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Simplifying Advanced Vestibular Cases, in partnership with the American Academy of Audiology

Presenter: Sara Jagger, AuD, PhD; Kim Rutherford, PT, DSc, COMT

It's my pleasure to introduce our guest speakers today, Dr. Sara Jagger and Dr. Kim Rutherford. This course is produced in partnership with the American Academy of Audiology. We're so delighted to be the premier host for the Academy's CEU courses and we hope that you enjoy this course.

This course is entitled Simplifying Advanced Vestibular Cases in partnership with our American Academy of Audiology. If you'd like to learn more about our guest speakers today, selected by the Academy, you can learn about them on the course registration page. But at the time I will hand the mic over to you. Dr. Jagger, thank you so much.

It's our pleasure to be here and thank you so much for inviting us to speak with you today. First, I'd like to introduce Tish Gaffney, current President of aaa. She'd like to say a word or two.

I'm Tish Gaffney, President of the American Academy of Audiology. The Academy is the home for audiologists. We are dedicated to achieving recognition of audiologists as the experts in hearing and balance care and the field of audiology as an independent clinical specialty that is integral to the healthcare team. We offer our members the latest resources for practice management and clinical evidence based practice so that they can grow professionally and improve patient care. We advocate for our members in Washington and throughout the country to ensure that the voices of audiologists are heard and we help connect audiologists to one another through valuable networking opportunities.

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All right, moving into these are our disclosures and as all medical related presentations, these are limitations and risks here.

Our learning outcomes for today's presentation are listed here and then a few more details about Dr. Rutherford and myself. We both are employed by the American Institute of Balance. I am the director of Clit Clinical Science and Physician Relations and Dr. Rutherford is the COO.

So first today we are going to be discussing some key case history questions to review with patients. Then we'll present two multifactorial cases. These cover six different vestibular and non vestibular related disorders. We will review report writing and communication with physicians and providers some medical management options and Kim will be discussing the physical therapy management aspect for both cases.

So first we're going to discuss some key case history questions. This could take up the entire presentation by itself, so we'll keep this pretty to the Point first I want to know was there an initial attack of vertigo imbalance or what happened? So most of our vestibular disorders that we know about will cause an asymmetry in the firing of the hair cells. With the affected ear unable to provide as excitation as the unaffected ear. This will cause true vertigo that lasts minutes, up to maybe even 72 hours non stop.

Patients that experience a sudden bilateral vestibular loss will not have a true vertigo sensation because there's no asymmetry in that hair cell firing. But they will describe sort of an initial attack of disequilibrium and oscillopsia symptoms. Patients will remember a true episode of vertigo if the room started spin better believe they are going to remember it. This is usually quite severe. Nausea and emesis are very common secondary to the vertigo.

I want to then find out how long it lasted. BPPV for example, is always going to be less than a minute in duration. Attacks of a sudden unilateral vestibular loss is going to be maybe 20 minutes up to hours, up to a few days in duration. CNS related disorders like vestibular migraine, stroke or other cerebrovasc events, for example, can cause vertigo that lasts minutes, hours or days. I always say that the the brain

can do whatever it wants, right?

So it can, it can last as long as it wants or needs to. I also want to know what they were doing right before the episode began. BPPV is going to occur with a change in head position, such as rolling over, lying down, moving my head up or bending forward. Disorders that cause a sudden unilateral loss may begin at any time without any provocation. So they might have sitting still.

CNS can do the same thing sitting still. Symptoms may just start to begin. I want to know did anything change in the days or even weeks before this episode started? Was there a change in things like medication? Did they start, stop or even a change in dosage of medication?

Was there any kind of head trauma, motor vehicle accident, concussion, whiplash? By the way, if there was, it's very fair to ask if they are in litigation because of this head trauma. That's good to know for our reports and how detailed our assessment should be because the case may be going to court. Did they have an illness, upper respiratory infection, flu, Covid sinus infection, etc. Was there any increase in stress, like occupational or even personal stress?

It may be something personal with themselves or it may be something within their family or a close friend. I also want to know if they've had single or multiple episodes. How many have they had? With this question, we're assessing the stability of the disorder. So bppv, for example, it'll have multiple episodes.

Every time I move my head in certain ways, I get an episode of spinning vertigo lasting less than a minute. Other disorders may have only had one severe vertigo episode, such as with a labyrinthitis or neuritis, while other disorders will cause multiple episodes, like Meniere's disease or vestibular migraine. With audiology, we have to remember besides bppv, we cannot diagnose these disorders, but our case history and our testing can help lead the physicians to a good differential diagnosis. We

want to know too, as audiologists, if they're in a stable state, and that means that they're not having recurrent episodes. These patients will be ideal for vestibular rehabilitation therapy if they are stabilized.

Otherwise, if a patient continues to have episodes of vertigo, such as with Meniere's disease, the state of compensation is going to potentially change with every episode that they have. I also want to know about other symptoms that occur during the episode. This question helps narrow down differential diagnoses, otologic symptoms, headache, focal neurologic symptoms such as paresthesias, visual auras, photophobia or phonophobia, dysarthria, et cetera. These are important to know. Current symptoms Here I'm listening and asking about symptoms related to the VOR vestibulo ocular reflex and the VSR the vestibulospinal reflex.

