'll talk about this, like vestibular inputs, or some somatosensory problems. And are there some abnormalities in the motor outputs? So again, thinking about, what is coming out muscle-wise, muscle contraction-wise. And you'll see these two-way arrows, because they influence each other, right? So those muscle contractions actually influence the sensory and motor, and vice versa.

And if we think about the biggest influences on the brain in dystonia, we know visual input is a big one, sensory input, so somato-sensation, vestibular inputs, and then the coordination of those things, between the cortex, cerebellum, basal ganglia, amygdala, and hippocampus, are some of the biggest influences there. So those are influencing and are being processed, software-wise in the brain, and then what we see, is an involuntary muscle contraction. So we need to work our way backwards to understand the input/output problem. So that's the point of this figure. OK, so I have another poll here for you, and hopefully that poll doesn't change my microphone, it looks like it's

working. So I would love to know, going into that sensory talk, how comfortable are you, and how much do you use, testing of higher order sensation? So like, graphesthesia, stereognosis, even using things like the Recognise app, how comfortable are you with that? And I can see here, various levels of comfort with graphesthesia, stereognosis, maybe there's a group of you that are like, I was even, I remember learning that in school, but I haven't really used it since then, that might be the group of you down in the ones here, and most of us are down in that lower level, and I think that's really normal, we don't use this very much. So, thank you so much for being honest, this is why you're here today, and there are a group of you too that do use this, so great for you. And I'm gonna go ahead and end the poll here, and I can actually broadcast, just so you can see where everybody is.

So, quite a range, but a lot of us hanging out in the bottom and that is totally where I was and I teach this stuff. So excellent, so we'll go ahead and close that poll, pull open our slide here. And I'm so glad you were honest with that because what we're gonna talk about is a lot of sensory, and that is because there are some clear sensory deficits, a lot of those higher order deficits in the dystonias. So I've broken this up into cervical and focal dystonia, these are the biggest areas researched in dystonia. What we see in cervical dystonia, are potential vestibular deficits, proprioceptive deficits, sensory perception deficits, and sensory organization deficits.

And there's even more things that I've seen clinically, this is what's coming out in the literature. So in particular, with cervical dystonia, and we're gonna talk about this, head repositioning accuracy or the joint position error, is a known deficit in cervical dystonia, I test it on everybody now. Sensory perception, so there have been a couple of small, small studies looking at subjective visual vertical, which is the bucket test, if you remember that, and the potential for a subclass of people with cervical dystonia, having an impairment in that. And then definitely sensory organization, doing that modified CTSIB-type testing. In focal dystonia, we also see proprioceptive or

kinesthetic problems, I prefer, if there's a unilateral focal dystonia, I prefer to use kinesthesia, so a matching of the limb position sense, in a person with focal dystonia, I find that more accurate than a pure proprioception test. But there's also been findings that vibration is impaired, so carry around your tuning fork for sure. Sensory integration, so stereognosis, graphesthesia, two-point discrimination, as well as the sensory organization. So I find that sensation in these sensory deficits, and exploring them are probably one of the biggest areas that people miss in assessing dystonia, and what I also find is that, it's a huge area where we can help our patients make progress. So, we're gonna hit on this sensory piece, but I wanna put it in the context of the whole evaluation. So we're not gonna go step-by-step of every subjective exam and every piece of the eval, but I wanna hit on some big ones that we'll be using in the cases today.

And we'll talk about key subjective exam questions, we'll talk about the movement analysis, we'll investigate the muscle activity, and we will talk about sensory testing, and getting to those predisposing factors. Now, I know that as PTs, we are really good at predisposing factors part, so I'm not gonna spend a lot of time on that, but that would be things like range and motion, muscle strength, neurodynamics, et cetera. So let's dive into the evaluation.

So aside from your normal subjective exam, it is really important to get to the heart of the treatment that they have had, and if they've had botulinum toxin, so BoNT, that's the abbreviation for it, if they've had Botox, or Xeomin, those are two of the biggest ones, we want to understand where they are in the cycle. So typically, the onset of the effect, is within the first week of injections, not typically right away, but within that first week, but the peak effect, and this is really where I see people most having an effect, is in that three to four week mark. So I actually like them to come in for an appointment at that time, so that we can look at what it looks like peak effect, and communicate that with the neurologist. Botox does typically wear off around 12 weeks, and so sometimes

we can see a wearing off effect. So asking questions about where they are in that cycle is very important so you can plan, and actually plan your neuroplastic intervention for that peak time, that is typically what has been most effective. Some other key questions subjectively, that you're probably asking everybody anyway, but maybe a little different take on it, I would say for dystonia. So the variability in the daily routine, this is a key one, there are actually evidence-based predictors of dystonia, and one of those includes a type A personality, very regimented, very predictable daily routine. And I like to ask about this for a person, especially when they have a focal task-specific dystonia, is how variable are they?

So for example, a runner runs the same exact pace in the same exact route, listening to the same exact music, and the same shoes, that's not very variable, very variable, that's not quite variable, and that tends to lead to a higher likelihood of a task-specific dystonia. So I ask about that, and I ask about their whole entire day, and how it relates and how variable it is, and then we incorporate that into intervention. I don't ask everybody about adverse childhood events, or trauma, but when they bring that up, and especially if that's related to the onset of the dystonia, that leads us down another pathway of conversations, what kinds of support have they gotten for that?

I'm certainly not a psychologist, so that doesn't become my role, but that certainly becomes a role in our overall management and referrals. Life stressors, most people with neurologic disorders, their symptoms worsen with stress, the case is very very true for dystonia, so talking about that, talking through that, we've had people where their dystonia got much worse because they lost their dog, or during tax season and they're an accountant, and so then we can actually plan treatment, plan for changes in their symptoms during those times, and helping them manage that. When there is also pain involved, and sometimes not even with pain, but if there are high threats or danger signals that contribute to the movement or pain, that's really helpful to explore. So I love the work by the NOI group, and the Protectometer, and using that for dystonia as

well. I think actually that's much more known in the pain world, but I use it for dystonia. And then asking those key questions about lifestyle, health, and fitness, most of the evidence and treatment for dystonia includes a huge lifestyle, fitness, nutrition component, so understanding the baseline of that, and that includes sleep, a big big factor of sleep, and you've probably have heard this in all of the neuroplasticity talks. Actually sleep deprivation has even been correlated with an onset of dystonia, so that's how important it is to the brain. And when there are multiple problems identified in these areas, I find a much higher success, and this has been shown in the literature as well, much higher success with an interdisciplinary team. I can't reinforce that enough. OK, so we go through subjective, get some of those key pieces that are specific to dystonia, and really, we're doing movement analysis, I know you all are PTs so you're doing this from the get-go, but let me tell you about a few key ingredients with dystonia.

