Speaker 1:

Welcome to Optimal neuro|spine Podcast. A podcast about optimizing our brain and spine in health and disease. Each episode leading neuroscientists, neurosurgeons, educators, patients, spine care and quality improvement experts discuss their research, experience, emerging science, surgical advances, and insights about how to optimize neurological and spine care. Now, here's your host, Dr. Max Boakye.

Dr. Max Boakye:

Welcome to the Optimal neuro|spine Podcast. My distinguished guest today is Dr. Joseph Neimat. Out of disclosure, he's my Chair of Neurosurgery at the University of Louisville. Dr. Neimat is a functional neurosurgeon and a clinician scientist. He is the Norton Professor and Chairman of Neurosurgery at the University of Louisville. His current research interests include investigation of the affective and cognitive properties of the basal ganglia, structures located deep in the brain that are responsible for normal movement. He also has research interests in creating novel devices for epilepsy and movement disorders. He has conducted research in robotic surgical applications of deep brain stimulators, innovations in the imaging space, and application of artificial intelligence in creating imaging space innovations. He has a busy clinical practice in treating movement disorders. We will be talking to him today about the future of functional neurosurgery and about his research and about his thoughts about innovation in neurosurgery. Dr. Neimat, welcome.

Dr. Joseph Neimat:

Thank you very much. It's a pleasure to be here, Max. Thank you.

Dr. Max Boakye:

Let's start by telling us a little bit about your current day-to-day clinical practice. What types of patients do you treat? What types of conditions do you treat?

Dr. Joseph Neimat:

I pride myself on trying to do all areas of functional neurosurgery, which, right now, includes movement disorders and deep brain stimulation, epilepsy, which includes stereo EEG, resective surgeries and sometimes stereotactic ablation. Neuromodulation for epilepsy, including VNS, RNS, responsive neurostimulation and DBS. And then also pain, which includes trigeminal neuralgia, both open surgical treatments, percutaneous treatments and radio surgery. And then some more complex pain, things like cingulotomy nucleus caudatus [inaudible 00:02:36] and even the occasional spinal stimulator as well.

Dr. Max Boakye:

What is the most common movement disorder that you treat?

Dr. Joseph Neimat:

Primarily Parkinson's disease. That is the most common movement disorder to come to surgery, although, it is less common than essential tremor which is meant to be 10 times more common in the population, but probably makes up somewhat fewer of our patients that come to surgery for a variety of reasons that we can [inaudible 00:03:01]. But it's a pretty good balance. We do a fair amount of Parkinson's disease, a bit less dystonia, which is a rare disease. And then very occasionally we do things like Tourette syndrome. I've also been involved in trials for using DBS for depression and OCD and a large part of my original research was sort of focused on those questions of circuits serving mood and cognition in the basal ganglia.

Dr. Max Boakye:

You have been a successful clinician scientist, you have a busy lab, you have received multiple funding from the National Institutes of Health. What is the focus of your research?

Dr. Joseph Neimat:

Sure. So I had a handful of foci. The one that kind of came out of my clinical interest in deep brain stimulation for psychiatric disease and for movement disorders was a study of the role of the basal ganglia in serving emotion and cognition. To that end, I and several collaborators, like Nelleke Van Wouwe and Scott Wiley, are looking at the basal ganglia and its effects on property called inhibitory control, which is your ability to pick from among potential motor actions or to quickly stop an action that may be countermanded by the situation that you find yourselves in. That's kind of a reductionist way of looking at the larger question which we wanted to ask which was how does cognition work? What does the basal ganglia do? What is this relationship? We seem to have a very similar mechanism that serves movement disorders and things like depression and OCD. How can it be that the same mechanism serves both of those, what on the surface seem to be, very different diseases? That's sort of where that interest came from.

Dr. Max Boakye:

What drew you to the field of functional neurosurgery? Why did you decide to specialize in functional neurosurgery?

Dr. Joseph Neimat:

Yeah. When I was a resident, I liked a lot of different things that I did. I mean, I certainly enjoyed brain tumors and vascular surgery and spine and such. Functional neurosurgery, I had a research interest in systems neuroscience and sort of understanding the neurophysiological functioning of the brain and was doing some research on that, actually studying the basal ganglia at that time using a primate model.

