Potential of Neurotechnology in Mental Health

Neurotechnology is transforming mental health care. Innovative tools are using real-time brain monitoring and neuro-responsive music to regulate brain function, mood, and cognition.

These advancements help reduce stress, improve focus, enhance sleep, and teach meditative states, offering a scalable solution to improving mental well-being and brain health.

We are talking to Dr. Kamran Fallahpour from Brain Resource Center to understand how these advancements can be applied in healthcare settings, such as pre-operative environments where they help reduce patient anxiety, minimize stress-related complications, and support better outcomes.

Full Transcript:

Priya Menon: Hello, and welcome to CureTalks. This is Priya Menon, your host. Today on CureTalks, we are discussing **Neurotechnology and its role in Mental Health**. We have with us Dr. Kamran Fallahpour, Clinical Psychologist and the Director of the Brain Resource Center. Dr. Fallahpour's clinical practice and research activities are focused on health psychology, applied neuroscience and computer human interface. Joining Dr. Fallahpour and the panel is patient advocate, David Stanley. Welcome to CureTalks everyone.

Dr. Kamran Fallahpour: Thank you. Thank you for having me.

Priya Menon: Dr. Fallahpour, such a pleasure to have you on CureTalks once again, and you have been working on some very exciting projects that involve neurotechnology. So I'm going to really start with a very, very basic question which I think all of us are actually thinking, seeing the topic here. What is neurotechnology?

Dr. Kamran Fallahpour: Okay, that's a good fundamental question to address. So, neurotechnology basically is a very general term, as you can imagine, that refers to kind of a broad set of devices, procedures, systems that can access, monitor and influence or regulate the brain and the nervous system. So, in neurotechnology, basically we aim at monitoring, but also influencing the brain, obviously with the goal of improving brain health.

Priya Menon: Absolutely. I want to take a deep dive into what I've been hearing and reading about your work, and where you say you do real time brain monitoring. And can you tell me, what is real-time brain monitoring and what insights does it provide about mental health?

Dr. Kamran Fallahpour: Absolutely, as you know our brain is, probably the most complex organism we know in our known universe. So the activity is quite complicated. But what's interesting is that we go in and out of various brain states and mind states, if you will. In other words, our brain is constantly, dynamically changing and shifting between various states. Now, we're not always aware of these changes, because from an evolutionary point of view, we were not privileged to know all the intricacies of what's happening in our brain at every moment and every second. Now, with the advancements in neuroscience, we're actually able to monitor and become aware of these changes in a split second. And, in fact, by becoming aware of it we can make changes, we can regulate it, and we can improve brain functions. How we feel, how we think, the two areas of emotional regulation, if you will, and then cognitive enhancement. So by monitoring, becoming aware of it, we can actually influence it.

Priya Menon: Doctor, can you talk a little bit in detail about the projects that you're currently working on? I know that you're working on using neuroresponsive music. So, maybe you can touch upon that, explain what it is and how it's helping and what the project is all about.

Dr. Kamran Fallahpour: Right. So just to give you a bit of background, all of this came out of 20 plus years of neuroscience research, clinical practice at my center, The Brain Resource Center, where really our mission is to take the learnings from neuroscience at any given time and translate it into clinical practice where people can actually benefit from it faster than the normal academic route that usually takes 10 to 20 years. So that's been kind of our mission to like that translational kind of type of neuroscience that can be applied to daily life of people. So with that as you can imagine we have dealt with a lot of both assessment which usually comprises of brain mapping techniques where we look at the brain, the brain dynamics, and then we understand, compared to norms or one's age, how does your brain or my brain kind of stand out in terms of its functionality? What is your unique brain signature, brain dynamics, if you will.

And that insight is very important, because similar to how we want to know our physical health, we want to know our brain health and brain dynamics. So that's the background we come from. We've set up an international brain databases in terms of having a reference database. We have developed hardware software that is in neurotechnology space to really help enhance our ability to do proper assessments for diagnostics, but also for brain training to help patients to reduce anxiety stress, PTSD, ADD, for brain injury, concussion, stroke and a host of other psychiatric neurological issues. So in this journey we have obviously learned a lot about the brain and the autonomic nervous system connection, and the connection of all that to stress and anxiety which when you think about it in majority, if not all psychiatric issues, there is one common kind of catalyst which is the stress response.