So of course you're gonna analyze the task, and I put a golfer here because a lot of people have heard of something like golfer's yips, and golfer's yips may actually be in some cases, a focal dystonia, and a task-specific dystonia. So one thing to analyze that task, and then to throw it into different environments and contexts, so here's where that neuroplasticity comes into your evaluation. So can you change the sensory input and motor output by changing the surface or the object?

So if we're gonna stick with this golfing analogy, we change the club, the weight of the club, we build up the club with some Theraputty, we attach different things to the club. Instead of being on the grass, we swing the club on the concrete, we wear different shoes, being upright with the club is really problematic, we'll throw you supine, throw you prone, throw you inverted, so putting you in many different environments or postures. We might just do part of the task, and part of the task might even just be thinking about golfing. So if we just think about golfing, do you start to have abnormal activation in your hand muscles, for example? So that might be where we start it. I

worked with a woman yesterday with a writer's dystonia, and just thinking about it, she had activation in her finger extensors, so that's where we had to start, is how can she just think about writing without that muscle activation? And this is what we're gonna hack out all morning, is how do we do things like that? So part and whole task, thinking about the task, changing the speed, this is a big one with the focal dystonias, runner's dystonia, writer's dystonia, changing the speed changes the sensory inputs and motor outputs, so can you change the speed of the task? Changing postures, so some of the most popular and helpful postures for cervical dystonia, for example, is putting the head down between the legs, many many people will completely be in neutral in that position and won't have dystonia, and that's a great place to start treatment then.

But, I'm not opposed to having people be completely inverted on a chair and things like that. So taking people through different postures. And with different visual inputs, so eyes open, eyes closed, eyes fixated, all of those can change the task. So this is different than how we might typically analyze a movement and task, because we are looking to change the sensory input, so that we can change the motor output. And one really nice way to do this is through using surface EMG. So if you have access to this, and I've seen many many companies coming up with much less expensive versions of surface EMG, I think it's much more accessible these days, then you can go through those different postures, and tasks, and positions, and environments, and actually look at the activity.

So I have a video here that we'll play, I just wanted to show you an example of what we do. And in this video, it's really short clip, is you can see the glut activity in this person, very regular with their activity, and I'm just gonna role that again, this is while they're walking, and you can actually see that, I'm gonna play that again here, you see little screen captures at the bottom, and so she actually had some dystonia with walking, and what we were looking at was, what is her normal activation, and can we change it

in her glutes, to decrease some of the hamstring overactivity? So this is just one example of this, this is actually a very inexpensive version of a surface EMG, and I've seen a lot out there on the market these days, so I don't promote one over another, but it's a very helpful tool in dystonia. OK, we can go back to the slides here. One thing I love about using surface EMG is when I am then working with a physician, I can say exactly what I've found, and make recommendations for Botox targets. And most neurologists find that very helpful because they are usually only looking quite statically, or in maybe one task, and we'll take them through many more tasks and be able to communicate it. OK, so we talked about the subjective, the movement analysis, looking at that muscle activity, let's talk about sensation. I could spend all day here, but we won't, I just really enjoy the sensory system.

So in general, what we're looking at, are the general or special sensations, so this is your like standard neuro exam, doing a vestibular screen, particularly for peripheral vestibular disorders, testing for vibration, and testing for response of the muscle to vibration, which is a little bit of a different test. The proprioception and kinesthesia, two point discrimination, discrimination, excuse me, and localization.

And then there's the higher order sensory testing, so I talked about the bucket test, the subjective visual vertical, joint position error, we're gonna look at here, laterality, testing that stereognosis and graphesthesia, using the CTSIB, and then also looking at the postural righting responses, which is something that perhaps you look at more often when you are working with kids, working with some babies to see if they have these intact, but we start looking at these much more, especially with cervical dystonia, because you can imagine that if you're postural righting is delayed, if it is not complete, that may actually be sending some of the wrong signals to the brain and causing a head tilt, for example. So this is something that we look at. So let's start with joint position error, and when would this be appropriate? 'Cause this is not for everybody, and this is the disclaimer by the way, with the sensory testing is, you couldn't possibly

do all of that in one evaluation. So I usually, by watching them move, and talking to them, start to get a sense that that sensory system is impaired, and we'll pick a couple of these. So cervical dystonia, joint position error testing, with the head laser lamp is my go-to, and I do try to do this with most people. And so the patient may say even things like, I don't even feel, I don't know where my head is in space, for example, and then you'll observe, and they look like they have poor head control, and that they don't have proprioception, and this can be in theory, specific quadrants, so I really encourage you to look at this, both in the horizontal plane and the vertical and diagonals. And the goal here is to be able to tell if that person can find a neutral head position, and it's really going to also give you some really nice sense of the smoothness of their head and neck movements. I always videotape these assessments, they're really nice pre and post.

And it's simple, you have a head laser lamp, you have a target, the target actually has different degrees on it, so that you can rate their performance, and the change in their performance. OK, so that's the joint position error testing, and once again, if you have questions on any of this, please put those in the Q&A, I'm happy to respond to questions as we go, versus doing them at the end, so for example, questions on the joint position error testing, questions here on two point discrimination, please put those in the Chat, I'm happy to respond to those as we go.

So, two point discrimination. I took a little picture because we just bought a new one of these for the clinic, I love these little digital calipers, because they give you a reading of the distance between the two points, and they're really inexpensive on Amazon. I'm not endorsing a particular brand, this just happens to be the one that we have. But this test is very good for the focal dystonia, and especially for people who are having trouble with fine control of the limb. And what we know in dystonia, is that people tend to have abnormal spatial discrimination thresholds. So what I recommend, is using those charts, they're usually in textbooks and the literature, of what is normal in the hand, the

foot, the low back is a big area that's been investigated, what are normal thresholds, and compare those to your patient. And I find that two point discrimination is often impaired, and this is something that we can then really work on, through sensory training. OK, and then sensory perception. So this testing is also very good for focal and cervical dystonia. The laterality mental rotation, I love the use of the Recognise app, and again, I have no affiliation with any of these things. I think if you are in the pain science world, you have used this, but essentially, what it takes you through is testing and training of looking at pictures, and recognizing whether it's left and right. It does it with limbs, it does it with the neck and back, which is really helpful, and it has been found to be impaired in dystonia.

