Orthotics and CP – Ref104

with Sam Walmsley

24th September 2020

TRANSCRIPT

Please note, this is not a verbatim transcript:

- *Some elements (repetition or time-sensitive material for example) may have been removed*
- *In some cases, related material may have been grouped out of chronological sequence.*
- *The text may have been altered slightly for clarity.*
- *Capitalisation and punctuation may be erratic…*
- *There may be errors in transcription. If something appears odd, please refer to the recording itself (and let us know, so that we can correct the text!)*

Steven Bruce
Good afternoon and welcome to another lunchtime learning session with the Academy of Physical Medicine. My guest today is a gentleman called Sam Walmsley and Sam graduated in prosthetics and orthotics some 19 years ago from Salford University. But 15 years ago, he founded the London Orthotics Consultancy, which he's been with ever since. And he's got a load of really interesting specialisations, but in particular, he specialises in paediatric orthotics. And today, we're going to be talking about the role of orthotics in treating cerebral palsy. Sam, great to have you with us, great pleasure. And it looks like you're joining us from your gait lab, is that right?

Sam Walmsley
That's right, yeah. Nice to see you, Steven.

Steven Bruce
And you too. I wish we had time today to talk about all those other things. I mean, one of your specialisations, quite sort of distant from the orthotics world is pectus excavatum and carinatum, isn't it? Which perhaps we can get you back on to talk about on another occasion.

Sam Walmsley
Yeah, we do specialise in that, but there's a very good orthotic solution for it, that's why. So yeah, I'd be more than happy to come back and talk about it.

Steven Bruce
Okay, so this is perhaps a bit of a leap of imagination for some people, the idea that orthotics has a role in treating cerebral palsy. Do you want to talk to us first of all about perhaps what we mean by cerebral palsy, what the types are?

Sam Walmsley
Yeah, sure. So cerebral palsy describes a range of conditions caused by a brain injury that happens during the brain's development at the point of birth, or very soon after birth, and classically, it's split into different categories, described as spastic cerebral palsy, which then can be subcategorised by the area of the body it affects, either monoplegia, hemiplegia, being one part of the body, diplegia, being normally the lower part of the body, or quadriplegia, the whole body. Dyskinetic cerebral palsy can be split into athetoid and dystonic. But typically, it describes slow, writhing, uncontrolled movements, and generally affects the whole body. Or ataxia can affect depth perception and balance.

Steven Bruce
I should probably leap in at this stage and just explain to our audience that these slides will all be available as a download after the broadcast. And some of them will possibly be quite hard to read on a small screen, because they're quite complicated. So don't worry about it, if you can't read the slides in detail at this stage, they are already loaded up to the website ready to go.

Sam Walmsley
There's also wonderful resources on cerebral palsy. It's a very common condition out there, so there are lots of support groups, both here and in the US with lots of great information on them.

Steven Bruce
Do you know the incidence of cerebral palsy?

Sam Walmsley
I think, and I'll be shot down if I get this wrong, but I think it's one in 50,000 births. I'd have to look that up. So when we when we talk about the different types of cerebral palsy, it's actually the area of the brain that's affected that causes these different presentations. And by far the most common presentation that we see is spastic cerebral palsy, which is characterised by stiff muscles, basically, so spasticity within the muscles. But then the other different types are much rarer to see, but you will see them in clinic, and they just affect different areas of the brain caused by the original brain damage.

Steven Bruce
Okay, are they easy to recognise in a patient?

Sam Walmsley
Yeah. Once you once you become familiar with perhaps a gait pattern, or when a child's a little bit younger, the movement pattern a child presents with, it is easy to recognise. Yeah. So especially the dyskinetic types of cerebral palsy are quite easy to recognise because of the movements, quite involuntary movements that are occurring.

Steven Bruce
And when we spoke on the phone a few days ago, you mentioned this thing called SDR to me, what does that involve?

Sam Walmsley
Well, I think this is probably important to mention, because a lot of the spastic diplegic type, which is a very common presentation to see in clinic, and some of that hemiplegia, they are going for something called SDR, which is selective dorsal rhizotomy. Which is when a neurosurgeon opens up part of the spine, find some of the sensory nerves and selectively cuts those depending on which sensory nerves are overactive and causing some of the spasticity in the lower limbs. It's been around for quite a while, I think it has been applied in pioneered in places like Austria, but more recently, a place in America, St. Louis, has really pushed it very aggressively across the world in some respects, and then our own hospitals, Great Ormond Street, Leeds, Alder Hey and Bristol, they've all picked it up and they've run their own programmes. And it's gone through trials and testing and now it's part of the treatment process. It's quite an aggressive procedure, there's no turning back from it. There are some downsides to it in terms of muscle weakness, instability around joints, which will probably be very important for some of your members to consider. But it's important to mention because a lot of patients are going for or perhaps will go for it at some point. And it does mean that a patient who presents as a spastic diplegic diagnosis who's had SDR now has a completely different presentation, because a lot of the stiffness has gone. But they have a different set of problems to deal with. It puts you on a perhaps a different path for your rehabilitation. And that path, hopefully most of the time is a better path, you can get to a better place. But it doesn't mean there's any less work involved, or any less treatment involved. It just means that a lot of the spasticity hopefully has left.