Dr. Joseph Neimat:

As I looked at the opportunities that I would have to marry a clinical career and a research career, functional neurosurgery seemed to be a place where those things were very closely aligned, which is not to say that it doesn't happen in other areas of neurosurgery or other areas of medicine, but it just seemed like a very natural fit, too. I was working in a lab that was doing behavioral testing and primates and I could translate those very same studies into the OR and run those same studies in a DBS surgery, on a human subject. And so that was very exciting to me, that opportunity struck me. That's what sold me, I think, on functional neurosurgery.

Dr. Max Boakye:

How popular is functional neurosurgery among neurosurgical trainees?

Dr. Joseph Neimat:

I think we're still in the minority. I don't know the exact numbers. I can tell you that the membership of the ASSFN hovers around 600 individuals, so we're not a huge organization. Every year I think we probably train 20 or so fellows in functional neurosurgery. So it's a small group, it's not a huge group. But we do think it's one that will grow over future decades as the applications of these interventions are much more common. I think that we're going to be doing quite a lot more deep brain stimulation and other forms of functional neurosurgery. And so I think that people will find themselves just doing more of that.

Dr. Max Boakye:

Mm-hmm (affirmative). The organization that you mentioned, you are a current president of that organization?

Dr. Joseph Neimat:

I am, yeah. I've been president for about a year.

Dr. Max Boakye:

Let's talk about progress in functional neurosurgery. Have there been any breakthroughs in scientific understanding of movement disorders?

Dr. Joseph Neimat:

There have been. Yeah. I think that it's an interesting thing that, sort of paralleling my thoughts on how I went into this field, we have learned so much about the neurophysiology of the brain, actually, from the surgeries themselves. Curiously, people have been intervening surgeons since Irving Cooper, have been intervening in the function of the basal ganglia to treat tremor and Parkinson's disease and other movement disorders. The understanding of these circuits was relatively mature even 70 years ago. So even 70 years ago, people understood enough that they could intervene effectively in the brain to treat these diseases. That was matured, I think, in the late 80's, early 90's with the advent of deep brain stimulation. Although stimulation had been performed before, it was really with [inaudible 00:07:48] that sort of was a champion and became the mainstay of our surgical interventions.

Dr. Joseph Neimat:

In the last decade, I would say we really have matured our understanding of what that deep brain stimulation is doing. For a long time we were somewhat uncertain about the mechanism, it seemed to create what we were calling a functional lesion. That it behaved as if you were ablating the cells that you were stimulating. And so even the term stimulation was sometimes thought to be something of a misnomer. It wasn't clear what we were doing. I think in the last decade through a number of studies, Phil Starr and others have really found that what we seem to be doing is manipulating these aberrant oscillations that occur between the basal ganglia and cortex. And I think that recognition is really doing quite a lot to shape the future field of functional neurosurgery.

Dr. Max Boakye:

So would you say there are some conditions that we definitely are treating better now than we did a decade or two ago?

Dr. Joseph Neimat:

I think so. I think that we have seen the application of DBS to more diseases. Not all of them perfectly, we're still working out some of those, like depression. We certainly are more efficient in the way that we treat the diseases that we have treated well like Parkinson's and essential tremor. We are becoming more knowledgeable about how exactly we are intervening and I think we are on the cusp of a very significant change. There has been incremental change in the benefit which we achieve disease control. I think it's going to change dramatically in the next decade as we really start to apply what we've recently learned to our devices.

Dr. Joseph Neimat:

So we're just starting to see the advent of novel patterns of stimulation. Certainly in spinal stimulation, to some extent. In deep brain stimulation we are just introducing the first closed-loop stimulators, the first being used in epilepsy with the RNS NeuroPace device. And now with novel devices that promise that, although they haven't been completely developed just yet. I think closed-loop stimulation is really going to be the future of functional neurosurgery. The ability to read meaningful signal from the brain and adjust it in real time to make stimulation adjustments that respond meaningfully to the way the brain is performing.

Dr. Max Boakye:

That's exciting. So when you think of the future of functional neurosurgery, what is it that gets you the most excited?

