Chronic Pain and Neurofeedback Training – Ref276

with Jon Graham & Nick Birch

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TRANSCRIPT

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Steven Bruce
Good evening. Welcome to our last live broadcast till the new year and I promise you, it's going to be a good one. Before I introduce this evening's guests, I'd just like to reassure you that we aren't all disappearing home after the show and leaving you alone until January. The office itself closes on Friday the 23rd. But even then, if you've got a desperate problem, there will always be someone on hand to help you out. You might have to put up with me instead of the wonderful Ana, but I'm sure you will cope. Anyway, this evening, we are looking at that old chestnut chronic pain. Both my guests have been on the show before and both were hugely popular. First, I have Nick Birch, a spinal consultant who cut his teeth as a doctor in the early 1980s, before becoming an orthopaedic consultant in the mid-90s. He specialised for most of his career in the spine, and as a result, there's not much he doesn't know about it. He's also very happy to tell it like it is. So ask him a question and I know you'll get a straightforward answer. Welcome back, Nick.

Nick Birch
Thank you, Steven.

Steven Bruce
Also treading the boards today, we've got Jon Graham, Jon is recognised internationally as a specialist neurological physiotherapist. And his first gig with us was several years ago when he brought Rex in to meet us. Worth looking back at it actually, Rex is a robot exoskeleton and I had great fun trying that out in the studio. But the point of the show was to demonstrate the kits and Jon's expertise in spinal injury rehabilitation amongst other things. So welcome back to you, Jon, I'm looking forward to seeing what toys you brought in to demonstrate this evening.

Jon Graham
Thank you.

Steven Bruce
Since we're talking technology, at least in part, we are still waiting for someone to be brave enough to join us through the video link. So if you've got a question, the button's on the webpage below the video screen, and if you'd like to be the first to join us in person, as it were, then give it a press and Ana will sort it all out for you. Otherwise, of course, just let us have your thoughts, your experience your questions via the chat links. And we'll see what Nick and Jon can do to help you out. Right, Nick, what's new in chronic pain?

Nick Birch
Quite a lot, actually. So you might be aware that in 2021, NICE updated their guidance on chronic pain and its management. And what they've done is to define chronic pain now as primary and secondary. And it'd be nice if the slides advanced. There we are. So primary and secondary chronic pain, so in the past, we knew that chronic pain was complex, you could have somebody who has knee arthritis. And by definition, their pain is chronic, because it goes on for more than three months. But of course, then they go and have a knee replacement or whatever the treatment might be. And as a result, then for the majority, the pain disappears. So that secondary chronic pain, because it's secondary to something else going on, primary chronic pain, it's fascinating for me for most of my career as a consultant because I

knew in, certainly as early as 96, 97, that there were changes within the central nervous system that occurred with people who had pain for a long period of time. And you could do treatment to them that you think would just work and they'll get all right, it didn't. We didn't know why but it's now very obvious why it is and that is because primary chronic pain is essentially neurological. So what you're looking at is changes within the organisation of the networks in the brain. And that really leads on to most of the advice now has come from NICE regarding the way to treat primary chronic pain.

Steven Bruce
What's causing it?

Nick Birch
A trigger. It's probably epigenetic. So something happens to you, you get backache, sciatica, something triggers, and you have a predisposition. And we know from some of the UK biobank studies and the twins, UK twin studies, that there are some people who are more likely to develop chronic pain because of their genetic makeup. And so there's an epigenetic event, it turns on some gene somewhere, that then produces a downstream effect within the brain, and you get alterations in neural networks and neurotransmitters. And that then means that the message is coming into your nervous system, instead of being interpreted in the way that it should be. So I could be moving my hand and that might be a proprioceptive message, but then it could then be interpreted by the brain as being a pain message. So normal sensation, then becomes misrepresented as pain.

Steven Bruce
So are they at the stage where they've identified what gene it is that's causing this and therefore they can prospectively say so one is susceptible?

Nick Birch
There are candidate genes, but I think it's a bit early stage yet to be able to say to people that you could screen them, because if we could do that, it'd be nice to say, well, let's screen you to see if you were likely to go on to get chronic pain, but we're not at that stage yet.

Steven Bruce
You and I have shared a couple of patients with chronic pain. And we have to choose our words carefully on this. But chronic pain patients can be quite difficult, quite challenging to deal with, can't they? Which comes first? Are they challenging patients in the first place? And that's what leads them to be susceptible to chronic pain? Or are they challenging because they've had pain for years and years and years? And just can't see an end to it.

Nick Birch
Or are they challenging because the way they've been treated? Or not treated as the case may be or not believed? And I think one of the problems is that it's a combination of all of these. So you've got somebody who's got pain. And if then you go by the NICE guidance, which is to say, well, have they actually got a condition that would lead you to believe that amount of pain is appropriate? If you as a doctor, or as an osteopath think, well, no, actually, they're trying to kind of make it up. You don't believe them. And then they start to bang their heads against the wall, and then they go to somebody else who doesn't believe

that they get around this circle, whereby they're seeing people who aren't believing that they can have something that seems to be out with what is normal, you know, well hang on a second, I treated you, I gave you medication, why didn't you get better, it's your fault. And they despair. And patients I see usually need time and space to just dismantle all of the stuff that's gone before, to try to work out what is actually that sort of the baseline of where they are. And then to build them up again, and to get their treatments in a logical order. So you say okay, have you tried the baseline conservative treatment? Have you tried this? Have you tried that? When you've done all that, and you still got pain, that's where you've got primary chronic pain, which is neurological, so you have to exclude all the right things. I think the big, big difficulty is that patients get desperately frustrated by the slowness of which things happen. And that in its own right feeds into chronic pain, because the slowly it happens, the more likely it becomes ingrained in the nervous system.

Steven Bruce
I suspect they get frustrated as well. I've seen this in one patient only recently, about the lack of joined up-adness in the NHS as well. They'll go and see a consultant on one hand, but the GP won't know about the results or whatever. And they can't get a single answer from their practitioners.

Nick Birch
And that's actually true. But it's not just the NHS. I mean, it's actually the whole of healthcare systems across the world. Because you have to have, in some respects, it means sort of Seamus Malone in the wonderful book he wrote, at the end of his career, describing patients who've got complex problems and supertankers, you need to have a captain of the supertanker to be able to turn it and to guide it. Because if you don't, you got lots of people that supertanker just carries on going. And if you've managed a patient with chronic pain, are like a supertanker, unless you've got someone there who's actually taking charge and saying, look, we need to make sure that you're being guided through all of the right stages at the right time...

Steven Bruce
Who's the right person to do that?

Nick Birch
Doesn't matter. It could be anybody, somebody who's actually got the time to spend with them. And who's got the knowledge, you need some specialist knowledge, but I think what you really need is an understanding of people and good communication skills, more than anything else. And you don't you have to be a particular person, you need to have a competency rather than a professional certificate.

Steven Bruce
Yes, I see so often, I think not just with guests here, but with patients in my own clinic, when you listen to them, you think well actually, I think probably what went wrong there was that somebody didn't handle you properly and not give you the treatment you needed but they just didn't speak to you the way you're expected to be spoken to.

Nick Birch
I think that's obviously right. being dismissive is never helpful to any patient. And if you've got someone who keeps coming back and is complaining of pain, and you think, I've come to the limit of what I can do, the next thing to do is not to dismiss them, but say, okay, you need to see someone who does know how to deal with it. And that's the step that often isn't taken.

Steven Bruce
You are yourself in a great position at the moment, I always feel because since you stopped doing surgery, you don't have any skin in any particular remedial game, do you, so you're able to do that captain of the ship stuff, and say, well, I'm not going to give you the treatment, but I can tell you where to go and get it and marshal the soldiers.

Nick Birch
And the other thing I can do, which is I think that if people can do it within their professional lives, is actually to say, I'm going to dedicate time. So if somebody comes along to me, if I know they've got a particularly difficult problem, they'll get an hour of my time, and you just let them speak. And if people can offload in the first 10, 15, 20 minutes there, suddenly they think I'd be listened to, that in its own right is a significant therapeutic intervention. And it really helps them. So you're absolutely right. I mean, because nowadays, I don't say to people, well, I've got a hammer, you look like a nail, I'm gonna hit you, I gotta do surgery, I've got lots of other things I can do. It's helped by colleagues like Jon, I mean, because we work very collaboratively together with a lot of neurological type problems. And having that ability to go without then having to resort to surgery is really quite helpful.

Steven Bruce
We're a bit off piste at the moment, but just while we're talking,

Nick Birch
Forget the deck. It doesn't matter.