Steven Bruce
Do you know the general success rate for that operation?

Sam Walmsley
Well, I think these things are slightly debatable. I mean, most SDRs are considered successful. That's my reading into it. But we've had patients who perhaps they haven't been as successful as they wished. And also, I think sometimes some of the perceived goals of the surgery are maybe not met. So especially early days with a lot of the SDR, a lot of the patients thought they were not going to have to wear orthotics in the future. And I think that was perhaps a bit misconceived. But on the whole, I think parents are very pleased that they've gone for the surgery, but they are confronted with different problems along the way. So I think it's early days, to be quite honest. I mean, we need to see some of these children when they're 20 and 30, to really see the real success of the surgery.

Steven Bruce
You've also given us this ICF assessment here, do we need to know about this, it's quite a complicated little diagram?

Sam Walmsley
It is complicated, but it's really important for how we, as orthotists, should be looking at our patients, because a lot of the time I think we get tarred with the brush that we you fit pair of AFO's, and you're just worried about how the patient walks in a gait lab environment. But actually, when we're looking at this is the International Classification of Function, and we're looking at all the different areas a patient operates. So, of course, probably the most important thing to us are the bones and joints and protecting them. That's paramount. Because if we don't do that as an orthotist, if we don't support the foot and ankle, if we don't protect the knee and the hip, then that's going to result in bony surgery, which, orthopaedic surgery can be very successful, but there's also lots of risks, and it can take children off their feet altogether. So it's important that we do our best to try and reduce the incidence of some of these major interventions. But then we're also looking at function. And I think, a lot of the time, again, orthotics, maybe get well, they can stand up straight, but they can't play with their friends. Well, sometimes we have to take a pragmatic approach to some of our prescriptions, so that we're saying, yeah, well, you take off for playing football with your friends and you put it back on again for walking around the classroom. So there's lots of different ways that we assess our patients, but we try and funnel it through this system so that we're setting goals, so the patient will come and see us and we set goals around these areas to make sure that we're achieving those goals.

Steven Bruce
So is this a chart, is this an assessment used in order to establish goals in each of those many areas that are listed there? Or is it a chart to assess the degree of impairment?

Sam Walmsley
No, it's a chart to assess goals. So from this, we're asking the patient, what's important to you? A patient often is going to come in and they're going to say, well, my child is going to go to school in September and I want them to be able to walk around the classroom. That's a really common one. And so we'll be looking at yes, that's really important, we need to help with function and participation, but also if we don't

do something the foot's at risk of complete collapse, the knee is hyperextending, or the child's falling into crouch. So we're actually really focusing on some of the body structures and function. And maybe we're setting goals around range of movement at the hip or the knee, whereas the parent wants us to also set goals around their participation in school. So it just helps us all frame these goals correctly and measure it when the patient comes back for review.

Steven Bruce
And obviously, you talked a lot about the patient's parents giving you the information. What's the oldest patients that you generally see in regards to cerebral palsy?

Sam Walmsley
70. We see adult patients with cerebral palsy, yeah, I've got a number of adult patients that have very complex gait patterns because of their poor walking over the years. And so we will see patients all the way through those. There tends to be and most parents with children with cerebral palsy who have gone through their school and are now an adult will tell you about falling off a cliff. And it does happen, the paediatric services are generally good, or at least they're very responsive, and then you get into adult services and boom, there's not a lot there for the parents and their children. So we do see a lot of adult patients as well who seek out help and are looking for something bespoke.

Steven Bruce
And the world must become quite challenging for an adult patient. Because of course, one of the challenges they have is is communication, and finding their way around what's available to them and talking to related healthcare officials must be quite difficult.

Sam Walmsley
Yeah. I've got a really charming patient from Bristol, who, though he has communication difficulties, he's in a wheelchair most of the time, he uses his AFO's for transfers and small movements around his office. But he didn't think twice about getting on a train in Bristol, getting to Paddington and coming to Kingston upon Thames by himself. And so actually, a lot of the time whilst those are perhaps, and that's one of the things you learn as clinician when you deal with CP, their perceived problems, you're dealing with very, very capable driven people to get things done.

Steven Bruce
And I accept that, and it must be doubly frustrating, because they can think very clearly, but communication can sometimes be so challenging.

