

# Bone Fragility

with Nick Birch  
7<sup>th</sup> October 2020

## TRANSCRIPT

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**Steven Bruce**

Good evening and welcome to The Academy of Physical Medicine for the first of our shows back in the studio since we had lockdown all those many months ago! I'm very excited about this and I know my team as well, because they haven't been behind the cameras or in the production booth for a very long time, so getting it all together this evening has been quite exciting. Not least because of course, we are having to apply all those COVID precautions that you'd expect in a clinic and as normal, we've got our clinic divided here into a clinic end and a waiting room end. And in the waiting room and at the moment are our three models that we're using for this evening. So we've got three models in there. Models, say hello. Welcome, thank you for joining us. Thank you for taking your time out to come and join us at the Academy. As you will have seen the models are all wearing their facemasks just as they would in the clinic and you will see we're adhering to all sorts of other COVID measures as we go along. Most importantly, this evening, I'm joined by Mr. Nick Birch. Nick's been one of my guests on many occasions in the past and he is a specialist spinal consultant, orthopaedic spinal consultant, working out of Northampton. He's been in to talk to us about spondylolisthesis, about bone fragility, about all sorts of bone dysfunctions in the past. This evening, we're going to be talking about bone fragility and bone density. Nick, I'd love to shake your hand but we're not allowed to but it's a great pleasure to have you back in the studio.

**Nick Birch**

Virtual shake. Delighted to be here.

**Steven Bruce**

You're our first guest since the lockdown. Nick, you better explain to us all what it is you're gonna do this evening.

**Nick Birch**

Yeah, so we going to do some health assessments. We're using REMS technology. REMS is Radiofrequency Echographic Multi Spectrometry, better to say rems, it's the new technology that's going to challenge DEXA. DEXA is our standard X-ray based bone density measurement device. It's in a hospital, you have to have a big room, it's got to be lead shielded, you have to have big computers. You go along, you have your scan, so you've got to go to the hospital and in these days of COVID of course that's an issue. And then at some point your results are sent back to your GP or to your rheumatologist. This is point of care. This is an ultrasound-based system using a simple ultrasound probe. It's a highly sophisticated Italian machine. So, it's not just your ultrasound that you get for your abdominal scans when you go have a baby, it's much more complicated than that.

**Steven Bruce**

Is it important that it's Italian?

**Nick Birch**

Yes, actually, because the design is so good. So, when you see the reports, the reports are beautiful, compared to DEXA reports, which are not beautiful. So, the design is good. And the output is equivalent to DEXA but of course it's point of care. So, I've been around to lots of sports clubs and to Pilates studios around the country, I take this, it comes in the back of the car, and as you've seen setting up tonight, it takes about 20 minutes, and I can take the scan to the person. There's no radiation, so there's no danger. Sure, DEXA has a very low dose of radiation and you can probably have lots of DEXA scans and not really have an issue, there are other people who don't mind radiation which is fine. The accuracy is the same as DEXA, which is good. But the benefit of this now with the software it has, is it not only tells you what your bone density is but it also tells you what your bone toughness is. And that's really key because we've for a long time wondered, why is it that women with overtly ordinary bone density fracture? So, what's called osteopenia, which is that transition to a normal bone and then osteoporosis, why are they fracturing more commonly than people with osteoporosis? This tells us now, why that is because we have what's called a fragility score and that's actually measuring how well your bones are made. So put that together as a package and we have a really good understanding of a woman's bone health and prediction for fractures in the future.

**Steven Bruce**

So, two quick questions before we start your demonstration as it were, is there any advantage of DEXA over this?

**Nick Birch**

No, is the answer.

**Steven Bruce**

The second is that, back in the 1990s, I remember in my teaching college that they had a little portable job that you stuck your foot in and that measured your bone density. What's the value of those?

**Nick Birch**

Quantitative ultrasound is a very useful screening tool. It doesn't give you the degree of accuracy of DEXA or REMS. It's quite good for screening to say, are you in the zone where it's normal or are you in the zone where it's osteoporotic? But it won't give you actual proper diagnosis compared to these more accurate technologies.

**Steven Bruce**

Right, should we get our first model over? So what Nick's doing right at the moment is just getting the base data for the machinery and he's done this with a couple of our models already, but it's just to take their weight and measure their height accurately so that he's got an accurate BMI, which is important for, as you'll see, the results you get from this system. Nick, BMI is often said to be quite misleading, is that not the case here?

**Nick Birch**

Misleading in what sense?

