Speaker 1:

Welcome to Optimal neuro|spine Podcast. A podcast about optimizing our brain and spine in health and disease. Each episode leading neuroscientist, 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. Today I have two excellent guests, who will be talking to us about their recent paper titled Activity-dependent spinal cord neuromodulation rapidly restores trunk and leg motor functions after complete paralysis.

Dr. Max Boakye:

This was published in Nature of Medicine and in the last few weeks and has received a lot of press. The two senior co-authors of the paper are here. We'll be talking to them briefly about their work and their research and the field of neuromodulation of spinal cord injury. So, Dr. Gregoire Courtine is a neuroscientist and a professor at the, and I may not be saying this right, École Polytechnique Fédérale de Lausanne (EPFL), EPFL. He can correct me later if I was wrong. Where he is the co-director of the Defitech center for interventional neurotherapies, neuro restoration of spinal cord injury. His research focuses on the field of neurotechnology with the aim to restore locomotive functions in patients with central nervous system disorders such as spinal cord injuries. And he has published extensively in this area including the much discussed paper that we're going to talk about.

Dr. Max Boakye:

Dr. Jocelyne Bloch is a neuroscientist and a neurosurgeon at Lausanne University Hospital and also at the EPFL she is in charge of the Functional Neurosurgery Unit at the Lausanne University Hospital. She's an expert in de-brain stimulation and neuromodulation for movement disorders. Her recent work focuses on cortical cells called double cortin related to neurogenesis brain repair and also her work has recently focused on neuromodulation of spinal cord injury. Since 2019 Dr. Bloch and Dr Courtine have led the NeuroRestore Laboratory jointly managed by the Lausanne University Hospital, the University of Lausanne, the Defitech Foundation and the EPFL.

Dr. Max Boakye:

Today we'll be talking to them about some exciting things that they're doing in their research. Dr Courtine and Dr. Bloch welcome.

Dr. Gregoire Courtine:

Thank you very much for inviting us.

Dr. Max Boakye:

So, would you summarize briefly the take home message for your paper?

Dr. Gregoire Courtine:

I think the main message is that, for the first time we have developed purposed green technology to stimulate the human spinal cord with the goal to restore mobility of the spinal cord injury. And this new technology have been very effective, very rapidly enabling people to stand, step and train extensively

and at the end they could use this technology outside the laboratory in order to support activities of daily living. Such as standing, walking, cycling, swimming, et cetera.

Dr. Max Boakye:

That is very exciting. Summarize for me, the current understanding of how this works, for the lay person, how much residual fibers does the spinal cord injury person need and does the response to your [inaudible 00:03:32] stimulation depend on the amount of the residual fibers?

Dr. Gregoire Courtine:

Excellent question. So the key to understand is that, after spinal cord injury the region of the spinal cord that control like muscle is disconnected from the brain. So, the natural current from the brain does not reach this region. Although, this region in the majority of cases is intact. So, it is last six centimeters of spinal cord. When we activate the spinal cord [inaudible 00:03:57] stimulation we reactivate it, enable to be functional.

Dr. Gregoire Courtine:

It doesn't take any fibers from the brain for this to occur. We can in anyone in the six centimeter span induce standing and enable walking [inaudible 00:04:12]. But the modulation of this movement we call [inaudible 00:04:16] fibers and with the total of nine individuals so far we are still at this [inaudible 00:04:21] correlation between the amount of residual fibers and how much people are able to modulate this activity.

Dr. Max Boakye:

Two of the three research participants in your paper recovered the ability to volitionally generate hip flexion from superimposition without epidural stimulation after six months of neuro rehabilitation. Do you know if the non-responder individual presented characteristics that were different from the other two individuals. For example, less amount of spared cord tissue at the lesion sight or a different level of spasticity prior to the beginning of epidural stimulation?