I often find that it's impaired, and this is very trainable in a similar way to how you may apply graded motor imagery, graded exposure in somebody with persistent pain, and we'll talk about that a little bit. But I like to take, I don't just like to test to test, I'm testing these things because they go directly into treatment. And then finally, good old stereognosis and graphesthesia, has been shown to be impaired, especially in focal dystonia, hand dystonia, and if you recall, that's either writing on the hands, or placing objects in the hands, and this goes into direct treatment as well.

Fun treatment too. OK, so that took us through the sensory testing, once again, let me know if you have any questions on the sensory testing. I think predisposing factors, you're gonna be really clear on. So looking for things that may have contributed to an abnormal movement pattern that just stuck where that neuroplasticity went awry. So is there weakness or imbalance? Is there poor body awareness? Is there a flexibility, muscle and joint flexibility problem? Nerve tension, neurodynamics is a big one. So I have found some abnormalities almost in every patient that I have worked with, with focal dystonia, and this is clinical here, I have not found this in the literature, and it's hard to know chicken or egg for a lot of these, did the dystonia cause this, or did this cause the dystonia? But I have found treating it can actually really help contribute to

progression of your treatment program in a person with dystonia. Looking at breathing pattern, so this is especially true in cervical dystonia, if there's a lot of scaling, and a large neck muscle activity for breathing, that might be a contributing factor. And then personal factors, so I have mentioned these before, this is not just anecdotal, this is in the literature, high achiever, perfectionists, maybe impatient and compulsive. Sometimes I think of these things in myself, I definitely can lean towards the perfectionistic side of things and have to work on that really hard. But this is a definite factor in the development, especially of the focal dystonias, and something that may need to be addressed as well. OK, we're gonna come to another poll, 'cause we just got through the evaluation component. And now I would like you to rate yourself on your comfort level in treating dystonia.

And if you're so inclined to put in the Q&A as well, I would love to hear what kinds of dystonia have you seen, cervical dystonia, runner's dystonia, writer's cramps, focal, any kind of focal dystonia, dystonia in Parkinson's maybe, I would love to hear if you'd put that in the Q&A, in the notes, what kinds of dystonia you have seen and treated, that would be really helpful. As we go through, we can talk about those types of cases, as we go through the webinar.

OK, and I've seen cervical dystonia and upper extremity dystonia, great, we're gonna talk about both of those today. Cervical dystonia in Parkinson's, yep, so we're not focusing on Parkinson's today specifically, but a lot of these pieces apply to Parkinson's, so I'm glad you mentioned that. Ah, the dyskinetic cerebral palsy, yes, me too, and dystonia can be a big part of that, and some of these pieces, especially the sensory pieces can be applied to cerebral palsy. So if you have a kiddo with more of that athetoid, dystonic, dyskinetic movement, the dystonia can respond to some of these sensory pieces. Thank you so much for sharing that, because we'll talk about all of those pieces. And it looks like the comfort level of treating with dystonia is in the lower end, which is great, I'm glad you're here today. I hope that by the time we're

done talking through these treatments, and applying them to cases, you'll rate yourself a little more comfortable, and feel really confident working with the next patient that you see. So, let's go back to the slides now and move into treatment. This is where the fun really really hits. OK, so let's talk first about this overall treatment plan, and program, because we are just one piece of the pie, and my experience, the literature shows too, that an interdisciplinary group is going to lend itself to the best success. We work a lot, at Re+Active, with OT, because we have an OT here who specializes in lifestyle intervention. So sleep, anxiety, stress, all of those pieces that are highly contributing to the overall dystonia.

The MD, as I mentioned, is a huge piece of our pie. Having an overall fitness plan, and aerobic activity is important, so I will work with our personal trainers here at Re+Active, sometimes we'll set people up in an intensive program, so that they're addressing all of these pieces at once, the diet and sleep, practicing mindfulness. Now this can backfire on people with an over-attention to their body, so this is a very special practice of mindfulness, I would say, I don't just tell people to pick up an app and do it, there's some education involved with that.

Psychology for appropriate cases as well. So if you can amass that team, and find the right referrals for a person, you're gonna have a lot more success. OK, this slide has a ton on it, and I didn't want to go droning on, on all of the evidence, especially because there are many studies, but they are small studies. So we don't have huge randomized controlled trials in dystonia, it's a more rare disorder, and most of these studies are smaller, the evidence of level is lower, some of them are case studies. But, with that being said, we do have some evidence, we do have some evidence in particular, in the physical therapy world, that certain things that we do can be helpful. So, we're gonna speak about how these apply, as we go through our framework here, but sensory tricks, use of surface EMG, especially as a biofeedback method. Use of muscle vibration, so I know in clinic, in some of these tests, they use special electronic

vibrating devices and things like that, we might use TENS, we might use some of those vibrating balls, that's one of my favorite little tools, those vibration balls. People have even used the vibration function on their phone as vibration. Sensory stimulation in TENS, this is something I try with almost every patient to see if that's a good response for them, because it's really easy to use with multiple tasks. Using some training with body awareness and perception. The learning-based sensorimotor training, and that's what we're gonna spend our heart of our time on today. Practicing sensory discrimination, so if you've worked in the sensory field, or in hand therapy, or even, I've seen this in the foot, using a lot of those buckets of rice, and different objects, and things like that, that's some of the sensory discrimination training that we'll talk about. Proprioceptive with the vibration training, mirror training, and we're gonna watch some videos of this today.

And mental training, some mental practice. So all of these have been shown in the literature to have a small but potentially mighty affect in dystonia. I would add to that with what we have found in our clinic, so this is from our clinical expertise, training the joint position error, and I think you could throw this is in that bucket of proprioceptive training, right? Training JPE, using sensory stimulation, using the surface EMG, as I showed you in that video, changing the posture and the alignment, and the righting reactions, so body and head, and trunk, eyes, and head, for example.

Applying the OPTIMAL theory, and we'll talk about that as well, that's probably one of my biggest pieces of treatment intervention and what you've been hearing, I think, all week with this series of webinars of neuroplasticity, because that's really a big driver of neuroplasticity. And then changing those positions and environment with your task-specific training. So, let's dive into this learning-based sensorimotor retraining. So the terminology of this, this LBSMT, is usually what it's called, this was published by Byl, Archer, and McKenzie, three amazing physical therapists in this field, and we have kind of put our spin on that, is what I would say. So they have published this in 2008,

with a study in focal hand dystonia, and we broke it really into these three main topics that lead to retraining the sensorimotor system. So we're gonna talk about each of these separately, the setup, which is preparing the brain, the work, which is the training the brain, and then getting to and treating those underlying factors. And it's not that it goes in an order here, like one, two, three, these are likely happening at the same time. So let's talk about each of them, individually, as we prepare here. So the setup, the preparing the brain, this includes some of those pieces of the OPTIMAL theory that I'm gonna hit on in a moment, but that includes enhanced expectancies, or expectations of improvements, that the person has some control and autonomy, you can really imagine, especially after having dystonia for a long time, that you feel very much not in control, of your body, and so ways we can provide autonomy are very important. Quieting the nervous system in general, and I've learned a lot about this from working with our yoga therapists, and with psychologists, and there's evidence here as well. And then imagining experiencing normal movements with joy.