Sam Walmsley
Yeah, exactly. Yeah, it is one of the challenges about any of the consultations that we do sometimes.

Steven Bruce
And I said that last diagram was quite complicated. There's no way this one's going to come out well on a small screen, but it'll be part of the handout. This presumably gives us a schematic that you would use in terms of working out what you're going to prescribe.

Sam Walmsley
No one really needs to memorise this or know this, don't worry. This is something that is taught to orthotists at quite an early stage, at graduate level now. And that has been developed by a physiotherapist called Elaine Owen, who you will see within my references is the main person who's done most of the good research on how to build and design AFO's. But what it tells us is, importantly, that there is an algorithm for designing an AFO and importantly, footwear, as well. Because an AFO, a splint, should not be supplied by itself, it should be supplied with a shoe to go with it. Because if you're putting a splint with a fixed ankle, or even a hinged ankle, on the ground, what you do to the shoe then influences the biomechanics of that process. And there is a clear algorithm on how this should be done. And I think that that's often lost a lot of the time, it's sometimes considered a bit of an art this process, but actually there is science behind it and it's well evidenced, it works. But as you can see, there are huge processes there. And the problem when you've got a process driven situation is that one of those processes goes wrong, and then later down the line, it's not working. And so the reputation that these things get is that they don't work or it's not working or that way in which we prescribe orthotics isn't working, but actually it's because one of those processes isn't done correctly, be it in the initial assessment, be it maybe in setting the goals, if you get the goals and expectations wrong. But often it's the casting process or the manufacturing or the orthotics themselves, where it doesn't go quite right. So it's a difficult thing to produce to deliver results, but there are lots of guidance on how to do it correctly.

Steven Bruce
One thing I perhaps ought to clear up here is you're using terminology, which is commonplace to you, but you might want to explain what an AFO is to the audience.

Sam Walmsley
Sorry, yeah. Ankle foot orthosis. So we tend to describe orthotics by the joints that they act upon. So an ankle foot osthosis obviously controls the ankle movement and the foot, we go into a KAFO, a knee ankle foot orthosis when it comes above the knee, and an HKAFO. And for example, spinal braces are describes as TLSO's, thoracicolumbar sacral orthosis. So, that's the way we describe our orthotics.

Steven Bruce
I've just had a question from Nick, who's wondering whether the London Orthotic Consultancy also provides NHS services or is it purely private?

Sam Walmsley
So we have the odd NHS patient who seeks us out. Often, it's because their local service can't provide what they want, or there's been a problem and to placate that problem. Maybe the referrers can find a route to see us, but we don't take a routine referral from the NHS, we're a purely private clinic.

Steven Bruce
Right. So I interrupted your flow there, what have we got next? There's another complicated algorithm here as well.

Sam Walmsley
Yeah. So again, importantly, one of the ways in which we manufacture the orthosis is by taking a plaster cast. And a plaster cast has to be set at a very specific angle if we're going to get these things right, because the range of movement that we set the ankle at will determine how well the patient can move within the orthotic. So I've just seen a patient this morning, and I've taken a plaster cast of him, and I set his ankle at minus 15 degrees from neutral. 90 degrees would be about there. So I've dropped his foot down by minus 15 degrees. And this is going to get a little bit complicated, but the reason for that, if everyone's interested, is that the gastrocnemius muscle affects three joints, it affects the knee joint, the ankle joint and the subtalar joint. So if I assess this child, as is pointed out in this algorithm, and he can only achieve minus 15 degrees with his knee extended and his rear foot held in neutral, his subtalar joint neutral. If I'm expecting him to walk standing up with his knee extended, I have to set the ankle at that angle. He then can also achieve a terminal swing, so he'll be able to swing through terminal swing, and potentially get a heel strike as well. Because if I was to set him at 90 degrees it will tighten the gastrocnemius, which means he'll have less range of movement at the knee. So that was getting a little bit technical, but then again, what I wanted to demonstrate with that slide was that actually, there's an algorithm for how we cast and how we prescribe these orthotics. It's very well set out and evidenced.

Steven Bruce
Yeah. Somebody's asked what the difference is between your orthotics and NHS orthotics? Are they producing as good quality as yours or, my own experience of normal, if I can call them normal, normal foot orthotics is that NHS ones tend to be clunky and not particularly sophisticated.

