PodChatLive Episode 65

Ian Griffiths (0:00): Perfect I've just been filled with dread and realized that before we're in live I didn't check exactly how to pronounce your name Jayishni, so I'm just going to go with it and just ... I'm more worried about your surname actually so just be polite and pretend that I've got it right. Welcome everyone to episode 65. Absolutely delighted that doctor Jayishni Maharaj has agreed to join us at 6 am. Six am her time so thank you so much for your time. We've been looking forward to this one as well and because it's on tibialis posterior which is a tissue that we're all familiar with as clinicians. We see a lot of it in clinic. We think like we've got an amazing researcher who's spent so many years of her life and a PhD looking at this so yeah we couldn't be more couldn't be more delighted to kind of do a bit of a deep dive into tib post if that's ok to call it that shortened it from that from this point forward. So first of all thanks for coming again Jayishni and where should we start. We had a few questions come in about this one and a lot of them that were sort of more about can we revise or can we at least start with the basics before we get on to the really cool stuff that your research and your sort of discussion of supination moments all that really cool physics and stuff so I know it gets everyone going late in the night and early in the morning where you are. Could we go back to basics and revise some anatomy. Which is never a bad thing to do but you know. Some structural anatomy of tib post because I know I've certainly heard a lecture of yours online before and one of the first things you opened up with it was just how complex it is which I think is worth starting there if that's ok.

Jayishni Maharaj (1:42): thanks for having me online for the chat in. Yes I spent a bit of time a little bit of time studying the tibialis posterior. I think it's a beautiful muscle personally and it's got this beautiful structure and a really important function actually. so starting with its structure it's a by pennate muscle so going back further sorry it come it's in the posterior compartment of our leg so it's one of the deepest muscles in our leg and it has two compartments. are so superficial and deep which has all the muscle fibres and then it's got this really long tendon. so the muscle belly itself sits in approximately from the middle to the one-third just one third of the leg and from the distal one third of the leg you have the tendon forming which then comes down behind the medial malleolus and inserts into basically every single bone in the foot except for the talus and the phalanges. and so it's it has this really important role in stability. but primarily its structure it consists of pennate muscle fibres. so what I mean by that is that it's fibres are orientated at an angle rather than running parallel. and this is really cool because it allows it to have a really large cross-sectional area. and a really large cross-sectional area means it can generate a lots of forces or higher forces does that make sense? yeah absolutely so yeah pennate muscle fibers long tendon really important the its structures really important for its function actually so like I said because the muscle has these pennate muscle fibre orientation it can generate large forces which then have a consequence on its function perfect.

Ian Griffiths (3.58): but before we get on to function which we definitely will because I know the majority of your PhD and certainly the publication's of yours I've read are very much about function. one more bit of sort of anatomy or structure to discuss and that is the

often red comment about it about its tendon having a set a region or an area of avascularity or an area which is more prone to pathology or where symptoms seem to manifest. any comment on that? you know anything up-to-date all about that.

Jayishni Maharaj (4:32): look I've read those studies too where they say around the medial malleolus there's a region of avascularity. those studies are very difficult to do they're very cellular level and yeah and so I can't really comment on it I think with the development of technology and things we'll be able to explore that area a little bit more and really figure out what area is our RA- vascular and whatnot. but I'm I'm sorry I can't really comment on that.

Ian Griffiths (5:09): no not at all we always like it when someone says no you know that's that's cool to. and so coming on to its function and what's the best place to start? maybe we should just ask you to sort of explain a bit I mean explain a bit about what you did in your PhD, what you've you know how you did it, what you found and then we'll kind of you know inevitably call pull things out from there.

