

A reminder, your agenda and the PDF of the presentation is in the files pod. I recommend you access those immediately. Also, we have the sign in sheet that will need to be returned to Troy, myself, or the email in the packet you received. We will present that information in the chat box shortly. Also, this presentation is being recorded. We also ask that if you have any questions during the presentation, please feel free to put all of your questions in the chat box. We love your questions. Whatever you want to do, share whatever you want to share in the chat box. Also, as a reminder, we have questions pre-recorded and they will be available. Please feel free to access and share with people. You will have to do a short registration, just your name and email to access those, but yes, they are available. If you want to raise your hand, there is a little man in the corner pocket that will allow you to do so. We recommend you use the chat box. Reminder, there will be a survey that goes out about a week from now that will be very important for us to plan for next year's skills and all of the funding and everything we are doing in regards to pain skills. Please, please, please give us survey responses. I know it is different because we are doing this virtually, but we really appreciate any feedback you can give us.

Separately from that, the CME survey. This survey is completely different from the survey you will get from infinity conference group. It will not be the same. You will have to complete that survey to receive your CME. We have to manually add every single credit for each individual person. It will take three to four weeks.

You will receive an email from the CME system once it is time to receive those credits. Also, if you have trouble, this is a logistics thing. If you have trouble for whatever reason and the slide goes blank you are having tech issues, we recommend you leave the room and come back in because you should be allowed to -- You should be able to see this again. This has worked a couple times for people, so we highly recommend you do that.

Without further ado, I will hand over to our presenters. Welcome to Dr.Chae, Monica Kramer, and Muzna Ahmed. Thank you.

Good morning, everyone. Obviously, we want to introduce ourselves individually when it is our turn to present our part of the lecture. First of all, we wanted to explain that we have this workshop in two parts. >> The first part will be using slides to share information that we feel it is important to share with you.

The second part after the break will be more of a using cases, actual cases that we had the privilege to treat and using that as a platform so we can share more information with all of you.

Having said that, I just want to welcome everyone. We are honored and grateful that you have chosen to join this workshop. This is definitely an exciting topic for us, TBI and pain. This is what we do. Those of you that attended the previous session on Tuesday, we are in the same network. We see complex cases primarily with the diagnosis or suspected diagnosis of TBI.

What we found over the years, even though the usual presenting concern or diagnosis, they all have some type of pain problem. Most have chronic pain. We have been amazed by the number of incidents of pain in this population. When we were asked to lead this workshop, we thought this would be a great opportunity to share all of our experiences with you. Even though we are a clinic, we feel like we are a pain clinic as well. That is sort of the background story for us.

Personally, I am trained in pain medicine and certified in brain injury medicine. I have done some soul-searching, going out in different fields and finally found a happy medium where I treat all three and I use all of my skills to manage my patients.

Let's go over some of the slides before we go into details. Disclosures, we have nothing to disclose. Again, these views are all personal and does not reflect any of the official policies with the Department of Defense. I just wanted to share that. Here is our title slide.

What I was going to do today, it is such a broad topic, TBI pain. We struggle how to share this knowledge with all of you. What we decided to do, at least from my part, instead of spending a lot of time on diagnostic criteria, I decided to focus on more based on past pathophysiology. A lot of times as clinicians, we focus on diagnosing people and rightfully so. Often times we stored focus on what is going on in the brain. That is where I will be spending most of my time and I will branch off into how that can relate to -- How this can affect pain, perception, and hopefully that will set us up well for the rest of the presenters in the lecture.

So, TBI and pain. It is very common. Actually if you do medical research, there are a lot of articles out there citing the range of incidents kind of fluctuates, but they all agree at least half of TBI patients report acute and or chronic pain during some point of their , I guess, timeline or history.

In 2008, the milder spectrum of TBI, mild TBI associated with a higher rate of pain led to severe TBI, especially with lower pain. The suspicion there was not so much there was actually a discrepancy with actual pain with this population, but the moderate to severe TBI patient has impairments, especially expressing their emotion and verbal difficulties. Of course, this population also has some alteration of consciousness. Therefore, they just cannot report pain exactly as they could because as you all know, you know, ready much the pain scale we use our subjective self-reports.

If a person has difficulty expressing their emotion, which pain is emotion, they will have limitations on that and therefore underreport their problems. Some may be mild or moderate TBI, which we will be focusing more on during this workshop. Maybe it is a more true reflection of the incidence of pain in the TBI population, which is actually three out of four patients report some kind of pain. Whether it be right after the incident or injury, or maybe at the onset interestingly. >> Just to quote the numbers, I think it is safe to say 50% of TBI patients experience acute or chronic pain. Interestingly the injury and biological

factors are often not sufficient to account for the development of chronic pain.

A lot of times there is a disconnect or not a relationship between the severity of injury and the biological factors and the development of what we call chronic pain or severity of pain. Just by example, I see a lot of people who I think had pretty insignificant TBI. They had a very disabling headache, to the point where they cannot participate in any life activities, including work.

I have seen somebody completely missing their frontal lobe from TBI reporting no headache or pain. I should again say the severity of TBI is not equal to severity of pain. You can have the milder spectrum of TBI diagnosis and have disabling pain, and actually have severe TBI and have very mild or no pain.

As a clinician, it is very important that right off the bat we should not assume just because a person has milder TBI, they should not have pain or have less pain. Actually, quite opposite is true. That is an important point for me to mention that.

The degree of associated physical or structural damage, this issue can complicate the clinical presentation. As I mentioned earlier, the more severe spectrum of TBI, they have had more problems with language and expression. That actually impairs their ability to communicate. If you just rely on the typical "normal patient" between the provider and the patient, you can pretty much assume that your information gathering is going to be inadequate. You might want to consider supplementing that with something else, whether it be more of -- Less of a subjective pain scale or having somebody that knows the patient well, if they gave you further information.

If it is a more mild spectrum, or whatever the spectrum of TBI might be, if you notice the person has significant alteration of their emotion, you can also assume that their pain perception is going to be affected by the emotional state that they actually are at during their time of visit. >> Unfortunately, our healthcare system gives us a snapshot of a patient, whether it be three-minute even to an hour. We have to understand we are literally getting a snapshot of a broader presentation for someone with TBI. I think it is very important that we understand the limitation of a TBI patient, and it comes to history gathering and trying to understand what exactly is going on with them. A very important point to mention there.

So, the next slide. Pain location, not surprisingly, headache or head pain is the most common for this population. You know, the whole body can be affected. I always find it fascinating that this injury does not call for, or does not explain some of the pain locations, if any. Often times I say that, again, the mechanism of injury does not match the location of pain. This is something we commonly see in the patient population. According to Lucas and this group, pretty much he says we should consider or expect people with TBI can have pain in any part of the body. Approaches to managing TBI -related extracranial pain, in fact

even headache management which we typically call posttraumatic headache, it is lacking.

For extracranial pain, it is more lacking. In fact, outcomes from standard pain treatments may be worse in patients with history of TBI, according to a journal in 2016. That is pretty much my experience as well. My practice was primarily pain management.

I also found this is a very frustrating population to treat. I tried to avoid this as much as I could. One of those is the TBI population and psychiatric diagnosis patients. If you have two of them together, those are definitely the people I do not want to see mainly because I know the outcome will be poor. Whatever I do to treat the pain, it will not come out well in this patient population. That was proven in a recent article from 2016.

I think the other speakers here will tell you we don't expect standard pain treatments to work with this patient population. In fact, they have gone through standard pain treatments before coming to us. We can say this is all very accurate.

Acute pain and TBI, since there are different mechanisms involved in acute pain in TBI compared to chronic pain with TBI, this has to do with the physiology. Basically, the damage affects perception. The diagnosis is significantly involved with acute pain. We will talk about the importance of the nervous system and TBI. Pain is very commonly seen, which may be the reason why the standard pain treatment did not work in the TBI population because often times we underestimate the significance and often times we go off of the pain generators without adding the fact that the pain is also sympathetically needed. You have to look at acute pain in that perspective.

Whereas chronic pain, you know, mechanisms can still be in play, but we often see centralization of pain. It will sort of evolve into not just involving the pain generator, the extracranial location, but actually pain is centralized to more higher levels in the deceptive pathway. It actually involves the actual perception of the pain itself and it becomes more of a suffering rather than just pain, you know, symptoms. >> There are multiple factors that start to come into the picture, whether it be personality traits, their past experiences, their interpretation of what suffering is. All of those complicated factors come into the picture. That is often times what we are dealing with in our clinic.

At least the way we approach this, if you look at the journals in general, the pain journals, this is sort of the clinical guideline recommendation. It really calls, especially with the TBI population, it calls for personalized, individualized, interdisciplinary approach. We emphasize the word rehabilitation management, in which mechanisms and other factors supporting pain are identified prior to initiating treatment. >> We will come back to that recommendation later, but that is what I wanted to remind you about.

So, what is the definition of TBI? I wanted to look at the physiology perspective on what TBI is instead of going into clinical criteria of

TBI. I simply wanted to say, and I often say this a lot, TBI, you can look at the central nervous system injury. Try to understand TBI is a central nervous system injury. A lot of things start to fall into place. This will make things a lot less complicated, or less challenging. This will be less challenging for you when you approach your patient.

As you all know, the brain is part of the central nervous system. We are talking about injury to that organ. When the brain gets injured, when we talk about TBI, it requires external force. There are different implementations of brain injury. It does not require extra external force to cause the injury, but in TBI for our definition, we will basically talk about injury to the brain, central nervous system that was caused by external force.

Whether it be small or big, there is some type of external force. It is enough to induce change. Change meaning it could be physical change, like literally tearing the axon or causing hemorrhage, all the way to just functional change. The structure might be intact but there is destruction of the mechanism or electrical impulses of the brain. Whatever it is that can induce change, right? That is what we are talking about in regard to what TBI is.

That type of damage results in physical injury, like a hematoma. They usually require nonsurgical intervention, but also this type of change involves what we call microscopic changes or damage. You might not be able to see it visually with the naked eye, but under the microscope, you can clearly see evidence of damage. That is where the explosion of understanding TBI over the past 10 or 15 years, it is really the discovery of what is going on underneath what we see through imaging studies or through the OR to the naked eyes.

What makes it more baffling, after the initial damage to the brain, it seems like there is a delayed effect. It is almost like an aftershock. It is the earthquake and the aftershock that comes later. We all anticipate that, right? We all brace ourselves for the damage. When it comes to TBI, there is definitely aftershock where there is a delay and damage actually. This can delay symptoms. If you are not looking for that, you might wonder why this person is getting worse after a few days or weeks or even months after the injury. That actually can happen.

You can look at that aspect of whether it is microscopic, or further delay onset of injury, this is a very complex interaction between we will call it cellular metabolic changes that can lead to further damage in the surrounding area or the network of the damage in the brain.

What makes things even more complicated, more compounding, actually the brain has this innate ability to heal and repair itself. We call this neural plasticity. Unfortunately, there were a pair does not have a clear map, clear memory how it was before the injury. >> When the brain starts to repair itself, sometimes the reconnection of the axons, it is not exactly the same as before the injury. When that happens, you will see this reconnection that sometimes results in different basically networks or different connections than prior to the injury leading to changes in symptoms and sometimes changes in personality or changes in behavior.

Changes in their perception or insight really complicates the picture for the condition.

It is very important that we understand that we care for the injury. This could happen later on after the onset of the injury. This can complicate the clinical picture. You can see the primary event when the injury happened. The secondary event and the repair phase can also complicate the picture. You can see already this is a very complex process and phenomenon.