Even severe psychiatric disorders start with a period of increased stress in one's life, usually not all the time, but majority of the time. So really harnessing stress is a major goal in our clinical work, which we have done again for the past 20 years. So, some of the Protocols and some of the learnings we've had from looking at thousands of brain maps and doing tens of thousands of actually clinical sessions. Looking at brain monitoring, EEG, neurofeedback, other neuromodulation techniques, we develop basically techniques to no algorithms of looking at the brain and knowing that well, is this person getting more stressed or less stressed, more anxious, less anxious. So these algorithms we have developed. And now put into basically a model where, rather than having to go to a clinic to

actually experience that we can actually put it in a headphone form with sensors that can not only monitor your brain activity for stress, anxiety so forth. But it can also train your brain how to lower stress, how to lower anxiety, using real time, brain monitoring, but also what you mentioned Priya what we call neuro responsive music, which is another aspect of this. So in order for me to get into that, let me talk a little bit about the science behind this, which has to do with operant conditioning. So in terms of training the brain, we need to reward the brain for the right behavior. In other words, when neurons in the brain fire in synchrony

and get into a particular state. Let's say a relaxation state by our sensors we can monitor and be aware of that.

Now we can feed that back to one's attention, using sound and music and using that signal whenever your brain gets more relaxed and your nervous system is more into that parasympathetic state, then your brain gets rewarded by changes in the music. That's what we call neuro responsive music. In other words, the music adapts and changes to the moment to moment changes in your brain and your brain state and autonomic nervous system state and it morphs and changes to help guide your brain more efficiently and more deeply and quicker to get into those relaxed, calm, and meditative states that obviously are the goal. So I hope that gives you an idea of how that looks. I can go much deeper into that, if you like, and then I like to address one of the latest iterations of this for the preoperative space where we actually use it to lower patient anxiety before they start a procedure like a surgery or some other procedure.

Priya Menon: No, it's really exciting. Can you talk again a little bit because I didn't quite understand the neuroresponsive music. Right? That's what helps with the calming and reducing of anxiety. Right?

Dr. Kamran Fallahpour: Absolutely. So that's a whole topic that will delving into it probably needs just an hour just to discuss that. But in a nutshell we know that music is a neuromodulator, meaning that music and when I say music, the right kind of music can actually have the power to shift and change our brain state, and our nervous system and music has been used for thousands of years in terms of its impact on our psyche, emotional state and to calm down the nervous system or to mobilize the nervous system for various states. So music, in fact, was being used even thousands of years ago in therapeutic settings, even instead of anesthetics. So there is evidence that music, especially in the East, was being used in that fashion thousands of years ago. But today, through neuroscience and neuroscience research we're actually understanding the underpinnings of what properties in music can actually enhance that. And then, using that in itself, we produce music that is composed and produced specifically to put people in a state of calm, relaxation, meditation, etc. But in addition to that, what makes it what we call neuro responsive is that there are elements in the music. Let's say, imagine a track in music that actually changes in real time in response to your brain state. And it makes it easier for you to understand that your brain is getting more in a more relaxed state versus a more stress or anxiety driven state. So that's really the power of neuro responsive music that it can really help based on operant conditioning and brain plasticity to help drive the brain into those desired states.

Priya Menon: And how are we administering this, Dr. Fallahpour? David, this is my last question before I pull you in. So how are we administering?

Dr. Kamran Fallahpour: Absolutely. So, I'll give you an example. So this is our device, which is a headphone, that the form itself is quite familiar. It looks like a high end headphone that you might use to listen to spotify, or your own music, but the difference is that it has 3 sensors that are placed basically very systematically and specific regions (no audio)_____ having to need any kind of preparation because they're spring action. And they're dry sensors. You just put them on. And basically, now we are able to read your brain activity in this region in real time. Now with this comes an app that runs on an iphone or ipad, basically a smartphone. And the app can then take you through these stages or steps that can basically start the session, get you to start the music and the brain activity that's coming from these sensors that are being monitored changes the music to help guide you through those steps of relaxation, calmness, and meditative states.