**Steven Bruce**

Well, in the sense that people with a high BMI are said to be unhealthy and yet your average rugby prop forward is probably well into the obese range.

**Nick Birch**

Yeah, it is misleading that sense. BMI is very important, from the point of view of bone health because the higher the BMI you have, the more pressure you put through your bones and therefore your bones are likely to be more mineralized. And so, the highest BMI I've ever measured was a woman who was 50 and she had very dense bone. But she had fractured because actually, she's 50, she's not doing very much, so her bones weren't very tough. Whereas there's a whole bunch of rugby players who've got normalish BMIs but then if they're forwards, they've been thrown up into the air, two metres coming down, crash, onto their feet and they have the toughest bones you can possibly imagine, elephantine. Susie, do you want to pop yourself up onto the couch and lie yourself back. The first thing we maintain is dignity because, this being an ultrasound scan, I have to look at your hip. So, if I could get you just to slip your trousers down to just above your knees, that'd be perfect. Thank you very much. Normally, we have the order of the purple towel. The purple towel is something that's going back to when I was at Moulton. I'd like to put these just at shoulder width there and that one rotate out like that. So, the order of purple towel maintains dignity. Have you had in the past an ultrasound scan?

**Susie**

Only when I was pregnant.

**Nick Birch**

Okay. So, you know it involves gel and it was cold?

**Susie**

Yeah.

**Nick Birch**

Okay, good.

**Steven Bruce**

We should have microwaved it for you first, shouldn't we?

**Nick Birch**

I tried that but the trouble with that is that the gel becomes very runny. And it doesn't work that well. So that's fine. So, what we do is protect your clothes just with some tissue here. So, if I can just do that there and then I'll pop these on. Okay, now, have you got a history in your family of osteoporosis?

**Susie**

No.

**Nick Birch**

Have you ever had a fracture?

**Susie**

No.

**Nick Birch**

Have you got any long-term medical conditions that require regular treatment, things like thyroid disease, liver and kidney disease, diabetes, that sort of stuff?

**Susie**

No.

**Nick Birch**

Any gut problems like celiac disease, Crohn's disease?

**Susie**

No.

**Nick Birch**

Rheumatoid arthritis?

**Susie**

No.

**Nick Birch**

Do you smoke? Take steroids? Do you drink three units of alcohol or more per day?

**Susie**

No.

**Steven Bruce**

Susie!

**Susie**

Not per day!

**Nick Birch**

Those are all screening questions called the FRAX calculation. And what that does is it gives us an estimate, population-based estimate, of what your risk of a fracture is, what's called a major osteoporotic fracture, which is either your arm, your spine, or your hip, and then it also subdivides that into the hip as well. And we know that from yours, it's 3.7% chance of you having a major osteoporotic fracture in the next 10 years and it's about 44% chance, you're gonna break your hip from osteoporosis, very, very low. So, you've got a 96.3% chance that you will not get a major osteoporotic fracture in the next 10 years.

**Susie**

Sounds good.

**Steven Bruce**

That's based purely on BMI and those risk factors you ran through just then?

**Nick Birch**

That's based upon all the data that came out of Sheffield which John Kanis was doing originally and has since been taken up by the World Health Organisation. And what they've done is they've taken hundreds of thousands of women who've fractured and looked at what their body composition was and what their risks were and they put it in an algorithm and done an analysis of that. And these are the risk factors that are the most important for impaired bone health and fractures. Okay. So, because we've been talking, the machine is a little bit irritated and saying, get on with it. So, what we've got now is, I don't know if you can see that, is that you've got the outline of your hip, on the right of the femoral head and you can see the hip joint and then that pale white line underneath the red line, that's your neck of femur. And that's the bit we're really interested in because that's the bit that gets more fragile and tends to break and you hear of fractured neck of femur in older ladies and that's that bit. So, what I'm doing now is I'm shining the ultrasound at your hip and it's bouncing off that 3.5 million times a second. So, we're going to get about 100, in 40 seconds, we get about 160 million pictures. And when it bounces back onto the probe, it's subtly different and because it's slightly different, it then gives us the information we need to know. Okay, it didn't like that. Okay, so the first scan, we've got a failed scan, it's come up, there's no result and the reason for that is because I don't normally wear gloves. I've got to get used to wearing gloves now. So, let's calculate that and go forward. Okay, so the first thing we've got here is that the great thing about this system is it doesn't matter how many times you do it, because it's ultrasound, it is repeatable and there's no risk.