Jayishni Maharaj (5:33): yeah absolutely so I guess before I started my PhD um we kind of already knew a fair bit about tib post. like we knew that was a plantor flexor inverter and that's just it's a location relative to the joint axis. and Jim Wooburn and George Murley's group down at Latrobe had done some really beautiful studies using electromyography. so putting wires into the tibialis posterior muscle to understand its activation. so that's what EMG lets us tells us about it tells us about when a muscle is active. and these groups had done some beautiful studies across lots of sorry studying lots of different factors and how it influences activation of the tibialis posterior. and from those studies we knew that look the tib post is active during contact so after we heel strike and then again during mid stance and from those tib post has a really important role during after heel strike and in midstance. what I was really interested in during my PhD was how the actual muscle and the tendon functioned. so yes we knew when the muscle was active and non-active not active but what I wanted to know was what is the actual muscle and tendon doing. okay so a lot of previous work at the medial gastrocnemius and triceps groups had shown that look the muscle fibers in tendon do very different things. and the reason why they do different things is likely to be tibialis posterior the medial gastrocnemius and Achilles tendon have a similar structure. and what but what I mean by that is the medial gastrocnemius has these small short pennate muscle fibers similar to tib post that can generate it lots and lots of forces. and the achilles tendon is this long springy tendon right that can change a lot of length. and so there was a lot of similarities in that regard to the tibialis posterior muscle short pennant muscle fibers and a long tendon. so if i go back to the medial gastrocnemius we know that the medial gastrocnemius the tendon does a lot of the length change yeah and that's because it's a really elastic tissue. so what I wanted to know was does this also happen it to in the tib post? we know the tib post undergoes or experiences a lot of dysfunction or it's predisposed to tendinopathy straining juice painful tendinopathy but I kind of wanted to know okay is this because of its function and how it functions during walking does the tendon experience more strain in the muscle and why does it do this. so those were kind of some of the things that add a very basic science level I was interested in and then I wanted to see how things

like foot posture and foot orthoses clinical things how that affected the mechanical function of the tibialis posterior muscle intended. so actually do you want to know what I found yeah.

Ian Griffiths (9:06): absolutely.

Jayishni Maharaj (9:09): that was the rationale to I did what I did and what we found was so to study what we studied we used ultrasound. so we have these really cool long ultrasound probes which we attach to the leg and I've got some images here actually can we put these we put this image.

Craig Payne (9:36): you just use the share just use the share screen button at the green button

Ian Griffiths (9:42): audience love an image as well this is perfect unless unless they're listening to the podcast after the fact that sorry the podcast.

Jayishni Maharaj (9:46): so this is one of my images so here you can see this blue this is a person walking we've got the markers the pink markers on it to quantify your motion of the different segments for by shank and the multi segment foot model to quantify motion of all the different segments in our foot but here you see this linear transducer. and we attach this linear transducer to the leg using elastic bandage and to capture that to capture the fascicles of the tibialis posterior we attach it to the front of the leg. so just so it's like attached on the anterior aspect of the leg and so what you can see here is an ultrasound image that we catch up and so we've got your skin up here and a little bit of fat your superficial compartment of tibialis anterior your deep compartment of tibialis anterior down here you can see we've got tib post and tib post like I just mentioned before and has a superficial compartment and then a deep compartment. so I am look I investigated the length changes of the fascicles during walking in the superficial compartment and you can see here that it starts down here so that's where we see mark the starting point that's the ending point and it because it's at an angle we can also measure its inclination angle. and then I think I've got it image here sorry these are just slides that I had but here's a video of how we actually track the length changes of the fascicles. so that's what the tibialis posterior muscle fascicles do during walking and so this is one stride starting a heel strike and ending at heel strike. if I stop this so basically what we showed was so I measured that in a whole bunch of people and what we showed was actually during walking the muscle fibers are pretty isometric. they do shorten a little bit during propulsion but generally they function in an isometric manner and that's kind of cool because this allows the muscle to generate these really high forces. so that was cool we go okay the actual muscle belly it functions in a generally isometric behavior but we know that the whole muscle tendon unit for the muscle plus the tendon it's not functioning in an isometric manner during walking at all we know that at heel strike it lengthens and then it shortens during push off and we modeled this I modeled it using some of my foot models that I've created during my PhD and we can talk about that a bit later. but so the question was if the muscle fascicles are behaving relatively isometrically then it must be the tendon that's doing all the length changes right that's the only other tissue and so that's what we kind of showed during a PhD was the fibers that function isometrically and it's a tendon that's responsible for all the length changes. it's kind of neat that it's the tendon

because one of the cool things about long stretchy tendons is that they can stretch and absorb energy and then they can recycle that energy during late stance. so that's where we get into some of the energetic work which I can delve into if you would really like but in a nutshell that's what I kind of was really interested in and what I guess my PhD added to the literature was instead of just looking at the EMG s and the activations of the tibialis posterior I measured what was actually happening in the muscle fibers and at the whole muscle tendon unit length and therefore was able to understand okay the tendon lengthens during heel strike during pronation and then shortens during late stance and the lengthening during that initial contract phase is probably what predisposes it to injury because as a tendon lengthens during that early heel contact it has to absorb energy and so that's what I think is predisposed to injury but yeah.