Dr. Joseph Neimat:

I think that it's this idea of an intricate interplay between our interventions and the function of the brain itself. Thus far, we really have been, if you look at most of our functional neurosurgery interventions, they can be achieved really just with ablation, right? I mean, you can control tremor with ablation, you can treat some of the cardinal symptoms of Parkinson's disease with ablation, you can treat epilepsy with ablation or resection. That's not a very mature way to interface with this tremendously intricate and complex structure. We're just now beginning to understand how the brain may actually work, or at least some of the signals that connote different forms of activity. And so as we understand that, we can now perform more meaningful interventions with stimulation. We can apply stimulation in a patterned way that augments what the brain is trying to do. I find that tremendously exciting, not to mention what that might achieve in furthering the understanding of the brain and its function. I think that's also very exciting, they go hand in hand.

Dr. Max Boakye:

In many fields there has been a revolution in personalized medicine and the impact of personalized medicine. How has this impacted the field of functional neurosurgery?

Dr. Joseph Neimat:

I think it's been inherent in functional neurosurgery for some time in the sense that we, as part of our surgeries for the longest time, have sought to sort of map the brain and apply our interventions precisely. Each individual has a slightly different anatomy as far as their basal ganglia circuits and so, to the extent that we try in each case to apply them with the patient awake while looking at the physiology precisely. That is a form of personalization. You know, of course that can exist on many levels. We are understanding these diseases better, we are acknowledging genetic propensities toward disease in one way or another, and so that may also influence how we think about what those different disease subtypes mean as far as progression and response. So we are further if you sort of think about it as it pertains to each individual patient. When we think about our therapies.

Dr. Max Boakye:

Can you comment on some of the technological advancements that are being used in functional neurosurgery, such as ultrasound, the ability to turn neurons often on? Can you comment on some of these developments?

Dr. Joseph Neimat:

Yeah, absolutely. There's been... It's hard to think of all the things that have been applied to functional neurosurgery. Let's take focused ultrasound for an example, we have for years been able to oblate circuits in the brain and effectively control tremor, for example. I think functional ultrasound is a very nice innovation in that space. Although the endpoint of that therapy is the same ablation. We can now do it in a very minimally invasive way, without making an incision, without drilling a hole. And that's a significant advantage.

Dr. Joseph Neimat:

What I think is most interesting in focused ultrasound is its application both to other targets, potentially for chronic pain, for brain tumors, for epilepsy. And even for things like people have been exploring its use as a tool for what we call liquid biopsy, where we do an endovascular sampling of the vessels around a brain tumor and heat it slightly just enough to disrupt the blood brain barrier, either to do a biopsy, to sample some of the factors that might indicate what the tumor is and, or to treat perhaps by breaking the blood brain barrier and then treating with a local chemotherapeutic agent that would be more effective.

Dr. Joseph Neimat:

So I think that is very exciting in epilepsy. Also, stereotactic ablation, laser ablation has really changed the field pretty dramatically but many things that we used to do with open resection we now are able to do with laser ablation and have the patient out the next day with just a very small single stitch incision. And so that again is advantageous.

Dr. Joseph Neimat:

The one that I've spoken about the most maybe is this idea of closed-loop stimulation. I really do think that that promises to be a game changer for functional neurosurgery, the ability to match stimulation to the physiological profile at any given second is going to be much more effective and really will allow us to treat diseases that, right now, we're not treating as well.

Dr. Max Boakye:

And of course, brain computer interface, which was subject of two previous podcasts that I did. That falls within the domain of functional neurosurgery, too. Is that correct?

Dr. Joseph Neimat:

Yeah, I think so. I think all of these things in a way are. At least all the stimulation things that we've talked about are a form of brain computer interface. I think we think of it as implants for patients who have perhaps spinal cord injury or brain injury and ability to drive robots or computer driven cursors, et cetera. I think in a broader perspective, the ability to, on many fronts, restore sensation, to restore sight. There's been ongoing trials of being able to restore sight to patients who have blind, to restore hearing to treat diseases of tinnitus, et cetera. To interpret language with cortical implants, certainly to drive motor prosthesis. All of those things, I think, are a form of brain computer interface. The traditional DBS that we've been doing certainly is a simplified form of a brain computer interface.