Dr. Gregoire Courtine:

Yeah, that's a very good question and if indeed I will respond to the stimulation indeed the extent of the modulation [inaudible 00:05:01] as the one, amount of residual fibers and the degree of spasticity between the residual [inaudible 00:05:08] in the spinal cord. The one person that did not show some volitional movements recovery without the stimulation was not necessarily different from the other [inaudible 00:05:19]. He was more recently injured, was total of one year after the injury. But we don't really know probably the [inaudible 00:05:27] was more severe but we have no direct evidence of this.

Dr. Max Boakye:

Thanks for that explanation. In your previous work, you emphasize the importance of residual pathways to promote recovery with neuro rehab and Epi-Stim training in patients with incomplete injuries. As you know, others have shown that individuals with motor complete injuries have the ability to recover voluntary movement in the presence of stimulation without the need for any training providing evidence for immediate supraspinal control. How do you design your protocols to strengthen these pathways instead of forcing a dependency on the stimulation to generate the desired movements?

Dr. Gregoire Courtine:

So, what we have observed that when we turn on the stimulation and this is even better observed in [inaudible 00:06:15] which we can really control all the factors. We can see that there's immediate recovery of an excess from the brain to spinal cord below the injury. The more severe the region, the less effective is this communication when it's complete, there's absolutely nothing going through and no modulation. So this is one thing to emphasize, to see any neurological recovery without the stimulation, they need to be some residual pathways, there's no miracle, there's no growth of mass fibers through [inaudible 00:06:43] injury.

Dr. Gregoire Courtine:

When we foresee that it's different maybe from others is that, we don't apply continuous stimulation, we apply the pattern stimulation. Meaning we stimulate the spinal cord at the correct location, with the correct timing to activate the spinal cord as the brain would do naturally in order to walk. So there's really a stroke of [inaudible 00:07:01] between what the brain is aiming at doing and where we stimulate and we believe that this convulsions enable more growth of residual connection and hence the recovery.

Dr. Max Boakye:

I see. But the rehab is still important. Is that a situation where they could just stimulate and move without doing rehab to strengthen?

Dr. Gregoire Courtine:

See the whole idea of this [inaudible 00:07:24] stimulation because we have the volition and we stimulate at the current location where the brain is trying to activate then it's effective [inaudible 00:07:33] the training and by repeating the co-activation of the brain and the spinal cord very precisely we believe that it is what enable the growth of new nerve connection.

Dr. Max Boakye:

Oh okay, thanks for clarifying. Looking back, anything do you know now that you wish you knew starting out in this field? And how long have you been in this field, 10, 15 years? Anything that you know now that you wish you knew back then?

Dr. Gregoire Courtine:

[inaudible 00:07:57] 20 years actually Max, so-

Dr. Max Boakye:

Okay. You look much younger so.

Dr. Gregoire Courtine:

20 years ago you know I was [inaudible 00:08:07] in front of the [inaudible 00:08:09] was next door. I mean it was an amazing moment for the field I believe of neuromodulation at the spinal cord tissue but altogether [inaudible 00:08:19] then [inaudible 00:08:20] in front of the first human beings stimulated and back then I think I didn't make the right choice to dive into the mechanism, really understand what do we stimulate otherwise to develop this [inaudible 00:08:31] stimulation and what I wish to know is what I don't know yet, what the future of this technology like how much can push it and what should be

compliment it because we know it's not enough. It's not a cure for spinal cord injury so, what should we add in order to have a true impact in the recovery of people.

Dr. Max Boakye:

The question for Dr. Bloch, for the neurosurgeons in the audience and I have a lot of neurosurgeons that listen to my podcast, you are an inspiration. Describe briefly your evolution and training and your current practice. How much research and how much surgery?

Dr. Jocelyne Bloch:

So I was trained in Switzerland mainly in Lausanne and but also in Zurich. And only during my training I was lucky enough to have access to basic research. I spent two full years doing research and I really loved it. And it completely changed my way of thinking and I knew that I needed a new surgery to find the topic in which I have access to discoveries, to research and that's why I've chosen to be function neurosurgeon. So, now I'm mainly a function neurosurgeon in Lausanne doing 50% of my time taking care of patients and the rest of the time is taking care of the NeuroRestore together with Gregoire.