So in the first one here, we see expectations. So one of the first pieces that is so important in driving neuroplasticity is that there's actually an expectation of improvement. Many people have been to therapy before, they have had this for a long time, they've been to many doctors, and acupuncture, and so on, and actually they're coming in with very low expectations. And that is the first piece that we'll need to change, and that's usually through providing them education about neuroplastic training, as well as providing examples, videos, case scenarios of other people that have had improvements. Quieting the nervous system, and a couple of things that I love for this, and we're gonna talk about more in the next slide, but quieting the nervous system, something as simple as bouncing on a ball. Bouncing rhythmic activity really quiets the nervous system, I know I find this personally, when I hop on the trampoline with my kids, we get excited, but it actually is very calming too. So bouncing on a ball, rocking in a hammock, now I know not everybody has a hammock in the clinic, I've actually brought a portable one in for some people, but that's also

very calming and quieting. And the last people actually in the slides, these are actually my kids when they were younger, but imagining and experiencing normal movements or positions with joy, this primes the nervous system for changes. So grabbing pictures of, this is my younger daughter running through a museum, and the joy in that run, so pictures, videos that somebody might be able to have from their past would help with that mental imagery. The second I have here is somebody looking out a window with joy, and somebody with cervical dystonia, has typically lost that joy of looking out a window. So those are just a couple of examples of this. Now, in this next here, I actually would love another poll here. And we'll pull that up, because before I got into this field I had not done this at all.

So have you done quieting the nervous system, or grounding activities with a patient before? And I, oops, somebody put something in the chat, and it just disappeared, if you don't mind putting that in again, I would love that. I think accidentally deleted it. OK, no, you're just saying hello. Thank you Thank you for coming there. OK, so this is really nice. Let me actually show you the results here. You'll see that over half of you have done this in a session and I think this is becoming more and more, as just the world in general is getting more attuned to our nervous systems, to mindfulness. I'm gonna go ahead and end that poll, but there is a group of us that haven't, and honestly, I hadn't either until I was really more deep this world, and had yoga therapists as part of our practice, started getting interested in mindfulness-based stress reduction and attending that in training in that myself.

But we know now there's a lot of literature. So that's why I put this in here, is because not everybody is aware, but this can have a big impact on people with dystonia. So some different techniques that can help with toning the parasympathetic nervous system, so we think of the sympathetic is fight or flight, the parasympathetic helps to calm that fight or flight, one of those is an extended exhale, and this can be very tricky to teach, because at first, you need to start with a non-judgmental attention to the

breath. So that means just sitting, and I'll ask you to do this while I'm here, just sitting, and just paying attention to how you're breathing, and not judging it, which is hard when you're a therapist, 'cause you're probably already started going, oh, I'm breathing too much in my upper chest, don't judge it, just notice it. So take a moment and don't judge, notice how you're breathing, and this is how this practice starts. So paying attention to it, and then one way that we can activate more of the parasympathetic system, is to extend the exhale. So after you've paid attention to it, now you can breathe in, and what I like to do, is breathe in for two and exhale for four, or breathe in for three, exhale for six, it depends on your comfort level, but I'd love for you to try that. So inhaling for two seconds, so you inhale for two, one, two, exhale for four, one, two, three, four.

And if you're doing this with a patient, what is really nice, I'm often videotaping this, is if they have cervical dystonia for example, you will see that if their system responds to this well, their cervical dystonia will greatly decrease with the extended exhale. And this would be a place to start practice then. Similarly, with some of the grounding exercises, so I love a grounding exercise of climbing inside the body, feeling your feet grounded to the floor, or your sit bones grounded to the chair, those are a couple of other ideas that have been helpful.

And then using breath with the movement, this is why I love yoga for people with dystonia, but an awareness of feeling and breath with their movement. Now this is quite individualized, I actually had a gentleman who I was seeing for cervical dystonia and oromandibular dystonia, he was visiting from India, and he practiced deep breathing daily, and you know what? It increased his dystonia, so we actually had to change his position of breathing, but also have him actually not practice that kind of deep breathing, he was a beautiful breather, but it contributed to his dystonia, so we needed to change that up. So not everybody responds in the same way to these practices. And then let's dive into the OPTIMAL theory here a little bit, and if you're not

familiar with the theory, I highly recommend this paper by Wulf of and Lewthwaite of 2016, I'm not gonna go into tremendous detail about the entire paper, but this theory includes these three main pieces that drive motor learning. So enhanced expectancies, autonomy, and an external focus of attention. We will be discussing these in detail with our cases, and brainstorming ways that we can provide these to people to drive motor learning. This I have found especially helpful in dystonia and driving neuroplasticity. So we'll talk about those in this work of training the brain. So, we have primed the nervous system, and again, often this is happening at the same time, prime the nervous system, and now we want to actually start laying down those new pathways. So if you imagine that neuroplasticity went awry, now we want to make those connections more salient, and more accurate.

We wanna decrease the amount of abnormal movements, retrain the normal movements, we're gonna often move from a non-target task to a target task, so we're not gonna dive right into do a difficult musical piece, for example. We're gonna improve sensorimotor discrimination, and we're gonna do a lot of this with an external focus of attention. So let's start with, how do we inhibit abnormal movements? So, this could be really tricky, if you have laryngeal dystonia, and you talk all of the time, right? So in that case, we may have to find positions where you can talk with less of the dystonia.

But for some people, we ask them to stop practicing, so stop practicing your musical instrument, practice a different task or practice with a different musical instrument, practice in a different environment or position. Use sensory tricks so that you don't have that abnormal movement with the task at hand. And it is a lot of practice in these other positions and tasks to drive home that neuroplasticity. Then we're gonna retrain these normal patterns. So we're gonna try to re-differentiate the motor patterns, so thinking of a musician who is having a full hand spasm, or cramp while playing, we wanna help isolate and provide discrete movements and training in those. Improve their sensory input with the movement, and then have an incremental challenge, with

positive reinforcements, and this is where that OPTIMAL theory comes into play. So we talked a little bit about enhanced expectancies, when we were priming because we want that expectation of change, providing videos, anecdotes of other people who have had improvements, primes the brain, releases dopamine to start making some of those changes. So that was the enhanced expectancy part, where we'll actually be setting up the brain to retrain the normal movements. Providing autonomy and the external focus of attention, helps to couple the action with the goal, so let me give you an example of that.