Dr. Joseph Neimat:

As we become more intelligent about the way we stimulate, I think those closed-loop devices will fundamentally restore function in a way that marries brains and computers. And I think that will be sort of a very natural thing through the future.

Dr. Joseph Neimat:

One other thing to touch on is, we may come to a point where we are augmenting the brain with computers and that will be a very interesting thing. There are already studies that have demonstrated the ability to improve memory through stimulation of the fornix. It's possible to use brain computer interfaces to provide additional sensory perceptions that we don't currently have to see in the infrared spectrum or other things. It would not be surprising to me if we sort of have a form of brain plastic surgery or cosmetic surgery where we're augmenting our abilities with novel devices.

Dr. Max Boakye:

Obesity and depression, one of the two conditions that affect a majority of the human race. Can you update on the current status of functional neurosurgical treatments for obesity and depression?

Dr. Joseph Neimat:

Obesity? I mean, there have been a number of small trials with some successes. I'm not aware of any large scale trial yet to treat obesity. On the flip side, singular stimulation, Cg25 stimulation, has been used effectively to treat anorexia. And so, we may be able to treat... These are both ends of that spectrum. I think the challenge there is identifying what that disease is. So there are [inaudible 00:17:04] of some of the trials that have gone on, are directly treating appetite through hypothalamic stimulation that it alters ones drive to eat. At the same time there's an element of addiction, both in some forms of obesity and in some forms of eating disorders like anorexia and bulimia. And so addressing that with stimulation of the nucleus commons or singular area may also be important. And so I think the next step for those interventions will be a more nuanced understanding of what the disease itself is derived from.

Dr. Joseph Neimat:

And it may be different in different patients. You may have patients who, some, who have a more addictive obesity and others who have a more appetite of obesity, and that may take a more nuanced intervention. As far as depression goes... There's sort of a storied history of the trials that have been done for that. Both Medtronic and St. Jude, now Abbott, have done trials for depression in the US. In other countries that has been approved, in Europe and in Canada. But in the US, those trials were halted for a variety of reasons. We think that they just did not consistently demonstrate the effect that we wanted to see, which we saw very clearly in some patients, there are a combination of reasons for that. One is probably patient selection, another maybe target identification.

Dr. Joseph Neimat:

It was about 10 years ago that those trials were all in the interim. There have been a number of things that I think have, sort of, are promising to change that game a little bit. One is novel forms of targeting being done at Emory and with the help of Cameron Mcintyre, who's an imaging specialist who helps to sort of do DTI modeling of fields of stimulation. Through their work they've been able to improve their efficacy substantially simply by identifying where the stimulation should be targeted in order to maximize the effect on the network that serves depression.

Dr. Joseph Neimat:

And then a very exciting study that's ongoing now through the work of Nader Pouratian and [inaudible 00:19:03] is a more precise way of approaching patients and putting stereo-EEG electrodes, like we use for epilepsy in different known targets in the brain that underlie depression. And this is, again, a form of sort of personalized medicine to identify a patient's depression and look specifically at that individual and essentially map the network that underlies their depression and then intervene with focal stimulation only in the area that is most meaningful for that patient. I think that's a paradigm shift potentially if it's effective, that could change the way we approach patients and promises to be much more effective than the DBS surgery we've done today.

Dr. Max Boakye:

I would like to talk little bit more about your research. What is your best contribution? What would you consider to be your most important and contribution and research that you're proudest of?

Dr. Joseph Neimat:

That's a good question. You know, so I've enjoyed... In my research career, there's sort of two areas that I focused on. So one I had sort of touched on was studies looking at the effect of the basal ganglia in controlling emotion and cognition. Of those, there was a study we did some years ago where we actually identified cells in the vestibular gyrus. We were also looking in some of our patients who were undergoing surgery for depression, that explicitly coded individual emotions. There were cells that were precisely coded for sadness or for melancholy or for happiness or for, you know...or disgust. And so I think that was an exciting finding that I enjoyed being part of. On the other front, you know, so stepping away from that neurophysiology research, I was fortunate in my time at Vanderbilt and since in my time here at University of Louisville to just run into some very capable engineers who had an interest in sort of developing techniques that could be used in neurosurgery.