Steven Bruce
When you were doing surgery, despite the fact that I'm sure you must have selected your patients carefully to pick the ones who would do well, you must have had people who didn't do well, what's your attitude to handling them, especially if it was a private patient who spent 1000s on his treatment, and then he still got the back pain he came in with?

Nick Birch
That's really difficult. It's really challenging. I mean, the first thing is that if you, as a surgeon, you have to be absolutely honest with yourself and have complete integrity to say, that person in front of me is telling me that they're not doing well. I'm not going to put my spin on that and say, look, your X rays look fine. You must be okay. You listen to what they're saying. So the first thing is hard, you have to be hard on yourself. And then when you do that, it's okay, it's fine. I mean, we're not gonna let you stew, you've got a problem. Let's find out what's going on. So you have a very low threshold for investigation, and a very low threshold for then saying, look, if I don't know what's going on, I know someone who does know what's going on. So you then have to swallow your pride and say, you know, this hasn't gone right. For

whatever reason, maybe I have cocked up, maybe I've actually done something technically, that's actually led to a complication that's given them further problem. There are some standout cases in my career where actually that didn't happen. It was one guy who had a spinal fusion. Three days later, he developed paralysis, and I thought, my God, what have I done, he turned out to be picked up a virus and got Guillain Barre. But you beat yourself up in the first few days, sadly until you find out what's going on. But the most important thing is to say, there's a problem. Let's face it, and you know, we're not going to close it down and sort of suggest that you are somehow getting better when you're not. So it's honesty, really.

Steven Bruce
Yes. I suspect that people in my position, probably less so in yours, Jon, because you're a physiotherapist, therefore, you're very much embedded within the NHS world in conventional medicine, but osteopaths and chiropractors terribly worried about cocking it up because a complaint against us just adds fuel to the debate that osteopaths and chiropractors don't know what they're doing, which I don't think is the case, but within every profession, there'll be somebody who gets something wrong from time to time.

Nick Birch
But you do see that, with physios.

Jon Graham
Yeah, there's still some people who it could be their first experience of physios and they've still got the chaps are run on with a sponge onto a football match. And suddenly, they have to build up their confidence in what we're going to do with them.

Steven Bruce
Are you in NHS practice, or only in private?

Jon Graham
I'm in private practice.

Steven Bruce
And people expect different things of a private physio than they do from an NHS physio, don't they? Because expectations are quite low of physios in the NHS field, I think.

Jon Graham
Yeah, I've been in the NHS for 19 years.

Steven Bruce
And that's not a reflection of physios, it's a reflection of what the NHS do.

Jon Graham
I think you're right that they're coming with the current expectations but also in my early years of working in private practice, what was notable was they actually do the exercises you gave them to do. Because

they pay to get them. In the first six months I thought crumbs, I got really good all of a sudden, no, they're actually taking note of what they were told to do.

Nick Birch
But one of the things that you'll get, Steven in your practice is that I know that osteopaths in general will say someone with an acute problem. If I can't get you right in three or four sessions, we need to look elsewhere because osteopathy should work in that time course. The problem is if you've got a one size fits all model, much of what goes on in the NHS, unfortunately, is that because that's the time constraint it has, six sessions. That's it, you know end of. What if somebody needs nine sessions, well, they don't get it. So then they aren't treated. And then they go on. And problem then, so then they go back to the GP, say it hasn't worked. And then they say, well, physiotherapy doesn't work. No, it's not. It's not physiotherapy doesn't work. It's just you didn't have the right dose. That's, I think, one of the problems with, as I say, this one size fits all type model.

Steven Bruce
So let's get back on track. Can we get the slides up on the screen behind us.

Nick Birch
I've clicked through some of the slides. And I know that the audience will have actually, hopefully had time to read them as we've gone along. So all that we've done is on the slide is to say what's primary chronic pain, what's secondary chronic pain, then there's this thing called central sensitisation, and central sensitisation that is very definitely something that is genetically predisposed to you, that has been shown. And it's really something that is identified 20 odd years ago by Clifford Wolf. And he realised that in some people, their nervous system becomes completely over reactive. And therefore, a minor pain becomes a major pain, that's called hyperalgesia. normal sensation comes painful, and we couldn't explain that in the 1990s. And then after Professor Wolf did all of his seminal work at the end of the 90s, beginning of the 2000s, we then understood it. And now we know from functional MRI, where central sensitisation occurs in the brain. We also know there's a whole bunch of different chronic problems, things like fibromyalgia, temporomandibular, joint problems, multiple chemical sensitivities, these things, all of which are likely to predispose people to central sensitisation. And it's very difficult to treat.

Steven Bruce
You mentioned that multiple chemical syndrome, it says on the slide amongst those 13 rings that contribute to this. What do you mean by that? Is this over pharmacy or polypharmacy?

Nick Birch
No, it's basically people being allergic to the 20th century. Remember those people you know...

Steven Bruce
The 21st century.

Nick Birch
No, because it came out in the 20s. Because the syndrome was in the 20th century, before we understood about central sensitisation. And then it was renamed because actually what it was, was that if you're

exposed to certain chemicals, then you got symptoms. And this was an overreaction of the nervous system. And that's what this multiple chemical sensitivity was. So good. It was, it was originally labels, I'm allergic to the 20th century.

Steven Bruce
Also, fibromyalgia crops up again on your list here, doesn't it, which seems to crop up quite a lot. But I've always thought of fibromyalgia as being a name given to a collection of painful symptoms rather than a thing in its own right.

Nick Birch
So, fibromyalgia is defined by the American Rheumatological Association as being multiple sources of pain in certain areas, I think you have to have 13 out of 32, whatever it might be 13 or 18, whatever, but you, you push something vaguely sharpened to somebody and they yelp. The diagnostic criteria are fairly clear. The question though, is, is fibromyalgia a primary diagnosis in its own right, is it an entity or is it the manifestation of something else? And in my mind, fibromyalgia, unfortunately gets mixed up with chronic central pain, primary chronic pain, central sensitisation, often menopause, because fibromyalgia is much more common in women in the peri menopausal period, and it may well be that there's actually some of the pain syndromes you get with menopause, are then called fibromyalgia. And it's a bit like, it's a dustbin diagnosis. You go see a rheumatologist with multiple pain sources, and they say, oh, you got fibromyalgia. Here's a leaflet, off you go. That's it. That's the end of the treatment. Whereas actually, it may well be that it is central sensitisation. And the treatment for that might then be the right way forward.

Steven Bruce
Somebody who's known to the system as CR says that David Handscomb, a spinal surgeon predicted which patient would respond to surgery depending on the amount of stress they were under prior to surgery.

Nick Birch
Well, it's well known that if you've had I mean, stressful events will magnify pain responses. And the less stressed that somebody is, the more likely they are to do well with surgery and to rehabilitate very well.

Steven Bruce
I would have thought most people prior to spinal surgery will be quite stressed.

Nick Birch
On the day of surgery, but if you've had a discectomy for a nasty L5, S1 disc hernia, if you've had rip roaring leg pain for three months, you go into that operation, really looking forward to actually getting rid of that pain, so actually, you can be less stressed. Whereas if you've got back pain and suddenly said to you, well, there's a 70% chance you'll be okay. And there's a 30% chance you won't be and maybe a pain will be somewhat worse. And maybe I'll make a hole in the dura, and you have a dural tear, and you'll get meningitis. And then you might get paralysed, and then you might end up in a wheelchair, etc. That's a really good reason to be stressed about having surgery.

Steven Bruce
So informed consent is a bad thing.

Nick Birch
Informed consent done properly is a good thing, read my two papers on informed consent.

Steven Bruce
Well, outline of those papers, are they about how to get proper informed consent, definitions of what it means?

Nick Birch
Primarily. They're a review of the Montgomery process and where we are with Montgomery and actually why we have to spend time with patients, exactly tell them what's going to happen, what the treatment we're offering them is compared to no treatment or any other treatment. And making sure it's in terms that they understand. This goes back to communication; it's actually talking to people in ways that they understand and know what's important for them.

Steven Bruce
Yeah. Okay. Well, if I can, I'll share those with the audience. Can I share your slides with them as well afterwards as a handout?

Nick Birch
Yeah, no, you can send them, that's absolutely fine. So but go back to the recommendations for treating chronic pain, because this really sort of comes down to the second half of this broadcast. And that is, the big problem with NICE was it said, the only thing that we can really suggest for primary chronic pain is acceptance commitment therapy, and CBT and an exercise programme. That's it. But they reintroduced acupuncture, because their previous iteration, they said, oh, you can't have acupuncture.

Steven Bruce
On the basis there was no evidence.