So I was working with a woman yesterday who has had a 10-year history of cervical dystonia, and very difficult for her to turn her head to the left. However, when we were training, we were training with some rhythmic rocking movements, when we provided her some external focus in her hands, we actually used Boomwhackers, they're these little sticks that you whack together and they make different musical notes, when she could focus on that and turn and twist her head, and at the same time whacking and looking at these objects, I know this is a lot of going on here, we were doing it to music too, it was just incredibly fun, she could have full normal movement in both directions. So that was an external focus of attention, I wasn't telling her, move your head left, I was just saying look at the Boomwhackers, right?

And that allowed her to have more automatic movement and improved motor learning. So that's an example of an external focus of attention. The sensory tricks, so let's talk about sensory tricks, I'm sure you have seen these in cervical dystonia, I have a couple of pictures of common ones, the arm over head, the hand on the chin, they just change the sensory input into the head for cervical dystonia. So other things that have been found helpful, and I encourage you to do these in your evaluations, use these in treatments, inversions, elevating the arms, chewing on a toothpick, touching somewhere on the face, touching somewhere on the ears, bending down grounding hands between the legs when sitting or standing, touching the chin, these are all really

helpful sensory tricks. Some example of sensory tricks, which are really sensory training, in a focal dystonia, I'm gonna go through these pictures here. So, I'm gonna start with this guy here at the guitar, so this is somebody who had a musician's dystonia, and it's kind of hard to tell, but you can see his left leg is elevated. When we changed his base of support, his hand spasms went away, so that was one example. Just to the right of him here, so this woman here, this was a woman who did fine, fine paintings, and so in prone and with a build up of her paintbrush, she was able to regain control, and we would then progress from there, from that position. So that's an example of changing the environment, also changing the object. This last picture here would be changing the weight, and also the speed, so this woman was a woman with runner's dystonia, and we could unweight her in the AlterG, to change her environment. And then finally, we're gonna show a video here, of another changing the object, of a person with writer's dystonia.

And this is the Y pen, and you can still see just a tiny bit of tremor there, but with the Y pen, with a little bit of assistance from the other hand, he could actually write. Other than that, he was not able to write. So I like to have a lot of different writing utensils available for people, and the Y pen is just one example. We can go back to the slides here. So a lot of different ways that we can change that sensory input to drive our training and our neuroplasticity, and now, let's talk about decreasing that abnormal movement.

So that was changing the sensory input, how about that change in position or environment? So one example we actually show was that woman painting on her stomach, I love just sitting up in a different way, so sitting up against the wall, so these are all examples in cervical dystonia, sitting up against the wall with a external focus, which is the block. Lying on the side with the hand in a particular position, so these were all people with cervical dystonia, who could attain neutral with these changes in position and environment. This is using TENS, so that same gentleman that you saw

with the Y pen, we used TENS on one of his most overactive muscle, and that also changed his writing, so that was something that we could give him to do at home. And there is some evidence for Kinesio taping as well, this is a woman with cervical dystonia, and a very simple taping cue here, I know that it is Kinesio tape and it is, I'll kinda pull it over here, so she had a simple piece across, and then coming back here, she also had a lot of pain and this helped with it, but I actually find taping is more of a sensory input, but a way, and even a sensory trick, but a way to decrease that abnormal movement, not everybody, a lot of people don't respond to tape, but some people do, so I think it's worth trying. And then this is where it gets so fun, retraining those normal patterns, using mirror or video, unweighting, or changing that environment, proprioceptive feedback, all of these things. So I have a couple videos, we'll start with the first one here, and this is a video of using, let's make sure I got the right video here, yup, so what we did is took a video and inverted it, and then she moved her leg at the same time, so this was almost like a mirror therapy with video.

And so there's some really great apps out now with video inversions that are really nice, so she could watch this for the mental imagery of the normal movement as she was practicing. OK, so now let's go to the next video. And in this video, this is a woman you're gonna meet in just a moment, she is using that external focus with the laser on a picture in the hallway with us, as a way to train her head position, while she's walking, so a little more dynamic activity. OK, we'll come back to the slides here, those were just a few examples of how we then might be progressing someone through this, getting to the more normal patterns, so we might have to start with things like the mirror, the picture down here at the bottom is a gentleman who had it with typing, and we used mirror therapy, so a simple mirror between his hands so that he could get the feedback, the normal visual feedback which does wonders for the brain, so very similar to what you might do in somebody with persistent pain. And this is the same, so I mentioned this before, and we had, in relation to somebody with persistent pain, similar here in dystonia, we might have a graded exposure progression, we might start

with right/left discrimination, like using the Recognise app. We might then progress to imagined movement, and mirror therapy, 'cause remember, I mentioned a case of many people just thinking about the movement, and they have an abnormal contraction, so we may have to back up 'cause we don't wanna reinforce that abnormal contraction, we want to take one step before that. We might use mirror therapy, we might do the movement in an altered environment or context, and then finally get to the movement in the target context. That can be really challenging because of course, our runners, our musicians, they want to be in that target environment and task right away, and slowing that down can be really difficult.

The last piece here that I'll highlight, which I think you, most physical therapists are really great at these underlying factors, by how do they come into play with the dystonia. So how might their biomechanics have contributed to the dystonia, what about a strength and balance, or flexibility, the nerve mobility, maybe their balance and breathing? And I'd like to show a video here, just a little mini case for you. And this is woman with runner's dystonia, and she had her runner's dystonia onset after she injured her adductors, no I'm sorry, her hip flexors, so she had just a strain of her hip flexors in a marathon, and she continued running, and I'm gonna just show her again, I know we only have her sagittal view here, but what you can appreciate in the biomechanical analysis, if I start to pause it here, she has some excessive knee flexion, and this was her response, so she ended up with knee flexion external rotation, to clear her leg because she wasn't flexing her hip forward for that whole marathon, and then she continued running like that.

And we can go back to the slides here. So through her biomechanical analysis, we were able to pick up some of those subtle running problems that, in her dystonia now, it ended up having, she was kicking herself, kicking her opposite leg because she was externally rotating, kicking her bottom because she was excessively activating her hamstrings, and she couldn't break out of that. So we did have to address her

underlying strength deficit, she had hip flexor strength deficit, the acute injury was long gone, but we had to address those underlying problems, she also had some nerve mobility problems, and incorporate that into her training. Now ultimately, where she changed her running was not through a change in just addressing her strength, so we addressed her strength, but we actually had to address the whole motor program, the whole sensorimotor program, and she's one of my favorite cases because the thing that worked best for her was actually strapping a small object, so changing the sensory input for her, at the back of her leg at her hamstring, which was very overactive, so her hamstring was the dystonic muscle, she ended up running with like a little teddy bear strapped to the back of her leg, and she could run perfectly normal with that. So that was a sensory trick in cue, and we could retrain that sensory pattern, so she didn't have activation of her hamstrings. So that was one little case there. I'll just give you a little brief overview of how you might setup your treatment planning.