Priya Menon: Thank you. David, you can go ahead and ask your questions.

David Stanley: Okay, a couple of things are going to be off script, because I think I misinterpreted a little bit of what you were up to, but a couple of things are going to be on script. So if we can back up just a couple minutes was a lot of this work done with functional MRI machines, the foundational work for this. How did you get to this point? I think that's the question number one.

Dr. Kamran Fallahpour: Yeah, that's a great question, David. So, as I said, my background is neuroscience and clinical psychology. So I started with clinical psychology. And obviously because of my interest in the brain, I got involved in some studies that look at, not FMRI. Although FMRI informed some of our studies and some of our work, but they were more based on quantitative EEG, meaning that with EEG, as you know, their electrical activity in the brain electroencephalogram which basically measures moment to moment changes in the brain and depending on where the sensors are, it can give us information about what networks and what regions in the brain are activated or dampened or not activated.

So, you can correlate that with whether your frontal lobe is activated, whether your sensory motor strip or perceptual kind of regions in the brain that are related to processing information and so on. So this knowledge, basically from quantitative EEG can help us develop norms to know let's say, a patient with anxiety, disorder, or depression, or ADD, or brain injury, will have a specific signature in the brain that can not only be helpful diagnostically to understand what the issues are. But it can also help us with training that particular brain for optimized performance, meaning that reducing the symptoms. Let's say if it's anxiety or depression, but also optimizing the general self-regulation of the brain. So, really quantitative EEG is the basis of this work. I was actually involved in developing the largest quantitative EEG database that was international database to develop norms for it. So we did that.

At the same time, since we were interested in not only assessment and diagnostics, but also in actually doing some training what we call brain computer interface to actually use neuromodulation techniques and brain plasticity to really help shift and train brain states. So we developed specific hardware that basically measures brain activity, but also trains the brain how to dampen or stimulate that area. In fact, we developed years ago the 1st Bluetooth based EEG monitoring device that work wirelessly. And this device is obviously a few generations after that. But our work in that space also informed but also, David, for the past 20 some years I've been seeing patients at my clinic with anxiety disorders, PTSD, stress disorders, other diagnosis basically and we have used similar techniques within the clinic setting to really help optimize their brain functions, reduce their symptoms, improve basically and strengthen what already works.

And with those kind of findings, we were able to basically put kind of a lighter version of that into this technology where it can be accessed by the masses who really, I don't want to kind of quote it as a clinical device, but more like a lifestyle device that can help with stress and reducing anxiety and some of the other symptoms we discussed. But the newest iteration of this is actually find itself in the pre-operative space where it can be used to reduce anxiety before procedures, surgeries where patients may opt out of wanting to use sedatives, or even if they are on sedatives, maybe they need to lower their anxiety. Given the fact that stress and anxiety before procedure can actually shift not only patient satisfaction. But the outcome of these procedures, due to stress, anxiety and making actually the surgeons less comfortable with the procedure if the patient is anxious. So that's an area that we have entered now, and we're seeing great results in that as well.

David Stanley: I have some personal experience in that arena. In 2006 I had a massive amount of surgery for melanoma at the University of Michigan, Ann Arbor Hospital, and it took 2 chapters in my melanoma book to describe how bad my panic attack was before, and I was freaking out everybody in Pre-OP, because I was having such a massive panic attack until they could get the anesthesiology resident, the chief over there to give me a about enough boost bar to take down an elephant. I was literally on my knees shouting because I was just I mean, literally out of control, because I was panic stricken. I had cancer, I was facing 4 to 6 hours of surgery, and my wife was terrified. It was really it was a situation. And where were you in 2006 with this technology, Doctor? That's what I want to know.

Dr. Kamran Fallahpour: We were actually doing it at our clinic then. But we didn't have this device to really kind of be able to go there. But, David, you're a perfect example of that, like imagine if you had this over the clinic you were going to, if they had this device half hour before your procedure, rather than sitting there with stress and anxiety about what's going to happen, you would be wearing this doing a very calming kind of session, where the sound and music helps you really get into those sympathetic states where your nervous system is calm, you would have had a totally different experience. And in fact…

David Stanley: And you know

Dr. Kamran Fallahpour: We've already started this, yeah, go ahead.