Ian Griffiths (14:51): absolutely it's great and I definitely want to take gonna call your bluff and take you up on the offer coming back to the energetics later if that's okay and before we do let's just ask the questions probably on most people's minds and you sort of alluded to it very briefly which is where as where does foot posture come into this because we you know it's the most historic belief isn't it that that's a more pronated posture for want of a better description will be will predispose you more to this problem and that would kind of tie in sort of with what you said there with regard to the greater lengthening eccentric demands as we pronate and I know in some of your work having glanced across the PhD that you looked at the sort of correlation between foot posture. so what we are finding is there is the classic more pronated foot that the guarantee that this is going to be more of a problem.

Jayishni Maharaj (15:44): yeah that's why I also investigate it because there is this belief that yeah having a pronated foot posture predisposes you to tib post tendon dysfunction or tendinopathy but using the measures that I used so I use the arch high index the foot posture index and the foot mobility magnitude I actually couldn't create any sort of model to understand the variance in the moments subtalar joint moments and energetics found. when I added width to the equation yes I could I could create a model to understand or predict some of the variants in the subtalar joint moments in energetics so based on the measures that I collected and the population that I looked at which was quite extensive to be honest like I looked at our fifty something people so I did get a fair bit of variability as well in the data across the population should I say so foot structure per se I couldn't say has a direct link to subtalar joint moments and energetics but in saying that there's a lot of new cool techniques that are coming out which might be able to help us better understand this relationship we we pick out a couple of random not random but we pick out selective points when we look at our chart index and we look at certain things like six variables when we quantify foot posture index. I don't know if that's a true representation of the whole entire for the foot is quite a complex structure something like 3d foot scans or something like that might be able to give us a better indication of foot structure and then be able to help us understand how that predicts tib post tendon strain. similarly it could be more deeper it could be at the bone level the structure of the actual bone so what I'm trying to say is no there was no relationship between the measures I looked at but that doesn't mean to say

that a more broader structure or a more deeper structure like the actual bone structure and may have a relationship does that make sense?

Craig Payne (18:35): yeah before sorry Ian before you go any further I've just posted a couple of links to your paper papers covering some of that. but Simon Spooner's just asked a couple of questions but I'll just pick on one of them the other one can wait Simon I'm just a quick comment how were you measuring the subtalar joint moment and he said here I think it's a typo mid line if what I think mid line of foot does that make sense.

Jayishni Maharaj (19:01): yeah okay so that's a really great question so typically rearfoot moments measured between the tibia and the calcaneus in a somewhat six degree of freedom and a six degree of freedom manner. what I did was that I created a foot model during my PhD in open sim and in open sim we can model joints as a six degree of freedom or we can give them more biological joined axes as we could say it almost like so my subtalar joint axis was tri planar. so similar to what the literature has illustrated and what kevin says a lot of that is so it was an oblique axis that allowed for pronation and supination to occur. so they were tri planar moments there weren't just inversion eversion moments there were tri planar so they included the dorsiflexion and plantarflexion eversion inversion and abduction adduction into it together. does that make sense so that's how we calculated moments of course using ground reaction forces and kinematics.

Craig Payne (20:27): no sure well I've just I've just linked to four of your papers in the chat so I think if they want to know the nitty-gritty details of how you measured it that we arrived in that they'll be described in the methods of those papers.

Jayishni Maharaj (20:39): absolutely and soon we'll also make a model open access once we validated it so you can play around with it.