So in that article by Byl, they actually did fitness exercises three to five days a week, and intensity for aerobic activity, they did Brainfits, a cognitive program, they did supervised group practice, and they did home practice. And they compared two groups, what they found actually, the group that only did home practice had about half of the compliance and half of the improvement as well. What we have found clinically, is for some people, it helps to setup an intensive, where they're coming more frequently, and then progress that to one to two times a week, or one time a month. But it's so individualized, I have found people that are able to come once a week, and don't need an intensive to be able to progress. But we do followup with people because on that journey, when they become sleep deprived again, when there's a big stressor, some of their symptoms may reoccur. It's helpful to build that into the plan, into their self-management, so that they feel really confident, they can manage it themselves, but also helpful to check in with them, and progress a plan. OK, I'm so excited for the end here, and the last 30 minutes or so, we're gonna apply this to a couple of cases, I would really love your participation with this as well. So this is a

woman, you got a little preview of her earlier, she was 63, she had a six-year history of cervical dystonia with a big pain component, so that was one of the primary issues for her. We used the patient-specific functional scale, rating people from zero to 10, so she reported that sitting for a prolonged time was a two out of 10, so she was really impaired with that, that's where her dystonia and pain was the worst, and then basically doing any afternoon activities, she was a zero, not able to do those. She was getting Xeomin injections every six to eight weeks, she does have some history, and she's very forthcoming where she felt like this contributed to her pain and her dystonia, she has been about 10 years sober, but she had a history of alcohol abuse, depression, and some early childhood trauma.

And she was getting a lot of other care, so she had had a sensory nerve ablation, she was using THC topically, acupuncture, yoga, she did body work, she did Pilates, she had a lot of great avenues of staying active. And just briefly on her exam, she has this very mild right head turn and tilt, her pain is on the left side, but greatly limited range of motion, so she's only able to turn her head to the left and right, about 30 degrees. She had difficulty maintaining a straight path with her eyes closed, and she was reporting some difficulty with this as well, functionally.

She had some difficulty with eye/head differentiation, her JPE error was consistently greater than six degrees, and she actually had a positive head impulse test on the left. So she, maybe unbeknownst to her, had some mild hypofunction and that can be a contributor to the dystonia itself. OK, so we're gonna apply these steps to her case, and see what we're gonna do. So, first step in this case was preparing the brain. So providing some enhanced expectations or expectancies, and we know with people like her, so this is one of the statements that's been used in the literature, I use it as well, people like you with cervical dystonia, was very mild, it's been going on for six years, can a very good outcome with this training. So providing that type of statement and feedback to her helps prepare her for a positive recovery. So the other was autonomy,

so in her case, we identified two key areas to address, and we could then ask her, which is most important to you, and most beneficial to work on first? So this was just one example of giving her a simple choice of where she would like to begin. Now I like to keep this very simple and not vague and overwhelming big question of like, where do you wanna start? Because that can actually cause more stress. So simple questions are better for autonomy, so this is where we started with her. And she's already doing yoga and Pilates, and then we incorporated some meditations practices, some self-compassion meditative practices with those, that she was already doing. So this became part of her home program. We also did a lot on training the brain.

So what you see in the picture here on the left, is she's on the ball, she's using mirror feedback, and we're doing some of those postural righting reactions to the left and right, and disassociating head and neck movements. She loved this, she could get in a neutral position without pain, it was very effective, and we were able then to progress that through many different positions. And next, we'll show a video. So you had seen the video prior, of her using an external focus, I love the head laser lamp as an external focus. And here, she's using that, so she was able to progress from walking forward to walking backwards.

And you can see that keeping that laser on a certain part of that picture, helps her to keep her head in the middle, right? So instead of the head turn. And then in the next video, I think we have one more here, you'll see her walking with her eyes closed. So we practiced many things in low-light conditions, half-body glasses, which are glasses that block off the lower half of the body, and then we were able to progress that to walking with eyes closed. And we'll head back to the slides here. And those were just many of the different ways and ideas that we were able to use to train and progress her through different movements. We had to start in sitting, and then we can move all the way up to walking backwards, and eyes closed, and all of those pieces. We also had to treat the underlying factors here, so we needed to start treating the underlying

vestibular problem, we did times one and times two viewing, able to get that very quickly, in this picture here, you can see that she is on a pillow, this is what she could use at home, using a small target for her times two viewing, and she was able to progress that pretty quickly to walking and moving and really busy environments. This is not a picture of her, clearly, this is another person with one of our therapists, but she had such limited cervical range of motion, and we ended up having to do quite a bit of manual therapy, to get her C/T junction moving a little better, her first rib mobilized, a lot of soft tissue work, and suboccipital work to help improve her range of motion. So those things aren't out of the picture at all in dystonia and certainly helped her.

So, what did we do? We saw her for once a week, for nine months, and I know that's a really long time, but she did have this for six years, and a lot of ups and downs over that time. So we setup her plan initially for a three-month timeframe, she kept making really great progress, and we measured her progress primarily through that PSFS, so through her functional changes. And then, we were able to progress her from that, to every other week for about nine months. And after that, we were able to followup with her, and do some maintenance for once a month.

So we actually put her on a skilled maintenance plan, she actually has Medicare, so this was something that we had to do, medically necessary and justify it, and that's why we had those really distinct activity measures for her. So what you can see here, is that pre, she was sitting prolonged was a two, and her afternoon activities was a zero. Post, she was able to sit for prolonged times at a six, and start doing activities in the afternoon. This changed her life drastically, so you can imagine not being able to do things in the afternoon, to being able to do things in the afternoon. So this was a huge change. Her joint position error also improved to less than six degree error in all of her movements, so she was accurate in all movements. She was also phenomenal, she got her own head lamp, which by the way, you can get those on Amazon now, for really inexpensive, and she practiced, she practiced a lot. And her neck range improved from

very limited and painful, to 60 degrees bilaterally without pain. And then the ongoing management that we did from a maintenance perspective, was that when things change for her, when her mother-in-law died, when the election happened, actually it was a very stressful event, she's very involved politically, and we would come back to some of our sensory training. At this point however, because it's been awhile since this first writeup of the case, at this point, she's very strong in self-management, and that's what I say with all of my patients, is my goal is that I don't see you anymore, right? So we may start off on this initial maintenance, which is mostly for reassessing and reintegrating the sensorimotor, but most people are able to manage independently after a time point.