So VOR symptoms are things like oscillopsia, blurred or bouncy vision with head movement, or maybe a feeling of exaggeration of movement when moving my head. So I move my head a little bit. I feel like I move my head a lot farther, farther than I really did. These may be provoked in specific planes. So does it always happen when I turn my head to the right or the left or both?

The vestibulospinal reflex symptoms are going to be more surface dependent preferences, falls, a lack of coordination of movement or a loss of sure footedness. Now I'll ask about provoking symptoms. Do symptoms provoke when you move your head or your body? BPPV will happen when I move my head up, down for posterior anterior canal, side to side with a horizontal canal rolling over to each side. Those types of things if they have an uncompensated unilateral vestibular loss.

This can provoke oscillopsia or vestibular recruitment. That feeling like I'm moving farther more than I really am and or imbalance when they're moving in the direction of the affected side. So if my right ear is my affected ear, every time I move move to the right, I feel symptoms not so much when I move to the left. CNS involvement may or may not be influenced by movement at all. Cervicogenic is another

consideration too and these will be provoked with head movement in certain directions.

So there can be overlap between cervical dizziness and vestibular related dizziness. Do symptoms provoke with moving the body, lying down, rolling over, rising up from a seated position or a lying down position? Non compensated uncompensated UVD will provoke with that vestibular recruitment when turning while walking. CNS again may or may not be provoked by movement. Something like an orthostatic hypotension or a postural orthostatic tachycardia syndrome.

POTS Vasovagal dizziness even can occur when somebody is sitting too long and they stand up quickly, for example. Does anything make symptoms worse? This overlaps with the last question a bit, but Vestibular migraine Meniere's disease may be affected by things like weather patterns, atmospheric changes, weather changes, dietary intake Visual patterns may be bothersome secondary to vestibular disorders. Migraine psychiatric dizziness may be triggered by stress. These conditions can also cause those visual patterns to be bothersome too.

Things like superior canal dehiscence will cause patients to say dizziness is provoked with loud sounds or pressure changes such as straining to use the bathroom or lifting something or blowing their nose forcefully when they have like a sinus cold for example. Does anything make symptoms better? Vestibular patients will say that sitting still and not moving their head makes them feel better. CNS may or may not feel better when they sit still. Also medications it is really useful for patients to bring in their current medications in a list and you do.

You should need to confirm that they are actually taking the medications on the list and as directed. Patients, for example, that are supposed to have their blood pressure controlled with medications may say well I only take that medication as needed, but it's on their list to take it every day. That might be a concerning factor with their dizziness. Medical History There are a lot of different things we could ask about. Otologic disease, diabetes, neuropathy, heart disease, hypertension, hypotension, arthritis,

orthopedic concerns A lot of different things neurologic conditions are important.

Headaches and migraine history. Another way to basically ask about medical history though are do you see any specialists? Is there anyone that you see on a regular basis or that are managing your medications that can help narrow down some of their medical history.

So here are a list of the different vestibular tests that we're familiar with that can test all the five different vestibular organs and both branches of the vestibular nerve with a comprehensive evaluation. Some of these may or may not be performed on every patient. Some of these you may not have the equipment for, but these are what's available.

We also have some other helpful tests that we'll briefly discuss today. One is called ambient pressure tympanometry and cervical dizziness tests.

So here's our first case. We have a 38 year old male with symptoms that sound pretty familiar of a vestibular neuritis episode that occurred about a year ago with a prolonged episode of vertigo lasting a few hours and no other otologic or focal neurologic symptoms. Commonly, patients are seen by maybe primary care, maybe ENT neurology. They might be at the emergency department or other physicians or providers and they end up getting sent to physical therapy first. This can occur for a number of reasons.

Sometimes there might be a wait to get vestibular testing done. In some areas, a provider might do a bedside test and say, oh, I think I found the issue. Let's get you over to pt. Sometimes there's just a lack of vestibular testing in the area or insurance could even be a concern. So this patient was sent to PT immediately because they could get him in quicker and PT was able to help with the oscillos, oscillopsia symptoms and some of the imbalance symptoms.

The patient's medical history is remarkable for migraines, none that were recent though. Anxiety, hypertension that was controlled pharmacologically. His medications include tramadol for sleep, diazepam for anxiety, atenolol for blood pressure. Next I'm going to turn it over to Kim Rutherford who is going to talk about the patient's physical therapy evaluation and management. Thanks, Dr.

Jagger. So as Dr. Jagger mentioned, it's kind of common protocol in a lot of areas for dizzy patients, patients experiencing balance deficits to be sent directly to physical therapy without any kind of diagnostic or medical workup. So this case is an excellent example of what this might look like. So as Sara mentioned, this patient went to a primary care physician, reported dizziness, and the patient was referred directly to physical therapy.