David Stanley: Oh, I was gonna say, I'm 66, and I've had a meditation, mindfulness practice since I was in my middle twenties. Doctor, it didn't help. I mean, maybe it helped a little, but I don't think so, because the data would suggest for my panic attack. It didn't help. So you making it available would have been huge.

Dr. Kamran Fallahpour: Yeah, absolutely. Because what happens is that the level of stress and anxiety. Let me give you an example, we have a a practice in Connecticut now that has kind of champion this coastal eye, and we have an ophthalmologist there who has been doing a lot of procedures that were in the past were done at a hospital, obviously doing some procedures at a hospital because of the — and this and that, and it's not always efficient. So, they've moved some of these procedures, such as cataract surgeries or retina detachment surgeries to a private setting right? Now, imagine in this private setting now, they're using this device and half hour, 45 min before their actual procedure, patients are using it. And we actually have data showing that not only the patients report that their stress goes down and they're more ready for the procedure, but also their brain activity we can measure, and it shows along with that that they're actually in a calmer state. And then the surgeon in this case Dr. Omar Shakir has been championing this with his patients. He is having an easier time and flow as a surgeon, because now the patient is not trembling with anxiety and stress. You can imagine the outcome is just so much more desirable. And we can get into all kinds of science about how that actually impacts the immune system, the chance of infections, and the overall patient satisfaction and the overall procedural success.

David Stanley: Yeah, stress is a horrendous – "pun intended" stressor on nearly every system in our body. And the better we are at alleviating that the better the patient is going to be. And I'll tell you there might be, there's a little vibe that you can sense that we are contagious individuals right? And when you're around somebody who's in that state, you have to make conscious decisions about how you are going to feel about things to avoid sucking up some of their panic. I mean, it spreads through the room. Let me ask you a couple of questions, heading in a slightly different direction. So I kind of hear you saying that it's a possibility then for folks, I have a lot of ex-military friends who suffer from just horrendously on PTSD, that's really never been appropriately addressed by the mental health system. Is this the sort of thing that is scalable, that would at some point in the hopefully in the near future, we might be able to see this working with, like through the VA system, or something where we could start addressing some of these horrendous trauma issues that our men and women coming back from war are seeing?

Dr. Kamran Fallahpour: Absolutely. I'm glad. Actually, you're bringing that up because PTSD is one area. Obviously, PTSD being a stress. The type of stress disorder is a perfect example of where this can be quite helpful. And not only that, your other very brilliant kind of focus on what's scalable,we're dealing with an epidemic of mental health issues globally also in US, but particularly PTSD of the veterans. Although we've also treated many individuals with chronic childhood traumas who have PTSD that looks a little different. But still it's PTSD, and this is a tool that is effective. It's scalable and is affordable. So those 3 criterias, at least in my book they are the criterias that can make a big dent in this epidemic we're dealing with. In particular when we talk about the idea of using it with veterans. We have already done some preliminary testing. We're in discussion with some people connected to the veterans community. And we are very keen on helping PTSD, and that's one of the areas we would like to focus. Aside from the pre-op that we're already starting with, yeah.

David Stanley: Is this? Would it be wrong to say, at some point we could see nearly everybody essentially in a "good mood," or at least they can. I've said I'm a poet as well, and I wrote one piece about how I am very rarely happy, but I am nearly always content. And is this a set of circumstances that you could see this happening to? Because I don't know if you can tell through the screen because I'm in Michigan, I think you're in New York. But I'm so freaking, excited, listening to you talk about this. It's just it's kind of we could do another 60 min when we're done here.

Dr. Kamran Fallahpour: Oh, absolutely! And I'm happy to do that. And I share your excitement, David. I often have to kind of dampen my own excitement, because the possibilities here are so vast and it can start, it can make such a big impact on not only suffering in terms of stress, PTSD, anxiety, but at a more global level in terms of our nervous system as species as a whole, because to your point we are in a part of era of our evolution as species where there is a mismatch between our autonomic nervous system and our brain, and how the society and technology has advanced so quickly and so fast. So stress, anxiety, sleep, all of these are big issues that our nervous system has not had a chance to adapt to. And I truly believe that it is through neuroscience where the next leap will happen in terms of our ability to adapt to our environment and to your point, David. I don't want to call it happiness, because to me the pursuit of happiness, as you can imagine, and I think we're on the same page on that based on your poem, that the pursuit of happiness is not necessarily the right direction, but to be content and to be able to kind of, be mindful, be present and be able to kind of feel okay in your own skin, is something that many people don't enjoy these days. And this kind of technology, I believe, has the promise to shift that to a great extent.