OK, so that was a case of cervical dystonia, a long treatment plan of sensorimotor training, preparing the brain, training the brain, treating some of those underlying factors. And now, we are going to spend the next, probably like 15 to 20 minutes, doing this together. So this is where you're going to join me and apply some of these ideas, so I'm asking for your participation here. This is a 65-year-old male, he has had a three-year history of toe curling with drumming, and now he's also finding it with other activities. He was referred to us specifically to look at, would Botox be a benefit for him, what about therapy?

And his movement disorder neurologist wanted our input. So on exam, his strength was intact, he did have some weakness on his left side, which is actually his, uninvolved side, and I would say very common that I'll find some proximal weakness in many people, myself included, I'm still working on my glute strength, so he had some weakness. He had impaired laterality in two point discrimination, especially in relation to his feet. He had impaired single-leg balance on his right side, so he actually could not balance on that leg. He had some nerve tension throughout his right lower extremity, so that positive slump test, sciatic nerve tension. And then, he had toe curling just with thinking about drumming, OK? So not even having to drum. So we had

him bring in a foot pedal, so that's another thing I often recommend for people, is if they have a task-specific dystonia, to bring in their musical instrument, their writing instruments, their paints, whatever it is, their keyboards, and so we had him bring in his drum pedal, we set it up with our plyo box there, and we're gonna watch this video together, and I'll point out a few things on it. So this is in slow-motion. What you can see there is that he's getting a lot of toe flexion, especially in the great toe, his heel is coming up, as he's drumming, we can even see some of his muscle activation. He's better when his heel is down, but it's difficult to stay down, and we just do the left foot so you can compare.

So you can see in the left foot, what that normal movement would look like, so it's really a pure dorsiflexion/plantarflexion, not toe activity. So let's just watch that one more time here, if we can, OK. Just so, because you kinda saw the left first, so you could see the normal, and just looking at the abnormal movement. So he can't keep his heel down, his toes are flexing, it's very hard for him to coordinate that movement. And then one more time on the normal, on the left side, that would be more of the normal movement.

So this is something that absolutely can happen, we can take that video off again here. He started having this dystonic movement, the toe curling with drumming only, and then it progressed to standing and walking. And this is often then when people start to go to the doctor because it's starting to affect other functions. OK, so I have some questions here, and actually, I'm gonna go back here first, because my first question to you, is just based on his movement, and the doctor asking, like is there a target for Botox? Just based on the movement, are there any muscles that you might think would be a good target for Botox? Based on his toe curling, maybe his plantarflexion, what do you think? So if you're catching the recording here too, just reflect on that. Based on his movements, what muscles might you Botox? And if you're here with us live, go ahead and put that in the Q&A, put that in the Chat, what area would you

consider, recommending to the doctor? Because this is part of the big question that's gonna come up, and the doctor wants to know, is there a target here, is there a clear muscle that's overactive? When you see the toe flexors, when you see the ankle plantarflexion, what might you target, what might you recommend? Yeah great, so getting a couple responses here. Like, he clearly has some over-activation of his toe flexors, maybe the great toe flexor more than others, and that could be a very clear target. Now we need our toe flexors for other things, so many of the good movement disorder specialists will go very slowly and do a low dose to start, so that we don't totally paralyze his toe flexors. And something else that I'm seeing here, it's a combination and I worry about his ability to walk if he had Botox, plus an increased fall risk, absolutely.

So exactly, you were reading my mind there, that's exactly the concern. And so might they consider just one, so maybe just great toe flexion? And he's already having balance problems, so could this be a concern? So I'm so glad you said that, absolutely. And this is the give and take with the idea of Botox, and this is why we wanna see if we could have an improvement without. So I kind of liken this to somebody coming in for conservative treatments, and thinking about surgery. Here, they're coming in for conservative treatment thinking about Botox because it's not without its side-effects.

So here are some questions that we're going to think about together, we'll go one-by-one. So I'm first very curious at all your creativity here, this is a person who loves to drum, he's a professional drummer, how are you gonna stop him from drumming, or what positions might you try, what other contexts would you do? So things to think about are his seating surface, changing his posture, his trunk position, head position, all of those things, what comes to your creative minds, when you think of different positions? So reflect on that, brainstorm this, for this particular case, but I'll tell you, brainstorming it for this case is gonna help with your other cases too, so what

different positions will you try? Maybe somebody has a creative idea of trying something weird on his foot, or on the drum pedal itself. I'd love to hear from you what different positions come to mind, what different environments or contexts come to mind with that. And as you reflect on that, I'm gonna wait for a few things to come up in the Chat, and thank you for being brave with sharing things, I appreciate that so much, but it also just makes this much more fun for me, I feel like we're having a conversation here, but also, really helps cement this for your patients. Yeah, so I think this is a great comment here, rearranging the drum positions, so that the bass pedal is more lateral, absolutely, and the same occurs for, the runner, you might have them step out more laterally, or more medially, or more forward, or more back, or how extended is their foot for this?

Maybe their seat is up higher or lower, maybe you tilt their seat a little bit in one direction or the other, or give them a little pad that tilts them into an anterior tilt, maybe they try it standing, maybe they can hit the bass drum if they're lying supine and it's down at their feet, maybe they're on their belly. So this is where it gets really fun and creative. Another example here, change the pedal so he can play with his heel instead of his toes, absolutely, like let's change the mechanics of the pedal, and if he can play with his heel, now we're activating the opposite muscles, that's a great idea. You all are so creative, I love it. Something else coming here, sitting on a therapy ball, absolutely, so sitting even bouncing on the ball, why not?

Let's throw a weighted vest at him, and we're actually getting to the second question, so how can we change that sensory proprioceptive input to contribute to his control during drumming? So if he has some sensory changes, can we change that for him? So sitting on a therapy ball might be one of those ways, adding a weighted vest, adding a weight to his foot, adding any object to his foot to change that sensory input. Changing the surface of the pedal, so can we put like a little acupuncture pad on the surface of his pedal? That would be another example. Let's throw up a couple other

pieces here, that I would love your input. If he's got some underlying issues, so he has some nerve tension. How might you address that and take that into his function? So I'm very curious to hear from you, some of your creative ideas for addressing his nerve tension and I think a lot of us do this in different ways, whether that's through glides or soft tissue, I wanna hear your creative ways of how you might address nerve tension, and how you might even take that into his function. And as you're thinking about those, some of the common things that we see, especially in focal dystonia of the foot, we can see nerve tension in all different patterns, and so I really advocate for testing all of the different nerves in the lower extremity, and addressing those and thinking about, how maybe the mechanics of their movement might be contributing to it.