Dr. Joseph Neimat:

And so in my time at Vanderbilt, I was involved in two significant projects. One was working with Ben [inaudible 00:21:00] and Pierre Haas developing a novel, physiologically based Atlas that, essentially, normalized the anatomy of different patients and allowed us to make predictions based on the last 100 plus patients that we had operated on of what the most efficacious targets would be. And using that algorithm, sort of AI based intervention, we were able to improve upon our targeting accuracy so that, in the end... At one point they essentially they pitted the computer against me and I cast [inaudible 00:21:31] and everyone else's come up against computers. I was pretty silently beaten by the computer targeting, which was astonishing.

Dr. Joseph Neimat:

Another project that, again, sort of rose just out of a happenstance meeting between myself and an engineer by the name Eric Barth was development of novel pneumatic robots that could be used for epilepsy surgery. I guess this was about 2011, 2012. Really just as people were starting to do ablations for epilepsy with lasers, we had the idea, they had two robots that we thought would work well together. One was these steerable probes. They're concatenated Nitinol needles that can be inserted into tissue and can be steered in a very precise way so that they don't shear tissue, but just sort of follow along a path to a target. And then at the same time, Eric was developing these pneumatic robots. It's essentially a small plastic bellows that you can inflate under high pressure, and that can move a probe in and out of the brain and can do so without any metal. So it can be used in an MRI environment. And so we combined those technologies and had the idea of approaching epilepsy surgery, not by drilling through the skull, but by entering through the foraminal valley. We've created something we call the Merlin Robot, which is the... I forget the words now. MRI Enabled Nonlinear Robotic Neurosurgery, I think is the acronym.

Dr. Joseph Neimat:

But the Merlin robot, essentially, can do without an incision what we do with our laser ablations. And so we've just received NIH funding again, to follow that research. And we're continuing to collaborate on that. I've also been involved in some novel DBS devices that I'm excited about that I think in the next decade may change the way we think about brain stimulation. There are a lot of things that I found that type of a collaboration working with some of these brilliant engineers who have technologies on the shelf that they don't quite know what to do with. And I find myself in the OR often saying, "Gee, I wish I had something to address this problem." And I just don't know how to fix it. Having those two people come together and sort of mull things over is a lot of fun. And I think sometimes can be very, very fruitful.

Dr. Max Boakye:

That's very interesting. How do you innovate? Is there a process that you follow or it just occurs to you out of the blue? Do you have a method to optimize innovation?

Dr. Joseph Neimat:

Yeah. I think it's a hard thing to do in a way. So something that I wanted to do here when I became chair was to have a curriculum in innovation. You met Shawn Glinter who was a friend from Nashville, who was an entrepreneur. He's started all kinds of medical companies and some have done wonderfully well and some have failed. And he just knows the space very well. And he and I tried to sort of teach our course to the residents about how you innovate and answer that very question, how do you get started? It's the sort thing that if you sit down and you sort of say to yourself, "Okay, now I'm going to be creative." It becomes a very difficult thing to do. I think that innovation comes naturally. I think the trick is just being alert to it and looking for opportunities.

Dr. Joseph Neimat:

We all have things in the course of any given day that frustrate us. And when you bump up against one of those more frequently, again and again, I think that's a time to sort of be alert to, "Okay, what is it that is bothering me here? Are there other people for whom this is a problem? Can I think of any available solutions that might make this better? And if I can't, maybe this collaboration with an engineer who has some tricks up his sleeve that I don't have might lend itself to fixing this problem." I think it should be as simple as problem solving. It's just a question of sort of hitting on the right combination of a problem and a good solution, an elegant solution.

Dr. Max Boakye:

So as Chair of neurosurgery, you said you had a curriculum to teach residents. Have you had additional thoughts about, first of all, was it an effective way to do it? And if not, have you had additional thoughts about how you might train the next generation of neuro-innovators?