David Stanley: I have been sitting on a cushion more or less every day since I was in my middle twenties, so roughly 40 years or so and I'm just now in my life at 66, getting to a point where I feel like that I'm generally speaking very level, very content. It took me 40 years, and I've never had any real, significant trauma in my life. The horrible things that so many people I know. I mean, I've had. I mean, I've lost relatives, and, but that's just life and.

Dr. Kamran Fallahpour: That's part of human experience, yeah.

David Stanley: Right exactly, and it makes us, if you approach it properly, it makes us better at being good people. But most people who have gone through some kind of horrible trauma like one of my buddies his PTSD from desert storm is just, it comes out of nowhere. And just yeah, he doesn't have that kind of time. He doesn't have that.

Dr. Kamran Fallahpour: Absolutely.

David Stanley: He doesn't have 40 years. I mean, this is groundbreaking stuff here, and the upsides are just… Let me ask you another question, then, so you have this external device, is there a possibility and this is such a loaded question based on what the guy who owns Twitter did. Is there a possibility of some sort of internal implant accomplishing the same thing and making sure that there are just multiple levels of safeguards in place to make sure those implants aren't manipulated for evil, so to speak, from the outside.

Dr. Kamran Fallahpour: Well, yeah, I guess the answer is, yes, we need to get much better at both from a procedural and medical point of view, but also from an ethical point of view, to address all the potential concerns for those things like implants and deep brain stimulation, and so forth. But yes, I mean I think most people would be wary of wanting to do that. But you could simply insert some sensor in the brain. And you could send the data basically to a device such as your mobile phone and be able to monitor. In fact, there is a term called hyper scanning like we see the near future to be people wearing this maybe not only to train or, let's say, for preoperative conditions, but also during the day. Just kind of keep monitoring your brain as you're doing various activities. And then sometimes you might get feedback. Let's say, if your stress is too high, maybe it can give you a signal, or sometimes you just review your brain activity during the day. All of these possibilities are there while wearing this, which is non-intrusive. So you don't, we don't need to really drill a hole in order to do that. But in some cases that may prove to be something people want to do like in deep brain stimulation, people who have severe disorders that otherwise cannot be controlled, that's an option, but I would say, for now we settle for wearables that are much more comfortable to use.

David Stanley: Well, and you're wearing your earbuds. And I'm wearing headphones, Priya is wearing earbuds, a lot of us we yeah through our minds.

Priya Menon: I find the ease of use, Dr. Fallahpour, that's the best thing about it, so easy to use. Just like anybody can use it.

Dr. Kamran Fallahpour: 100% like, imagine in our lab, when we want to do a procedure, let's say a brain map, you've probably seen or heard of these you put on these sensors, and then you have to add gel or some kind of cream, and then it's messy. And this and that. Whereas this you just put it on, and that's it. You're ready to go, and you can start brain training, and you can start to lower your anxiety. So really, putting this in a let's say, a clinic room where people are getting prepped for a medical procedure is a no brainer .

David Stanley: Priya, I have 2 more questions. I know we're bumping up against the time limit. Right? So I have 2 more questions. I think they're both pretty pretty straightforward.

Priya Menon: Yes.

David Stanley: In the chat, and I don't know if you noticed that, Doctor. We were talking for a second about what kind of music like I said, the Clarence Clemens saxophone solo in Bruce Springsteen's Jungle land that solo towards the end of the song, when he steps out and plays that tenor, it brings me to tears nearly every damn time. And I've that album came out in 1975, and I've listened to it a lot. So is that the sort of feel that kind of it's that sense of awe that takes you somewhere else and makes you feel both very, very small and very, very big, and at one with everything all at the same time. Is that the kind of thing that you're constructing with music that you're using with your patient base?