We are learning more and more. I'm sure next week there will be more articles, kind of bringing the light into the complexity of what we are dealing with when it comes to the brain and a lot of diagnostic tools that keep getting better. We have the same diagnostic tools. They can be really helpful. I will tell you that as a clinician, sometimes this diagnostic tool, this high-tech stuff is really amazing and helpful. It is incredible. A lot of times it makes me more confused because I cannot correlate what I can see on these amazing scans with the clinical feature.

I am here to tell you that a lot of diagnostic tools that we have, they tell us what is going on with the patient, but not anything about the prognosis. That is why it is difficult and challenging to treat this patient population.

I know there are very tiny words here, but I will try to read this to you. Comorbid factors may have an important effect on recovery. That can pretty much complicate the clinical picture. It is important to assess what other injuries occurred in addition to TBI at the time of the accident because that also can contribute to the pain presentation are not responding to treatment.

Noninjury factors are a big part of this picture. You know, we are always talking about it is super important to understand these factors, whether it be comorbid factors because that can give you a clue to what is going on with your patients and it can give you a clue on how to approach these patients. Their experience with previous medical providers and education level and vocational and financial history.

Just to summarize, TBI is the most complex disease known to man. This is the most complex of our organs.

Let's talk about the pathophysiology a little more. As I said earlier, I like to break it down to primary brain injury, which happens at the time of the impact. External force results indirect damage at the time of the event. Secondary brain injury, this refers to damage sustained minutes, hours, or days after the primary injury. I will tell you that many clinicians do not appreciate the impact of secondary brain injury many times. They just focus on primary brain injury, which is where I will say the pitfall -- Clinical pitfall happens.

There can be a lot of assumption with providing corporate care in this population. It's talks about primary brain injury. Primary brain injury, obviously any kind of external force can cause these types of injuries

and the brain. Contusions typically involve injury to the brain cells. It can rupture vessels by external force that results in hemorrhage. Also, there is a whiplash -like motion. This can also mix in with the stretching and shearing of the neurons and axons. Also, you can have penetrating injury, like a gunshot wound or something like this. This is a penetrating brain injury with the knife there.

Thankfully, the patient, believe it or not, survived. Obviously, that looks bad. It is not all bad. I treated a patient when I was a resident that involved something so this is a contusion.

They are circular usually. You can differentiate that with something like a hematoma, which is less bright in intensity because of the blood density versus actual brain tissue. This is highlighted by the moon shape. The epidural is more circular and more pronounced. This has a brighter signal. The difference again, for those of you already know, a subdural hematoma is caused by a ruptured vein, whereas epidural is due to a rupture of the artery.

Obviously it is more critical to intervene with the epidural hematoma because the rate of mortality is higher because that rupture can cause intracranial pressure, whereas subdural can be more fragile and have more time to spare before you can intervene and have the patient survive.

This is actually a classic brain injury. They can certainly happen during primary, but we often see this during secondary because the initial damage to the axons, what often times happens within a few minutes or hours or even days, there is actually cerebral edema. You can see pretty much lots of gray and white matter differentiation. It looks fairly faint across the board, as opposed to the epidural hematoma there. The brain is getting squished by the hematoma. Here you pretty much have no differentiation there.

Often times due to injury of the axons can lead to swelling of the brain. This is a typical picture of an MRI picture in a mild TBI patient. This is a normal MRI. You don't see the milder spectrum of TBI. We actually see less of evidence in the imaging studies. Here I am just going to mention here that mild, moderate, severe is based on these findings. There is probably a lot of confusion there. I am here to tell you to simplify a very complicated criteria, initially it was based on this graphic. If you do not see much going on the MRI or imaging studies, we tend to rate this as a milder spectrum.

If you have a lot of things going on with the imaging, we tend to go more toward severe. As you can see initially this has nothing to do with clinical prognosis. It does not tell you anything about how the person looks from a clinical presentation. It becomes a little more sophisticated of the TBI.

I am also here to tell you that no matter what criteria you use, it does not tell you anything about the prognosis. Certainly, more severe TBI with, we can have a rough idea or percentage of how many results in mortality, disability, and return to previous activities but it still does not give us a prognosis.

Just because somebody walks into your clinic and has a mild TBI diagnosis, you shouldn't assume they should be really fine.

Okay, I want to dive into a little more axonal injury. That seems to be more appropriate for this topic. As you can see in the cartoon, this is a picture of a typical injury like whiplash type of movement. When that happens, usually they don't get the contusion which is damage to the gray matter or brain cells. This can result in axonal injury. This can happen with actual care in any part of the axon or neuron. This could be a stretch of the axon that could trigger this cascade of events that produce secondary brain injury, which we talk about before.

This cartoon actually is pretty cool to understand what happens after the initial injury, what we call primary injury. As you can see on the left side, there is a cartoon figure has an injury in the frontal lobe, the red area. Also what happens is that involved probably the axonal injury because of the impact of the force, the stretching of the axons that triggers a cascade of events we have talked about. It can decrease blood flow. All of this neural cell death. Channels are becoming blocked or activated. All of these events that react to the primary injury, that reaction causes further damage in the area.

A primary event cannot cause as much damage in an area on the left, but after time passes, the secondary injury starts to damage other parts of the brain. As you can see on the right side of the figure, the red area gets damaged, resulting in more injury compared to the initial injury on the left. This is actually fairly common, unfortunately. This is more common of a reality for TBI patients, especially as the external force increases, right?

As that external force increases, you can see this in the clinical picture. It is super important to understand the mechanism of the injury when you are trying to understand the severity or implication of TBI and the clinical picture and prognosis.

I pay a little more attention on the course of recovery or what happened after the event. If somebody said they were rear-ended by a car going 55 miles per hour versus they were rear-ended by someone that was, you know, stop and go traffic. I know that external force level is different, and this complicates it.

I expect a more complicated picture like that. I will look for any kind of delayed symptoms. I tried to break it down. I will look at what happened at the time of the event. About a week later, what kind of symptoms are you experiencing? Often times you see the development of symptoms. It is almost like delayed onset of some of the symptoms that happened after the injury. Unfortunately, a lot of clinicians sort of, you know, they have poor understanding. They will start to question the patient and start to not believe the patient's story. They might exaggerate their problems.

I want you to know that often times, that is not the case. Not to say there is no secondary gain with TBI. We certainly see that, but I don't want this small population of people.

I will drill this point over and over. To have you walking out of the workshop and say that TBI is not obligated that I thought. And spend more time thinking what happened to the patient's brain for dive in and remove their symptoms. This Axon that you see on the figure on the top, there is a stretch for the sheathing of the Axon. Leading to the cascade of events. You can see on the left-hand side here, the Axon after stretching or disconnection causes swelling. And the regulation and it causes what we call, the injury. It impairs the transport and transfer in this case it means there is a communication between the brain cells. Leading into further damage. Interestingly, more and more evidence that the proteins are to appear at the site of the injury. You can see the deposit of the protein ultimately leading to the neurofibrillary tangle. That is healthy how right, especially associated with Alzheimer's or CTE diagnosis. All it is the protein that is evidence that there is a delay of a secondary injury to the brain. Evidence that there was a process going on that could result in further injury. Is sometimes the protein does not appear in the mix until after the injury. I want you to appreciate the delay onset and the physiology when it comes to secondary injury. Where there is a neuron there are different process. And you can read for yourself some of the things that can happen that can lead to acute neural dysfunction. This is seen in a few hours after a positive event. And is external force can cause a blood vessel injury. It can cause a hemorrhage that can come in the study. And some of the subtle injury and the brain barrier. Which cannot detect through the neural imaging study. That is another level of complexity. The blood brain barrier compromise as I will explain earlier does it later, why there is a high incident of sleep disorder. Also, why some medications do not work. Because the blood brain barrier is compromised. Oftentimes on the TBI patients. Sun to start blood-brain barrier is only a specific period of time. Can be a different window on how long the barrier is compromised. There is no diagnostic test to tell you how long it will take you can imagine that you give a certain medication to a patient through the window of compromise. And you can expect a different outcome than someone who does not have a compromise. I could spend an hour talking about the limitation of chronological treatment for pain in TBI patients. I wanted to explain the reason that a lot of conventional pain medicine does not work in these patients. As you know, most of the pain medicine that we use are off label. It is off label use for pain. It is typically migrant medicine that is used off label. Because of that, when have blood barrier compromise, you can bet you have more adverse side effects. That is the reason a lot of people do not tolerate medication after TBI. The used to tolerate medication before TBI. This is one of the main reasons that we have to appreciate this. Often times, TBI ideation patients do not approach with medication. Is more injection because of what I am talking about. Hoping they have pain generators contributing to pain. Often times, pain medication is not a good option with this population. This article in 2018 with the Kenny group with brain injury highlighted what we expected already. People with TBI have an increase of Amyloid Beta and Tau protein. And we can see that the more TBI you have, there is an increased protein with markers. It confirmed what we

suspected all along. There is an ongoing damage that can happen after the initial event. It calls into question what is the management of TBI looking like? We focus on 72 hours and that let them go and send them on their merry way, knowing there is a secondary issue going on? It changed clinical management protocol. In brain injury medicine. This is a picture of micro vasculature. I put this here to appreciate how thin the capillaries in vasculature can be in the brain. This is under a microscope. You can see why external force, this type of vasculature can be vulnerable to force. It should not be a surprise to you that there is a micro hemorrhage, when it comes to TBI. This is a section of the micro vasculature after the sharing of stretching. You can see on the right-hand side, it becomes more course. The left side is normal micro vasculature. It leads to the blood-brain barrier. It becomes more permeable. Which can affect the communication and the Chronicle logical intervention. In 2010 through the present time, there was an explosion of understanding in sleep medicine. Especially with the understanding of lymphatic pathway. For the purpose of time, we will focus the topic of our discussion and I will not talk too much about this. And Glymphatic Pathway is responsible for the metabolic hearing of the brain. It turns on while we sleep. That is why sleep is so important for brain health. That is when the clearance and metabolic information gets cleared. It turns out in TBI the