Sam Walmsley
Well, I don't want to be rude about anyone in my profession. I think that the orthotic profession in general suffers from managers giving us a lack of time to deliver what we need to do. So for example, in the clinic, the assessment I did this morning took me two hours. I walked them over a gait lab, which is a piece of equipment, a 2D video vector gait lab, which is a relatively simple piece of equipment. It's got some forceplates in the floor, and I'll show you some videos later to explain this, but the force that the patient exerts on the floor has an equal and opposite force that then is emitted on my screen and matched up with the video. So I know where that force is relative to the ankle, knee and hip. And then I can prescribe my orthotics effectively or fine tune them. So that's the first thing, if you haven't got that, it's like a midwife that's assessing without ultrasound, for example, or assessing a fracture without an X-ray. You've got to have these bits of kit in your clinic if you're going to do things properly. But also, it took me two hours. Now when I was working in the NHS, you have 20 minutes for the same type of patient, and you have to cast in that time as well. It takes me half an hour to cast, if I'm going to do it properly. So there just isn't really the time, a lot of time. And one of the other issues is that the way that the orthotic industry itself is constructed is that a lot of manufacturing is done in hubs and that's to create efficiencies. So a manufacturer might be in Sheffield, and the orthotist might be in Brighton. And so the communication between the orthotist and the technician is via scribbles on a bit of paper or maybe an email. And that's how you get something completely bespoke made for a very challenging presentation. And then you've got 20 minutes to fit it the other end. Whereas here we have two hours to assess it, a gait lab, I take it upstairs to my technicians in the workshop and say, oh, this is a tricky one. Let me see it at the casting stage, let me see it at the rectification stage, let me see it in the trimline stage. And so I have so much input, that that feedback between the technician and the orthotist is essential. I couldn't do it without that.

So there's a big difference between what the NHS can supply because of the limitations set upon it, but also the structure. And I have to say not all NHS units are designed that way, there are some situations where the manufacturing is in house and that works a lot better, I think. But a lot of the situations that orthotists find themselves in are pretty poor for them to be able to deliver a really good orthotic.

Steven Bruce
You talked earlier on as though the ankle, plantar flexion, dorsiflexion was the primary elements of the orthotics. There must be other elements that you incorporate into them?

Sam Walmsley
Yeah, of course. So we're looking at the sagittal plane at that point, what are we concerned about, in terms of how we align the orthotic sagitally. Generally, an orthotic should be set up in neutral. There are some exceptions to that. But when we look at the coronal plane, so this patient had huge valgus collapse of the foot and ankle, almost with a broaching midfoot. And so what I'm looking to do is try and create a very neutral calcaneus relative to the calf, so that when they stand the weight line is going through that area, so that they're not rotating and collapsing through the midfoott. And then there's the other slightly more artistic things that we get into where we're trying to scoop and support areas of the foot to take pressure off bones, like the navicular. So we are considering some of those elements all the time, and orthotics almost should be set up like that. The ankle angle is very important, because it's also slightly counterintuitive. And this is a very important point and this was really lost on orthotics, for many years it was lost on orthotics: an orthotic was always set up at 90 degrees. And that's because the evidence was that we, in normal gait, we stood in mid stance, so when you're going through, right in the middle of your stance phase, so your standing leg is on the floor, and the other swinging leg has got foot and the knee at the side of the standing leg, it was thought that that leg was at 90 degrees, that the shank was perpendicular to the ground, or at 90 degrees. However, that was wrong, actually the shank is always inclined slightly. And how we then set up the whole AFO, in terms of the ankle angle and the shank to vertical angle, has been completely sort of reimagined. It happened a while ago, but it's really only starting to take hold. And again, this is all work done by Elaine Owen and her group, and some other people around the world, but that's the person I know best, to really re-educate our profession, and orthopaedic surgeons who were asking for the 90 degrees, both in terms of the shank angle and also the ankle angle. I've got a couple of slides on that later, actually. But yeah, it's a very important point and perhaps one of the ones that you always like to hammer home when you're doing these presentations because, sure as dammit, if you make a nice pair of AFO's with wedges on, people ask you, why are those wedges on the AFO's? They're not wedges, they're the ankle angle and the shank to vertical angle. Let's describe them in those terms and then you can perhaps move the debate on a little bit.

Steven Bruce
There's a lot of evidence, I believe, that the proprioceptive feedback from orthotics, in a non-cerebral palsy patient, has quite an effect. Is that the same with cerebral palsy patients?

Sam Walmsley
Yes. I've done quite a lot of work on proprioceptive insoles that were quite remarkable in terms of how they changed body posture, with very small little wedges under the first met head and some really interesting stuff that I used to do when I first started here. I think it's a different element, it's a different

type of proprioception. What we're looking for is getting stability through the foot and ankle so that someone with a movement disorder feels stable. If you're walking on a foot that is wobbling around underneath, how can you then control your knee and your hip effectively? So we're looking to really stabilise around the foot and ankle with the orthotics and that, in a sense, helps with the proprioception. There were some things called DAFO's which had something called a neurological footplate, that was purported to help with proprioception and be tone reducing. I think what they were actually doing is they were pushing in on all the soft bits of the foot and making sure that when a child moves, they feel super stable. So then that has a tone reducing element to it. So it's quite an interesting side of what we do. But it's something that we're perhaps aware of, we don't necessarily go out there to improve that, but it happens naturally if you make good and well-fitting orthotic.