Nick Birch
There wasn't enough evidence to support it. And then they turned it around again. And I'm not sure of any randomised control trials that were actually then introduced to support the vote for us. There were people in the British Pain Society, who had been sat on that NICE panel to begin with, who were sued. And so there may have been other factors there. But what it does show is that NICE will change their recommendations depending upon let's let's be generous and say whatever the evidence is. And that's important, because they say at the moment the recommendation is no biofeedback. So neurofeedback training, which is what we're going to go on to, is considered by some people a forward biofeedback. So what we are suggesting in reality is that if you get enough evidence of it, then you represent us to NICE, then it may well be that that's something that's going to be worthwhile.

Steven Bruce
What does NICE mean at the moment by biofeedback?

Nick Birch
Anything that's biofeedback, anything that you are interacting with another entity be that a computer interface, or whatever it might be. And that then is changing the way that the brain is actually functioning. Biofeedback can be something as simple as wearing something on your shoulder that feeds back from your skin to your brain to say where your shoulder is in space. So there's quite a good example. Certainly, when I was doing shoulder surgery in the 1990s, we had a group of patients who had recurrent dislocations in their shoulders, mainly because they had altered patterning of the muscles. So the agonist and antagonist muscles were not working away, they kept the shoulder in place, so they kept dislocating. But if you put a little cuff around here, so that they got feedback from the skin, the brain knew where the shoulder was, and then could overcome that muscle imbalance.

Steven Bruce
So no other feedback other than the pressure of a cuff? There wasn't an electrical connection?

Nick Birch
No, girls, it was a bustier. Yeah, just actually have your bustier on there. And as a form of biofeedback that's actually using one sense to inform the brain of something else that's happening. And there are various forms of biofeedback and one of those, which is neurofeedback training.

Steven Bruce
And for years, we used tubigrip with that in mind, and we didn't do anything to strengthen ligaments or tissues, it just gave feedback.

Nick Birch
Yeah. And effectively, it's proprioceptive, isn't it? So one of the things that I think that NICE gets excited by, is the placebo effect as well and that's specifically we need to talk about that because the placebo effect has been known obviously for centuries, well, not centuries, but a century and a half, it's very specific because it affects certain parts of the brain. So the anterior cingulate cortex, prefrontal cortex, the periaqueductal grey, these are all areas that where opioid receptors are concentrated. The thing about neurofeedback training and biofeedback is it doesn't affect those parts of the brain, that's primarily affecting the somatosensory cortex and the insula. So what we know is that this new technology that Jon and I've been involved in, and I've run the proof of concept trial, and Jon's gonna go through that in a second. That is not affected by the standard placebo effect. So therefore, any effect that we have in the treatment that we are trying to then help people with is unlikely to be a placebo.

Steven Bruce
So, you're saying that the neurofeedback that we're going to see doesn't affect those areas of the brain, but by some mechanism we know that other factors do affect that. If we try a placebo through a sugar pill, we know that that does affect it.

Nick Birch
Yeah. So your standard opiate, opioid networks, that's what the placebo effect is essentially tapping into.

Steven Bruce
Right. Could I just take you back for a second to fibromyalgia, which I thought might provoke some interest? Lawrence says, how does it differ from polymyalgia rheumatica?

Nick Birch
Polymyalgia rheumatica is an autoimmune anti-inflammatory condition. And typically, you get a very high ESR and CRP. You give them a dose of steroids and magically they get better. So they're totally separate conditions. The only thing that connects them is the myalgia. That means a muscle pain.

Steven Bruce
And Wendy says, I find some of my patients with fibromyalgia are just happy to get a label and a diagnosis. When I first trained as an osteopath, one of the things that used to upset one of our senior tutors was that people were obsessed with labels for things, and thought he felt that he often made them feel worse, when he goes on to say most of their symptoms can be explained biomechanically but then it's convincing them that it may not be fibromyalgia and more leg length differences or scoliosis problems, etc. How do you convince them that it might not be fibromyalgia and might be biomechanical?

Nick Birch
By doing a proper examination. I mean, I think that's a completely valid point. If you look at somebody, you can't make a diagnosis of fibromyalgia unless you get them to take their clothes off. How many people, I would challenge, not challenge, really, but just actually put out there as something for your audience to really think about. And that is, if somebody comes in with a diagnosis of fibromyalgia, get them to ask, were you examined properly? Did they take off all your clothes down to your underpants? And do all the tests that you needed to do to go through the American College of Rheumatology tests? And if they did, then it's possible that diagnosis is correct and if they didn't, then I think when they say it is absolutely correct, and that is you've got to look at the biomechanics, the whole of the body that it starts off with, have they got flat feet? Have they got knot knees? Have they got a leg length discrepancy? Have they got a scoliosis, have they got a kyphosis? So it's all very, very straightforward.

Steven Bruce
Out of curiosity, what would you regard as a leg length difference?

Nick Birch
More than one centimetre. So physiologically, one centimetre is easily tolerated. More than one centimetre is less easily tolerated. And anything that is more than two centimetres is significant.

Steven Bruce
Okay. We've got a neurofeedback training slide up on our screen. Is that for you, Jon?

Jon Graham
Yes, no, absolutely. So just go back a little bit. I mean, just the biofeedback. So biofeedback is making information available that is normally not available, it's normally automatic. So heart rate, for example, heart rate monitor is a form of biofeedback. So if you've got your chest strap on, you see your heart rate,

you do some deep breaths, and that descends. That's biofeedback. So what we're looking at is the brain activity that we're completely unaware of, how can we influence that and reduce pain?

Steven Bruce
Isn't there a big difference between one, looking at a monitor in response to a heart rate, monitors, you're looking at the readout on your Fitbit, or whatever it might be, and simply having a bit of Tubigrip around your arm, which is telling you where your elbow is in space.

Jon Graham
So they're still biofeedback. So they're still making you these external agent to make you available for something that you're not normally consciously aware of. So I'm not normally consciously aware of where my elbow is in space. And then suddenly, you put a tubigrip on it, and then you're aware, but it's like, the first time we put a wedding ring on or a watch, we're suddenly where your wrist is, and to a certain extent, we couldn't wear clothing, there's a necessary gating of sensory information anyway. It's important. So with this particular area, it's been known for a long period of time back into the 90s, that there are certain areas of the brain that produce a characteristic array of brainwaves that are predictive of potential chronic pain. So you will see this even when somebody at the moment is at a sort of not avertly suffering, you can say, well, actually I've got a feeling, give that a month or two and you will see some pain symptoms were emerging.

Steven Bruce
Is this a pattern that you would have seen long, long, long, long ago. What is it? Is it brought on by some other trigger later in life? And so it might only happen a month or two before the chronic pain?

Jon Graham
No, I think the indication is that if you're looking at someone who's had an injury, that potentially looking at these brainwaves and certain people, it probably goes back to the epigenetic stuff that, you know that'll be the mechanism underlying it. But the key thing in terms of understanding what we're talking about, in terms of the research is that there are the two key brainwaves, we're looking at are theta and alpha. And what differentiates or classifies them is the actual frequency that they're working at. So if you think of an old school, sort of graphic equaliser, in people with chronic pain in a particular area of the brain, the C4, the theta is like high bass is pulsing up here. And the alpha is down here. And if you then look at individuals that don't have chronic pain, they're graphic equaliser is different. It's high alpha, low theta. So they got low bass, high treble. So these are internal automatic activities. And so what we're doing with the neurofeedback training is making them explicit, so that the individual can then influence them. So what the axon device does is it, as you'll see in a moment, it's a headset, and it's sampling, it's not putting anything into the brain, it's picking up those brainwaves. And relaying the brainwaves to the software, that then gamifies, the therapy process. So it's one strand of logic, if you kind of can accept that, in chronic pain, there's a particular look at that graphic equaliser, we've got high theta, low alpha in non-pain, low theta, high alpha.

Steven Bruce
So just to clarify, high theta, low alpha, is that driving chronic pain or a response to chronic pain?

Jon Graham
So that's a good question, Nick.

Nick Birch
I think it's reactive. I think people who have not had chronic pain in the past are likely to have a baseline of either equal alpha and theta or higher alpha than theta, if you put a person who's a calm individual, they're likely to have high alpha and low theta, because that's the nature of those, what the brainwaves are actually reflecting. If then they get pain, and then it becomes chronic, that's when it flips over. However, there will be people I'm sure who are effectively anxious or have already got a reason for their brain waves to be in a particular configuration, who are more likely, than to just flip into that situation. So I think that's part of the answer.

Steven Bruce
Okay. We're gonna go onto your thing in a minute. Can I just go back a little bit, this is completely off piste, as far as what our discussion is this evening. But Sophie says, what treatment would you recommend Nick for leg lengths differences.