Glymphatic Pathway gets torn. We brought attention to the importance of sleep and recovery from TBI. Are why a person does work later on after the event. It is because they get worse because they are not getting the Glymphatic Pathway clearance from the brain because the impairment to Glymphatic Pathway. If you look at the literature, TBI is a factor for sleep disorder. Around 50% of patients have disorders. The question comes up. Could sleep dysfunction after TBI, which affects metabolic clearance. It is worth considering. This slide is from an apology study in 2014. The article talked about dementia and Alzheimer's. And how a person can progress to dementia with the role of genetics. And they're talking about sleep disorders and how can contribute to a person progressing to dementia. Along with the protein. And I think TBI, concerning this picture, it can be added. If you have someone in the cycle who has TBI, even if TBI is on the mild spectrum, you can have this cycle. Leading to problems. And may not necessarily result in dementia, but cognitive impairment. This is a picture for us to appreciate the delay of cognitive problems. It may be explained by the TBI cycle. Ms. Kramer will talk more about this. But TBI damages the pathway. Because the system starts off in the brain stem, which is primarily white matter. It is not surprising it is affected by external force, the TBI. It is well understood in the brain injury field, discussion is evident following TBI, including mild TBI. And mild symptoms are commonly seen in the patient population and it is due to nerve destruction. It is super important that they primary brain injury we talked about, consider autonomic nervous system a primary target. This is to show you why that is the case. As I mentioned, the auto nuclei is embedded in the brain matter. On the next slide, I call it auto pneumatic system. Potential nerve system. Because parasympathetic and sympathetic systems oppose each other. If you have damage to the automatic nerve system, you can inspect young or yang is active and what is deactivated. Oftentimes the

sympathetic is the overpowered one. Often times it gets activated too often and the parasympathetic gets activated and it an opportunity time especially doing activities that require sympathetic input. And it gets activated. It is like a person who has a stroke was a weakness of the flexors. And you find the opposing muscle playing a role of the affected muscle. Therefore, the opposing muscles are fine. Because the affected muscle from the stroke can cause results with impairment of function. I think it is a demonstration of the nervous system. The reason this gets complicated as it is a stress response. This unopposed issue can affect the cognitive function. Or high written angiotensin. It can affect metabolism and how we burn and store our energy. And insulin resistance which can play a role in cortisol and wait weight and tachycardia arrhythmia. And when they sleep. ANS can result in impairment. And the location of the injury. This coaching is perfect because it breaks down into the different levels. From the spinal cord to the brainstem. Have to appreciate that defending and is Dean pathways transfers through the levels. And this is part of the funnel network. External force damages the printable areas. The pathway can be affected by TBI. If you have ascending and descending pathways that are impaired by the TBI event, you can assume that proper communication, the sunny pathway is negatively impacted. Therefore, you can have perceptual pain or increase perception of pain. And also, you cannot modulation at different levels down to the spinal cord. That modulation can be impacted by TBI. There so many factors that can be damaged by the mechanism of TBI, that we should appreciate that oftentimes patients have pain, especially chronic pain problems because they have damage to the neural septic pathway. Whether it be the actual pathway or the receptor pathway. From the cortex down to the spinal cord. With that, and to remind you, because the axons are damaged by mild or moderate TBI, other central areas are affected by TBI. Whether ocular network, vestibule network, auditory network or the small network, they can all be affected by TBI. And Dr. Muzna Ahmed will mention how we approach this later. Going back to the clinical recommendation, where we recommend what is most effective, it is personalized or precision approach to pain medication in which mechanisms and other factors supporting pain are identified during the event. Thank you for your attention. This is my part of the talk. This is the building that we work in. With that, like to turn it over to Miss Kramer.

Thank you very much, good morning, my name is Monica Kramer, and I am a physical therapist. If you have not moved or set up in the last hour, please do so. I have been stretching and getting up. It would be great. I would not be a physical therapist if I did not say that. Today, I'm going to talk more about the nervous system.

And having mild TBI and how it may be related to pain. We will start off with the autonomic nervous system taking control of the party. It arises from the nervous system. And Dr. Heechin Chae to talk about it. Understanding the autonomic nervous system may give us an insight into chronic pain. The two systems are this sympathetic system which is flight or fight response. One of the things it does is regulates blood pressure and blood flow to the system. One of the systems is to constrict airway is heart rate. The ANS his cardiac muscles, glands to the organs via the sympathetic or parasympathetic. Pick it helps to adapt to change. The role of ANS. And having difficulty. Here is a list

of what ANS regulates. You can start thinking if the ANS is compromised. A patient will have difficulty regulating the basic bodily functions. Regulating blood pressure. Gastrointestinal movement and secretion. Body temperature, metabolism and so forth. The autonomic nervous system, overtime, if it is compromised these are systems you will see in the clinic. Chronic pain, insomnia, stress, conditioning, depression, anxiety, fibromyalgia and muscle and skeletal complaints. How many patients do you see and how many complaints do you see besides pain? What if you want to. When you see somebody in the clinic, is the only complaint about pain or do they complain about other symptoms? I know when I see patients not sleeping well, it is hard to motivate them. Because they are fatigued, and they have pain. We will talk about this in the case studies on the end. Reasons for ANS dysfunction after mild TBI. It could be from neural inflammation, oxidative stress, cerebral perfusion or cerebral flow or reflex dysfunction. It is nothing new, but this is what happens. Neural inflammation could be destruction of the blood brain barrier area the blood brain barrier area is to create a barrier for toxins to the brain. When there is a disruption to the barrier, it allows substances to enter the brain and cytokines are released. Cytokine regulation is you Matt Parris sympathetic and parasympathetic systems. Also, what happens after having a mild TBI there may be an imbalance for the feedback that leads to this function. It can affect immune systems and that means your patient may have difficulties. Feeling sick, easily infected. The things that you can think about is like when you get the flu and there is neural inflammation. Also, neural inflammation affects the parasympathetic site. Increase in inflammatory markers that inflammatory markers. The ANS regulates the diameter of blood vessels that contains smooth muscle. It also relates blood pressure. When there is ANS dysfunction, there can be a lower cerebral perfusion. When there is a lower cerebral perfusion it is said to be associated with a cognitive decline. The next picture, I feel like is what we spoke about. A visual that explains dysfunction after TBI. Going to be said, neural inflammation, activated stress and neural degeneration and brain barrier disruption. It triggers the ANS system and triggers the negative feedback. The mechanism. It is disrupted and you will get clinical symptoms of headaches, cognition, anxiety and sleep disorder.

We are moving on to what we see in the clinic. Most common symptoms that we see are headaches. Following TBI, usually people with mild TBI, 25 to 90% report a headache. That is what we see in our clinic. Most likely, they will have a headache. We also see patients that have dizziness. Dizziness from a vestibular deficit. That also may contribute to their pain. And their autonomic network. And impairment complaints are attention deficit, memory, and executive function. People that have emotional disturbance and their most frequent system is anxiety, followed by TBI. Also associated with fatigue, depression and pain. If you are not sleeping, you are in trouble. The next slide is a comparison of side-by-side between ANS and mild TBI symptoms. You can see the similarities with the multidisciplinary clinic. And we can address them through multidisciplinary. Which makes life a whole lot easier. What I do in the clinic's education on chronic pain. We address it through neural pain science education, mirror image therapy to change their perception of pain. If they are deconditioned and having a headache, with deconditioning and trying to return to exercise, and having

headaches, we can do a dynamic assessment, but most likely, a decommissioned treadmill test and it checks heart rate variability with their headache, to see when the heartbreak a certain level and the headache increases, we issue an exercise program after that and see them again in three weeks to see if it has changed. I can talk about this a little more the physical cervical strain or any muscle skeletal dysfunctions. Within the function movement and either have them figure out or reeducate muscles that are not participating. We do vestibular balance assessment for dizziness symptoms. To see the difference between them. Other things we do to help with pain is to write needling. Only doing dry needling to do more pain clinic. Going into more pain clinic neural science education. >> Most patients receive this education, and it helps with improving knowledge and helping works and promotes recovery. This is a big thing that we do, that I do in the clinic. And increasing patient's pain knowledge of how it is processed. Adjusting the knowledge and adjusting it. Talking about fear avoidance. We evaluate muscular skeletal perceptions a modified movement. To not avoid the movement. Always talking about why they are doing things the way they are doing them and how to make it better. Pain catastrophic station. We discuss matters that may continue to their pain. Memory and stressors in life. And disability. How does it affect them functionally? Why is it affecting them functionally? And unhealthy attitudes. Education on how pain is processed and referring to other disciplines. When providing neural pain education, we address other disciplines. And can help with changing perception of pain. I think we are fortunate, being able to address this with other disciplines. Behavioral health and OT. Sent has at the first on the get to see the patient and we have to try to see if we can get other disciplines, a buy-in basically. These are my references. I think I will pass it on, unless there are questions. I will pass it on to Dr. Muzna Ahmed.

Hello everyone, I am Muzna Ahmed, an occupational therapist. I am going to speak about sensory integration, which is an underutilized, but impactful approach to assessing and treating a patient who has difficulty with assessing, reporting, processing etc. their pain. And Dr. Heechin Chae did a very good job laying the foundation of what a patient would present like this. My part is looking at one way to approach the patient that is not frequently used. And it can produce more meaningful and impactful outcomes. Sensory integration is a standard part of occupational health. I will start with a quick overview of what we do. For occupational there be, when we see occupation, we refer to anything that you do that occupies your time. This includes work, home life and everything in between. It is related to lifestyle habit change. It is in the five pillars of brain health that Dr. Heechin Chae refer to. Sleep, pain, resiliency, movement and attrition. Will get into the five pillars for multidisciplinary and interdisciplinary approach later. What does occupational therapy have to do with pain care? Both in OT and PT -- pink hair, you have the goal of return to dust I'm sorry, it is the primary means of intervention. The primary goal is achieving health, well-being and participation through engagement and activity. It means you stay healthy and you get healthy. The scope tends to align more with pain rehabilitation. The frame of reference is pain management. Even though pain may not go away, you could change your experience. To collaborate with the patient this way it is collaboration. Use neuroscience to

obtain education. More injury does not necessarily mean more pain. More pain does not necessarily mean more injury.

At the same time, introducing the patient to the difference between pain and chronic pain. Pain is a signal to your body about pain or injury or disease. Chronic pain is less of a warning sign and more of a reflection of neural mechanisms that are not operating. >> What is sensory integration? We use this to describe processes in the brain that allow us to take information we receive from our senses, organize it, and respond purposely. Why does it matter? We all have sensory preferences, whether it is as simple as being annoyed by a tag in the back of your shirt or not being able to tolerate certain foods because you had a bad experience. Our work and home environments are set up to support a specific range of preferences. If you are constantly operating to perform and participate in an apparent that is not a good fit for you, and adds to your physical and emotional load can result in the perception of pain that is distressing or disruptive to your daily function.

The term sensory integration is only routinely used in occupational therapy literature. Some form of the term sensory integration is used. At the core, Everett agrees interactions in the brain are signals coming in from the environment and the body. And integration or perception refers to organizational approach signals to generate and establish behavioral response. It allows your body to function in the environment. In this chart there is a quick summary of different ways terms are used across disciplines. Jean hires an occupational therapy psychologist was the pioneer. In addition to the stuff on this chart she had core hypotheses that she put forward as to why it should be an integral part of care for anyone. She studied children and now we know it applies across the span. There is awareness for activity and engagement. And motor learning is influenced and not dependent on sensation. And body awareness creates a postural model to understand motor development. And sensory systems were developed and integrated environment.

One tool that we can use to look at sensory integration is the sensory profile. The 60 items in question are that house measure sensory processing patterns that taste, movement, visual, touch activity and auditory processing. It can be used multiple ways. It could be used as a tool to increase insight for patient was no relationship to the body anymore it can be used to inform future intervention for automation therapy or other disciplines for information you get to give you a running start, if you will on an approach to not just pain education but the pain intervention you will use. And can be used to complement our supplement intervention with other providers. The individual answers the question and examples are on the slide. They answer questions regarding how he or she response to sensations. As opposed to how they respond to any other time. The development and establishment are outside the scope of this presentation. It is a presentation on its own. The sample that was used was standardized use on adolescents. 180 adolescents, 500 adults. We are not using this to make a diagnosis. We are using this to get more information about how a person is processing incoming data. Our goal is to change their pain experience by modifying the sensory environment. We can also change the pain experience by changing the threshold to sensitivity. And that takes time. Sent has a

preference will not change how do we optimize performance and their tolerance to activities? The demand of performance is not going away. Modifying the sensory environment is sometimes a quicker way. We will walk through an example. We go through each of the six categories. We can go through sensory processing which is much less than others. It is similar to most people. Much more than other people. And you describe the rating in relation to for groups. From the work done with instrument they determined that you fall generally into one of four categories. The first category was below registration. This person has a really high threshold. It allows them for two notice stimuli and impacts of behavior. This is a person who bumps into walls. And they do not have a get them. It is low registration, and they have a passive response. They are not doing anything active about it. They are not consciously aware of it. It takes a lot for them to notice something. The sensory seeing has a high threshold. It takes them a lot to see something is getting attention. They have active coping strategy. These are sensation seekers. Adrenaline junkies. They need to go super-fast on a motorcycle to see it is going fast. Versus the average person who would perceive the sensation of going fast and the lesser speed. Low registration. Versus sensory sensitivity, who have low threshold for stimuli. They are easily distractible. They hear everything and see everything. Temperature changes quickly. They have a passive response strategy. On the other side, sensory avoiding has low threshold. They are bothered by things quicker. Noises sound too loud earlier than they would to someone else. They have active coping strategies. They avoided. A sensory sensitive person low threshold. It just shows up as distractibility. Suf behind them can totally derail what they are doing. Sensory avoiding gets bothered sound. They intentionally create their environment to support their function. They will shut the door. The make sure they are in a quiet area. Each category is divided by a low threshold for detection or high threshold. Do you have an active coping strategy?