Dr. Kamran Fallahpour: Absolutely, and I feel like we could be talking just a few hours just on that topic. But that sense of awe is an aspect of it, although it's not just that. But, David, I think it was William James, the great American psychologist, who talked about that sense of awe and goose bumps. And he was talking about the problem with humanity today is that we don't get that enough.

Priya Menon: I know

Dr. Kamran Fallahpour: And those are the moments that you are moved by music or by nature's beauty, and it transforms you, and music has the power to do that. But music also has the power to entrain your brain, your respiration, other rhythms in your nervous system, your circadian rhythm. So music really has the power to engage and change and shift these physiological parameters. And in neuroscience based music, we utilize this knowledge and experience to really help people reduce anxiety, improve calmness, and even in some cases improve attention. And, David, you were talking about meditation and spending decades trying to meditate. We all know, based on literature, how much meditation can actually help improve the brain, improve mood. But what the problem is when I sit down to meditate, I don't know where I am, unless I've been trained by by like a Zen master. Right? But we don't have access.

David Stanley: Exactly.

Dr. Kamran Fallahpour: But this device actually enables you to have kind of a Zen master present with you every second telling you you're on the right track or you're on the wrong track, and that ability actually trains your brain much faster, much deeper. In fact, years ago I had a Tibetan monk in my lab, and he was interested in understanding how these devices monitor the brain and meditative states. So we spent the day together, and then, after the day he was happy with the finding I share with him. And I said to him, well, can you share with me what you learned today, and how it can help us. And he said, Well, I learned that what I teach my students in 3 years using this kind of technology, you can probably teach it in 3 months, and that was very telling about the power of this kind of technology.

David Stanley: Did he happen to write a book? Because that story, I know you can't mention names. But that really rings a bell because I read a lot of modern Buddhist literature, and I think somebody wrote a book based on meeting with you or one of the chapters.

Dr. Kamran Fallahpour: It's possible. I have to say I've met with a lot of people over the years from journalists to meditators to Buddhist monks. I have not read the book, but it's not unusual for me to hear

from someone else. Oh, you were on this TV show or in this book and this and that. So it's possible. But I cannot share the name, unfortunately..

David Stanley: If I stumble on it, I will, and it probably will come to me just as I'm doing something else later on today that I'll go. Yeah, that's the book. I'll message you. All right, so I have one last question. So I've been a coach and an athlete all my life and we all know that the the single biggest delineator of athletic excellence is between the ears. All things being equal, even not equal, the person who is in the the perfect state of mind whether it's like a ski racer in a starting gate, or a pitcher before a big game is where your head is at. Is this something that you've given much thought to about how this could influence for good the levels of athletic performance.

Dr. Kamran Fallahpour: Absolutely, in fact, that could be another episode that we just get into that. About 15 years ago I actually did this study with a colleague in Netherlands looking at one of the athletic activities, particularly the putting game of golf, because it has a lot of the Zen aspect like, it's like, you gotta have that muscle memory. And you gotta basically perfect your skill in terms of your movements. But the rest of it to your point and what makes an Olympic kind of champion versus someone who's really good is actually the mindset to your point. And we actually demonstrated that we can improve the game by looking at brain activities right before you actually have your shot and then training people how to get into that state of mind. So we've already done that study. It has been referred to many times in sports psychology, and in fact, we are in discussion with some athlete kind of related companies or bodies that are interested in incorporating this technology. I must also add that the CEO of our company- Vital neuro, John Golden comes from the background where his and his previous company EXOS.

They basically train athletes.And when John came and joined forces with us here at Vital, he was telling me that in training athletes what was missing was the mindset and he found that the mindset is here. And this is one of the areas that we also are interested in digging further. But really, right now, our focus is more areas, more like obviously, things like PTSD, the pre-OP market. And yeah, and sports and all that is very interesting. And has huge potential. But we have multiple paths moving forward at the same time.

Priya Menon: Thank you. David.

David Stanley: I know we're bumping up against time. I could do this all day, or at least another hour. But I'll shut up now, Priya.

Priya Menon: So yeah, so I'm just going to wrap it up. Dr. Fallahpour, I think what you're doing is absolutely exciting, very exciting. This video will be shared on curetalks.com. Thank you. Everyone.