Nick Birch
If it's a minor leg length discrepancy I'd solve with a heel cup, is the first thing. And if that doesn't sort it out, then refer to a well-trained podiatrist. And a well-trained podiatrist will normally sort them out, up to about two centimetres with good orthotics. As long as they wear them, that's absolutely fine. Anything that's much longer, much bigger than that, if they've got a congenital abnormality, a congenital short limb, and they've got a big leg length discrepancy, and that's given them scoliosis. Yeah, if you pick that up in a child, then you might be looking at a leg lengthening type procedure. But that's thankfully, pretty rare.

Steven Bruce
Right. I was told long, long, long ago, when I first started studying gait analysis that anything as you say about an inch, two centimetres or so in difference, then, instead of any sort of heel lift, you're looking at a sole lift on the shoe, which I discovered is remarkably easy to get done at various shoe places.

Jon Graham
I would normally raise up to about 1.25 centimetres inside the shoe. Because of the structure of everyday shoes, if you raise more than 1.2, you then affect the whole heel. And that is exactly as you said, you can just split the sole and put an insert in there, which will give you more...

Steven Bruce
Anything more than that, of course it's altering the balance of the Achilles tendon.

Nick Birch
But if you go back to when we were kids, there were always cobblers in the local towns that would then do the built-up boots because there was people who'd had TB of their hip. So they also had short legs. And they didn't have any leg lengthening type surgery at that time. There were no Ilizarovs around. It was all somebody in the village who had a boot on that there's this big and they had, as you said, an odd gait and they had back pain, all the other things that went with it. So yeah, it's absolutely right. It's external

beyond as I said, I mean, I would say sort with a thin heel, up to a centimetre, maybe you can get the podiatry gains, you're being a bit mean at 1.25.

Jon Graham
It's just the shoe. Yeah, it pushes the heel up too high.

Nick Birch
But that's what you do with a whole foot orthotic. As opposed to just a heel. Yeah, you're right. Yeah, heel, I'd go one centimetre.

Steven Bruce
I'm always telling people how helpful my team are to others. And I was coughing a bit earlier on and I'll bet this is Ana, because I've just been told Ana's got a cough sweet for me if I need it, so they're going to do something with the cameras while you talk. And somebody's gonna come in here and give me a cough sweet now. And it all happened seamlessly. If I hadn't mentioned it, nobody would know.

Nick Birch
It's long COVID.

Steven Bruce
It's long COVID. Everything is long COVID. Jon, back to you.

Jon Graham
Yes, so what we're trying to do is we're trying to in this cohort, we're trying to alter the brainwaves such that we've got, we lower the theta, raise the alpha. So we're trying to make that unconscious information available to the individual so they can alter it. The other strand is, some of the audience may have remembered from back in the day, Tomorrow's World on a Thursday night. This was a science programme. And one of the things they did, which just illustrates how you can learn these things. They picked on a chap in the audience and said, right, sir, can you see that counter over there? Well, yes, it says, can you see how it slowly counting up? 1, 2, 3? Yeah. So as you're doing that, sir, well done. And keep up with a good work. And the guy looked completely confused. And they came back regularly through the show. So look at that you're doing a fantastic job there, sir. And the numbers were going up at a faster rate. And they got to the end of the show. And they said, what do you think? And he said, well, I can, I can see that, whatever I'm doing, I'm doing better, because the numbers are sort of flying by, I have no idea what I'm doing to influence those numbers. So they then pulled out a little chap from behind the screen and all that had happened was this, behind the screens fellow had been looking with a telescope. And every time this chap blinked, he hit a clicker. And throughout the period of the programme the brain, because it's getting that positive, you're doing well. It's auditory stuff, you're getting some visual feedback of those numbers going on his brain is just trying to learn that connection. So by the end of the programme, the brain had managed to get a sort of a slight change in terms of the blink rate. So there being potentially some postsynaptic, the membranes had kind of come a bit more sensitive to release of transmitters.

Steven Bruce
Again, I've probably lost the thread. But I was thinking as you were talking simply artificially lowering theta or raising alpha or whatever isn't going to change chronic pain because it's being driven by the chronic pain, it's not driving it. But if you're talking about a positive feedback mechanism hasn't there got to be something which says that if I keep doing this, it will lower my pain.

Jon Graham
So again, you're looking back at the central knub, there has been some sensitisation, so the brain activity has changed, long after whatever the trigger was, it's the burglar alarm that keeps going off long after the burglars fled. And the manifestation of that that we're seeing is this altered brain activity. And as we'll see from the results here, if we can influence that activity and change that, to what would associate with a state of not being in chronic pain, you then get these results.

Nick Birch
Yeah, a thing to remember, of course, is that pain is only felt within the brain. But so with primary chronic pain, all you've got is a neuronal circuit that has altered the way it's interpreting the world. It's a bit like being in the matrix. And suddenly, you know, whichever pill you've taken, you've gone down the rabbit hole, and then to you the world is real. The world of chronic pain is very real, because that's what the brain is experiencing. All we're doing with the axon device is trying to retrain the brain, so that those circuits say something else. And that's all it is. And that's why it's called neurofeedback training.

Steven Bruce
In terms of, Katrina has asked a question. Have you heard of neurofeedback being used for treating ADHD? Which she asks because someone she knows is having this treatment? She's not previously heard of it.

Nick Birch
Yeah, it's one of the indications for neurofeedback training.

Steven Bruce
It is, okay. And is that exactly the same sort of thing we're going to see this evening?

Jon Graham
Yeah.

Steven Bruce
Right. So you've got some results on here from a trial of...

Jon Graham
So, going back for the audience for the logic of this. So that person at the end of that studio, the brain had made the connections to change the resting blink rate. By the time that person went home woke up the next day, they were back to their normal blink rate. Had they been constantly, every day exposed to that kind of activity, the brain may go, well, actually, that's the rate we need to be at. So with the axon system, we don't just give that person one experience in modulating their brainwaves, they get numerous

opportunities to do that. So that you get the neuroplasticity, you actually get the neurological change within the brain. Now, whilst there is this high theta, low alpha in chronic pain. Periodically, there'll be a switch the other way, it's not a constant, it's predominantly high theta low alpha and then there'll be a switch. So what the axon does is, when it sees that switch, it then gives the reward within the gains, and the brains thinking, hang on a minute, why have I just got a reward, and that's where you start to get the change in those, the rate at which the fluctuation goes in the direction you want, changes. So during 20 to 21, we screened 29, was it?

Nick Birch
33 people.

Jon Graham
And we ended up with in this thing, 19 people into the trial, of which 16 completed, this was during lockdown, so that the original plan that we went to the research ethics board was we would train these individuals in person how to use the headsets, send them away to use them at home, we had to do the whole thing remotely.

Steven Bruce
Is 19 a reasonable number for a pilot study or pilot trial?

Steven Bruce
How long does a session last?

Jon Graham
For a proof of concept. It's absolutely fine. In fact, it was then accepted by the New Zealand Health Board as sufficient proof of concept to them fund this very large trial that's gone on in 2022. So our individual during lockdown, where the packages were delivered, they were trained remotely via zoom, how to put it on, how to connect the tablet that gives them the feedback to the internet, how to play the games that will see Nick doing in a minute. And we encourage people to do between four and six sessions a week, for an eight-week period.

Jon Graham
So a session lasts about 42 minutes, because you set a baseline because the brain is changing. So each session you want to know what that baseline fluctuation is looking like. So that you reward them as you go along. We did a number of questionnaires before they started, number of questionnaires at the end. And then at three and six months.

Steven Bruce
Is this only relevant to primary chronic pain?

Jon Graham
No, because there was a mixture within the group, we took a broad brushstroke in terms of some of primary and secondary. So one person was, for example that was awaiting hip replacement.

Steven Bruce
Do the latest studies need to split it between the two to show who benefits more or does it not matter?

Jon Graham
I think the key thing at the moment is if you look at the responders, we found that 11 out of 16 responded in our trial which is 69% and 79 had a positive effect and the other in the other trials. The interesting thing is, what makes a responder and going back to the earlier question, is a responder somebody who hasn't had previous traumatic events. So it could be something as simple as that. One of the things that Nick and I are looking at in subsequent study is about optimism, pessimism, do people think that life can be different, are they responders, but in our original trial 11 out of 16 responded and 50 positively and 50% of those had a greater than 30% improvement in pain, which is clinically significant.

Steven Bruce
Was there a dropout rate similar in both trials? The other I think were three dropped out in the UK one wasn't there.