Now that we have determined a sensory preference, what do you do? We can facilitate a return to activity intolerance of activity by working on the sensory threshold. Things like desensitization, biofeedback. You can modify the sensory environment. Both approaches can integrate sensory. Modifying the sensory environment is often used.

We are going to walk through an example. Analyzing the environment. Each sensory environment, whether auditory or visual, olfactory or receptive vestibular can be modified. You can change repetition or stimuli, predictability, familiarity and speed. It will all fit together better as it progresses. As an example, let's walk through someone from the sensory profile who has reported sensory activity. As a reminder that is low threshold. They notice stimuli earlier and it has high distractibility. If the migraine trigger is visual, this is an example of high take the parameters, for example brightness of colors for intensity versus auditory would change intensity volume or frequency in down the list of parameters. And repetition with clean lines impactors. Competing stimulant would be clutter. Birdittt ability would be organized movement. Familiarity with versus and affecting. And speed would be static environment versus moving. For example, driving. Over an example. There is a slight coming up. We did a sensory profile. We get a better understanding. And then we modified the environment. They take the

trigger and scenario. Francis a migraine gets sugar by visual stimuli. And they try to increase their tolerance. That we look at how to modify the environmental's rounders for that. For son who is sensory sensitive, these are the directions of where you modify the parameters. Would you improve intensity, increase the amount, increase consistency, greatly decrease competing stimulant, increase project ability, increase military or decrease speed? It is sensory sensitivity. They detect seemingly bothersome earlier than the than the average person. They do not have an active coping strategy it would make sense at they detect earlier, by detecting sensory, you would facility their tolerance. We combine this we can modify dresses and auditory apartment, but it depends on what the triggering scenario is. It is one situation where you have trouble performing the way that you want. This is an example. The persons migraine trigger is visual. On the left side, with the parameters me to official environment. On the right side, I have the directions that the parameters need to be modified in. For person who is sensory sensitive. Putting this together we were together and say to want to decrease colors in your environment? What can we do relate to that? At there is natural light, get a full-spectrum light. Where is the lighting positioned? Behind you, in front of you, beside you is generally better to facilitate attention. Is there a glare? What is the contrast light with the items on your desk? Is there a lot of shifting between your desk top level work in computer level work? Does it require changes for your level of adapting for contrast and brightness? A lot of modifying factors that have nothing to do with changing sensory preference. It has everything to do with increasing tolerance and the environment. It is very tedious, but it impacts the way for someone to walk with concrete strategies that will make a difference. As we tie everything together with the case study, you will see that tolerance and meaningful engagement and activity impacts pain perception. And pain perception is limiting and prohibiting perception. Going down the list, the number of items to process. How often do they use it? Is there woodgrain or anything like that is a predictable? is in the same spot just to add a cognitive effort. Familiarity, visual input. Recognizable and known versus unknown settings. Are things set up a way that you want. Get the pack up everything?

You have to use eyestrain the which could be related to your migraine. Where are you working? Is there traffic, blocking traffic or otherwise. Are people able to move in both directions up front to you? Or just one direction. To have a window? Are you looking at trees or dynamic moving objects? All of those things make a difference. It is homing in on things in place in the work environment. And how to modify those. Whether it is Botox injections or stress management or the event that was the reciprocating event for migraines. Those all take time. This is a way to enhance, complement and supplement the work of everyone else and have them walk away with something concrete. It is hard to wrap your head around a TBI is you cannot at it. Pain is another one of those things. Especially with something chronic. The tissue is healed and still impacting performance. It can be frustrating for people to not relate what they are feeling to what they are seeing. This is a great way to start.

This is summarizing each sensory preference we have talked about. What direction you would adjust the sensory perimeter. For sensation avoiding, these are the ones with low threshold. And they have different strategies. Sensation avoiding as the active strategy. And intentionally creating or avoiding the situation that helped them to feel better. And sensation sensitivity has a low Paschal. And sensation avoiding. And way more than someone who is sensation avoiding. And way more in the perimeter when it comes to direction. It is important to distinguish between low registration and registration avoiding. They both had a threshold and had different coping strategies with it. And they can get mixed up a lot. You want to pay attention to everything being stated correctly. It is a situation that will ferment with another behavior pattern. This takes practice. Some people, for the migrant they have and auditory trigger. And that is fine and that is great. We do one at a time. With an out all the sheets in front of them. In a slow manner. This depends on having insight, right? Being able to answer questions related to, do you seek out -- do you avoid a room and there is a certain number of people? They are obvious questions. There are more subtle questions. This is assuming a person has buy-in to the answers. If they lose insight, we have something for that. If they are not able to answer the question, and a lot of people cannot really handle the questions. They know what bothers them and they know not doing it is better, but anything in between, they cannot offer. It is a reflection of changes to the secondary injury. The auto nervous system. The pain receptor system. It is also a reflection of the population we work with. If they cannot be cognizant of the time, they are tired or in pain. Or anxious. Because it could affect their safety. They are trained to turn off their systems. Or trying to not have feedback that could impact performance. It is the function of adrenaline and all that stuff that masks it and pushed through things that or not make them stop. When they come in here, some patients cannot answer the questions, or those who get flustered with how are you doing? Can I make you more comfortable? A lot of people get flustered with those questions. That we start with the body part and what I feel and body locations. We got each part and circle words that resonate with them. And they are supposed to rate with a feel at that moment. Know what they feel in general. A lot of people have trouble expressing an opinion for what they feel at the moment. You get interesting responses. Regardless of if the tool is used as it is meant to or not. Or however you have a discussion with someone about pain. You always get information. For occupational therapy, I always start subsequent sessions. The first thing I say is, what we do today that will make a difference. And then have them practice tuning in. And leading the session in a way that will go outside the scope. I know we are scheduled for break in 10 minutes.

Another way to introduce the concept of what are we feeling? It is the zones of regulation. The blue zone is what you feel when you are not feeling that well. As you're getting ready to wind down. The green zone is the zone you are in for most of the day, ideally. Where the demands of the environment are not too much for what you are able to offer. The physical, cognitive and emotional standpoint. The Gellos on is when the environments are to test your capacity at that moment. You started notice some of the symptoms that are against experiencing symptoms of a migraine etc. The red zone is inside a threat. I do not use this as

often. I use the sensory profile a lot and body sensation a lot. Some people, it really resonates with them. It is just out of the way to present the same information. Before you are in pain, there are a lot of antecedents. And before that there are pre-antecedents. Let's figure out, how does your body change. What is happening in your body before a migrant register as a migraine? It is a lot easier to stop. You notice the sensation in your fingertips change with regular consistency. It is a lot easier to interrupt the pain experience when your fingers feel differently. I want to touch on the importance of the activity.

In the conventional pain model and clinics, a lot of guidance involves not doing an activity that aggravates the pain. Or concept related to energy conservation. Sometimes, you get the experience we have given a recommendation that you know will change somebody's pain experience and facilitate healing and/or prevent injury. And they are not doing those changes. This is where the meaning of the activity is important. Say someone is a homemaker, and identity is tied closer to the home and taking care of the home and the family. And they come and say that pain is bothering them, and it is affecting their ability to vacuum. That can happen. The logical recommendation would be to divide it up to one room one day into another room another day. Or for someone to get a housekeeper. That would not resonate with someone and it would not be an effective strategy for someone whose identity is not closely attached to that to her, it does not feel that she kept a clean home. That is important. Sometimes the meaning that someone attaches to an activity and what they consider successfully working out and successfully doing their job, is the barrier to them, incorporating strategy. Occupational strategy is fulfilling the meaning. Every activity is important. The barriers and protective factors are all about meaning. How does this make your life richer? What does it mean to you? Talking about pain in general. And Dr. Heechin Chae touched on this. In some cultures, pain is a sign of weakness. In some cultures, it is a sign of honor. Pain is weakness leaving the body. People come with Association. People, thoughts related to pain. And what it means to their life and what it means to their sense of identity when they are at a provider. Because their experience of pain and is interfering with the ability to what they what. Doesn't want.

This is one way to talk about meaning. Most are in some type of physical pain. We learn to tolerate pain with a specific injury. And they want to live better. I offer the invitation of what if we did not work will be love. What if we did not wait until the pain went away to do the activity the impacts that pain? Let's do what we love and see where pain fits in. This is important for the reasons we talked about. And also, it is your pain experience. It is not just pain. We have a receptor that gives feedback and in store braid. Combined with how much sleep we got. How well rested we are? Drinking water? What is on our plate that day? All of that gets put together and synthesized and integrated. We either have pain reception or we do not. Getting people back to doing what they are not doing anymore can be overly powerful way to change how they relate to and present pain.

One example is called the occupational experience profile. I know it is small. The core of it is a timing diary. Write down what you did, how

you did it with and where you did it. And you will rate it in terms of what it added to your life. Productivity social connection. Pleasure and rest. How did it add meaning to your life? Where did you do it, who did you do it with? It is something you have to use intentionally. It can be very jarring for someone to see if they do not do anything other than the half to do. I have to be at work. And I go home and there is nothing there. I can watch TV. I can avoid my family or anything like that. People do not realize how much they change their day and how much pain dictates their day. We know this from experience. People who are feeling good do different things during the day than those who are not feeling good when you have a headache, your day looks different. There are lots of studies that talk about social media use patterns can be predictive of behavioral health. Again, reflection of what you do that can affect your health. This is a way for people to see that. And see how much pain frames their day versus living a life and working with pain within that.

The 4 areas we are waiting our pleasure, productivity, restoration and connection. Again, this ties into people tuning in to being able to not just register body sensations register to pain. Tune into body sensations related to pleasure, abolishment and essence of renewal instead of being drained. And essence of social connections. We will take up break in into the five pillars as related to multi-disciplinary care models.

We will come back at 10:45 a.m. >> - [The event is on a 15-minute recess. The session will reconvene at 10:45 a.m. Eastern Standard Time.

Welcome back. Hope you had a good break. The next part we will talk about is the five pillars of brain health as part of brain rehab care.

We have established that patients who are reporting chronic pain or come to the clinic with chronic pain as their symptom with TBI, have usually altered sensory threshold. That impacts their ability to perceive, process, report, and change their daily pain experience. We use the foundation of the clinic, five pillars of brain health. That each individually can be predisposing, precipitating or protect Tatian -- perpetuating factors for pain. Each of them in relation to each other can also be protective factors or risk factors. Working in the area of pain care, sometimes it becomes like a chicken and the egg situation, which one came first. And we are asking why my looking at a chicken and an egg in the first place. We use these five pillars to figure out the answers to that question. From a multidisciplinary perspective, we will briefly say how we touch on each of those pillars and then when we talk about case studies, you will see integration reflect about the interdisciplinary approach. Related to the five pillars, we set team goals. Everyone that has assess the patient, we come up with a goal with the patient that all the providers can have a hand in. Once we get to the individual discipline they will declare. Like why therapy would be related to sleep or why would music therapy be related to nutrition. Everything is tied together. The clinic does a really good job of making patients aware of how everything is tied together. And how multiple modalities in traditional and nontraditional, can change the pain experience. From an OC perspective, for sleep, the pathways that clear out the metabolic waste. When they come to our clinic, they have heard

the things about sleep hygiene. They know the importance of taking time to wind down.