**Steven Bruce**

And if you do repeat, let's say, you had to do this five times, once you did it five times, and it worked five times, would you find the results to be pretty much the same? Or would it be very dependent on how you hold the ultrasound head?

**Nick Birch**

No, it's operator independent. And as long as you've got it pointed in the right place, then the machine recognises the anatomy. The machine recognises the anatomy and will give you the bone result irrespective.

So, what's happening here is that the rubber gloves are slightly slippery and I'm trying to hold the probe absolutely steady so that we get exactly the right anatomy. When we do that, then we'll get a result.

**Steven Bruce**

How many of these machines are there in the country?

**Nick Birch**

In this country, about six. Maybe a bit more than that, actually, there are four, I think in research labs and maybe another three or four elsewhere. It's less than 10. Okay, that's better. So now, what's happening now is it's saying analysis in progress. When it's doing that, it means it's got enough information to process your result here and it's going to come up with the result. If you get a few little flashes of a femur and then it goes off, as we did last time, you know you haven't got a result. If it goes on too long and it has to think about it for too long, it often comes back and says "I can't be bothered" and then you get no result. Now, the number of times that I need to do an acquisition where I don't get a result is dependent upon a few things. One is the body composition, your body composition is perfect and that's fine, it's just a matter of getting used to using a glove and this is not something we've using much in the past because prior to COVID, we didn't have to use gloves. So, what did I tell you before we started? I said, where would your bone density be? It's just in the yellow zone. So, it's good, isn't it? So, what we're going to do is just to save that and do that. Okay, so now we've done that, that's fine. So now go to the spine. So, for the spine, we go through the abdomen, you don't have to change position which is fine. So, if I take that off there now and I can just get rid of that bit of gel. Okay, so we maintain the dignity here. So, can I just get you to put that up to, just up to your ribs. What I will ask you to do is just put your arms down by your sides, be completely relaxed. So again, protecting you and your clothes from the gel. It's not toxic, it's just very uncomfortable wandering home with gel on your clothes. Okay, so we want to see the first four lumbar vertebrae. So, this is exactly the same protocol as DEXA, one, two, three and four. So, first of all we're looking for the aorta, which is seen as a pulsating black structure, and the bright white behind that, they're the anterior vertebral bodies, the front of the vertebrae. So, we know L3 is around about the umbilicus. So that's L2 there, that's L1 there. What I've got to do is to change some of the settings. Susie, if I press like that, is that uncomfortable?

**Susie**

That's fine.

**Nick Birch**

Okay, that's good. So, on the on the hip scan, it looked at your hip for 40 seconds and did about 160 million acquisitions pictures. This looks at each individual vertebra for 20 seconds, about 80 million for each individual vertebra. And so, it goes on, then it tells me when to move. That's the first one it's done. Now, to make a diagnosis of what your bone health is on the vertebra, we need at least two, three is good, but ideally four. And each individual vertebra is able to be assessed both for its bone density and then they add it all together to give you an overall score. So, what we're looking at is what's called a T score, that T score compares your bone to a healthy 30-year-old. That's our standard reference. If you're under 30, you can't have a T score, because you're below the reference, so then we have what's called a Z score and Z score

compares you to other people your age. So that's quite useful if you're under 30 but also if you're over 75, because the T score, when you're 45 years older than your reference, it's not very much of value or relevance, is it? So, what we like to do is to people in your age group, nice and young, you get a T score, so looking at you compared to our reference 30-year-old, and then also a Z score, to see how you fare compared to other women your age. So, one question, of course, is why 30? And that's because that's the very best your bone ever is, that's called peak bone mass. So, when you're born, there's no calcium in your bone, you're just cartilage, and then it rises all the way up to 30 and then it stabilises for about 10 years and then after 40 it starts to drop and of course around menopause, that's when you get a big drop. So, lots of different factors, but menopause is a very important one, around the age of 45-55 which is the usual time for menopause in most women.

**Steven Bruce**

Do you see many problems below the age of 30? Because I presume that originally, at least, people weren't too concerned with younger people.

**Nick Birch**

Yeah, we do. And the problems we see are in girls who are underweight, that have a low BMI. So a good example of that are ballerinas, who starve themselves to reduce their weight. I've done some values for the Royal Ballet and their bone density at the age of 25-26, when it should be really good, is well below what it should be.

**Steven Bruce**

Despite all that impact?