Jon Graham
So the dropout rate, that's a good question. This is only just to come to completion. So we've only been given some headline data on this one to show, so it's the first time it's going to be shared outside of the research group. So what's interesting is how similar that the figures are, so in our proof of concept we had 69% reported significant improvements in quality of life 69 improvements in depression and anxiety, 63% improvement in sleep quality and 69% up who had up related their alpha and improved their pain. And broadly similar in the New Zealand trial, slightly less in terms of the improvement there but broadly similar in terms of the depression, anxiety and stress.

Nick Birch
What I think's interesting there is that in the New Zealand trial that was a true randomised controlled trial against placebo, and 80% were responding, so higher than in the proof of concept. And of course, our proof of concept was very much hand holding, these are people who would guide you through so we're really finding our way with it. So the fact that then you go into an RCT, you get a better result than your highly controlled, highly regulated proof of concept actually says that, yeah, this is working well, which is good.

Steven Bruce
Okay, we're gonna do the practical in a second. Can I put a couple of questions here beforehand, since they've come in and French Claire says, will Jon elaborate on how they use the feedback machine to reeducate the theta and alpha brainwaves in chronic pain patients? I imagine that's what you're about to do.

Jon Graham
You will see that.

Nick Birch
They need to understand one concept and that is neuroplasticity. When you and I were children and going through whichever medical school training or osteopathic training you did, we were told that the brain was fixed. That there were no changes. Once you had an adult brain you had no changes possible. We now know that it's complete bunkum, the brain changes it could change almost on an hour-by-hour basis because of neuroplasticity. And the key here is, what the neurofeedback training is doing, is tapping into that neuroplasticity so that the networks of change to produce the chronic pain we're trying to change the back again. And that's the key, it's neuroplasticity. And Jon mentioned that earlier.

Steven Bruce
Plasticity is just the neuronal connections.

Nick Birch
Just neuronal connections, just changing it back to where they should be instead of being this aberrant connective process.

Jon Graham
One thing about neuroplasticity I like is the human lens. So, the human lens is a very optically, you can't see through it, it's like glass with Vaseline on it. So the reason that babies take four to six weeks to have some vague idea who mum and dad is, is the neural nets in their eyes are adapting to the imperfections in the lens. So it starts as early as that.

Steven Bruce
Guest 134 says, how do you interpret when a patient describes severe pain in a particular area, but when you the practitioner palpate that area when the patient is distracted, the patient shows no reaction.

Nick Birch
That's a good example of primary chronic pain, that is that they've got pain coming from somewhere. But the joint moves completely normally, turn it around, flip it around and say, if I rub my thigh, and it hurts just when I touch it, why is it hurting, that should be just ordinary, but that's allodynia. So that's actually a primary chronic pain with central sensitisation, so the fact that they've actually got a localization for it just means that that is the brain says that that's originally where the message came from. It could well be they've got a sprained ankle, or a bit of back pain or whatever else, but it's all long gone. So they're now maybe complete normally, but they're still complaining of pain there. It's a representation within the brain of what their map is of the body.

Steven Bruce
Okay. A couple of people who apparently asked whether there is a rule for psychedelics or cannabis products in the treatment of chronic pain?

Nick Birch
Well, I mean, CBD is very well understood now. We know that there's a cannabinoid receptor system, there are type one and type two receptors in the brain. I think the thing that hasn't been worked out particularly well is how do the cannabinoid system and the opioid system work together. And the other

part of it is actually the psychogenic part of it, which is, you know, essentially magic mushrooms psilocybin, where do all of these various receptor systems that can modulate brain activity whether they will fit in, so CBD for some people works extraordinarily well. In other people, it's less effective. You take out the THC, so you don't get the hyperactivity, the high as it were. And what you're looking at, should be just type one or type two cannabinoid activation. And if that's what works for you, that's absolutely great.

Steven Bruce
You said one of the problems is we don't know why it works. Is that a problem? Aren't there quite a lot of conventional drugs, we don't know how they work, but they do so we use them.

Nick Birch
Well paracetamol is a good example as well.

Steven Bruce
I would have thought Aspirin.

Nick Birch
Well, no, aspirin is fairly straightforward anti-inflammatory. But paracetamol is the classic and no one knows how paracetamol works. We don't really know how general anaesthetics work, you know, so you're actually right. Does it matter? Yes, it does matter. Because I think when you're dealing with substances that are, if you like, lost leaders for an epidemic of a disaster like opiates, you've got to make sure that if you're introducing something new, you know as much about it as you can, aspirin would never get approval these days, not because we don't know how it works, because it's cycloxigenase inhibitor, it's actually because we know that the side effects can be pretty disastrous for some people. Paracetamol would not get approval because we can't prove how it works. Most general studies would not get approval. If you're going to introduce a new cannabinoid, or if you're going to introduce a psilocybin for magic mushrooms, we need to know a lot more about the pharmacology.

Steven Bruce
Okay, last question before we move on, Darren says, so how does this process affect the substance P-receptors and help to reduce sprouting as found in chronic pain?

Nick Birch
Most of the symptoms P receptors are peripheral rather than central. So the answer to that is, we're not really aiming at that peripheral-type activation, so the neurone utilisation that you see for instance in the outer part of the degenerative disc when you're getting ingrowth of new blood vessels, ingrowth of new nerves, and when substance P is really important in that sort of environment, that's not what we're talking about here, we're talking about internal neuronal networks within the brain which are very much more the sort of usual brain neuropeptides.

Steven Bruce
Okay, thank you. So now we're gonna watch Nick play some games.

Nick Birch
Yeah.

Steven Bruce
Jon, you're dangling a receiver behind your back. Let's be careful. Nick's sitting here.

Jon Graham
Yeah.

Steven Bruce
When he put this on, I thought he was about to go on his bicycle.

Jon Graham
I do describe it to people as a broken cycle helmet. So hopefully, the audience can see what we're seeing on the laptop. So they can't yet.

Steven Bruce
Well, Justin will control what the audience see. So what's going on in this bicycle helmet?

Steven Bruce
Are we seeing that on the revolving brain?

Jon Graham
So basically, in this broken bike helmet, we've got a number of electrodes that are picking up Nick's brain activity over C4.

Steven Bruce
Those four lines there.

Jon Graham
So the revolving brain is a sort of an infographic just kind of showing a generic brain, and where you can see the little lights there, the coloured sections in the sort of networks there, that's indicating the area of the brain. So that trace that we're seeing there is Nick's brain activity in the alpha, theta, and beta areas.

Jon Graham
It's four lines, and then one is the earth for want of a better word. So when an individual is first putting this on, we like to kind of put this on because it gives us an idea of the fluctuation. And you can see the movement artefacts if I touch it, as Nick shakes his head around a bit as well, you can see those artefacts. So that's the key thing that when someone's working with it, they have to keep quite still, because you'll get movement artefacts, which the software might confuse with actual.

Steven Bruce
And how many sensors have you got in here?

Jon Graham
So there are six sensors. So if we go back, so we're gonna start and then. So that gives us the four, so there's two earths and four actives. So that's one of the reasons why we've got the headset as well just to ensure a really tight fit. So we can then go, as we know we're getting a good connection. So the first part of it, and this is the key thing to establish a baseline, what is Nick's brain activity now, what is his relative theta, and his relative alpha. So there's a baseline established with your eyes open, but of course, because keeping your eyes open is an active muscle activity, there are also EMG artefacts coming from the muscles that make your eyes open, which can confuse the electrodes. So there's a baseline eyes open, baseline eyes closed, and then the software is able to take out the EMG artefacts from your eyes being open.

Steven Bruce
Nick's not currently listening to his playlist on Spotify, is he?

Jon Graham
Hopefully he's got earplugs, and he's tuning out, so his eyes open, concentrating on that cross. And of course, because Nick hasn't got chronic pain, his threshold will be quite high.

Steven Bruce
So do we need to stay here?

Jon Graham
So no, in terms of...

Steven Bruce
Should we go and sit over there?

Jon Graham
I'm gonna click on the next bit. So normally, it's two minutes. I think in fact, let's go back to the neurofeedback for ADHD. I mean, there are clinics where you can go and have that done. At the moment, I don't think you can get it done at home. So one of the things about this excellent headset, is it's available for home use as a concept. Because the the research that sort of inspired the development of this was based on lab research. You could go in and someone could wire you all up, but in order to do the intervention, you'd have to turn up at the lab and be wired up. The key thing is what the developers of this, what they want is something that can be used at home.

Steven Bruce
So Nick's now doing this with his eyes closed.