Steven Bruce
We've had quite a few more questions come in. Nick's come back in again, because you're using terminology, which is not common with us. When you say the shank, do you mean the tibia?

Sam Walmsley
Yeah, sorry. Again, I should perhaps explain it better with a slide later, but the shank is the lower leg. So the shank to vertical means you take a vertical line to the ground, and where is that shank line sitting on it? Is it zero? So that would be that shank is perpendicular ground as well. Or we always set them between 10 to 12 degrees, 10 to 15 degrees with CP, but normally, if I measured a normal population of gait patterns, then that shank would be with 10 to 12 degrees to the vertical line.

Steven Bruce
Okay, I'm going to offend some of my audience and be accused of sexism here, but I think this question has come in from one of my female viewers. It says, are the leopard print orthotics behind you more expensive than the other ones?

Sam Walmsley
Absolutely. You can have them in any colour you like.

Steven Bruce
What is the purpose of that? Is that just to make them more attractive?

Sam Walmsley
Yeah, I mean, we're treating children, aren't we? And there's got to be an element of fun to these things. I mean, orthotics, they're not something you want your child to wear, they're not something that you want to wear yourself. It's an unfortunate consequence of having a condition. We try to make them a bit more fun, a bit more engaging for the child. And it's one of the things that the child always likes doing, picking the colour of their splint and going through it with their parents to decide which one they want. And there's always an interesting battle between the parents who want to maybe have something a bit more subdued for school, and the child who wants the multicoloured rainbow ones. But yeah, it's to generally to add a bit of fun to it. And it's not just a private practice thing, NHS provide that as well.

Steven Bruce

I'm guessing that last one is a carbon fibre orthotic, are all of yours carbon fibre?

Sam Walmsley
No, no, not at all. We provide carbon fibre a lot more for the adult population, and especially for stroke patients, MS. They're lighter, they're stronger, we can apply joints to them to make them more dynamic. But they also are a lot more expensive. So to do it for a child, and we do occasionally get asked for it when parents or there's a situation where money is not such a problem, we do occasionally get asked to do it. The issues with carbon fibre are it's less easy to adjust. With the plastic splints we can adjust them and if I make the best fitting pair of splints in the world, we will have to adjust them because the child is going to grow. So when you make something out of carbon fibre, you have to be careful to think about where that child might grow and how you're going to then facilitate that within a splint to make it last as long as possible. Because if you spend £3,000 on a pair of AFO's, you want them to last a year at least, even for a child. So these things can get very expensive when you get into the carbon fibre types.

Steven Bruce
Somebody's actually asked how long it takes to get used to wearing these things, particularly if you've got one of your hip knee ankle orthoses?

Sam Walmsley
That's a good question. If they are well fitting and they are designed correctly, then you should be comfortable straightaway. Again, we always offer a service that allows patient to come back, because I can't ever guarantee that what we make is going to be successful first go. So patients can come back and see us free of charge and get things sorted and fixed as many times as they want to. Because being comfortable in a splint that you've got to wear all day every day is essential. But there are other elements to that question really in terms of, if you're teaching a child how to walk, how quickly does a child get used to it? Well, actually, sometimes you're going through developing their motor skills and their motor patterns, there's some videos later that I can explain that with, and so actually, there's an element of getting used to it in terms of beginning to walk properly as well.

Steven Bruce
I don't know how many of your videos we're going to get to, we've only got a quarter of an hour left and I've still got loads of questions to ask you, so we might be booking you for a phase two in a little while. Somebody's asked about whether these orthotics are also useful in cases of muscular dystrophy, and in particular whoever asked the question has a patient who's got orthotics, but they're not always comfortable?

Sam Walmsley
Yeah, muscular dystrophy has a long history of using orthotics and it's it's very important to stabilise and control those presentations, so yes. I would say that, a lot of the time in orthotics, we're confronted with these problems, orthotics don't work or I don't believe in orthotics. that's another one we get, which is really odd one or I've tried them and they don't work. Well, it's like getting into a car that's broken down and saying cars don't work. If you use orthotics, if they're designed properly, and they're designed correctly, you talk to the patients, you get what their goals are, you manufacture them in a way which achieves those, then they should be comfortable. It's hard, I'm not saying it's easy, and we get problems

just as like anyone else, but you have to then be able to deal with the problems. So I'd urge him to go back to the patient and seek out some some help.

Steven Bruce
Stu has asked what happens to ankle ligaments whilst in the cast? And I'm assuming he means the orthotic.