The challenge is not in that. It is either they are not getting the change they want, where the recommendations aren't conducive or don't align with their personal inclination and preferences. My part is really being upfront about that. What are your thoughts and expectations in do's and don'ts? What are you willing to try or what you have no interest in and let's go from there. We increase probability that a strategy we work on is going to make an impact.

For nutrition, we know certain foods are inflammatory and tend to be inflammatory and the majority of people are affected. That can add to inflammation component of pain. There are also foods that will have an Anzio lytic effect. It carries over to muscle tension and that could be something that is good as recommending oatmeal as part of your eating habit plan directed towards reducing muscle tension at night. That's one example. Resiliency and stress. Here the focus is on let's find strategies that you can recruit in real time that requires trial and error but was strategies we will go to paper. When you are in the midst of losing your temper and in the midst of high anxiety or when you haven't slept well, is that the strategy, are you going to want to debrief. People will honestly say no. We match the strategy to what their body cessation are telling them at the time and go from there. Physical movement, Monica will touch on their physical therapy. Finding people's meaning behind the physical activity. What is your intent. Is the intent to train for a 25 mile walk that you no longer have to do but you want to train that way, or to play with the kids or reach into overhead cabinet without it incapacitating you. focus on the activity and apply the strategy to that. Pain can aggravate pain and then pain on its own as well. For brain health, if you are spending a lot of time and attention on pain that takes away resources from other processes in the body. With focus on again, what is pain impacting, what does your day look like, how much of your day is full of activities that offer meaning to your life, and lets them look at pain as a function of that, versus something that is waiting to be fixed or removed from the situation before you can engage in life. I'm going to handed over to Monica to talk about physical therapy related to these five pillars. And then Dr. Chae. Then we will go through other disciplines that we couldn't -- we could only have so many presenters. We would like to have a whole clinic ideally, but we will do our best to get them justice.

Hello. How we address the five pillars. We are supporting all of our other disciplines with referrals and nutrition referrals. I do touch on it when doing pain neuroscience education because I know it's important for them to feel like they are being supported in all the disciplines. They definitely talk about what bothers them and we do have meetings that we communicate where they have some of these complaints and they may have not brought up to the OT or the music therapist or acupuncturist or vice versa. Resilience. Figuring out what makes them feel better. Again, that is touched on in the narrow pain science. Also maybe finding the things that they enjoy like yoga.

Or is it discussing walking with their families. Different things -- or breathing while meditating. Definitely physical movement, those are physical movement and pain are the ones that we focus on the most. Looking to see functionally what it is always the goal; it is always functioning. What can't they do? Why can't they turn their head? Is it that they want to be able to jump up and down and they can't because they get dizzy or what is it? Usually that is what we focus on, listening to the patient and asking them what is it that you want to get out of this. Maybe explain why things are happening. I feel like once I have a discussion and what are the symptoms and why it may be happening, they really -- empty regulates them and brings them back.

That is with the support of the other disciplines. We adjust pain musculoskeletal. If it is musculoskeletal pain it will change. If it does not change, it is -- there may be other contributing factors that contribute to your pain. It is not only musculoskeletal. People that come to CS usually have been already to a different physical therapy place and are addressing the actual pain and not addressing the overall issues. That is what we are looking to see what the patient needs from us to function and get back to what they need to be doing. That is with the whichever makes them happier. Dr. Chae, I will pass it on to you.

Thank you. We want to add to what Monica Kramer said. It's very important that we recognize that at least the patient population, when they come to the clinic, they really have gone through a lot of treatments and did not experience the outcome they expected. We spent a lot of time in the beginning to find out why. Why they are in pain. Why they continue to have pain despite treatments and medication usage. We have spent quite a bit of time -- that pretty much needs to lead to patient discovery that a lot of things have happened that could have contributed to pain. They simplify their complex issue by coming to our clinic at thinking that the reason they are in such pain is because of TBI. We are very clear about spending a lot of time and even the pathophysiology of perspective of TBI in finding this premorbid or comorbid factors that contribute to patient clinical presentations.

We actually do what we call timeline. Looking back from their childhood, all of the events that could have contributed to the pain, and majority if not all of the patients get the desk gets a prize, how many events have happened in their lives that could contribute to their current symptoms. Obviously they are main factors but that also calls for us providers to appreciate -- specially military that we treat, a lot of things have happened in their lives that they are not aware of or they learn to suppress. That reflects in their presentation to providers. We will only get a fraction -- the information that we really need in order to properly treat the patient. The five pillars we are talking about is really a foundational approach to say these are the main things that actually have meaning. This activity we take for granted. Which is sort of part of our everyday lives. That has been impacted by pain, chronic pain. Of course, in this population along with TBI, however that affected them or the perception, -- let's get back to the five foundations. It is critical to see how pain or any other symptoms have negatively impacted. As you can see the slide, while we do -- all of our patients pretty much have deficiency in all areas. And nutrition, it is again, it is a way for

us to help them appreciate like there is a meaning and reason why we eat, and it is not just because we are hungry. It is actually to provide appropriate nutrients for our lives and recharge and recover from daily grind. All of our patients have forgotten that. They often tell me that they just don't even taste with the. They just chow down and swallow. It is basically something they just check off. There is no enjoyment in that activity. It is difficult to have culinary discussion with your loved ones. Went there enjoying nice meal out. Those kinds of things, they seem trivial, but it has a significant impact. As we are talking with people, that is what we are talking about with the five pillars. The agenda calls for us to talk about some of the research and those things, and TBI in pain arena. I wanted to use the clinical approach that we have developed over the past seven years and share with you how we approach the patient and how we manage this in our complex patients. And share some of the outcomes. We are going to talk about some cases to illustrate the points.

This is talking about different disciplines that we have in our clinic. I'm not going to spend too much time. You can read on your own. They provide unique perspectives and different angles as we tackle a common problem as a team. With the patient we developed a phone call prescription. Not for pills or medications or treatments, but prescriptions on how we are going to rehab patients. How we are going to restore meaning in their daily activities and improve their function. Therefore, they can actually learn to live with pain. Instead of waiting for pain to go away so they can resume their old activities. A lot of times it can be destructive as well.

That is the foundation of the reason we have these different disciplines, and why we spend a lot of time at the beginning developing this prescription, the goals, patient develops with us. Especially with the primary doctor in the clinic. The patient takes this prescription to all the appointments as providers they are referred to. When we get together to discuss the case or progress, we put this prescription in front of us and discuss the patient's progress towards that goal. A lot of times we are not interested -- the goal is not reducing pain by 50%. That is not the typical goal that we want a patient to have in the prescription. It is actually -- the type of functional goal. I want to be able to complete the work task without getting distracted, or I want to be able to go home by 6:00 p.m., or I want to remember certain things that are critical. Whatever it is that is meaningful to the patient, we try to narrow down and be as specific as possible, that a patient that is impacted by pain or other symptoms associated with TBI in pain. That is what we do. I would like to illustrate that a little bit by sharing cases with you. before we get to that, I would like to do -- I would like you to engage with us. Using the chat box. We are going to give you three poll questions. I think it will help us to understand more where you are and what kind of challenges you might be having. We will post the first question and then you can type in your answers. We will wait for your answers to pop up.

I see pain management as the most frequent. Physical therapy. Pain management followed by physical therapy. Trying integrative therapies, acupuncture, OMT, microcurrent. Great. Alternative way of managing pain. Referred to PT. A lot of the evaluation. That's great. That is a good

sign of a good clinician, that we evaluate the patient just in case we missed it the first time. Why isn't that person not responding to the treatment? Will go to the next question.

Our perception with patients. Neurosensory test. That's the leading answer. Standardized assessment. Patient history. I'm going to ask Dr. Ahmed to response a number three. It says adequate to the sensory evaluation that you are talking about in your lecture.

I think the neurosensory testing is traditionally what is used even in my schooling and early training. That is what I was using. It wasn't until this clinic six years ago that I really started using the sensory profile and homing in on that as an area that needs to be looked at. The language that people use is really important. Dr. Chae knows this and other first touch medical providers know this, very quickly when you talk to someone, you can tell the words they years, and how they are sitting, and how they relate to why they are in that appointment, really gives you the direction that you need to go to in terms of how you will further increase insight or approach pain management. There are patients that are just there for their shoulder plane -- pain and they're not interested in stress were nutrition or changing habits. I want to get out of here. Then they go to physical therapy and they do a great job of this. You have been doing PT in movement is not making a better. It means from a neuroscience perspective that there's something else going on. Sensory is not -- unless it is a stroke or amputation or spinal cord, sensory is usually not a standard part of the workup in terms of actually getting information to some. How someone is processing, their sensitivity. You can do the light touch and all of that but in terms of getting into detail about what is registering with the person the earliest, in terms of sensory input, whether they notice a pain start or attention starts to wane or frustration tolerance decreases, it's usually not an area that is touched upon often but it is a powerful tool to generate quick strategies.

Great. This is a good point to mention the reason that we are highlighting sensory integration therapy and sensory assessment. I personally feel and professionally speaking, I have come to appreciate the importance of adding that aspect into chronic patients and TBI. As I learn more that TBI can alter the sensory threshold. Which includes pain. It naturally taught me what is the treatment out there that can help normalize or at least help people address this alteration of sensory threshold. Some of the disciplines actually added understanding of this phenomena about TBI.

Vision therapy became an important part of the clinic once we realize that it alters the sensory threshold including vision. Visual processing. Same thing with balance.

In pain, it can be altered by sensory as we discussed. OT became -- these for my perspective and even as a podiatrist, we should know everything about rehab. I had different perspectives or goals of occupational therapy in the clinic. A lot of people -- a lot of people don't think to understand what OT does and you can explain that very well in the lecture, but it is a good time to explain to our audience why they should

consider OT. Question number two on the poll question, OT rate should be higher than 5%. Maybe you can explain that, and also, is it true that in all not all occupational therapy practices what you have been lecturing.