Ian Griffiths (20:50): and I don't have a good good enough inverse dynamics knowledge to ask any more questions on that so I'm just going to quickly sidestep into you you mentioned mid-foot mobility magnitude and I just wanted to double-check well I want to ask you what you found with regard we we talked about what you found with regards to foot posture and tib post correlations I want to ask you what you found with regards to such mobility and tib post but before I do just check the list I'm visualizing them the same mid-foot mobility magnitude is it the one that Bill Bensino you know used for is classic kind of treatment direction test for patellofemoral pain is it that same one great the might there might be a few people watching that aren't super familiar with that so do you mind just quickly describing how you would sort of clinically sort of assess someone's mobility because it's something that's fairly easy to do in clinic and then what what the link between that was or wasn't with tib post pathology

Jayishni Maharaj (21:44): absolutely yes foot mobility is looking at the change in arch height and the width of the mid-foot from non-weight-bearing to weight-bearing so there's lots of intricacies on how to measure it but fundamentally it's a change from non-weight-bearing to weight bearing says as you put weight on the foot. and so what we're kind of looking at is what is it change what is the mobility of the foot and so yeah like other groups have shown that this is quite an important measure when trying to well I guess what people

have shown is that it's more of an intermediate measure between static posture and more dynamic mobility and so that's why I also integrated it into my model so that study that you're a alluding to Ian and I was just more interested in holistically what is the influence of posture and mobility on function. so I was trying to come up with multiple variables that a clinician could apply in private practice to be able to predict tendon stress and strain. but unfortunately I wasn't able to create any sort of thing like this because these measures aren't they just weren't able to predict it so I may I put foot posture into the mix I put foot mobility into the mix I had a few other measures into the model and tried to get okay if I put all these different measures into it which ones help me predict it and both foot posture and mobility weren't able to predict it that much foot mobility had some sort of relationship with the energetics. but it was very moderate to mild so mild to moderate so I wouldn't be going saying use this definitely.

Ian Griffiths (23:56): step width let's quickly touch on that as well because I think has super interesting because we know in there in in the running literature we've got some step width sort of recommendations for sort of reducing ITB strain and tibial stress you know someone runs with an narrow step width we often encourage them in the presence of ITB or M TSS to increase their step width are we is my interpretation of your paper the craig is showing here and that with someone with tibialis posterior sort of issues we we could or we should be encouraging them to increase step widths as well and this is this walking running or both

Jayishni Maharaj (24:39): and yeah so one thing that came out of that foot posture and mobility paper was that we could create start creating models to predict and then stress and strain or subtalar joint energetics using step width and so I was like hey this is kind of neat this is not something that I had thought about so I did a subsequent study and got several participants to walk a different step width and we measured subtalar joint moments and energetics and yeah what we found was that as we increase that step width the moments and energy absorption and power generation reduced significantly so I measured subtalar joint mechanics, if you go back to some of my publications is this direct link between what happens at the subtalar joint and the tibialis posterior tendon function. so yeah I I think step width is a really cool exciting thing that we should be paying a little bit more attention to because it's quite a easy I say easy modifiable factor that doesn't it's hard to train but I think it's got potential a lot of potential there definitely and the results if you have a look at the paper are really clean and beautiful and show that yes there's this direct relationship there how it happens or what it its effects are on the clinical population is a different study so all my research to date has been normal healthy people. but I guess we have to start somewhere.

Ian Griffiths (26:27): yeah and makes it makes complete sense if it's reducing stress energetics joint moments that you know pathological group that's they're the kind of things that rightly or wrongly we would clinically be trying to do anyway with our intervention so I know it's a big big step to pardon the pun but a big step to make when we haven't got the data to support it but I think it's a lot as Craig always says it's it's theoretically coherent biologically plausible at this stage isn't it

Jayishni Maharaj (26:59): and that's kind of like what what oh sorry oh sorry to interrupt you but ultimately that's what the point of foot orthoses are foot orthoses try to change moments and energetics and so if we can if we've got this step width which also changes subtalar joint moments and energetics it could be a simple simple thing to look at even just to look at okay when you're watching your participants participation look maybe just observing the step width and writing notes on that we've been interesting in itself yeah an easy point to start.

Ian Griffiths (27:43) yeah absolutely and well we've mentioned foot orthoses now so you know that cats out the bag we're gonna come onto them unless craig there's any other questions that are really.