Jon Graham
So Nick's got the eyes closed. So again, it's establishing what's the EMG activity that could be confusing the EG activity. We know that for the very best, most accurate baseline, you probably need about two minutes. But that makes quite dull TV. So we've kind of just dropped it down to give it a minute on each. And then normally, when an individual is using it clinically at home, they will play each of the games for

five minutes, and then have a minute in between, minimum rest before they go on to the next game to do six games. And then it does the baseline at the end. So we've got a choice of games, there's a puzzle game, there's a balloon game. The bars actually show you the very raw, like a graphic equaliser. The one that's kind of nice to look at as an audience person, so there's a sort of screensaver. So the bar on the right is the movement bar. So if Nick just shakes around a little bit. Nick, can you shake your head? See the artefacts, so that's biofeedback, keep still. On the left, the white line is the threshold. And every time that the pink go, the alpha and theta ratio goes above that threshold, a piece drops into place. So that is the visual feedback.

Steven Bruce
Right. So Nick's not moving those pieces deliberately.

Jon Graham
No, so he is being visually rewarded. When he gets that natural fluctuation from high theta, low alpha. And if it's maintained for point four of a second, then he also gets, you can set it up a little auditory paying as well. So you can have auditory and visual, but it's quite a penetrating. I've just left it the for the visual stuff.

Steven Bruce
So what does he do to change these theta and alpha levels?

Jon Graham
So again, it's a bit like the guy in the thing, the guy didn't do anything. The guy just sat watching the screen thinking, why are those numbers going up? So you're zoning out, you were just relaxing into this. This has proved one of the more popular games to do because you're seeing a pretty scene, gradually assembled before you. On the initial training session, you have to don't try and mentally sort of teleport those pieces into place. And sometimes people who are struggling, we actually say, just close your eyes. And then sometimes that can work. Please stay still and check your two fingers. Next.

Nick Birch
The difficulty, of course, this environment is not totally conducive to neurofeedback training. So I can hear you guys in the background. And that then becomes a little bit distracting. But I think you can see from that first, jigsaw, all I was doing, I was just looking at it. And as John said, just zoning out.

Jon Graham
It is actually just quite a relaxing process. I mean, my wife was also one of the clinicians involved in training the participants in the proof-of-concept trial, because we've got a kit at home, she actually quite enjoys doing a round of games. I mean, one of the other things is, we know, for example that mindfulness for some individuals can work and it's backed, how do the drugs work, we don't know how mindfulness works. But if engaging in mindfulness reduces your pain over time, then there's got to be some kind of neuroplastic changes to bring that about. And that may well be this change in the theta and alpha.

Steven Bruce
Mindfulness, of course, doesn't have this positive feedback.

Jon Graham
And that's why I think not everyone can, it's hard to engage with. I think this is a much easier thing for people to be involved with.

Steven Bruce
Is that more so in the modern age where perhaps lots of people like electronic gadgets, rather than sitting on a map going on?

Jon Graham
Potentially. But I think ultimately, for those people that can do it, and get clinical benefits, something's changing within the brain. So in all likelihood, it is going to be the brain activity in C four, but we know that it's hard for people to do.

Steven Bruce
So in your study, if Nick genuinely had chronic pain of one sort or another, how long is he going to be doing this for, how many sessions is it going before he starts to see a change?

Jon Graham
So behind this, there is a clinicians portal. So as clinicians we can see session by session, what their resting rates are. And in the responders, you see a really nice graph literally of the theta going down and the alpha going up. So in some individuals, we saw it within two weeks that people were saying, I'm sleeping a little bit better, I feel better in myself, I'm not quite hitting those peaks of pain, that then it seemed to sort of stay steady for a while. And then as you get to sort of week six, seven, then again, it seems to march on and get more results. Of those 16, four people carried on using it, because they felt that although their pain was in some cases 50% better, they wanted to go how good will this get?

Nick Birch
So that's two jigsaws I've done, so I would normally I mean, how many minutes that was, about five in total I would guess.

Steven Bruce
Possibly, yeah.

Jon Graham
I've set it for two minutes.

Nick Birch
Okay, so then I take a break for at least a minute, they get back to another block, do six training blocks in a session.

Steven Bruce
Which I would imagine is quite an attractive thing to do.

Nick Birch
It can be quite exhausting. I remember the first time I did it at Jon's place and I felt absolutely exhausted the first time I ever did it. And I think quite a lot of people find that, don't they?

Steven Bruce
Should we go back over here? There's a prop to have a look at. Now in in 20 years time, the NHS will have four of those and they'll be trying to work them through windows eight. I'm guessing that the NHS isn't going to see these in service anytime soon. What about in private practice because presumably lots of us have lots of chronic pain patients. We need lots of these in every single osteopath, chiropractor, physiotherapy practice in the country.

Nick Birch
So Jon and I are running a, we're calling it a commercial validation trial. So having done the proof-of-concept last year, in year four, we then want to say okay, well let's put it into our practices, is fundamentally full of patients who've got chronic pain. I see maybe 25% with acute problems but most of them are chronic patients. Of those, so I would see 18 to 20 patients in a week. So everyone gets an hour, so it's about 20 hours consulting. And of those, I would probably find two who would benefit from this each week. So you're really talking about 10% of the chronic pain patients and it goes back to what Wendy said earlier about essentially working out who's got fibromyalgia, who's not got fibromyalgia, if you examine them, you know, what the biomechanics are. So if somebody comes to me with an adult scoliosis, and they've got chronic pain. Well, the adult scoliosis has to be investigated and treated first, you know, so we get all those things. Because this is essentially what you're looking at people who've gone through that whole process, who've had a total comprehensive assessment and then you said, okay, we've tried everything, there's nothing we want to do and we're gonna stick a needle or draw a knife into you cause I don't think it's gonna work. Let's try this and I reckon about 10% of my chronic patients are like that.

Steven Bruce
So therefore, what you just said though, it wouldn't take long to train clinicians to learn who to weed out and who to recommend for this because we are looking for chronic pain of no other cause, which I think was the original definition of primary chronic pain.

Nick Birch
Yeah.

Steven Bruce
Okay. This is probably going to take this off piste again, I apologise for that, but the questions are coming in slightly quicker. Katherine says that a patient with diagnosed hyper vascular syndrome from birth causing pain in the right upper extremity. If the pain symptoms are associated with a congenital syndrome, and have always been painful, would it be possible to affect neuroplasticity to reduce pain with biofeedback?

Nick Birch
Well, first thing is that that's likely to be a combination of chronic primary and chronic secondary pain because it's secondary to a congenital malformation. You can get, as the NICE guidance or as you said, you can get primary chronic pain with secondary pain. And that may explain why some people have knee replacements, don't get better afterwards, because actually, they've gone over to be centrally sensitised, and they've got primary chronic pain as well. Can it be used to mitigate the symptoms? Yes, in the sense that if you look at the results of the trials, both the trials, it is much more to do with the management of symptoms that are allied, if you like to your primary symptom of pain, because if half the people are getting about 30% or 40% reduction of pain, but they're feeling their quality of life is better, it means the other things that go with chronic pain, so sleep deprivation, anxiety, depression, central sensitisation, all of those are being improved at the same time. So the answer to her yes. Because you can modify some of the primary components of this mixed bag.

Steven Bruce
Okay. Good news for Katherine's patient. Lawrence says he had a patient whose son had epilepsy and was on cannabis, but was trying this for seizure reduction, in your experience is it efficacious with epilepsy as well?

Nick Birch
I have no idea.

Steven Bruce
I think we're talking about this.

Nick Birch
This for epilepsy?

Jon Graham
Primarily for the epilepsy.

Nick Birch
I don't know of any evidence at the moment saying neurofeedback training for epilepsy.

Steven Bruce
Okay. And French Claire again says this is a very pragmatic way to show the patient how relaxation is deeply beneficial to their level of pain.

Nick Birch
Totally agree with that.

Steven Bruce
And again, she says what techniques would be advised to the patient once they're aware of the brainwaves? So you've explained about theta and alpha...

Jon Graham
So it's interesting, some of the individuals in the in our trial, and some of the people in New Zealand, because there was some autism qualitative research going on as well and some interviewing afterwards. And people were saying, well, actually, when it wasn't with the machine, the game and I felt well, you know what, this is coming back on again, I actually imagined myself in front of the screen. And that allowed them to just to get again, wasn't as good as but it kind of helped. But the key thing is it's back to the central premise of you've got a disordered part of the brain that's then generating these brainwaves in these frequency arrays, and actually, the longer you do it over the eight weeks and the four to six sessions a week, you're physically changing through neuronal sprouting, the structure of the brain in such a way that you're not getting the whole frequencies change, this upregulation of alpha and downregulation of theta.