For occupational therapy, I think this poll reflects the physical dysfunction part where if there is upper extremity -- that is the most -- the widest discrimination occupational therapy does, physical therapy does the lower extremity. On the civilian side, a lot of outpatient clinics have physical therapists do both, physical and upper extremity rehab. Physical therapists get a lot more training and education on upper extremity dysfunction than occupational therapists do on lower dysfunction including gait training. Sometimes it is just a matter of how systems are set up, healthcare systems are set up, and funding and reimbursement. For occupational therapy, in my experience, most people have the concept of two daily activities like helping someone go to the bathroom when their mobility has changed or getting dressed and then upper extremity rehab. That is why it's important to frame occupational therapy with the word occupation as anything you do that occupies your time. There really is no area. If someone is having trouble embedding a strategy into their daily routine, if they're having trouble recruiting that strategy in real time, if they are not getting the results they want, whether it is a physical goal, emotional goal, cognitive goal, occupational therapist would be a very good person to have on your team. It's about combining the science of the brain and meeting the person where they are and making sure is the meaning of the activity intact. Is the person understanding -- is the information accessible to them? Is it something that is feasible and sustainable? All disciplines are trained to look at the bigger picture that is feasible for the setting. Occupational therapy in particular is all about the meaning. It only matter to the patient and the goalsetting also reflects that. Sometimes if you have a pain related goal or when you are doing a surgery consult for pain, it can get very frustrating as a surgeon for example, measuring success by range of motion and you are measuring success by pain. Follow-up visits look great. You have gained 15 degrees in your wrist, but pain is what is impacting your ability to lift the mug or play with your children. It could be a big disconnect when the patient walks away thinking the surgery was unsuccessful in reporting a poor outcome, whereas the surgeon was 15 degrees, great. How are you measuring progress? What does this mean to you? Are you looking for -- are you looking for change in the actual, quality or quantity of the pain? Are you able to distinguish between the different qualities of pain or is it just pain is pain? If you are looking for return to activity without having a multi-day recovery period, again, that is a different goal. Really how are we assessing progress. My last question on my E valves says what does progress look like to you. How will you know if your time in the clinic is worth it? Not only is it a question most people say they've never been asked, but a lot of people don't know how to answer the question and say they will have to get back to me. What does progress look like to me. I'm here for this but how am I gauging progress. Lab scores, imaging, test scores, they are a part of the picture, but a test score doesn't mean anything if the person is not having impact in their daily life. I would encourage -- the more discipline the better.

In the case studies you will see it. A lot of pain can be associated with trauma. A distressing or disturbing event. Those kinds of experiences we know get stored in nonverbal parts of the brain. Talking to someone may not be the most direct or effective or personalized route to making a difference in their pain experience or their pain outcome.

Whereas yes, theoretically medication should have worked if not having an impact. And having the disciplines that work on nonverbal legalities such as music or art therapy. It can be a great way for them to communicate their pain experience and form interventions for the reevaluation or however you want to go forward.

Thank you, Dr. Ahmed. I think their audience responses. There are some audience that uses OT. Primarily for coping skills. We are very familiar with that term. Health providers are brought into teach patients how to cope with pain. There is a different -- how we approach in our clinic and when we talk about pain rehab, we actually talk about coping skills but we talked about as you mentioned, finding meaning in daily entities and they learn to sacrifice over the years. We tried to add them back to their daily lives. Teaching explained how important those are. Those are what is reflected in pain pillars. The nutrition. The sleep. The resiliency with leisure activities. Some of those things we talk about, often they gave up or they just focused on what they have to do. With coping skills, patients just want to -- give me tools that I can do my work. Give me tools that I can do my yardwork. It is not about my finding enjoyment and meaning in life. I would like you to comment on the difference between the coping skills and when we are trying to communicate with the audience today. You can go first.

I would like to say something. As a PT, the Dr. refers to us and then it is mostly our job because as the patient, I'm going to physical therapy. There are skeletal issues. It's really easy for them to come. They like to come. In turn, I know when a patient -- even on the second visit, there showing some deficit that I know is not mostly musculoskeletal. I begin to talk to them about what are other contributing factors to their pain. I feel like the gatekeeper to maybe trying were educating patients on occupational therapy and what they do or even promoting the rest of our clinic. And then they just charge, and I see them in the hallways. Later, they are a different patient. That is why this multidisciplinary approach is worth it. I think also, coping, the word coping, can have a negative connotation. That your pain is here to stay and deal with it. Again, word choice is very important. I pay close attention to the words that someone uses, and I make sure that I ask what does -- what do you mean when you say incapacitated.

How are you defining that not only to scale the goals but to understand why we are doing what we are doing. Yes, there is an aspect of coping, when yes you are experiencing pain in that moment and it is impacting the ability to function in some way, what is a strategy to help Molly -- modulate those sensations. Also thriving. Pain is a part of the daily experience; it is not your life. But it does become your life if you don't have the support of a team who is working front that big picture perspective of pain, so it is almost -- very unlikely for someone not to have a positive change in their pain experience. When they spend time on

maximizing and optimizing eating habits and exercise habits and stress resiliency habits. Paying attention to pain is extremely training. We all wake up with a certain -- physical and emotional and spiritual and cognitive. If we are spending all of our energy focusing on pain, there is very little left for other things. What would happen if we as you are right now, what's one thing we can do from the science of brain health, optimize eating. What is one thing we can do right now to get your body moving that doesn't incapacitate you. What is one thing. The 1% difference is. And then let's revisit this concept of pain is limiting me in paintings stopping me. There is pain you come into a doctor for and there is pain you don't. That is again based on your prior experience in your pain threshold and all of those things. The impact of pain on your activities is fluid and contingent on a lot of things. Those five pillars are not intact, you are going to impact the outcome of any surgery or pain medication or injection if you don't relearn movement patterns. You will end up right back in the same spot. You really want to work with a team and be on the same page and communicate what are my goals and what am I looking for. What will be a meaningful change to me? Not just a cleaning fully -- clinically meaningful but significant. I see a question in the chat box about how you refer to OT for pain for Mr. Rubel. You could say, it depends on the setting. Civilian side, you have to be very -- for insurance, specific. For the clinic you would say to work on lifestyle factors that are perpetuating their ability -- perpetuating the impact of pain on their daily activities on the civilian side. You could 66 -- specifically name the body part and say to increase function and ability to do whatever required work and home activity. You don't want to say shoulder range of motion. Insurance is tricky. On the civilian side, quality-of-life is not really something that insurance understands or takes into account even though that is the most meaningful outcome measure to us objectively. It is reflective and what kind of equipment they approve versus not. Yes, we can get you a wheelchair, but we won't give you money to adapt your bathroom.

Therapists aren't the people making the insurance policies and roles. Often things that get approved and don't get approved are at the discretion of people who have personal experience with diagnosis or have some other -- or lobbying or whatever. You really want to word as that it is going to increase safety and decrease pain or decrease caregiver burden. And tie that into any referral to get it covered. Please let me know in the chat box if I answered your question.

Thank you. What our experience has been, the attitude. We focus on patients understanding of why they are experiencing what they feel. And really focus on addressing their behavior that can promote healing. Or promote meaning in their lives. Interestingly we see people -- pain goes down. If we tell them that yes, you have to learn to live with pain, they get petrified. They don't really want to hear anything else we say to them. There is a lot of pushback. I think the choice of words, it is very critical. Like the first impression that we have with our patients, it's very important to communicate that we have a careful choice of words. They had experiences with other medical providers and healthcare systems, and they feel that they are a failure, and they feel like they are marginalized because they don't get better. I think it's important that they hear different types of careful choice of words. Even though we mean

the same thing, but we are very careful in choosing our words. We help them understand to empower them. I understand the consequence of chronic pain and TBI. There is more control. Really make them feel like -- take the patient center role in their care without dictating the care. What we think is a great idea -- we don't want them to feel that way. We actually want them to come up with ideas so we can plant the seeds indirectly and tell them what you think of this and that's a great idea. Even though we may take a longer time or take a detour, allowing the patient to dictate the care, I think also it took us a long way. Oftentimes, when I mentioned OT, sometimes I simply want for you to help me a good goal for the patient.

You guys do a better job than me coming up with good goals that focus on the patient. Sometimes I send a patient to Kramer not to just say please address the back pain. And can you assess whether they have daily exercise that is appropriate for this condition. Is it flaring up the pain or are they being afraid of pain, what is more appropriate? We do that based on their condition and exercise regimen.

Even though it takes longer having them dictate and figure out. We know from the motor learning literature, as messy as it looks, having them figuring out speeds up motor recovery than telling or coaching them. It's uncomfortable to watch sometimes and it takes a lot longer but that is a change that sticks. That is the thing that maximizes the firing of the neurons. Definitely empowering is important. You don't want to patient to only -- for discharge requirements as well, you don't want to patient to only think the benefit is because your hands are on them. Or it's coming from you. Anytime a patient reports a significant difference between when they walk in my office and walk out, I always make sure to reflected back on them that because of you letting me know what you needed, and because of your feedback, I don't work in a vacuum. I choose what I say and what I do based on your feedback. The improvement, that is coming from you. you did it. You let me know that information that would make a difference. Empowering from day one. It facilitates discharge but also -- that they are in charge. Sometimes it can seem like -- with TBI, my brain is separate, and I'm separate in my brain -- you are the boss of your brain. That empowering peace is important from day one.

What do you do with patients that have gone through a lot of physical therapy in the past?

My first question is how is this going to change? How are you and I going to make the change? That is my first question. What is the difference? And I'm looking to see definitely wet they are having deficits with and caring that out through an exercise and evaluating why they are having difficulty or pain. Maybe modifying and telling them to come up to the limit and not overdo it. Most patients like to exercise, and they enjoy it. But then they are down for two or three days and it's not okay. I tell them you should exercise every day and there's nothing wrong with exercising every day and going for a walk and running and exercising in whichever way. If you overdo it and you are therefore -- having to recover for three days, then you just missed out on two days so how can we change that? Because they do want to exercise and I'm not

going to make anybody run if that is not what they want so definitely asking them how functionally they will be better as if -- isn't walking more? And what does that look like? How does that look like and what is a meaningful change? And if it is not changing then really discussing to them why it may not be changing and I'm still there to support them but definitely referring to patients and I start talking to Muzna Ahmed and I say I have a patient for you and there are many times when I'm like that, if you're not sleeping right from other things he can talk about. I am not the only one here that can help you out. >> Great. Thank you. We are actually going to go to a couple of cases that we had in our clinic to hopefully put all things together. I think just going over the learning objectives and we talked about the physiology of TBI and pain and understanding of the limitation of pain medication and conventional pain treatment in patients with TBI, we start to cover that and will continue to cover that. But also learn practical applications to manage pain in patients with TBI and not the conventional approach. We shared what we call the five pillars, and we would like to make that a foundation of everything that we do. It is the foundation of behavior changes, promoting healthy habits, empowering patients and all those things that we feel is based on the five pillars. And the application we would like to discuss when we discussed the cases with all of you. Hopefully, that is what we will do for the last hour. The first case is about a U.S. Marine Corps officer who has a history of TBI, multiple concussions and some diagnosed and some undiagnosed. When he was in combat deployment primarily in the times of war. He had multiple combat deployments on Marine recon specialist and when we had the MRI of the brain, some of the diagnostic data to share with you, the brain was read as normal. I did not see any change or atrophy in the brain. He had testing that was called within normal limits but may have given lower effort due to chronic pain and anxiety. A lot of times the psychologists are good about communicating even though there are normal they can see that they are struggling because they are either tired or in pain or they are anxious. So, they make those kinds of comments and this is one of those people that the psychologist commented on.

He endorsed chronic headaches and multiple skeletal issues and chronic pain. He had a study that showed a S1 and lots of changes in the lumbar and psycho spine and C-spine degenerative changes. He was first referred to occupational therapy for headaches and sleep. But as you can see from imaging and the whole conversation, he has a lot of objective reasons for being in pain. And so, when we got him in the office, he was one of those people that did not have the language to express what would make a difference for him and how he was currently feeling. It was very click wheel -- quickly evident that it would not be a simple here is how to improve your sleep and here are some strategies for headaches.

I want all of you to type in your questions, opinions and thoughts. This is a time for us to engage and I should probably stall some of the initial information we gathered about the patient.

He obviously triggered pain generators in his body and the TBI, he could've had multiple concussions which may suggest an injury and when we talk about it at a moderate level you have to think about change and also the change can affect the pain perception and also affect the other

centuries and senses as well. Including autonomic nervous system and balance. Sympathetic and parasympathetic may not be working well together. That is the picture that we have and what other factors contribute to chronic pain? And I guess that is what we focus our efforts in the beginning to figure out what are the factors that contribute to the chronic pain can you share what we found about the contributing factors?