Sam Walmsley
Yeah, the cast is on for three minutes, so it is purely taking the mould. So ankle ligaments are stable, they're held in a good functional position. Don't forget that what we're trying to control is dysfunction. So if there is spasticity, specifically in the calf muscle, it can sometimes pull the foot into a pronated position, because the body weight is going forward no matter what and so if you've got a calf that stops your ankle from coming from plantar flex to 90 into dorsiflexion, and it's stopping at, say, minus five degrees, you're going to get movement forward somewhere. Now that might be by externally rotating your leg, it might be by completely collapsing your mid foot, taking your mid foot here, and totally and utterly broaching it. And I've seen patients who do that. So we're trying to control dysfunction and trying to stabilise. So ankle ligaments should be held in a good position. And long-term goals for our orthotics are to protect bones, joints, ligaments, tendons, muscles, to prevent surgery.

Steven Bruce
Nick has also asked whether you have views on off-the-shelf, shop bought orthotics? And I'm not sure, are people prone to buying off-the-shelf orthotics to deal with cerebral palsy?

Sam Walmsley
There are a few, yeah. I don't think they're so off-the-shelf that you go onto Amazon and buy them so readily. But you can get off-the-shelf orthotics that are provided via your orthotist, so they can prescribe something that's out of the catalogue. There are going to be some rare cases where they're appropriate, I would say. We don't deal with them, we find that if you're trying to control often 100% of something, you need something that you can fine tune and you've got little things that you're going to want to control to 100%. If an orthotic is out by 5%, over a year that could mean your patient deteriorates. And so you've got to really try and hold it as best as you can. So we tend to focus in on, and that's our whole business really, dealing with more complicated bespoke orthotics.

Steven Bruce
Okay, we'd better move along, hadn't we, because we're running out of time and you've got loads to show us. What was this particular image all about here?

Sam Walmsley
Yeah, so I just wanted to establish, an orthotist is trying to take a child into normal gait, I just wanted to show where the vectors are at temporal mid stance, going through the knee, which is the middle picture there. And on the left-hand side of the screen, you've got terminal stance, which is the most important part of the gait cycle really for us. Often people think that the heel strike is the most important thing and parents will be fixated on "We need to get heel strike. Why isn't the child heel striking?" It is important, don't get me wrong, we are going to look for that at some point, but if you don't get terminal stance, so

many wonderful things happen in terminal stance. You've got a stretch on the gastrocnemius, stretch on the hamstrings, a stretch on the hip flexors, and they're all things where if you don't stretch them, they get contracted, especially in spastic diplegia. That will take a child off their feet in their teenage years. So getting terminal stance in the gait pattern correct with the orthotics, it's like the sweet spot. It's everything that we look for. And we've almost been slightly programmed to get "Ooo, yeah, we got it!" and get all excited. But I also wanted to show that what happens in normal gait, you plantar flex the foot in a high heel, but we still put that vector in exactly the same place. So it doesn't matter what we do with the foot in normal situations and normal neurology, we still want to position shank slightly inclined and get those vectors in the right position. And that's why, when we're prescribing our orthotics and importantly when we're what we call tuning or aligning our AFO's and splints and orthotics, we're always looking to get to normal. And why wouldn't you? You want your child to walk normally, therefore, we know where normal is, so let's try and recreate that on our gait lab.

Steven Bruce
I'm struggling with this one, because clearly, you've got a vertical line on both of the centre parts of this image, but clearly, the angle of the shank, the tibia, cannot be the same in both of those because the foot is plantar flexed in the lower case, because of the shoes.

Sam Walmsley
But to the vertical. That isn't a vertical line that we've drawn on, that is a force plate line. So that's the vector. So that's where that lady is putting her force to make sure that she's stable. And temporal mid stance, she wants that force to be going through her knee, and then through her hip, and then preferably through her shoulder. That means she's going to be really balanced and stable at that stage. So that shank will be at the same angle, the front of the tibia, if we measure the front of that tibia on both to the vertical line, the shank to vertical line, it would be the same angle. The foot is plantar flexed, yes, but it's not the foot that we're really interested in there. The foot can be plantar flexed, we will still get the same angle of the shank and the same vector.

Steven Bruce
Okay. I think we have a chance to look at one of your videos now, don't we?