Craig Payne (27:55): no let's keep on with the theme there's a couple of comments here but I would save them to the end they've sort of been covered but yeah I think

Ian Griffiths (28:02): okay well just shout out if you need I haven't got the comments in front of me so shout out and interrupt me if you need to but yeah lets talk orthoses not because you know they're the only thing we do they're not the only arrow in our quiver obviously but inevitably it is the the topic there like that we like to talk about when it comes to these things these these lower extremity pathologies and also just speaking purely from personal experience and I'm quite sort of reserved in my prescription of orthoses you know I don't ditch them out to regulate a lot of my physiotherapy colleagues actually tell me I don't dish them out enough actually but the one rightly or wrongly the one thing I see that I'm perhaps falsely confident that I'll get a good result with is using tibialis posterior problems look I'm not saying I always get a good result just to clarify but I'm saying when people come in with you know four-foot space-occupying lesions I'm like oh my goodness not this you know is this gonna work but tib post I'm always a I've always got that slightly elevated confidence and I think it's because it just makes so much mechanical sense so I'm hoping you don't kind of shoo me down on that one but can we speak to some of your research Colonna you you included also she's in one of one of your papers I read this morning and I forgive me it's a comment which one it was but you certainly talked about I hear is you talked about also she's good could you speak to what the research is currently telling us about orthoses effect on of course the subtalar joint energetics the the the energy absorption perhaps of the tibialis posterior tendon etc

Jayishni Maharaj (29:35): yeah absolutely sorry I am I'm on a similar boat to you in like when I prescribed my orthotics to post tib tendon dysfunction patients I'm quite I'm more confident that it's going to be producing a positive outcome and I guess when I did this study it was a kind of thing that I was like yes I'm definitely going to find positive results here and it's gonna it's gonna be great. but I learned some other things from this study so so start to start from the beginning and for this study I collected data about 18 to 20 participants healthy participants they all had a pes planus foot posture so based on the foot posture index and I prescribed them custom-made foot orthosis so I made a plaster cast of every single participant we sent the orthoses away so the actual shape of the orthotic was customized to the participant even the in my protocol the the thickness of the shell device so we used a poly prop device but the thickness was dependent on the weight of the

participant but because all our participants had a very similar weight they all got the same thickness and I think I gave them a 5 degree rearfoot varus post so a 3/4 pretty stiff device is what I prescribed these patients participants. I then took a pair of athletic footwear sol-gel lighty Lighting's from Asics and I looked at three different conditions so barefoot walking no running in this study just walking so barefoot walking walking with just the Asics and then walking with the footwear and the orthoses. so I had a barefoot condition a quite a compliant foot footwear shoe and then a stiff shoe and tension combined Footwear yeah so those are my three conditions. what I found was that in the footwear and the foot orthoses conditions so the last two conditions the moments and the energy absorption at the subtalar joint reduced significantly. so there was this huge effect in moments and energetics with the true conditions but what I didn't find was a difference between the footwear condition and the footwear and orthoses condition and so I was trying to understand why this could be the case and so one of the reasons I think there was no difference was that the footwear was quite a compliant structure whereas the orthoses was much stiffer and if you go back to what I said about the function of the tendon the function of the tendon is to absorb energy during that initial heel contact phase. so we know that Footwear these days is created or designed to absorb energy where is my stiff foot orthoses wasn't really doing that so in that study basically we found that whilst both footwear and foot orthoses reduced the moments and energetics I think the effects were more due to the footwear rather than the orthoses and this was really interesting and makes me think that we can do more about designing and prescribing foot orthoses like looking more at cool designs and how we can alter the stiffness of the device because I think that might have a different or an additional effect mm-hmm

Ian Griffiths (34:05) and kind of makes complete sense when you think about it clinically where by someone often says even you know if they don't have the ability or finances to seek out medical opinion they often just seek out the pair of shoes in their in their closet that is most comfortable and chances are it will probably be some kind of walking boot or trainer which is where we'd always start to advise. so interesting thing evolving here where we could essentially take someone and say make some good Footwear choices increase your step width and we're probably you know sort of on the right track for it for it for a group of people aren't we before we've even asked them to sort of consider orthoses or you know as we're gonna rehab or you know strengthening of the structure etc which we should probably talk about shortly as well as much no that makes complete sense it's sort of come to mind with with clinical experience and things doesn't it and Craig anything that's come in anyone any questions.