The patient's insurance, which is, you know, a common hurdle we have in the physical therapy world, tends to give us a certain amount of visits based on the patient's ICD10 so in this case, UnitedHealthcare approved a total of six visits, which includes the initial evaluation. The patient was seen for their first visit and physical therapy and was only able to tolerate the bedside and functional evaluation, which I'll be outlining shortly. The remaining five visits that the physical therapist had with this patient largely focused on the functional impairments that the physical therapist was able to objectively quantify during their initial evaluation. So as Dr. Jagger mentioned, the patient was experiencing oscillopsia primarily in the vertical plane.

So that is exactly what the physical therapist focused on was gaze stabilization activities in the vertical plane. In addition to this, the patient had visual vestibular integration issues, meaning busy patterns. Optokinetics were very problematic. So the physical therapists integrated habituation exercises to help expose and essentially desensitize the patient to those complex visual environments. Something the physical therapist noted in their initial evaluation was cervical spine mobility issues, which again very common with patients, could be or could not be related to the dizziness.

But the physical therapist evaluated the cervical spine and found that there was soft tissue and joint mobilization issues. So there in turn measured it objectively and treated the patient for soft tissue mobilization and cervicogenic interventions to restore the patient's range of motion loss. The functional deficits that the physical therapist was able to measure through a series of outcome based testing revealed just general balance and strengthening activities were needed to help with just deconditioning and just lack of motion. So that's pretty common, the deconditioning, particularly patients who are having trouble with dizziness or intolerance to motion due to a previous vestibular or non vestibular incident. So something we want to focus though, that there was very limited focus on mobility with this particular patient for two reasons.

First and foremost, we only had six visits with the patient. So the VRT and the cervicogenic interventions took up a great majority of that. But in addition to it, the patient had a very limited tolerance to motion, to functional strengthening and activities due to that perceived disability and the dizziness they were having.

So I actually think we may have missed a slide and I apologize, I may have jumped ahead. So I'll reverse order just a little bit. This is an overview of the initial evaluation that the patient had. So you'll notice from a physical therapy perspective, we very much operate in a low tech to no tech environment. So that beautiful battery of tests that Dr.

Jagger outlined, we don't have access to that within our clinics. So a lot of the testing you see on the left hand side of the Screen are bedside, low tech, no tech. So I'll start the conversation sort of with that. The physical therapist did gaze testing, a head impulse test, and found this to be negative. The dynamic visual acuity for this particular patient, as we mentioned, revealed deficits in the vertical plane with the vestibular ocular reflex.

A common outcome measure physical therapists will use to measure a patient's perceived disability with movement is called the Dizziness Handicap Inventory. So this particular patient scored a 74 out of 100. This is a test that the higher the score you have, it is not the better the outcome. So based on this, the patient has a very high perceived disability handicap inventory. Postural stability testing is commonly done, obviously in a physical therapy or rehabilitation setting.

And we found through the modified cat sib, abnormal sway with all four conditions. No fall though, and reports of just increased subjective dizziness throughout all test positions, regardless of vision occluded or not. Optokinetics, I believe I mentioned, were problematic for this patient and increased their subjective report of dizziness. I mentioned the cervical spine limitations that were measured and ultimately I touched on the functional testing, which were sit to stand time, get up and go and motion sensitivity quotients. Again, very easy bedside, low tech type of testing that physical therapists can quantify a patient's tolerance or performance with functional movement.

So again, I apologize for jumping over that. So I may have gotten a little ahead of myself. So essentially this is what I reviewed prior to the slide, which was the intervention, which just to recap really shortly, was the physical therapist focused those limited visits on the objective quantified impairment that they were able to measure, which in this case was the oscillopsia in the vertical plane and primarily the cervical spine issues.

So we'll talk outcomes now. So, as every rehabilitation professional must do for patient care purposes, for insurance purposes, for documentation purposes, is we must reassess our outcomes that we measured the first visit. So you'll see the testing on the left hand side of the screen essentially represents the same battery of tests bedside that the physical therapist did during this patient's first visit. So results are as follows. The gaze testing and the hit test, which was initially negative, was also negative post therapy.

The dynamic visual acuity test, which initially showed deficits in the vertical plane, was now negative. The Dizziness Handicap Inventory, which to briefly review, is the patient's subjective report of their perception of their disability and how it is impacting their day to day, was still very high, a 72 out of 100 relative to the initial score of 74. Postural stability testing still noted some abnormal sway and poor tolerance to all the conditions, again not necessarily through instability, but through subjective reports of dizziness. Optokinetics was a 6 out of 10 from a subjective report of symptom provocation. And during their initial testing, it was a 7 out of 10.

Strength, range of motion, mobility from the cervical spine perspective was within normal limits after treatment, which makes sense. And the functional testing which we talked about, the patient's tolerance to movement remained unchanged.

So essentially, after the six visits were over, what are the next steps? So this is another oh so common concern. The patient was referred back to the primary care physician with the analysis that they had plateaued. The organic or the physical or biological or objective functional impairment that the physical therapist was able to measure did improve. So those measurable improvements included the cervical spine being clear and the oscillopsia being resolved.