I saw him a few months before everyone else started jumping on. We were hoping that, or the clinical reasoning was that if we could improve his sleep that we could start him on the correct pathway for improving in all the pillars including pain.

He was also impaired physical therapy at the main hospital while he was with you, correct?

Maybe, but I don't think so.

He was doing physical therapy thereto.

I will have Monica expand on what he was doing there. When I got him on my couch on the first day, he could not -- his ability to verbalize what was going on in his body at the time and what was limiting him versus what his expectations were was very impaired. And you could tell by the way that he was sitting that he was in a great deal of pain and it was going to impact his ability to process any communication that we had. After the initial eval the second time, usually the patient directs it and there are choices given but since he could not offer the feedback, I offered to -- I started it with we are just going to listen to a 15 minute thing and I try not to use meditation because it can be off-putting to some people and I just use the word relaxation podcast. And I say we are going to listen to something that will talk about pain attention to your muscles and the goal is to listen to it for as long as we can and can we try that? We tried it and at the end I did not ask about it or how he felt I just said what do you want and what you need? And he said I am tired of being in pain and tired of losing my temper. I'm tired. That was more information than I believe I would have gotten any other way. And so the third time I saw him, I started with some soft tissue mobilization. No talking was necessarily involved but it definitely facilitated the process and I wanted him to get used to sensory input on his skin that was different than the pain signal that was being generated from the inside.

Usually I always tell people that if you feel alternate sensation or pain or you feel it's not under your control, it's good to introduce stimulation that is under your control. Whether it is massaging your thesis and Tatian techniques or whatever, but I wanted to experience and have a reference point for a different kind of touched. Other than just discomfort with moving. He was extremely guarded in his movements. We started with a tissues great for -- tissue scraper gently on his back and you could feel the tension and feel the tension change as certain topics came up and if you had a migraine versus not, you could feel that all in the muscle but we had to approach it in a very incremental manner because it would have been way too much information. Just because I could

have explained where things are coming from doesn't mean that it was the right thing to do so at that time. Just getting used to that touch and we slowly started talking and that is where you get a more clear picture of the sleep and stress and learning about the habits would be impactful but it would not be anything up against just the level or constant level of muscle guarding and stress and fear of pain that he was having. He had structured his life to be able to do what he needed to do at work and completely unable to perform or participate at home.

It is interesting that you spent a lot of time trying to help the patient get reconnected to his body. Pretty much assumed that he is not aware of what is going on with his body even though he had clear pain generators, he could not verbalize what was wrong.

Yes or what compensation like what was the initial precipitating factor or what was a factor of making muscular skeletal compensation and that being a further pain generator and he knew he was in a lot of pain and was very guarded and all movements and very sensory avoidance. He also had low registration issues and he was disconnected from his body and the more we dug into it and the more we got the other disciplines involved, his physical pain is very closely tied to his traumatic experiences which he has never processed. One of the great things that happened when we got him into music therapy is the first time that he explored one of his most dramatic experiences through songwriting, I saw him in the waiting room because he was my next appointment and I did not recognize him and walked right past him because he did not look like the person who was in so much pain that he was squinting from the sunlight and taking small steps and he looked burdened that after the session and you would not guess that he was in pain, and highlighted the importance we cannot have put him in music therapy before because he would not have known what to do with it. >> The question to you is, as a physical therapist, how important is it to have a patient that understands what's going on with their body?

I felt fortunate. Usually it is the other way around where I get to see them first and slowly let them go to the other discipline and sometimes they come back to me after that having an understanding of their body flow and what they need to do and I think Muzna Ahmed did a great job setting him up for me because I asked him, you have been to physical therapy before, what are changes you want to make functionally? What is it you really want to do? All he said was I want to walk 15 minutes with my family? Definitely that is what we worked on. And it was not right off the bat that we worked on, we will do the 15 minutes now. No. We figured out when the pain starts and how many minutes is that for a baseline and figured out from there to kind of increase the limits every time he came in.

That's great. Some of the factors that contribute to chronic pain obviously inability to communicate and this is beyond TBI because neuropsychologists test showed he did not have any verbal language problems so this is something that is a part of it and we did conclude that he does have some altered sensation threshold that can affect his ability to verbalize or become aware but significantly a trauma and significant contributor and even to the point that it affected his

ability to connect to his body and more like a dissociation and if you ever hear the talk about compartmentalization and disassociation involved that suppresses the trauma events out of the memory of our conscious mind or at least attempt and to the point that he suppressed all other basic body needs including the pain signal and sometimes I see patients who can go hours without going to the bathroom. They have learned to suppress that. Significant inability to communicate and be in tune with the body enforced by the trauma is a big contributing factor. Any other factors that you can come up with?

General resiliency strategies and his strategy was to shut down and he was at his capacity and he had on his plate the stuff that he could deal with and he was not able to interact or participate or contribute or taken any more information especially with his family. He had what he had to get through at work and then everything fell apart, so resiliency was definitely a part of it. His nutrition was okay, but it could have definitely been maximized for function and physical activity. He had to build up to being able to do 220-minute walk today.

Yes, his endurance was low too or his tolerance basically was low.

All the pillars, basically.

That's great. Let's see what we did with this case. He had a lot of injections targeting the pain generators. A lot of medication trials, anticonvulsant, antidepressant and physical therapy as we mentioned. He also had chiropractic treatments and basically, he reported temporary relief. Not significant pain relief, of course. It was very temporarily. The discipline that he was engaged in an arc clinic is a long list but I think it really demonstrates all the factors and the tendency playing a role in chronic pain manifestation on the patient and I think we can highlight what each discipline focused on and did so that we can show you some of the benefits or improvements and what kind of change did the patient have. Would you like to go first, Monica Kramer? What we did was we work on his endurance. Getting moving and taking and knowing went to take a break. Essie said that was really hard for him and he just wanted to keep going. Education definitely one of the first educations. We also did dry needling and I know that is a passive treatment but definitely it made a difference in his movement. And he was able to do a little bit more walking when he did have treatment done.

Empowering them to do their exercises and this is what you did today ending with the session, always and this is how you feel better and you feel better? Definitely something you should be doing. For him to reassess his body and see that it was a positive change. And definitely he still continues to have pain with the outcome measures that were taken were the lower extremity functional index. He was 32 when he started and ended at a 45. He still had some deficits, but he did make a small improvement or a significant improvement.

For occupational therapy, what we worked on initially was being able to communicate what would make him more comfortable just in that appointment. He regularly had migraines 6 out of 10 that he would report that it took him a wild to be comfortable with after lots of queuing and

prompting to draw the shades are asking for a glass of water. We had him start taking a pressure relieving Cushion to his art therapy and other appointments because if he could sit without being as cognizant of the pain and he could focus on the session. But it took a while for him to get comfortable and I would catch him, where is your cushion? But it was strange for him to have a different body and bring state than what he was used to. Realizing that simple things like that could impact his ability to attend and process information. Especially verbal or auditory processing. When he was in appointments it was particularly challenging but if he is more physically comfortable then he realized that the ability gets enhanced. Really just advocating for himself and asking to reposition and asking for rest breaks and asking for those kinds of things. It sounds really simple and rudimentary, but his body just was not used to -- his body was used to being uncomfortable and his brain was used to being uncomfortable and introducing that and building from there. As it happens, he started talking, you could ask any provider when they first saw him, but he didn't talk. He just did not have a frame of reference for the healing process and so, our sessions focused on body sensations, self-advocacy and really having one minute, two minute or 3 minutes of a way of feeling. You could be in pain but is it sharp pain or throbbing pain and that is significant. Your body still has the capacity to change. And that was very -- that gave him hope and that is where we started.

The other disciplines involved like art therapy, music therapy was primarily to enhance his ability to process summation nonverbally because we recognize that he has a hard time expressing and verbalizing his emotion including pain. We decided to introduce art therapy and music therapy as a way to communicate or allow it to process and suppress emotions. That he could not process in a healthy way and it has become a toxin to his brain and thoughts. Music and art therapy was the way to do that and even in the lobby he showed evidence that he uses that to process summation and probably eliminate negative thoughts and introduce positive thoughts and finding the benefit from that. And the physician focused on reeducation and reconceptualizing this whole injury combat deployment space that he had developed a pattern of destructive thoughts. He basically like many war fighters we deal with he was guilty that many of his buddies died in deployment and it's a survival guilt he was carrying, and he would start to interpret pain as a punishment. I do deserve this pain because I survived and my buddies did not at almost in an unhealthy way waiting for something bad to happen or to die, really. It is not living alive but waiting to die. And we saw a show of himself. What is really important and to help him discover who he was before all the injuries started to take a hold it was important for him to help and for him to tell us who he was and what he was like before and we used his family to tell us who he was and we used art to speak who he was presenting not ideal picture but simply who he is at the core and I think you see that as a reference that this is where we should go back to or try to go back to and he discovered slowly that he used to actually enjoy some of the hobbies that he gave up after his first appointment back in 2004 and he discovered some of that and just finding and learning to live and finding meaning in daily activities. Even like work became mature and he did not find meaning in that. I think rebuilding within as other providers work on specific tools addressing

pain generators and taking care of some of the pain and reconnect thing that we talked about and it is comprehensive holistic whole person approach that we call it physical, emotional and spiritual and recognizing the pain and it's not just pain symptom and the sky is suffering. Pain is the root of the suffering that he has been carrying for many years. And helping him to rediscover himself what is the key on his outcome, and I think all of you mentioned how distant he was at the time of discharge and when we first saw him.

An example of the impact of the sensory information, we realized just how big of a trigger, auditory triggers were for his anxiety and as it related to anxiety the muscle tension. Having frequent outbursts was one of the most -- the thing that his family reported as stressing to them and through the work on sensory we were able to draft information sheet for his family with his own words describe loud noises because of his experience ramped up the anxiety and the response to have an outburst and say not nice things because that is the quickest way to shut things down and remove the stimulus and causing distress so being able to bring his family in on that including his kids, 18-year-old to 17-year-old and five-year-old was important and helped him at home with his dynamics, frequency of outburst went down and they understood I was family education as well but he did not quite understand the extent to which the auditory stuff was a trigger for anxiety related to the skeletal pain until we started digging into that.

That was great. Due to time we will move on to the next case. And the audience if you have any questions from the conversation that your hearing, please put it in the chat box and we will try to address it at the end. We will give you a few minutes to ask questions at the end. The second case involves a special operator who actually had hundreds and hundreds of air jumps and some of his TBI history involved bad landing including one where he landed on electrical line and got electrocuted and causing loss of consciousness and that really is the biggest of all the events or external forces the bad landing and the electrocution was the high-level TBI history for him. Fortunately, the damage was done -- it was significant, and the MRI showed nonspecific findings but one side than the other and was related to trauma. Really targeting the axonal -- the white matter area to support the assumption in the neuropsychology testing showed some difficulty retrieving neuro- verbal information with marked symptoms of depression, low self-esteem, and unusual degree of somatic concern.