**Nick Birch**

Yeah, despite that and unfortunately low body mass index is a very big predictor of poor bone health because then you combine that, they've got poor diet so they're usually not getting enough vitamin D, enough calcium, enough magnesium. These are all the key ingredients you need to get bone healthy, getting calcium into the system, from the gut into the bloodstream then into the bone itself. Okay, we're done, Susie, so what we can do is to de-gel you and we're going to go over to the couch. So, if you'd like to resume your normal state of dress, that's perfect. Okay, we'll start off with your femur. So, the first thing we know Suzy is that you're 52 years old, hope you don't mind everybody knowing, your weight is 61 kilograms and your height is 165, which means you have an absolutely normal body mass index, 22.4, absolutely the middle of the range, which is perfect. This is our first report. That's your result there today, that little cross in the circle. We've got a system here called a traffic light system. And the traffic light system is green, yellow, red, and that shows you normal bone, osteopenia and osteoporosis. Normal bone is compared to our healthy 30-year-old here. Now, when we looked at that and say, okay, well, if you take your normal 30-year-old, if you're below a certain level then you're into osteopenia, and that level is -1 on your T score. So, if you've got your T score down here, that's looking at you compared to your 30-year-old, healthy person, and -2.5 means you're 2.1 standard deviations below the average 30-year-old. So, when we look at the way that bone density spreads, it's what's called a normal population, a bell curve, and two standard deviations is now outside of



where 95% of people will be for the average. So, if you go to one standard deviation below, that's -1, that's the limit of normal -1 to -2.5 is then osteopenia, which is fine, which is what we'd expect, and then below -2.5 is osteoporosis. So, you're well off that at the moment, which is fine. But if you look here at your Z score, the Z score compares you to other women your age, and you're -1.3 on the Z score. So, you're about 13%, is what that equates to, below average with your age. That's because the average within your age here are about BMI of 26. These are related to body mass index. So, it's not just the fact that you've got a number below the average, that's not the issue because we'll get on to the bone toughness in a second. So, these are exactly the results that I'd expect in the femur for you, as you are today, which is fine. And there's your diagnosis, osteopenia, that's the World Health Organisation diagnosis. Here is your FRAX calculation, what it says is you've got 3.9% risk of major osteoporotic fracture, that's in your humerus, your shoulder, the wrist, the spine, or the hip, also ankle or elsewhere. And then your hip fracture rate is really very small 0.4% only. You've got some individual numbers to look at the total femur and the trochanter, the trochanter is that bony bit on the outside, when you feel your hip on the outside, that's the trochanter. So, we measure the trochanter, we measure the neck, we measure the whole thing and that's your result there. Now, what's really important is this: this is new technology, most DEXA scans do not have this function, this is called the fragility score. For DEXA there's something called trabecular bone score, which is the equivalent of this, and what it's looking at is how well your bones are made. Because it's all very well having very dense bones, but if they're made of chalk, they will fracture. Whereas if you've got very light bones, like a bird, but they're superbly engineered, they won't fracture. So that's how birds can fly and they can do all sorts of bits and pieces, they can put huge amounts of pressure through the wings and through their skeleton to not break bones. Whereas somebody who's got really dense bone, but who sits around does nothing and does no impact exercise can break bones. If you look at yours, your fragility score is really well into the green zone, you've got really healthy bone, which is fantastic. If we then combine that, what we now can do is update the FRAX calculation. So, we know that your FRAX calculation shows you've got a low risk of a future fracture, but now what we've got is we can say okay, well look, on our REMS fragility score you've got normal bone toughness, but you're osteopenic. So, you have what's called an R3 and an R3 then comes in here, it says, actually, it's not bad. Because look, your risk of a hip fracture in the next five years is between 4 and 8%. Well, that that's a bit higher than the FRAX calculation. This is now you. This is much more accurate than the FRAX, the FRAX is a population estimate based upon a whole bunch of different factors. It doesn't take anything about you into consideration, apart from body mass index, menopause and a few other bits and pieces. But this now has measured your individual risk. Here you are, R3, yellow zone, that's pretty much the same zone as your bone density, which is fine. And then that's your FRAX calculation. And then that shows you a nice, pretty picture of the zone of acquisition. So that's your femoral results, and then your spine result, very similar. T score: -2. And they should be very similar. If you get a result that's very different it's called discordant and we don't like that, because there shouldn't be a change in your bone density unless there's good reasons. So if, for instance, you'd had a stroke and you couldn't use your left leg, that might be quite different bone density from your spine. But of course, you don't have that, so we expect it to be similar. Minus -1.1 Z score, very similar. Don't worry about that red one there. That's just a graphic. This is, Steven, why the Italians are so good. They've got lots of design and it's already pretty, etc, but sometimes people get focused on the colours here, what you've got to look at actually is just the overall results here. And actually, Susie's results are fine. And they're very much as predicted.