However, more of the non organic impairments which Dr. Jagger will be walking through shortly, remained unremarkable and unchanged. So that was revealed through the dizziness Handicap Inventory, remaining very high pre and post as well as the functional testing and the postural stability testing. Something to note as I briefly touched on on the first slide is we did have some insurance constraints as a issue as well, so.

All right, thank you, Kim, so you're welcome. The patient now goes back to his primary care doctor and although his symptoms of oscillopsia are no longer present, he continued to experience pretty consistent imbalance that lasts all day on most days for the past year. These symptoms are present

when he's standing or ambulating. They may worsen with movement or with visual movement, such as things moving in his sight, in his vision. He endorses significant social isolation.

He feels others will see him and think that he's intoxicated. His primary care has EVAL had him evaluated by multiple specialties, cardiology, neurology, internal medicine. And there's been no organic cause to his symptoms that has been found.

So he went to ENT and audiology for audio vestibular testing. His audiometric testing shows normal hearing and admittance. His cervical vamp shows a 51.1percent right unilateral weakness. CDP was abnormal for all conditions. However, the patient did not fall.

He, he, she can perform conditions 5 and 6 once out of every out of the three trials. The calorics, OMS, rotary chair, SVV, VHIT of all canals and ocular motors were all within normal limits. So how do we interpret these results? We have a cervical vemp weakness with reduced right labyrinthine reactivity affecting the saccule and or the inf vestibular nerve or the descending motor pathway. This is an important test because calorics, ovimp, rotary chair all test the superior vestibular nerve.

The CVEMP's one of our only inferior vestibular nerve tests. We can use the posterior canal VHIT also to gain some information about that inferior vestibular nerve. The difference is that the VHIT for the right posterior semicircular canal will return to normal when the patient compensates, such as in this case case. So we have an asymmetric CVEMP with normal VHIT results for all canals. This might suggest that the patient has compensated for that vestibulopathy.

This would not be too surprising because as Dr. Rutherford mentioned, he's no longer having oscillopsia in the vertical plane. So it does show that his symptoms for that are better. We also have a global aphysiologic pattern of postural instability on cdp. The patient was able to randomly perform the more difficult conditions without being able to repeat these conditions.

It does not show a modality specific pattern of postural stability though. And all of our other vestibular tests are within normal limits. So now what? Well, we have a potential for something called persistent postural perceptual dizziness or 3 PD. This is a diagnosis that is encompassing of a lot of different previously known causes of dizziness, including things like postural phobic, postural vertigo, space and motion discomfort, visual vertigo, visually induced dizziness, chronic subjective dizziness.

There's been a lot of names for this over the years. More recently, this has been the term used to describe essentially all of these. The diagnostic criteria, per the article from Jeff Staub out of Mayo Clinic Rochester and colleagues, is that they need to have five parts. First, there's one or more symptoms of dizziness, unsteadiness or non spinning vertigo present most days for at least three months. The symptoms must last for hours at a time, but can vary in the severity.

They do not need to be continuous throughout the day. Symptoms are persistent and occur without specific provocation, but can be exacerbated by upright posture, active or passive motion without regard to direction or position, and exposing to visual stimuli or complex visual patterns. A lot of these are exactly what our patient is describing. The disorder is precipitated by some kind of condition that can cause vertigo, unsteadiness, dizziness, problems with balance or other neurologic medical conditions or psychological distress. This may be intermittent, it may be more persistent over time, and it may develop slowly and gradually worsen the symptoms do cause significant distress or functional impairment and they're not better accounted for by another disease or disorder.

So these symptoms do match what our patient is describing. He is having some kind of imbalance instability, they were precipitated by a vertigo event and it is causing him significant distress or and functional impairment.

When someone does have three PD, SSRIs and SNRIs are shown to be helpful. These can reduce symptoms by 60 to 70%. Vestibular imbalanced rehabilitation therapy can be helpful too. Our patient has already gone through six weeks of VRT to help with the oscillopsia symptoms following what we suspect may be an inferior vestibular neuritis attack. However, the best benefit comes from continued VRT for months three even six months to receive maximum benefit for this condition.

Cognitive behavioral therapy can also be used to help with 3 PD. It's sometimes it's better used if other managed not helpful and there's significant coexisting anxiety for this patient. The PT is a bit more complex and different than what was previously done. Essentially, the PT's goals are now to encourage the patient to do more and move more with each session, using in a way, cognitive behavioral therapy methods to show the patient how good they are and support them as needed while they increase their movements and essentially return back to their normal daily activities. The the PT acts almost like a cheerleader in telling them how great they're doing and giving them that emotional support too.

So stepping away from the case for example, but report writing in general, this is essential. We need to not only help our physician with potentially differential diagnosis, but sometimes we're actually educating providers. We need to always remember our audience reports for ENT versus neurolog or primary care physicians are going to be somewhat different. Ents are going to have much more detail information about anatomy physiology, while the primary care may not be as familiar. So we need to keep it a little more simple for them.