Steven Bruce
I guess it's too early and perhaps the study is too small to comment on. I know you said there wouldn't be permanent change in the brain because of course, it's plastic. But what sort of long term revelation to normal brainwaves?

Jon Graham
It's an interesting thing. So back to an earlier slide, when you can see that NICE is advocating exercise and we know as physical therapists that exercise is good. But when you've got this fear, with more exercise, it's going to make my pain worse, and they feel they can't do it. The nice thing about this is potentially, after you've got this internal change they potentially say, okay, now, you're in a position to start doing exercises. So potentially, you can maintain the benefits by doing exercise.

Steven Bruce
Rowena has asked whether this could be a helpful approach for restless leg syndrome, whether painful or not, and I saw that restless legs was one of the 13 circles on your chronic pain chart.

Nick Birch
Yeah, restless leg syndrome is considered to be, at least some people have restless leg syndrome because of central sensitisation. So and that's as long as you've excluded the other reasons for restless legs syndrome or cramps, and things like magnesium imbalance in the diet and making sure you've got enough nutrients to make sure your muscles are working well.

Steven Bruce
Right. Okay. Bottom line, how much does it cost says Jason.

Jon Graham
So the hope is that an individual, it will be a subscription model. So the first year would include the individual would have the headset, and then access to the software for a year.

Steven Bruce
The individual being the patient.

Jon Graham
Yes, the patient. So you're looking at a price point, we're trying to get between 850 to 1000, for that first year, and then subsequent years would be sort of 750, 800. So part of the clinical validation study that Nick and I are doing is trying to work out well, and see pragmatically, if you've done it for not the eight, if you've done it for 32 weeks, what happens thereafter? Do you get to a point where the brain's reorganised, you've been able to engage with doing some exercise and you actually have to all intents and purposes solved your chronic pain or is it something that you'll get a nice reduction, but every two or three months, it'll start to creep back up again. So you just do a little bit of a top up dose.

Nick Birch
How long will it take the NHS to change the NICE guidelines or to take on board...?

Nick Birch
There are a number of different models, as you'd imagine, one of which is you have an individual headset, and you've got the subscription to the software with all the various feedback and that's your 1000 pounds a year. And you might keep that yourself and you might then pay 750 per year for your ongoing licensing, a bit like a sort of super TV license. Alternatively, you would go to a Brain Train Cafe. And you'd go along lunchtime. And you'd take our set out that'd have been sterilised and then because it's linked to you, you would just keep your code in, and it comes off the cloud. So that's what I'd put it on, eyes closed, eyes open, and then away you go, have your half an hour session at lunchtime, then you go back to your stressful office and sit in your corral and do whatever you do. So there are lots of different ways you can think about it. And that would then fit lots of different pockets. The baseline model, the single user is about a third of what the NHS spends on chronic pain per person per year. So I did some work that informed the early part of these studies and looked at the international comparisons for how much we will spend in this country on chronic pain and in the UK for every chronic pain patient costs the NHS about 3400 pounds per year to treat them. So if we are able to get 75 to 80% of people responding to this for a third of the price, when you do the cost benefit analysis, it turns out that it's actually got a benefit that runs to something like 10,000 pounds per quality of life year. So as long as we've got 75 to 80% responders, then it works out to be a very cost-effective mechanism treatment.

Nick Birch
The NHS would be reactive rather than proactive, so NICE would have to be invited. Essentially, when they do a review of their chronic pain management recommendations, which will not be now until 25, 26. They would need to be persuaded that actually, this was a technology that had enough evidence to support it. So we'd need some more randomised control trials.

Steven Bruce
Okay, but there's time for that between now and 25, 26. Okay. And going back to your Brain Train cafes, do you see those being part of, say a physio, osteo, chiro clinic or?

Nick Birch
I would very much see that. I mean, if you've gotten, I mean here, for instance, you could have literally people walking on the street, sitting in a booth and then a glass of water, headset on and coming in and doing that for their lunchtime, morning, whatever else. You could do it in Tesco’s or Sainsbury's, they can

actually have their brain train cafe next to their sort of Starbucks type cafe. And that'd be obviously fine, so come in, have a brain training set, and then you get your latte, your skinny latte and whatever else afterwards.

Steven Bruce
But you talk about clinician input into the setup early on. So somewhere there was a clinician who's looking at the results, monitoring the progress.

Nick Birch
Well, I mean, that's through the cloud, that's through the clinician portal.

Jon Graham
So I think the cafes is the longer term maintenance part of it, I think it would initially be very much involved with your physio, your osteopath, or your chiropractor. So I think the model that we'd be looking at is probably be a clinician set. I mean, I've put it for tonight, put the software on my laptop, but in reality, it comes with a little Android tablet. So I think a clinicians kit would be a bigger box, a single tablet, and then the three headsets, the small, medium, and large. So I think before someone invests a 1000 pounds for their first year, as a clinician to say, well, I'll show you what it looks like, let's book you in in the next session and actually do your first session. And just to see, is this something that you feel you could engage with? And then potentially they would then order it.

Steven Bruce
And how much time is the clinician having to invest in looking at the results of all of these people at the Brain Train cafes who are using the kit?

Jon Graham
So I mean, the portal is probably in use in a clinical service that's set up for chronic pain. I envisage for most clinicians, with one person, or a handful of clinicians, ultimately, once you say, with the clinician's kit, given that individual a chance to see what someone would want to commit with. And then they've got their own kit. I'm not necessarily envisaging that you would be going on to see how the report was, but in our clinical validation trial, I've had a couple of texts saying, can I just ask you, I feel I'm doing a little bit better, what can you tell me? So actually, now you've asked, I can pick it up and say what actually I could see from week four, I could see your alpha was starting to rise and the thetas going down. And they go, well, that was the week that I was able to go out that night and so that it correlates very nicely.

Steven Bruce
I just think that the patient would say, well, I know I'm getting better because I've got less pain.

Jon Graham
I think and again, it comes back to one of the earlier things in terms of a certain type of people who get chronic pain or if you've got chronic pain, you become a certain type of person. And you're not, you know, there are very few jaw droppers of people that are going from seven to eight down to one or two, there's actually a grey area in the middle where I can't think it's working. Can you give me some feedback, oh

actually, I can see this and they're, ah, hang on a minute, if you're saying week four that, it kind of all ties together.

Nick Birch
But what you said earlier was absolutely true. And that is that the very first thing we noticed at the proof-of-concept trial about three weeks in, was that the feedback we were getting was I'm sleeping so much better. I can cope with my pain because I'm not tired. I'm not exhausted. So managing my pain is much easier because I am sleeping better. Once you get that part of it going you begin to break the cycle of chronic sleeplessness and then pain exacerbation. I think that's sort of where people begin to recognise they're responding quite well. And they need that validation occasionally, but to your point, regarding how much input there needs to be for the clinician, if you're a busy clinician, and you've got a dozen patients who are using the axon system, you don't want to be going on to the portal every day and looking to see, make sure they're okay. But what you might do is say, let's schedule a zoom catch up or face to face catch up four weeks in, and then I can have a quick look at that. And then we'll see exactly what your trends are. And the software will then give you that, so it will print it out. Okay, this is where you were, this is where you are now, how do you feel? The other thing is there is the subjective, you've got the objective part a bit, but there is subjective feedback, because they fill out, every time you log on to a session, there's a little scroll bars that say, where's your pain today? Did you get sleep last night, etc, doo, doo, doo, doo. Okay, so you've got your PROMs fed back. And so you can then look at the problems automatically. So you get that coming through every time you want to look at them.

Jon Graham
Again, one of the things I did in the New Zealand trial is they modified the software, so the software would send people a text in the morning, say, oh, don't forget, schedule your brain training. And then if they didn't, it could send them a second text saying later on, don't forget your brain train, they call it brain training. And I think at the end of day, we've gone from proof-of-concept 2021 to a large trial, it's still very much an emerging product, as well as technology. So one of the things you might have is rather than you sitting watching all your clients, you might have the system set up. So it will tell you, if one of the people who you thought you should be using it for it might say, well, actually, you know what? Patient A did not switch this device on for five days. And you get the text or the email from the software. So you might say, well, actually, you know what, I'm gonna give that patient a ring and find out what's going on.

Steven Bruce
Some people have asked about other applications. Paulie says, could this help in diagnosis of Parkinson's disease? And Imran says, have you tried it on MS patients or patients with stroke?

Jon Graham
So we excluded from the proof of concept trial, and it was excluded from the RCT MS and stroke, simply because the question would be, to what extent in a brain that's been affected by another pathology, to what extent would the learning ability and the neuroplasticity be affected? But given that in both conditions, pain can be a big issue, I think it will work.