Dr. Joseph Neimat:

Yeah, I think parts of it were effective. I do think it generated some very interesting conversations. At the same time, just as you can't force innovation, I think you can't necessarily force people to think about innovation or to teach innovation. I think there was a feeling of pressure in the first year, at least, that we tried it of, "Well, gee. Am I expected to now have an invention?" You know, residents would say to themselves, "Should I now have an invention that I'm meant to be producing here? That seems like a lot of pressure." So we've shaped it. I mean, I think we've tried to provide tools around the perimeter of innovation that are useful. Just educating people on what does it look like to take a product from an idea to a trial, to a prototype, to a trial, to FDA acceptance, to creating a company. Just educating people on what that is. It may be useful.

Dr. Joseph Neimat:

Educating people generally on sort of the socioeconomics aspect of neurosurgery and what we do, I think helps residents and helps everyone sort of understand the broader implications of what we're doing and what needs to happen in order to get a new therapy off the ground.

Dr. Joseph Neimat:

We've been involved in the last year. Something that I think has been very successful was working with medical students. We had a group of medical students that approached us with an interest in creating a bio design course, and they had a catchy title. They said they're going to call it Bluegrass Bio Design. And so working with them and they've been fantastic. I mean, so they engaged us. They engaged people at the school of engineering. They engaged people in the business school and they worked out a pretty thoughtful curriculum where they, starting the summer, brought a group of 10 students who wanted to volunteer and be involved in this. I broke them into groups, had them shadow us in the clinic, came up with a handful ideas that we sat around the table and brainstormed and then went off to the engineers and were given tools to address some of the problems they saw. I've been amazed. I mean, some of the things that they've come up with are very, very thoughtful. I think some of them do show real promise.

Dr. Joseph Neimat:

And to be honest, the most important thing I did in those conversations was just to take the pressure off. I said to that group earlier on, I said, "Hey, we're unlikely to come up with the next electric toothbrush or whatever the next gizmo is that it's going to change the world. Just think about the process, think about enjoying this, think about learning from what you see and coming up with novel ideas." And it really has paid dividends. I think they're having a good time. I think they're learning a ton and who knows some of these ideas I think could really take off.

Dr. Max Boakye:

So the devices that you've created so far, what is the current status? How close are you to having these have practical impact on patients? Do you hold patents? Where is it on the spectrum of tech transferred and device development?

Dr. Joseph Neimat:

I share some patents with people that I've worked with in the past, with the engineers and such. They're in various stages. So the work on computer guided imaging and targeting has become a company that is independent called Neurotargeting. And that works pretty closely with a number of other companies to provide them software support for novel devices with different companies. On the epilepsy robotic side, that is still very much in the prototype phase. So we have a prototype that can do, on a targeting mannequin, essentially what the surgery should be, and we've modeled what that would look like in the brain. The next step is probably to take that to either animal or cadaver studies. And we just got a grant to do that. So we're gearing up to follow that path.

Dr. Joseph Neimat:

Some of the novel DBS devices that I've been involved in, we got an SBIR from the NIH to work on that. We've finished the phase one SBIR and we're entering into a phase two. Again, there, we have a prototype of the novel DBS device that's driven by ultrasound and hope to apply that to a more advanced DBS stimulation. So, at various steps. I don't have anything that you can buy off the shelf right now. It certainly hasn't made me a millionaire. I do these things really because I enjoy them. I've always been quick to be open about the way we share it with the other people involved. I've been benefited by working with these brilliant engineers and I don't claim any ownership. We've always had very good interactions and I'll be thrilled if we get one of these things to the place where it can help people. I think that would be a win, whatever the success of the company. I think that would be exciting.

Dr. Max Boakye:

Yeah, definitely wish success for you in that endeavor. I want to talk about optimization of functional neurosurgery in just two areas. You're sticking functional neurosurgery valves, implanting stimulators in the brain and really are... There are risks. Can you comment on efforts? What you've been... The field is doing as a whole to reduce infection and hemorrhage rates and the other topic that I want to you to comment on is optimization of the treatment in terms of reducing racial and ethnic disparities in the treatment of Parkinson's and movement disorders and that sort of thing.