So how is this gentleman, while he's sitting playing drums, how is his position contributing to the nerve tension that he's experiencing, and can we change that position? So would love to hear your thoughts in the Q&A, of how you might address the underlying biomechanical nerve tension issues that might be contributing to his dystonia. And I'm not seeing anything in there here, so all right Susan, thank you, thank you for joining this conversation. Yeah, so I love that, having him practice the pedal and standing to extend the length of the nerve, that's a fabulous idea, and then he's not in that sitting position, which puts a lot of tension on the nerve already.

I feel my attention, just sitting here right now, 'cause it's about time to get up and move, so absolutely, and you know what? For him, we worked soft tissue-wise, we gave him some nerve glides, it was very interesting, these things really impacted his dystonia, so I highly, highly advocate addressing those underlying positions. And then we helped him become more variable, this is very hard if you're a professional musician, to become more variable in your practice and progression. So giving him ideas for that, different shoes, different surfaces on the pedal, different things strapped to his shoes, weights to his shoes, different objects to his shoes, so that it could be variable, as well as advocating for different songs and order of the songs in the

practice. So those were all things that we did with him. And then I just wanted to show you, we're just about finished here, I wanted to show you this video, so let's go ahead and watch the video. This is a mirror therapy that we did right away in that first session. So with the mirror directed at his left foot, so we're asking him to watch his left foot, or watch the mirror, and the brain's perceiving that as the right foot, and initially, he couldn't even think about tapping his foot without tension in his toe flexors, but what you can see here is quite profound, that he can, by watching his left foot in the mirror, and we actually have his right foot blocked, so he can't see it, you can see that he is able to tap his foot with his right normally, without excessive toe flexion.

I do wanna point out here, you can kind of see it, he was starting to get some tightness in his toe flexor, so we also had to address that, you can see his toe is just flexed a little bit, so we had to work through some of those soft tissue restrictions. But once again, here he is watching his left foot in the mirror, so his brain is perceiving that as his right foot, with that feedback, he's able to move more normally, so this was a great place for us to start, a huge success in that first session to find that. And this is what I find with a lot of our people, is there's a trial and error here of testing these things, and the response to them in that first session, so that you can start them on their progression right away.

OK, we can go back to the slides. But isn't that awesome, I love to see when somebody responds so positively to an initial piece like that. Thank you so much for joining me in that case, and for participating, and if you're watching the recording, just for reflecting and thinking about applying these to people. So here's my action step for you, for your next patient, for the next person you have with dystonia, what I would love for you to do is talk through learning-based sensorimotor training with them, are they ready to commit to that level of preparing the brain, training the brain, and the amount of practice that it takes to get there? With a person, if you're not doing this already, I would love to have you try those preparing the brain practices, so a breathing

practice for example, and then think about systematically progressing them through an activity to train the brain, and then I wanna know how it goes. So I put my email up on here, I don't always respond to emails like overnight, but within a couple days, I would love to hear from you, how it goes, if you have questions, and then I do wanna open up the last five minutes here for questions from you as well, lots of research, lots of references here for you, and so you'll have those in your slides, but I wanna thank you so much for joining me, and then please put some questions, if you have patient questions, treatment questions, I'd love to hear them here before we log off. OK, so here's a good question already, have you tried aquatic therapy with any of these patients? Absolutely I have, April, thanks so much for the question. I love aquatic therapy as a change in the environment, the sensory input is different, it's great for a runner's dystonia, it's great for, I mean wouldn't it be cool to see this drumming in the pool? Now I actually am not an aquatic therapy practice, so I have had to have people do this in their own pools, or at the gym, but I think that's a really great way to change the environment.

I've also had many people with cervical dystonia tell me, when we're talking about aerobic exercise, that swimming is one of the only ways that they can get fitness into their routine, because their dystonia is gone while they're swimming, and just think about it, the pool, the water, the rhythmic movement, you're prone, you're moving in a different way than typical, I think it's a really great activity, so thank you so much for that question, and I would highly advocate for that, using aquatic therapy. And as I'm answering the questions, if anybody has other questions, please put them in the Q&A, put them in the Chat, we have a couple more minutes here, I would love to chat with you all, and answer any questions. And if they're not, again, if you think of questions later on, please email me, I am super passionate about this topic, and many topics in neuro to be honest, but my passion is to help people with dystonia, and I think a big part of that is helping therapists have the right tools to treat it, because I certainly didn't learn this in school. So another great question, do you use compression, and

which type for distal or proximal dystonia? Absolutely, I've used compression, and Tracy, I think you also had asked me, or you had mentioned you had seen some kids with CP. So I have used compression in all kinds of dystonia, I've used it in CP with more the chorio, athetoid, dystonic CP, and I've used many different means of it, I've use abdominal binders, I've used ease wraps, I've used compression sleeves. I love the weighted vest, and I know it's not a compression vest, but the Balance-Based Torso-Weighting system, again, I'm not connected to this company in any way, it was developed by Cindy Horn, it's a tight vest with teeny tiny weights, and I love that if we're finding sensory and proprioceptive deficits in the trunk.

So I've used that in cases of more generalized dystonias, but also focal dystonias, you'd be surprised at how much the trunk, the hips, proximal pieces, contribute to a distal dystonia. So I have used all of the above, in every type, I will caution about bracing, sometimes the bracing can actually contribute to more dystonia, that the person actually fights it. And so Tracy said, what was that called? And I'm gonna put it here in the Chat, Balanced-Based Torso-Weighting, or BBTW. Cindy Horn is the researcher and developer of that, I'm gonna just send that to everybody here. I've no connection to this company whatsoever, but she has done some research in this field, she teaches courses on it as well, but that is a great tool to have, it's a great neuro tool, but I've used it in dystonia as well, thanks for asking the question. And I think we're about up on time, again, email me, I'd love to hear from you, thank you so much for joining me in the discussion, and just for being interested in dystonia, honestly, a lot of people say they've been to many healthcare providers who don't understand, and don't know what this is, and so I'm very excited that they're gonna be able to find you and that won't be the case. So thank you so so much, and I will sign off here.

- [Calista] Well, thank you so much Dr. Hershberg, for sharing your expertise with us today, such a great course and videos. So we're gonna wrap-up today's course, but as a reminder, we have two more courses coming up this week in our virtual conference,

so hope to see everyone attend those, and if you're seeing this on the recording, to catch those later. Have a great day everyone, and thank you again, Dr. Hershberg.