Steven Bruce
So are those separate trials in their own right, then?

Jon Graham
Potentially down the line, they'll be separate trials.

Nick Birch
But it's not diagnostic.

Jon Graham
No, no, it's not.

Nick Birch
The first thing is it's not diagnostic. That's the first thing. The second thing is, is it likely to be beneficial in neurological conditions that are known to be not only organic, as in, you've got Parkinson's with your dopamine changes, but you've also got significant affective disorders. And we know that people with Parkinson's very frequently have a psychological deterioration. And that's then partly, it's going to be neural network, and it's partly going to be a reaction. Will they get benefit from that, there's a possibility they might do. But the big problem with Parkinson's is that this requires you to be still. So unless you are typical Parkinson's with bradykinesia, rigid, that's perfect. Okay, that's fine. But if your Parkinson's is you got a tremor, it's going to be very difficult to use a Neurofeedback system to help them.

Steven Bruce
Darren says, I think you answered this question earlier. Darren says, what were the results like in terms of time, six months or 12 months after follow-up? We haven't got there, have we?

Nick Birch
We have. We got there for the proof of concept.

Steven Bruce
For the proof of concept, but for larger trials.

Nick Birch
What's the answer?

Jon Graham
So I think they were still present at six months, sorry, three months. And then I think it was a slight diminish at that six.

Nick Birch
Well, we know what the three-month results is because we published that in the Frontiers in Pain Research, the paper. And that was that there was a tiny, tiny drop off in results at three months. That was the 12 weeks post training. So that was 20 weeks after they started the process. Then the six months results were coming through. And at that time, as Jon said, there was a slightly further drop off. What we have got though is, you've got four patients who've continued to use it and you've continued to have good results.

Steven Bruce
I was gonna say that eight month follow up. I think you said there was actually six months after they lost wore the headset. So maybe there's a reason for the drop off.

Nick Birch
Yeah, absolutely. And we would expect that to proportionately in the patients to have reverted back. Because we're not going to change fundamentally in terms of their genetics, or their psychological profiles, and so something else might happen that then pushes them back over.

Jon Graham
The other thing was, it was in the depression anxiety, we used the HADS scale.

Steven Bruce
HADS?

Jon Graham
Hospital Anxiety and Depression Scale. And that then classifies the degree of anxiety and depression. And there were people that were actually, their answers were at the clinical threshold.

Nick Birch
Yeah, I mean, the people who actually had anxiety or depression, because with the HADS you have either normal, borderline, or actual state anxiety or state depression. Those all are the ones that were state anxiety, state depression, came back down to either borderline or normal after training. So it was quite astonishing. And then there were just a couple then crept back above a threshold into the borderline by the end of the 12 weeks.

Jon Graham
So another study this year, sorry, it's going to be next year, 2023, in one of London's psychiatric hospitals is looking, psychiatric services, looking at just using it for depression and anxiety, and not pain at all. One of the things that you found was that because you've got to reveal it, you've got a touch of tinnitus, and you did feel after one of your sessions, that your tinnitus wasn't ringing as much. So we did a quick literature research and again, in lab based setups, they have used it and found that there has been changes in tinnitus using slightly different parts of the brain. So I think one of the developments that exalgo, the actual company behind it, will be looking at is, how could we set up the electrode array to pick up the part of the brain that seems really implicated in that because that, for some people, that's quite a, there's quite a large population that do suffer from that.

Nick Birch
Well, it is. I mean, of course, the interesting thing about tinnitus is that the treatment for it is exactly the same as primary chronic pain. And that is CBT and Acceptance Commitment Therapy. It'll get better, it won't bother you so much as time goes by, my ears are ringing now, when my tinnitus is doing it, it doesn't bother me, I just get on with it, that's obviously fine. But for a lot of people, actually it's highly intrusive, and it ruins their lives. So if we can do something to help, then that's going to be a major advance.

Jon Graham
I think you were also thinking along, smoking cessation does actually, rather than you know, there's other areas of the brain that are kind of involved in addiction such that you put rather than the Nicorette or whatever you just do eight weeks of brain training.

Steven Bruce
Interesting stuff. I got two quick questions for you before we finish, because we are up against the clock. Darren would like some clarification. He says, I think I may be misunderstanding this. But if the patient's had an injury and this turns to chronic pain, there will be structural changes to the peripheral nervous system leading to this central sensitisation, bypassing this area and changing brain frequency surely will be short term until you deal with the area causing the bombardment and hence oversensitisation.

Nick Birch
Well no, the thing with that is that by definition, that the injury that caused the initial change, healed a long time ago, that's in the definition of chronic pain. And the pain has gone on for more than three months and the injury has healed. He's absolutely right. That's where it originated. And he's absolutely right, you get peripheral sensitisation, as well as central sensitisation. And the two go hand in hand. And sometimes they're quite difficult to treat. It is likely that if you can get the primary central sensitisation, primary central pain reduced because of your descending pain management system that is intrinsic to your spinal, your brain spinal cord, that in its own right will then down regulate the oversensitisation in the dorsal root ganglion and in the peripheral nervous system, and therefore, you'll get that synergistic improvement. That's what we hope. What we do know is that with central sensitisation, there was a dramatic improvement in the patients, all of our patients were centrally sensitised in the proof of concept, and there was dramatic improvement in the central sensitisation when we looked at it between the beginning and the end, and nobody was in the extreme group at the end, having had four people in the extreme at the beginning.

Steven Bruce
Which is very encouraging. The final question came from Sarah earlier on and she's asked, what happened to your wrong trousers' equipment? In other words, the rex that we demonstrated on the first show.

Jon Graham
Every time someone says that, a puppy dies. So yeah, it's still very much in clinical use.

Steven Bruce
There will be people who didn't see that show. And I think one of the things you told us during that show is that there was a very moving episode when two people, paralysed I think from the waist down, for the first time were able to...

Jon Graham
Were standing up, yes.

Steven Bruce
Which was I mean; I'd recommend people to look back at the recording at some point. But that's all we got time for. We've had 457 people watching, so we're getting above our normal average for an evening show. So it was clearly of interest to everybody and I had lots of feedback. I've certainly enjoyed it.

Jon Graham
And we'll give you the reference to the papers that you can download.

Steven Bruce
Yes, if you will, I'll share those. I'll send out an email tomorrow and share the papers with people. Thank you both very much.

Nick Birch
You're welcome.

Jon Graham
You're welcome.

Steven Bruce
Well, how about that for the final show of the year, hope you enjoyed it as much as I did. I'm back on Wednesday, the fourth of January for an evening show with Kelston Chorley to discuss how hysterectomy affects how we treat patients and how they respond. This is one that was requested by a member. So don't forget, if you've got a particular interest or concern, if you let us know, we'll do our best to find an expert to cover it for you. I'm not going to go through everything that's coming up in the new year because it would take too long but we are going to be talking about mindfulness, we're going to be talking about stress related pain. So look out for those in the diary, either on the app or on the calendar on the website. A quick bit of information, however, about four courses. We are running a first aid course on Sunday, the 12th of February, one of our very popular online courses. It's live, fully interactive, definitely meets the requirements set by both the GCC and the GOSC. And there are more details at apmcpd.co.uk/help! Then there is the hypo pressive breathing course which isn't one of ours, it's being run by the ladies who came to demonstrate the techniques on the show here. That's on the weekend of the 25th, 26th of March but you can access it through the website. And I'd really appreciate if you helped me spread the word about this because I think it's suitable for anybody who deals with postnatal ladies, whether they're midwives, nurses, Pilates instructors, whatever. And the technique is absolutely brilliant for fixing leaky ladies and so much better than anything else which is on offer. You can find that one at apmcbd.co.uk/hypo. Sadly, or perhaps it's a good thing, the Laurie Hartman masterclass over the weekend of the first and second of April, sold its final place earlier this afternoon. We are starting up a waiting list. This is a brilliant course for osteopaths and for chiropractors. It takes manipulation to a completely new and much safer level. So if you'd like a place on another course, go to apmcpd.co.uk/MLT for minimal leverage technique. And if there are enough people interested, we'll set up another course probably sometime in April. I have to speak to Laurie about that. I'll email you tomorrow with details of Serena Simmons' course about behavioural change interventions for physical therapists, something which is very much in line with what were talking about this evening. That will be an online course starting at the end of January. Serena was absolutely superb when she appeared here last week and the course

is huge value, only 125 quid, so I would urge you to take a look at that. That's it for tonight. Hope you had a good time this evening and I look forward to you joining me next year. Good night and Merry Christmas.