Dr. Joseph Neimat:

Sure. Those are both, I think, very thoughtful and challenging challenges for our field. So on the quality side, we have been looking at this for years and years and I do think that we are making incremental progress in the safety of our surgery, certainly in the last 10 years. I think that the surgery has become much more safe and even more efficacious through innovations and imaging, through innovations and frame technology, through potentially changes in the strategy with which electrodes are placed. All of those things have had an influence. It's also been helped, I think, by some of these database efforts that we talked about. So the algorithm that we talked about, the AI algorithm that improves targeting has been sort of packaged in something called the Cranial Vault Atlas. And so through that technology, you can sort of look at a patient, use the computer to normalize their anatomy and then make predictions about how you do that surgery and what trajectory you should take and what is the safest thing.

Dr. Joseph Neimat:

And I think that promises a great deal in terms of safety, because if you know where you need to be from the outset and it does a better job of predicting our target than we do, the surgeons. We can do that surgery more safely. That's going to be a major contributor to improving the quality of these surgeries over the next decade. As far as racial and ethnic disparities, I do think this is a significant problem. We do not reach populations equally in any disease and that's true with Parkinson's disease and tremor. I think the challenge ahead of functional neurosurgery is making people aware of these therapies. Generally, we currently treat in Parkinson's disease probably only about 10% of the patients that could be helped by it. With tremor it's even less, there are tenfold, more patients and fewer patients being treated.

Dr. Joseph Neimat:

And so we have of a huge potential to help patients in the future and in doing so I think we have to be mindful of how we reach out to populations, how we are balanced and how we are actually proactive in reaching out to populations that traditionally have not seen this kind of advanced care. And so that, I think is something that we're working on every day. I think of it sort of patient by patient that you want to make sure you reach out and you treat every patient equally and fairly. And sometimes they'll lay their concerns when there's distrust of the medical system because of historical missteps. I do think, from a population perspective, we're going have to be more proactive about how we reach out to patients. That's critical.

Dr. Max Boakye:

So for the last question for you, it's my magic wand question. I ask every guest, if you had a magic wand, what would you like to see in the world of functional neurosurgery?

Dr. Joseph Neimat:

So if I had a magic wand, I would like to have a nuanced understanding of the way the brain functions. This is not an easy magic wand trick, right? I think, to have a nuanced understanding of the way that the brain works, of how the circuitry serves each function and when function is disrupted, what represents that disfunction. What change in firing underlies it. Then I think it would be relatively easy, if you could sort of read the tea leaves in that way, then it's pretty simple to put the electrode where you need to fix it and send the series of signals that would counterbalance whatever the misfunction is. That obviously is a sort of fantastical way of thinking about the brain and what we might do. But I think it's not that crazy.

Dr. Joseph Neimat:

I think that we actually are slowly taking steps to do just that. And I've seen it over the last decade in multiple different areas. If you look at sensory phenomenon, we are increasingly understanding how we might superimpose sensory phenomenon onto the brains with an electrical device and restore sight or restore sensation in patients that are paralyzed. In motor phenomenon we are increasingly understanding and able to decode from the activity in cortex, what the intended motor activity is that is enabling things like the brain computer interfaces that we talked about. And then the basal ganglia is helping us correct motor disease. There's been phenomenal work by Eddie Chang and others, looking at language cortex and face recognition and decoding the way that that is represented in the brain. So I think we are slowly, step by step, sort of translating. There's no single Rosetta Stone yet, but we're slowly translating what the brain is encoding. And as we are learning those things, we can interface the brain in a much more meaningful way. That's the part of my field that I really look forward to over the next decade.

Dr. Max Boakye:

And that brings to the end of the interview. This has been a fascinating conversation with Dr. Joseph Neimat, Chair of Neurosurgery at The University of Louisville. Has been a really great conversation about our introduction to his research in cognition, and also his research in innovation and creation of new medical devices for creating epilepsy and movement disorders. Dr. Neimat, we really appreciate you taking the time to speak with us. It's been very illuminating. Thank you.

Dr. Joseph Neimat:

I just to thank you in turn, Max. I mean, it's been a pleasure to be interviewed in this way and I think you're doing a great service to the neurosurgical community to challenge us to think not just about what it is that we're doing, but how to optimize it, how to improve the quality that we provide for our patients. And so thank you for this opportunity. I appreciate that.

Speaker 1:

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