Craig Payne (35:01) I think everyone's just so engrossed in listening.

Ian Griffths (35:08) well let's talk a bit about if we can just about strengthening the tendon I know I'm going of script here it's just suddenly come to mind that you know when someone comes in the sort of things we would work through we would reduce as Craig always talks about reduce the load on the tissue which i think is kind of what we're talking about here and then give the tissues some ability and at some point in the future to to tolerate or cope with greater load increases increase its capacity any experience from your work or all the

people you surround yourself with in this work about the sort of golden ways to do that you know rehab wise what what are you use clinically and what are your thoughts on the evidence base for sort of strengths for this tendon and what works and what doesn't.

Jayishni Maharaj (35:51): absolutely I think strengthening is a really really important for this dysfunction and condition I'm gonna just start back with a bit more basic science so we've got a tendent and for strain induced injuries whether it's the excessive strain that's causing the injury okay so then if we take a step back and go okay what is causing the strain in this tendon so the tendon has structural properties and material properties and the material properties is like its composition and generally across our bodies the material properties are very consistent across different tendons what changes however is the structural properties. so like I said to you before like having a long tendon means it's going to be really stretchy yeah so there's two things that we can change in a tendon to influence or prevent strain we can change the length which we really can't change or we can change its cross-sectional area. okay cross sectional area determines how much stress it induces so how much stress goes through it and therefore it's strength. and so if we want to change the cross sectional area of the tendon we look at strengthening exercises because generally what happens is more strengthening exercises increases, I've lost Craig increases he does sometimes just sorry that's that's the mechanism of how strengthening will help a tendent and I know there's been a few there was a really nice randomized control trial actually that looked at eccentric exercises concentric exercises and strength stretching with foot orthoses and later found that eccentric exercises really helped it and with the eccentric exercises there's a lot more force going through that muscle so a lot more load and this I if you measured the tendon for structure would influence the cross-sectional area of the tendon and therefore help it that way so increasing strength increases the cross-sectional area it reduces the strength and so yes definitely

Ian Griffths (38:34): yeah and just more more sort of I guess practically well what are your go to to just in case you know I know we've got a wide range of people that watch this some people that are very engrossed in rehab on a regular basis other people probably dip their toe in and others maybe haven't looked at it since they graduated so what do you all go to do you have any kind of favorite exercises that you found you get the most bang for your buck all that your patients are most compliant with or like most things do you tailor it depending on the context.

Jayishni Maharaj (29:04): yeah I am tempted to tailor it but some of my favorites probably some exercises with the thera-band as well as heel raises I really like the heel raises and you really for tib post you really need to get that end range of inversion going on so not just the plantar flexion but the plantar flexion with the inversion. I like to prescribe those too but I'm sure there's a lot more people out there that know a little bit more.

Ian Griffiths (39:40): we've all got our favorites every yeah ok

Craig Payne (39:43): I'm just going right just kind of make a comment on the the strengthening issue and I know it's a little bit it's a question without notice but I keep referring back to and I can't remember how old it is or the author's the study three or five

or six years ago that looked at muscle strength and runners and how rapidly it declines after the age of 50 so the the patient population was looking at with things like post tib tendon dysfunction you know tend to be in that way I I struggle a lot with the concept of strengthening when muscle strengths declining naturally anyway with aging and yeah can we make it stronger or can we just perhaps slow the declines on I I don't know I'm just staying to question the value of it in some patient groups because of that natural decline

Jayishni Maharaj (40:33): this group tends to be either very active or sedimentary like quiet inactive and I think in the inactive group if you're really like I said once you reduce that strain on the tendons you kind of want to increase its cross-sectional area so it's kind of bout looking at the tendon and trying to influence or change it a little bit like sometimes you don't need huge changes either I don't know.

Craig Payne (41:01): yeah thanks you know I just struggle with the concept of yeah I also think about that.

Jayishni Maharaj (41:09): because it's not all about just increasing the force generation by the tendon right because a lot of people think hey let's strengthen a muscle and let's get a greater force output from this muscle it's that's not the point of it here we're trying to do it to increase potentially the cross sectional area of the tendon so and the objective or the priority is slightly different that's the take I might take on anything.