Not that they're not intelligent themselves, but ents just have more training on the actual anatomy and physiology parts. Most providers want very clear, concise reports without a lot of jargon. They we always need to make sure we answer questions about is there peripheral vestibular evidence, is there central vestibular evidence? And when we can we should provide some appropriate recommendations too. So our report for case one needs to be as simple as we can and to the point for the vestibular

portion.

For the unilateral vestibular dysfunction, we can report on the asymmetric CVEMP when reporting results as audiologists remember, we can't make diagnoses except for bppv, so we can only report on the anatomical suggested site of lesion with 3 PD. Our report writing is a little more specific, mostly because a lot of physicians and providers are still unaware of 3 PD. We can use the word suspected because we're not diagnosing the condition. We're suspecting the condition based on the patient's reported symptoms and their presentation. With this type of verbiage in the report, we can provide the medical providers with specifics about our patient and about the 3 PD criteria, and we can also tie in our CDP results here.

We would never want to call CDP in in these cases aphysiologic or accuse the patient of malingering because they're not the patients, they're not faking their symptoms. They this is a real disease disorder and they have probably been told it's all in their head at some point. Those kind of more accusations in a way to the patient is actually potential to cause them to get worse over time.

Communicating Results with Providers Every provider will have their way their preferred ways of communication. Some will prefer a phone call, some may prefer an email so they can communicate with you without playing phone tag. You just have to be extra careful about HIPAA in that case and make sure the email is secured. If you're in a medical facility, you may have secure messaging available between providers and that can be usually fairly easy to use if you're going to call. Sometimes first thing in the morning when the office opens, or just after lunch before clinic starts or at the end of the day.

Are a lot of times the best times to get a provider on the phone. If their provider's unfamiliar with something that you're discussing, such as 3pd, for example, you can send them articles to help them understand and become familiar with this. They're not going to remember everything you say, so

having that kind of backup with research is extremely helpful and useful. Useful and overall good communication with referring providers can really help increase referrals to your practice.

So with our case, the patient does have symptoms that are related to 3 PD. There was a triggering event, such as a vestibular event. In this case he was started on Fluoxetine or Prozac and he restarted vrt. This time, however, he was giving much higher level activities with VRT because he's already compensated. Essentially the therapy again was geared to show him how well he' doing.

He was also given a home exercise program to do to help sort of speed the process along with the exercises that physical therapy knew that the patient could safely do on their own, but also help get him moving more because of his anxiety. He actually did want to do cognitive behavioral therapy and he did continue those sessions long term because he thought they were very useful. After about eight weeks of the medication, the VRT and cognitive behavioral therapy, he did feel about 90% better. Of note with him, which happens with a lot of patients with 3 PD, is that once somebody actually explains it to them and spends time talking to them about this disorder, which a lot of times is either physical therapy or audiology, that is enough to make them feel better. And they might actually get 30, 40% better just because somebody finally understands them and what's going on and can actually give them a diagnosis in a way.

So that is something that is useful if you have time to spend talking about this, that this is a possibility and that the referring provider would be the one to make the final diagnosis. But just the fact that somebody out there cares and understands and has seen patients like this before can be very useful.

Okay, switching into our second case. Now. This is a 56 year old male. He was taking down his Christmas lights. He thinks that he was reaching out for the Christmas lights when he lost his footing and he fell off the light ladder.

Fortunately, he fell onto grass and not concrete. He was pretty sure that he lost consciousness for a short time, but he's not completely sure. He doesn't remember it too well. He doesn't remember a lot of the details about the fall very well. He reports an immediate onset of headache, dizziness, imbalance and neck pain.

His wife did call an ambulance and at the emergency department he had a CT scan that was essentially unremarkable. He was told that he has a concussion. He did not have to be admitted to the hospital. He was sent home with an outpatient appointment for neurology and told to also follow up with his primary care physician. Neurology ends up sending the patient for vestibular testing so we get to see him first.

On the audiology side, his medical history is remarkable for high cholesterol managed by lovastatin, and he has pre diabetes managed pretty well with diet and exercise.

So the patient was seen about two weeks after his fall for the vestibular testing. All of his symptoms started after the head trauma. None of these were present prior to the head trauma. So he states that his current symptoms are headache that is present most of the time. When asked how severe the headaches are, with 10 being the worst headache ever, he reports his constant headache will be a minimum of five or six out of 10, but it can reach a 10 out of 10.

He notes that his headaches definitely worsen throughout the day, Especially when he's trying to be more active. When patients have headaches, it's helpful to ask what other symptoms occur at the same time. With this gentleman. It's also helpful to ask associated symptoms with his constant headaches and symptoms that occur when his headaches increase. So he reports that nausea is present at a very low level pretty much all day.

Movement can increase the nausea. Nausea. Nausea will also reportedly increase when the headaches increase. The photophobia and phonophobia are present most of the time, but also become worse when the headaches get worse. He also reports constant pulsatile tinnitus, oral fullness and autophagy in the left ear.