Dr. Max Boakye:

Mm-hmm (affirmative) your team is admirable example of a beautiful collaboration between a neurosurgeon scientist and a basic scientist. Any pearls and suggestions for other centers, how to do this well?

Dr. Jocelyne Bloch:

It's hard to give a recipe, I think if we were lucky to meet when Gregoire came to Lausanne and he met me, I had this interest for research and he has the interest in applying research in clinical studies and together we did a lot and we also probably inspired young people. We have a lot of young people working with us that do a lot of work and they help us going fast and nicely. But it's hard to give one advice. I would say yes, except passion and motivation.

Dr. Max Boakye:

Let me see if I have time, I do not have time for it but let me ask a couple of more questions for you because I know you have another appointment. I assume the best steps are to obtain FDA approvals etc. On a previous webinar with Christopher Reeve Foundation a few days ago, you answered a lot of questions so I will refer the audience to that webinar but a couple of questions Dr. Courtine. Can you characterize, I know there are a couple of different approaches to Epi-Stim. Can you characterize the current approaches and how unique is your approach and what would you say has been your most significant contribution?

Dr. Gregoire Courtine:

I think, I mean until now people have used epidural stimulation all [inaudible 00:11:10] stimulation to apply an electrical field about the spinal cord. The idea that you maybe increase [inaudible 00:11:16] reactivate the spinal cord and we do the same but we do it, is different is that because we can create stimulation at different locations then we still [inaudible 00:11:26] different region, we can be more specificity, so instead of activating just one group of muscle, we can activate [inaudible 00:11:36] inflection, [inaudible 00:11:37] extension etc. In this specificity that we call [inaudible 00:11:43] so introducing time makes a huge difference because it add a level of control for the people. Increase the

[inaudible 00:11:50] of the stimulation and then have more access to this muscle. And that's, I feel is the key for a successful therapy in the future. And that's why we collaborate with [inaudible 00:12:00] Medical that is really breeding the technology that will be as you said, [inaudible 00:12:06] clinical trail to get FDA approval in order to make this available throughout the world [inaudible 00:12:13].

Dr. Max Boakye:

And I should mention [inaudible 00:12:14] I believe you formed a company Onward in 2014 in order to bring your technology to patients and they are organizing the FDA approval. Once again, that's all discussed in the Christopher Reeve interview that you did a few days ago.

Dr. Max Boakye:

The last question for you, which I ask all my guests, is my magic wand question. If you had a magic ward, what would you really really like to know, what question would you want answered immediately or what would you want to do with the wand to accelerate and have the most impact?

Dr. Gregoire Courtine:

Jocelyn what's your magic wand?

Dr. Jocelyne Bloch:

What is my magic wand? [inaudible 00:12:49].

Dr. Gregoire Courtine:

Jocelyn and I are both passionate about impacting the life of people with neurological disorder and neuromodulation we believe is going to become very soon the common new available treatment but we also know as I said before it is not enough. And you mentioned Max in the introduction Jocelyne works a lot in cell therapy also very much involved in [inaudible 00:13:14] research in neural repair, so now we have achieved regenerations for complete spinal cord injury especially combining neuromodulation. So, our magic wand is to achieve really the synergy between neuromodulation rehab and biological repair. To have really are pushing the cure for spinal cord injury. So, we have the rest of our career to see this dream coming true.

Dr. Max Boakye:

Thank you very much. Thank you Dr. Courtine and Dr. Bloch for taking the time to speak to me in a rapid fire fashion and for my audience, thank you for the exciting work the both of you have been doing.

Dr. Gregoire Courtine:

Thank you Max, see you soon in Louisville.

Dr. Max Boakye:

You bet.

Dr. Jocelyne Bloch:

Bye-bye.

Dr. Max Boakye:

Bye.

Speaker 1:

Thanks for listening to Optimal neuro|spine Podcast with Dr Max Boakye. If you enjoyed this episode, we hope you share it with others. Leave us positive reviews on social media or leave a rating or review on iTunes. Check out our website, maxboakye.com/podcasts. Virtual transcripts and other information, join us next time for another addition of Optimal neuro|spine show.