When you do reviews it lights up and there is something wrong with everything. A lot of somatic occupation and he still air jumped and parachuted when we saw him and still did not give up his jump status with interesting work function versus what he is reporting and the labs were only marked vitamin E level and the pain presentation was pain all over and it almost look like a fraud for myalgia patient but what is strike in is just guarding the body especially in the hip area and the MRI showed some disc bulges and bilateral hip showed changes bilaterally and nothing to limit his mobility and MRI NT spine showed multiple level, it is there but does it explain the level of disability and impairment and most likely not. And also we talked about the other contributing factors and when we spent a lot of time in the beginning trying to understand what

is going on and what are the contributing factors and what was striking to me as his primary talk in the clinic assessing him is that he verbalized no past traumas. He does not voice any trauma and denies depression anxiety and all he complained about was about pain and the symptoms that he had and he was a special operator so jumping and doing that stuff but when he comes home he sleeps -- does not sleep in his bed and he sleeps in the living room apart from his wife and he doesn't do much when he comes home. He went to the point where he can go out so significant discrepancy between his work level of activity versus outside of work and significant somatic symptoms. That is what we got out events and I suspected other factors here, but the patient was not either able or not willing to verbalize or communicate with us. He just wanted us to take care of the pain or get rid of the pain. When we sat down to make goals for the care I helped him to make this -- I made him agree that one of the goals was to sleep in his bed with his wife and he thought that was a good goal but I knew that involved a lot of factors just to get to that point. So, we made that goal not as an outcome goal, but I wanted to figure out what else was going on. Because I figured that I don't have all the information I need in the initial visit. And the diagnostic tool for pain and there some correlation but the level of function of disability did not correlate well to what I saw on the imaging. This is where we started, sleep three nights a week in your own bed next your wife. He thought it was a great idea and the second thing was leisure activity outside of work and he thought that was pretty reasonable. He was sent to other providers and this is the list of treatment that he had prior to coming to us. He had medication and he was on tramadol when I saw him and he got injections, I did not mention here but he also got a block with mixed results and has PT, chiropractor and multiple PTM visits. The story behind it once the PTM found that he finally told us he had TBI history and he thought it was a great idea for him to come see us. Initially he did not even tell us he had TBI and he just said I'm in pain. He would just show up with the lock to back type of pain or urgent care and the ER. That's how he ended up in our clinic. This as a discipline and he went to see them with two goals. Sleeping in your own bed next your wife three days a week and two leisure activities. He thought that he should have some kind of goal about pain and it took literally three visits for me to explain to him why I'm not putting pain as the goal or reduction or limiting pain because I basically told him that I use the pathophysiology education that I give you that you pretty much have injuries from all the jumps and it alters your ability to process your sensation including pain. What you are feeling is probably not exactly what is going on with the body. I use the imaging studies to educate including the scale to model and he thought that the bulges were the cause of all the pain so he was thinking that the bulges would make him paralyzed. He imagine what the bulges could do in his body and developed his own fear about it so I had to educate and unlearn all the things that he developed on his own to tell him this is what is going on and educate and that is why we are not going to put pain as a goal because the sensation has been altered. Really bringing on the OT to talk about how he can alter the sensation threshold and that is why he ended up seeing all the providers and to make a long story short, he came with a very challenging plan to sleep even one night per week in his own bed with his wife and it became -- I think Monica can mention from a physical therapy perspective white was challenging.

He would complain about how his back would be in pain while sleeping in his own bed and so he would have less pain while sleeping in a recliner sofa chair. And it is because it was fear avoidance. Even walking into the jam, you could see that he was walking in with just protecting his back leaning forward a little bit but not enough to be so obvious but definitely a change and he would not want to pick anything up from the floor and any functional things that he would think would make his back hurts and he would avoid totally. A lot of education about what the movement patterns were and how to reengage some of the muscles and use them the way they are supposed to be used and not avoid them. He did get a lot of other therapy. He got equine therapy which helped him move his hips a little bit more. He led the aquatic therapy. So, he could see that during the activities that he was able to move without increased pain. He did definitely use -- asking him -- I would see him in the pool and I would say what are the other strategies you are doing that you learned another discipline that can help you out with your pain? We did get -- he wanted to work on pain and so that was the goal, but the goal was written as how am I going to redirect my pain? That is how we addressed it so we could address it functionally because you do want to address with the patient wants too and that why the goal has been set up that way. Set up so that he has to make the difference. Always asking him, what are you going to do if you're in pain or what is your plan because you're not with me all the time and what are some of the things that you are going to do? Is it deep breathing or what are some stretches that you are doing? Is there sleep hygiene that you're doing beforehand that will make this better? Learning all of that helped him and his lower extremity functional index was a 48 and when he left us it was a 90. There was something in between when we took the assessment that it went down to 28. And I think it was one that that he started going out and went to Costco and he basically had a lot of pain during that time, but he did it. But definitely an improvement in the lower extremities functional index. But in reality, for discharge, we always want to ask them, what is your plan when your pain increases? Having them understand what they are going to do if it increases so they can have or be able to do activities outside of here.

Thank you.

He was not my patient but was fear avoiding from a sensory standpoint and even when I was tag teaming with the other OT and we physically made the bed more comfortable based on his musculoskeletal complaints he still avoided sleeping in the bed so that showed us there were more issues related or more challenges with the dynamic of the relationship. But there were also challenges with the cognitive part of pain perception and his thought Association. Now the bed is seen as a place of pain and a place of discomfort where I'm going to have nightmares and wake up feeling even worse so even if we physically address the pain and go at it straight from the musculoskeletal standpoint he will still not be able to return the goal so addressing the cognitive part of the fear avoidance and how the sleep environment has changed. And the same with the leisure activities in fear avoidance and not understanding that a bulging disc will means you will be paradise or increase in pain means he will be paralyzed. The Costco trip was good he did it and he was an extra pain,

but he still did it. >> I think the turning point for the case was when he realized that he has been basically he should focus on the reaction to pain. Trying to get rid of the pain which was futile attempt in this case for various reasons that we talked about that he did not realize that he actually was more disabled by the reaction to pain rather than the pain itself. The huge reaction to pain is fear. Fear is what drove him and his behavior not only activating the autonomic nervous system but really changing behavior altogether and the fear became so chronic that it started to affect his stomach acid production, metabolism and he developed hyperglycemia and all these things that we see signs of activated or chronic activated nervous system and he had it. It was really eye-opening for him that the reaction to pain primarily driven by pain whether it's real or unreal is what is slowly making him disabled. He made an attempt commitment to minimize or reduce the reaction to pain and that's why we got him interested in how to strategize and reduce that so even physical therapy became a different type of session for him and he realized, he turned that into some kind of symbolic torture chamber and there's a reason why he wanted to avoid it like relationship issues and it turns out he did not want to be intimate with his wife and he saw that as a place of intimacy and did not want to do it and that is one of the reasons he wanted to avoid the bed. It just causes more pain. But he did not discuss with his wife about changing the mattress. I simply asked him did you try to change the mattress and he looked at me funny like why would I do that and you said your mattress causes pain a simple conversations and it also turned out that he snores and his wife gets on him and I said you did not tell me that you snored. We found that he has sleep apnea, so we addressed that. All these things, we start with simple two goals in the beginning but we found as we worked with the person that he slowly revealed more information, unintentional stuff that he did not tell us started to come out and really helped to formalize an effective pain treatment plan that we saw significant concrete evidence of change. At the time of discharge he actually moved to the northwest and retired after 25 years or so and he retired to the northwest and he did something he never thought he would do which is drive himself and his family to the northwest and we talk about strategic stops but he actually drove Virginia to Portland, Washington and that itself is a good outcome right there and that was the good outcome there. And it illustrates the challenge that our patient population faces with just delayed on sent report or continuous responses combined with their own self perception of their combat or trauma experience complicating the clinical picture. You get to a point where it's not about -- there so many compounding factors involved that really takes a team with different layers of providers to peel off the onion layers and get to the core issue and once we do that, we found that everybody not only feels empowered that the team is actually helping them not like they are getting dragged by the team and the coaches for the patient finding meaning and discovering life and part of the multiple injuries they had and even medication injection starts to work and there is a centralized stuff going on and the ability to communicate properly verbally and nonverbally is a huge factor and they are not able to communicate properly with their loved ones and medical providers and therefore they get -- do not get the proper treatment. In the second case he did not get the sleep apnea address because he failed to report to us and sleep was such a nightmare that he did not want to

talk about it and we could go on and on but I hope that that will help the audience to help you on how to approach TBI patients with chronic pain and I know we only have a few minutes so if you have any questions for us about this case or the two cases or lecturers, this is great time to put it in the chat box and we will address as much as we can. If you don't have questions and that means we did a great job. Or if we can used you -- confused you. Either way, we would love to talk to you more so feel free to communicate even after the workshop and we would be happy to answer and you can always get our contact info.

Would you mind putting any of your emails or anything in the chat box so we can reach out.

We will put in the chat box. We will wait for any kind of question. One of the audience said, how many symptoms -- systems are impacted? How much brain can impact everything about ourselves and not just physical body but the soul and spirit. And when we injure a complex organ like the brain, we can assume that everything can be affected and we should not count mental -- compartmentalize and miss the big picture. The real conversation is healing, and it happens when we try to look at the brain as a comprehensive organ that affects so many symptoms. A lot of people think TBI is just memory issues calving Alzheimer's and I often tell them that having TBI can lead to heart attacks. We have to look at the brain is a very complex organ.

Adding to that point also, the patient and provider understanding the importance of perpetuating factors and when something becomes a chronic nature and the longer it's around, it's no longer the precipitating factors so what has the person done since they've been in pain is now driving the pain experience. Musculoskeletal complications, fear avoidance, all those things and those are the things that should be the focus of appointments and driving care. And it's usually intuitive, went to the back pain start or what were you doing?

A lot of my patients tell me I had TBI and I was in an accident and what do you mean you had TBI in 2008 or 2010 or multiple ones but a few years ago and they tell me I have TBI because I cannot remember and I have headache and a successful outcome in the clinic is actually changing the statement to I have TBI but all these things have happened to me and I did not take care of myself and now on the road to doing something good for myself and finding meaning to my everyday life and I think it's a statement that we like to hear from patients that I had TBI or not I have TBI because it is not a disease.

And understanding how all the pillars are related. If I had TBI because I cannot remember everything, 30% of memory happens during sleep so tying all those in so that they can see it's empowering to have education but also empowering to know there are lots of potential points of intervention.

We have one question that says with acute oral versus chronic pain, is it appropriate to both PT and OT? Or at what point would you refer to OT?

When I need help I feel like I always need help with either nutrition portion or the sleep issues to help because some patients do want to talk about what's wrong with them and continue with that and I want to figure out why the movement pattern happened so I feel like when they need more functional help is when I refer to OT and that is usually right away. >> Anytime someone has pain it's impacting function so as long as it is impacting something then that is IT relevant. It's really your comfort level and availability of OT and just to touch on something I did not cover, Dr. Chae asked Apollo teas do sensory and they don't. Everyone is trained to so you just want to reach out to the OT that you're working with and let them know what it is you're working with and find out if they're comfortable with providing that.

OT should be involved even in acute care depending on the history. I think you should consider OT even if it is acute pain because they can do a whole lot of good work along with PT to minimize the potential lack of response and whatever treatment you provide. It depends really on the other factors in addition to actual injury.

And for referring sensory, if you print sensory in your referral to inform the provider that you want to make sure from insurance standpoint that it's not just sensory because that will not resonate with insurance companies. You want to relate the sensory to reduction in pain or increase in safety or reducing caregiver burden.

Definitely email Muzna Ahmed if you want more specific lingo verbiage to request sensory therapy for OT. We have run out of time. Sorry about that.

No problem. We love questions. I really appreciate you all. It was a fantastic presentation and Thank you for joining us for this TBI and pain workshop and the Pain Skills Training and again a reminder that the prerecorded sessions are still available and thank you so much Dr. Heechin Chae, Monica Kramer and Muzna Ahmed. It was fantastic. Everybody, have a great rest of your day.

>>> [Event concluded]