His concussion related symptoms include confusion, disorientation, ataxic gait, sleep issues, increased irritability and slurred speech. He also does report that his neck does has been hurting and his head feels heavy like a bowling ball.

So in my own mind, when somebody comes in with a large list of symptoms such as these, I've worked a lot with concussion patients in the past and I typically try to separate their symptoms into different silos. So for him, I separated kind of in my own mind or maybe if I'm writing this down, I separate his symptoms into cortical concussion symptoms. Something that might be more related to like a post traumatic headache or migraine. Audio vestibular symptoms and then cervical type of symptoms. For the audio vestibular symptoms, the pulsatile tinnitus may or may not be an audio vestibular, but I don't know yet.

Autophagy, earfulness and dizziness. Dizziness can be related to pretty much any of these.

So in his testing, I'm going to go through these fairly briefly. One test on each slide. His vestibular testing the modified CAT S where his eyes are open on solid ground and then eyes are open and closed on foam. He did fall on condition two and condition four when his eyes were closed on solid ground and on foam. His audiogram was received at an out from an outside clinic.

That is why the photocopy of a photocopy of a photocopy is here. Well, when we asked, do you have hearing loss? He says, well, somebody told me I do. But he does have a mixed left ear, high hearing loss with a low frequency conductive component. Component.

His tympanometry was normal and a Jerger type A. His acoustic reflexes, both IPSILATERAL and contralateral were present. So that does not make a lot of sense. Right. So we have a mixed low frequency hearing loss, the conductive component and the low frequencies.

But we have normal emittance testing, so that does not fit very well. Moving into the VNG portion, his saccades, he has hypermetric responses. So every time the the saccade moves to the right or to the left, he has these overshoots that are occurring consistently in both directions. This is a cerebellar dysfunction indicator. And with this, when this occurs, it's not going to happen just once or twice.

It will repeat over and over throughout the saccades.

During gaze testing he did have a pretty consistent downbeat nystagmus with eccentric gaze that reached up to 12 to 13 degrees per second. Pure downbeat, no torsion or horizontal component. On calorics he did have hyper responses. So if you can see the numbers here, his left warm response was 148 degrees per second second and left cool was 105 degrees per second. Right warm 93 right cool was 65.

So he does meet criteria for these to be excessively hyper responsive. Rotary chair testing. On the step velocity test he had a long time constant. This is also something that can occur with motion intolerance. But typically it's a central vestibular indicator is ECOG testing.

So ECOG was done because post concussion, post MTBI patients can have have high drops for example that can occur and they may have a positive electrocochleography test. So he actually ended up ignore this. This one's a pretty messy ECOG here. But he did have a positive large SP AP ratio on his ecog and the area under the curve was also abnormally high.

Ocular vamp, he had a large left amplitude. The scaling here is only 10 microvolts. So this is a large left left amplitude of 24 microvolts. And the right is within normal limits.

So for superior canal dehiscence we have different symptoms and signs that we look at. So symptoms can include a tulio effect or a henna effect where they get dizzy with pressure changes or with sound autophony. Pulsatile tinnitus can occur on the signs. We can have nystagmus that provokes during the VNG test. For example, example, the enlarged vemp can occur the pseudo conductive hearing loss.

That means that the admittance testing is normal in that ear. OAEs might even be present, but you have a conductive low frequency hearing loss that is a pseudo conductive hearing loss with present Acoustic reflexes. In our case we also have these patients also by the the way can have dizziness when they wear hearing aids, for example. So all of a sudden hearing aids are causing them to be dizzy. One thing that I also want to mention too is electrocochleography has been shown in literature to become positive when patients have superior canal dehiscence or other third window.

So they could have a third window paralymph fistula or a dehiscence and that can cause the ECOG to actually have a positive finding too. That looks like a mini years disease. Another test, one of the ones I mentioned before, that is a newer test is called ambient pressure tympanometry. This is a measure of the tympanic membrane compliance without any external pressure changes. So essentially the tip tip goes into the ear canal and we are able to measure the tympanic membrane movement without the patient moving at all or anything happening in the emits machine.

There's multiple middle ear disorders that this is sensitive to and a dehiscence or third window is also potential to have a sensitivity with this test. Normally we will not see a response, so the patient will have basically a flat line on the test and it takes about 20 seconds to run. Usually the patulus eustachian tube function test is a way that you can run it on some emittance machines if you have that accuracy success. From the article from Ty and all from 2020 this shows this one in a shows A ambient pressure

tympanometry is normal with no fluctuations. B is showing a lot of noisy fluctuations.

C and D shows respiration synchronous wave patterns that can potentially occur with things like eustachian tube dysfunction. E and F show a pulse synchronous waveform pattern. Both of these E and F do. So this is actually a way that we can potentially measure pulsatile tinnitus.

So in this case, in our case two, the test was performed using a patchless eustachian tube function test on the the inner acoustics Titan machine. The Timstar Pro can do this as well. The inner acoustics at 235 extended version can do it or the Titan versions 3 and 4 can do it. But what we see here is A a pulse synchronous waveform so that matches potentially a superior canal dehiscence. Along with our enlarged ECOG positive ECOG test and our VEMP testing as well as some of his symptoms, he also has what we would think is probably a post traumatic headache.