Sam Walmsley
Yeah, so what I'm gonna do is I'm going to share my screen now. So this is a little girl with spastic diplegia. And so what we're looking at when she's walking is what's happening, specifically in this video in her sagittal plane, and we're looking at what's happening at the foot and ankle. So she's striking the floor with the forefoot, we're looking at where the vectors are. So see the vector on that left leg is way in front of the knee. So that means there is now what we call a hyperextension moment happening at the knee, that knee is being pushed back. So that's incorrect. Also, the heel is coming off the floor too early. And as she rises through, you see the vector is now, she's managing to get the vector into the correct position here, she's sort of doing it but at the expense of her mid foot. If we looked at the coronal plane, her mid foot would be completely collapsed because she's got a stiff calf. And then as she stepped through, importantly with this little girl, she's actually got quite a tight hamstring, so as she steps through the hamstring on the tight leg spoils the gait on the good leg. So as she steps with the right leg, her left knee... So let me show you this, she swings through here, you will see the knee suddenly starts to collapse on

the left leg. So that vector should now be in front of the knee still, here, and that red line, and it's now behind the knee. So now this leg is wanting to flex which means the quad is too active here and so we would want to resolve that with our orthotics. And if I just run it through, we see on the right leg, which is actually her more effective side, it's actually a little bit better. So I just thought it was interesting to show you how these patterns of movement can be quite difficult to interpret with children and understanding that will then lead us to onto the prescription to try and resolve this gait pattern.

Steven Bruce
How much of that hamstring shortening is functional and how much neurological?

Sam Walmsley
I would say the majority of it is a neurological implication of the spasticity. But then what happens is because of the spasticity and because of a gait pattern, which means that she's flexing her knee and she's not getting the correct knee extension through her gait pattern consistently, then it becomes a shortening. So on the next slide, I think, on the presentation shows the range of movement assessment that we would go through.

Steven Bruce
Right. Again, this will be quite complicated and hard to make out on a small screen, but it is on the handouts.

Sam Walmsley
I just wanted to show with this the detail that we go into in terms of range of movement. We look at areas and then we sort of highlight areas which have problems and that will lead us to conclusions about how we're going to build our orthotics, but also what outcomes do we want to achieve for this child? Specifically for her we wanted to increase the length of her calf muscles, so minus four degrees and minus eight degrees on her right, we need to improve that over a period of time. And that would be a really powerful measure for that patient, because if we can take a child and move them orthopedically in a positive direction, that means every step that they're taking is doing some good, which is a really, I think, a powerful outcome measure for our orthotics. Sometimes orthotics are measured in get up and go. So they measure people across a 10 metre walkway and see how fast they are. That's all very well. But actually, if you say, I'll review in three months and see if your calf length is better, we know that you've been walking better for that whole three months.

Steven Bruce
Presumably, you go back to that diagram we saw earlier on and the main outcome has got to be the quality of life.

Sam Walmsley
Yeah, absolutely.

Steven Bruce
It's not really your calf length, it's how well they can perform their normal daily functions.

Sam Walmsley
Yeah, absolutely. It has to be. If we've improved their calf length and they can't walk around the classroom, then that's a problem. But it all has to feed in and work together, you're exactly right. Yeah.

Steven Bruce
We could probably ask this at the end, but we really are running out of time. Becky has asked whether you have any patients with EDS where orthotics can help, Ehlers-Danlos?

Sam Walmsley
Yes, we do. Really complicated group of patients. Always a challenge to get something that fits really well. Always knock on effects from wearing orthotics. If you really stabilise a joint, there's always another joint that could potentially become victim to a force that you just weren't considering. And they require a lot of time, a lot of patience as a clinician, but they can really be helped. I mean, some of them are incredibly challenging, when we're looking at stabilising the Atlas with CTLSO's, so yeah, very, very difficult patient groups, and we do have them, yeah.

Steven Bruce
Okay, come up with CTLSO's?

Sam Walmsley
So, essentially a headcollar that comes right up and then comes right down onto the pelvis. So we're stabilising the whole spine and the head and neck. That's another lecture.

Steven Bruce
Is this the same young lady here that was in the previous video?

Sam Walmsley
Yeah, so this was just the orthotics that she walked in on. And so part of the thing that we're looking at is she's been wearing AFO's and her range of movement's poor, so can we improve this range of movement over time? So, in this set of AFO's in this video... So she's got her AFO's on, she's been prescribed them without really footwear. And you can see that as she steps through, you see this swinging right leg pulls that left leg and that vector is still behind the knee. So that's a pair of AFO's she's been prescribed, she's wearing them all the time, but they're not working. And they're not working because someone hasn't stabilised the forefoot correctly to really push the knee back. So if I quickly run on to a prescription and we look at the difference with the orthotics that we've prescribed. So as she steps through now onto this left leg, that green vector on the, the green and the red just mean left and right, doesn't mean good and bad but that vector now is touching the front of the knee as she swings through, and so we're getting knee and importantly, at this point, just here, we've got hip extension and knee extension. So we're stretching out that hamstring and gastrocnemius with every step. And you can see the difference with her step on the original orthotics, where she's still got knee flexion. So they're quite subtle differences sometimes, but importantly, they make a difference to the patient's outcome.

Steven Bruce
And I've put up the next slide here, but what specifically did that young girl find that was better, what improved in her life as a result?