Ian Griffiths (41:38): yeah I see a lot in just classic overload classic overuse so they're definitely younger I wouldn't put them in the category you know I wouldn't put them in the category of decline and actually am they quite likely and given you know homework exercises you know can if you sell it as them being a you know more efficient runner afters all yeah I go to sell it right absolutely no other questions Craig?

Craig Payne (42:01): no nothing nothing just a couple of comments a couple of questions but they're not quite relevant to the thread we're on so we'll come back to them.

Ian Griffiths (42:09) cool I'm just looking at the time I was just before we wrapped up I just wanted ask Jayishni about you know because we know when people finish their PhD that I just give up right it's just a constant ongoing slog I know you're definitely gonna be working on something at the moment it's probably cool and exciting so as much as you're allowed to tell us what what does where does the future research kind of direction for you look like it's taking and is there anything you can tell us about that might be coming that we can get excited about and is it all going to be tib post or you know you know step away from tib post a bit

Jayishni Maharaj (42:41): so I'm really interested in measuring stresses and strains in muscles and tendons to understand both how it can improve our efficiency of more powerful or more power generating a movement such as walking and running but I'm also really interested in measuring stresses and strains because of its relationship to injury and in the foot measuring stresses and strains is difficult right now we have these great beautiful foot models out there but they don't really have tissues associated to them. and so that was one of the things that I did in my PhD I created a foot model and that has tissues attached to it

so the tib post tendon was my first tissue that I added to it but it's got lots of other tissues in it and so what I'm currently doing is I'm trying to validate this foot model trying to create a method or something that people can use at least play around with for clinicians but using research to measure stresses and strains and there's many ways to validate foot models so previous groups have used bone pins and looked put bone pins in bones of the foot and got people to walk and seeing how their bones actually moved that way but one of the really cool things that I'm really excited that is we're using high-speed video radiology to measure this so this is essentially we have two x-ray systems attached to high-speed cameras and which can take pictures one 250 frames per second of all the bones in the foot as you walk and run and so using that and CT scan so we create foot model we can actually quantify how the bone the actual bone is moving during walking learning I have some videos here I'm not sure if you want to see but that's that's where my future is

Ian Griffiths (44:56): we definitely want we definitely want to see ok I see plus anyone listening to the podcast after the fact will now has to be forced to come back and watch the video as well because they'll think they'll have FOMO.

Jayishni Maharaj (45:10): good so this is you know to x-ray system and if I try to play this sorry here you can see the foot coming into motion and we basically have that during walking and running and then these little orange foot models are bone models are created from CT scans so we take CT scans and we segment each slice up and we create these bone models and then what we do is in a program called Otis grouper we align the process we align the bone model to the x-ray and we do this for all the bones in the foot and so this is called bi-planar video radiology so I'm using this technology to validate that foot model and so here's my foot model at the moment compared to the biplane and stuff and you can see it does pretty good so my model is in gray we've got the whole tibia there but the mid foot for foot calcaneus and talus and the pink bones are the bones that were measured from the x-ray images and and you can see that it does a pretty decent job actually so that's where my future kind of sits at the moment we're trying to create these tools that both clinicians can use and play around with to see how different movements can change stresses and strains in our tissue but also researchers can use to investigate Footwear foot orthoses other factors strength training on how we function and how these tissues function.

Ian Griffiths (47:07): that is very cool that is very cool my list is all crossed off criag and let's know it's pressing

Craig Payne: that's probably a good note to finish on look there have been a couple of comments a couple of questions but that may be of Jayishni can later on come back you know to the discussion and just post a comment on the three rather than address them now because a couple of them are actually quite big issues and a couple of a quite a bit off the topic of the theme that we're talking about so the preface is a really good time to sort of wind out so thank you so much for getting up before 6:00 a.m. your time 7:00 a.m. my time for that for those of you who have joined like we have had quite a few people watching

during the the live which is which is great if you come back in about 10-15 minutes the full video will be on Facebook it'll be on YouTube later today so thanks so much guys

Ian Griffiths: happy Christmas by the way everyone and thank you yeah thanks Jayishni that was amazing and have you ever great Christmas and we'll then hopefully catch up

Jayishni Maharaj: Many thanks for having me Merry Christmas