So the International Headache System Society has classified headache According to trauma to the head and or neck. And these categories, among others for this classification, are related to new onset of headache post head trauma. So IHS also states that the headache post head trauma may be an isolated symptom or it may be a part of a constellation of symptoms which may be dizziness, fatigue, concentration issues, psychomotor slowing, memory problems, insomnia, anxiety, personality change changes, irritability, among others. When these types of symptoms do occur, the patients may be considered to have post concussive syndrome in addition to the post traumatic headache. Our report writing for this case we do have a lot of central vestibular indicators.

The hypermetric saccades, downbeat nystagmus, caloric hyper response, prolonged time constant on rotary chair. These are all central vestibular indicators specific to the cerebellum. So clinical correlations recommended there. We do have post concussive syndromes that are suspected. These we do recommend multidisciplinary approaches with this.

Physical therapy is one way that we can do this. Kim's going to talk about that as well as the cervical assessment management. And I do like to mention with providers that therapy is most beneficial if headache symptoms can be medically managed. Speech therapy can also be useful for post concussive symptoms. For slurred speech.

We do have a suspected third window pathology with our enhanced ocular vemp. In fact, the ECOG also being positive could suggest a left semicircular canal dehiscence or other third window. And we're recommending correlation with that and the symptoms with the high resolution of the temporal bones, CT scan and otherwise we don't have any other remarkable peripheral distance vestibular findings.

I will turn it back over to Kim to talk about physical therapy for this patient. Okay, thanks Sara. So essentially the order of operations with this patient isn't an ideal scenario because there was diagnostic testing done prior to physical therapy recommendations, which really allows the physical therapists with the knowledge of the previous diagnostic testing to in a much more streamlined, efficient manner know what they're dealing with and also be able to really target target their evaluation to the actual impairments that the patient has. So this patient was referred to physical therapy. As Sara mentioned post medical workup, the diagnosis that this patient was referred to versus just the previous one had a generic diagnosis.

If you go back to case one of just dizziness and giddiness, this has a greater degree of specificity which is cervical or neck pain, essentially put headache and imbalance. So this is what the patient was presenting with with a protracted recovery post Head trauma. So their primary position was just that or presentation. Neck pain with occasional dizziness with head movement, headache and unsteadiness with walking primarily on uneven surfaces, both of which were noticed more towards the latter part of the day than the earlier part of the day. This is really common with protracted MTBI patients that as fatigue in the day catches up with the patient, so to speak, their impairments and limitations become

more evident.

So following sort of the same format and rationale that we did with the initial case, the items on the left are those low tech, no tech outcome measures that are commonly used in physical therapy practice to help guide the evaluation and then ultimately guide the intervention. Sara mentioned sort of categorizing or symptom separation. Physical therapists, rehabilitation providers will often do the same thing and will utilize the post concussion symptom scale. This essentially is a subjective questionnaire where the patient ranks from a 1 to 6 on a grading scale what their most common symptoms are. This includes the 22 most common symptoms of post concussion or protracted recovery.

So this allows the physical therapist or the provider to look at which trajectory the patient looks like they're falling under. Is it vestibular, is it cervicogenic, is it headache, et cetera. Much like what Dr. Jagger outlined in this particular patient's case, their score was very high, indicating headache was a primary functional impairment and issue for them. Their comprehensive cervical evaluation was performed a to rule in and rule out the obvious, any mobility issues, you know, large component of head injury, have an accompanying neck injury due to the mechanism of injury.

So it goes without saying that the joints, the soft tissue have to be evaluated. But the patient was also evaluated to see if there was cervicogenic dizziness contributing to the patient's overall presentation. In this case, the cervical torsion test, which is a simple seated test where we can assess movement of the body on the head versus moving the head on the body to see if this increases the patient's symptoms. In this case, the patient tested positive for cervical torsion, which indicates that cervicogenic dizziness is present. Something that is, you know, undisputable and in the literature is the influence of aerobic, I should say specifically dosed aerobic activity with patients with protracted recovery.

So this physical therapist performed an aerobic capacity assessment to essentially determine what the patient's exercise threshold would be so they could prescribe and dose therapeutic intervention with

exercise to facilitate that optimization autonomic issue that the patient was having and also facilitate that cerebral automation that's needed a strength assessment. Again, Very standard protocol with most rehabilitation showed just some decreased trunk strength, lower body strength, which could be addressed to help with functional impairments or postural instability issues. And last but not least, a concussion specific tool for postural instability testing is the best test, the balance error scoring system. This patient initially scored a 44 out of 60, which this is not a great score. The more errors you have, the higher score you have.

So we determined that obviously postural instability is an issue here primarily with conditions where the eyes are closed. So those objective limitations that were measurable, there was direct treatment and direct intervention as a result. So this patient was seen for two times a week for four weeks. In this case, the rehabilitation provider was given eight total visits. Management strategies included cervical joint and soft tissue mobilization.