Sam Walmsley
I think the main thing that children will say when you put a good pair of orthotics that have been tuned or aligned properly is that they feel more stable. So they're able to stand in a more stable position without hopping around sometimes and moving around because they just haven't got balance. Often, it's as simple as putting a wedge. My clinic room's always covered with wedges. That's a big one, but we've got wedges everywhere to fill in the void underneath the heel. And as we do that, and I mean I've had a child walk into my clinic room with a pair of AFO's that I prescribed and they just weren't getting on right, and a three millimeter wedge underneath the heel sorts out all of their kinematics, their balance, and they walk out happy. So it can be a very subtle adjustment to get the balance and stability.

Steven Bruce
Sam, we've got two minutes left, and I don't like to run over because I'm conscious that many of the audience will have patients coming up very shortly. I think perhaps one of the things that would be useful for us to look at is how we would spot in a patient that they've not been given proper orthotics, and I wonder whether you could help us out with that one?

Sam Walmsley
So I mean, typically, we're looking at the alignment. So you can pick up an AFO and put on the patient's leg. First of all, is it fitting well? Are all the contours nice? Are the biomechanical control points strong? A leg should fit nicely and snugly into something, and this point here should be really well controlled. And if that looks good, are they aligned correctly? Have they got a wedge, or have they got a footwear prescription that came with it? Does the patient say, "Oh, yeah, they told me to wear these shoes with these wedges."? That's a good sign as well. But if it's going wrong, this is what we're concerned about when we're prescribing, if something isn't right and it's going wrong, then we start to see these types of things happening. This on your slide there, is something called patellar alta. So on the right, I've crudely drawn on the kneecap where it perhaps should be and what's actually happening here is, because this child is walking around in crouch gait permanently, so their knees are bending, that vector, that line off the force plate is behind their knee causing crouch gait, the quad is working so hard, it's pulling on the patella, and that patellar tendon is stretched. And so that kneecap actually starts to move up. Now, that's a problem both in terms of the efficiency of that muscle, but also pain. And one of the biggest indicators of quality of life is pain. And if a child, and often, I think I'm right in saying this, but quality life in a disabled child or the normal population, it's pretty much the same until you add pain in, then boom, quality of life drops right off the chart. So we have to avoid pain and that child is in pain with their knee, they're 13 years old and it's classically something that happens in adolescence. So they've walked around with a problem for 10 years, and now they've got knee pain that needs to be addressed by a very aggressive orthotic to really help and stabilise them. So we would make that patient something like this. Very stable prescription, big front shell, maximising lever arms up here, maximising lever arms on the forefoot as well, to deal with that issue. But what I wanted to demonstrate with that slide was the implications on the body of getting biomechanics wrong over a long period of time.

Steven Bruce
Okay, last very quick question. I hope it's a quick question. Mark has taken us back to that video of the young girl with her correct orthotics and has pointed out that she was using a stick to stabilise herself in the good orthotics.

Sam Walmsley
Yeah, so we have to make adjustments sometimes. That was the initial fitting, so what we're doing is we're saying we've got to have your walking properly, we need you to be perhaps a little bit more confident and stable. And when you apply a new prescription, it sometimes takes the children a little bit of time to get used to them. So we might use a walking aid to allow them to do that initially, but what's important is that we hopefully move past that at some point and so they can put down the walking aid, but also that we get the biomechanics right.

Steven Bruce
Okay, that's brilliant. Thank you. Sam, I'm sorry, we didn't have time to go through all of the material you've sent over for the presentation. On the handouts obviously, we have the details of the London Orthotic Consultancy. Easy enough to get in touch with you or with your fellow experts there if anyone has questions about this?

Sam Walmsley
Yeah, we've got clinics around the country now, we just opened up Manchester, but if you phonr the head office in Kingston, then we can set something up for you to have a chat with one of the orthotists, we've got nine orthotists with varying different degrees of specialism. Orthotics are complicated, they are difficult, they can help a lot of patients. So if you've got something and you're thinking, I wonder if that would help? Chat to one of the orthotists, I'm sure they're all very approachable, nice people, and they'd love to have a good conversation with a likeminded clinician.

Steven Bruce
And it occurred to me earlier, are orthotics a standard prescription for all cerebral palsy patients?

Sam Walmsley
Yeah, yeah, it's pretty much understood that the CP population will at some point have some kind of orthotic. That debate is largely been won.

Steven Bruce
Brilliant. Sam, thank you so much for your time. And again, I'm sorry, you had to cut it short, but I'm sure we've all learned a lot from that about what we should expect from the orthotics and obviously, who to refer to if we think that things might not be going according to plan.

Sam Walmsley
Yeah, great. It's been a pleasure. Thank you very much.

Steven Bruce
Our pleasure. Thank you.