This is twofold. This is obviously to address all of the cervicogenic issues from a range of motion perspective, but also that is the gold standard on how to address cervicogenic dizziness. Manual therapy is a key component of that. The physical therapists employed lower extremity core strengthening to help with postural instability general movement. And the big focus was on a very prescriptive aerobic activity approach that stayed within the patient's heart rate and symptom threshold to again facilitate that cerebral automation.

So here is the post therapy outcomes. You'll see the same tools that the physical therapist used initially are going to be used to reassess the patient. So the post concussion symptom scale, which again is that subjective questionnaire of those 22, two most common symptoms post head trauma, the patient is now ranking themself at a zero out of six, which is excellent. So the cervicogenic component of the headache has resolved their comprehensive cervical evaluation. They had a full restoration of range of

motion minimal pain, 1 out of 10 on a subjective pain scale versus the initial which was 7 out of 10, and the cervical torsion test, which now negative.

The aerobic capacity assessment was able to guide the physical therapist to give that appropriately dosed therapeutic intervention for aerobic activity. And the patient was discharged to their pre injury aerobic activity level. The strength assessment revealed normal trunk and lower extremity strength. And the postural instability testing, which was initially a 44 out of 60, was an 18 out of 60, which for this patient's gender, age is within normal limits.

So to kind of summarize this, you've got to see two very unique patient cases, one of which followed the trajectory of rehabilitation intervention prior to diagnostic intervention, and one of which that showed diagnostic intervention prior to therapy intervention. One thing we really like to emphasize here with our cohort, our colleagues, and obviously here at the institute is encouraging of that multidisciplinary approach. The testing protocol prior to rehabilitation really does help best quantify that patient's impairments and it in turn arms the physical therapist or the rehabilitation provider to be more efficient to know what to target, to know what to assess and what to measure and ultimately how to do. Very, very, very specific intervention that's patient specific. That improved efficiency from just an evaluation strategy, strategy from a visit management strategy all the way just to, you know, an intervention strategy essentially results in improved efficiency.

And the real win here is obviously improved patient outcomes. When a rehabilitation provider is armed with information going in to manage these complex patients whether they're vestibular or not. The more information they have, the better and it truly does allow for those diagnosis based strategies to be employed in a much more effective manner. Those improved experiences and outcomes are good for everybody. Obviously the patient being the first priority, but also from the ancillary care provider, which is in this case the audiologist and the physical therapist working as a team.

Getting improved outcomes obviously helps with the overall greater good of what we do as providers, but also helps strengthen those referral relationships with the physicians that send patients patients to us.

Dr. Jagger, did you have anything else you wanted to add? No. Thank you very much. Thank you from Kim and I for inviting us for this talk and for hosting U.S.

audiology Online. And we do have. There's a question in the Q and A that I wanted to address too. Thank you for asking. Any questions that you have for us, feel free to put them in the Q and A.

The patient, did the patient, the second patient, have CVEMP testing performed for this case, Case two? Yes. There were a lot of tests that were performed that I did not cover because showing every single test would have been really long and laborious. But the CVAM testing actually was within normal limits and symmetric as well as things like positionals that downbeating nystagmus did not get any worse or change in positionals post head shake, there was some dizziness, but there wasn't any change in the pre in, in, in nystagmus. So they had a full comprehensive battery just from the aspect of the abnormal test results or what we showed.

If anyone has any other questions, feel free to ask in the Q and A, we will be here. There's a question in the chat now about the what's the best way to find a vestibular physical therapist? That's a very good question, Kim. Do you want to answer this one? Sure.

Obviously the best approach, I always encourage audiologists, physicians, quite frankly, even physical therapists, is network in your community, ask questions. You can certainly do Google searches. You can go to AIB's website. We list all of our certified providers by zip code there as well. I think that's a really good way to find certified vestibular providers.

But there's other, other avenues as well. So I encourage you to reach out, make friends with, with all the physical therapists within your market because they may be trained from multiple different avenues. But the best way to really do that is just reach out to, you know, your cohort and your communities and make a friend because, you know, physical therapists are always looking to collaborate with diagnostic providers. So I just encourage you to reach out, build those relationships in your own, in your own market. It very good.

We'll be here for, for the rest of our time. If anyone has any questions at all, we're happy to stay on and answer for a few more minutes. Thank you, Dr. Jagger and Dr. Rutherford.

We don't have any other questions in the queue, so I'd like to just take this time to remind the participants, should you wish to earn the CEP credit, please wait for the exam to populate, then complete them all. Multiple choice exam and we'd like to again thank the American Academy of Audiology for the ongoing partnership. This is the first year of this partnership and it's been a success. If you've missed some of the other presentations put on by the academy, they're all in the library. And we'd like to take this time to thank Dr.

Jagger and Dr. Rutherford for sharing their expertise in these really interesting, interesting cases. I'll go ahead and close the classroom out. We hope you all enjoyed this presentation. Thank you so much.