**Steven Bruce**

Just before you get out of screen, Nick. Susie, when you look at that, you see your little crosses, it's in the yellow zone but it's quite close to the red zone and the lines all look as though they're going down, which would make me potentially think, gosh, it's only a year or two before I'm in the osteoporotic zone. Nick, I'm obviously interpreting that badly, because you said that Susie's bone structure and strength is good.

**Nick Birch**

No, you're interpreting it absolutely right. Because if we were doing a full bone health consultation, having gone through the results, what we'd then talk about is what you do in terms of weight bearing exercise. So, are you going to the gym? Are you doing lots of bone enhancing exercise? So, impact activity, vary the load, vary the frequency. That's the real key to good, strong bones that are tough. And do you have the right diet? So, have you got enough calcium going into the system? Have you got enough vitamin D? Do you have enough magnesium, enough boron? So, what is your diet? So, there's a whole bunch of different things there. Now, in the interest of time, we're not going to go through all of those today. But they are very important as a total bone health assessment, I would have then gone through that with you and we'd actually sit there. So, for instance, do you have dairy in your diet?

**Susie**

Yes.

**Nick Birch**

Okay. So, what you need to be aiming for is calcium around about 1000 milligrams per day. Do you take vitamin D supplements?

**Susie**

No.

**Nick Birch**

Okay, so the government recommends that everybody should take a vitamin D supplement in this country. So that's one of the few government recommendations that is pretty universal. They reckon 400 international units per day. But actually, you can go much higher than that. And there is some evidence now that if you go to 2000, 3000, 4000 international units a day, that's actually helpful. Coincidentally, vitamin D, is now showing some evidence that's actually protective for respiratory viruses, because it improves the immune system. So, it doesn't prevent COVID but because it makes your immune system work better, it means, if you do get COVID, you might actually have a lesser version of it. So, having a good vitamin D, it's got lots of different reasons to have that. And it's a really important substance in the body and behaves much more like a hormone than it does a vitamin. So, I would recommend that if nothing else from this tonight, start taking some vitamin D. The other two things I mentioned magnesium, boron, they're two trace elements that are required to get calcium from the bloodstream into the bone. Whereas vitamin D usually is getting calcium from the gut into the bloodstream so they all play their part in this whole process.

But you're right, because if we do something about that, if we could identify that Susie has actually got either not enough of this calcium, vitamin D or whatever else, or she's not doing enough impact exercise, we can change that.

**Steven Bruce**

You said varied exercise earlier on. So, it's not sufficient for Susie to become a lock forward for Northampton. Jumping up and down's not enough, it's gonna be varied?

**Nick Birch**

Yeah. So, the big problem with that is, if you have a single load going through your spine or your hip, a certain load at certain frequency, the adaptation will only be to adapt to that load and that'll be that. Whereas actually really what you want to do is have a varied load and varied frequency because then it'll adapt very nicely and you'll get a much better, tougher bone. So that is important.

**Steven Bruce**

All I do is cycling, which is no good at all.

**Nick Birch**

No, cycling is not a weight bearing exercise. So actually, that would explain perhaps that you wouldn't have particularly tough bone. I've got a whole bunch of elite sports people and the one with the worst bone density was a cyclist. So, whereas the one with the best bone density is a rugby forward. Anyway, here's your spine bone toughness, nicely in the green zone again. So, we're going to have an R3 on our estimate for your fractures. There you are, R3. And that says that, actually for you, your chance of a major osteoporotic fracture in the next five years is somewhere between 10 and 20%. But you can do something about that. So, had we had a bone density that was in the green zone and bone toughness in the green zone, then we would have had a lower, you would have been down here, less than 5 or 5 to 10. Because of the osteopenia, that's saying, actually, no, there is a slightly higher risk, but you can do something about it, as Steven says. Then you should be able to see some pretty pictures down there. Why L3 hasn't shown up, I'm not quite sure, because you can see the vertebrae there. So that's the report you get, you get your 10-page report, going through all this. And it gives you now, this is the very best assessment of bone health that you can have currently.

**Steven Bruce**

Susie, you're going through some sort of trial, I think, at the moment?

**Susie**

I am, I'm doing a trial for calming down the menopause symptoms. So, to try and get rid of the hot flushes during the day.

**Nick Birch**

What are you on?

**Susie**

I can't remember the name of it. Fluxo- something or other.

**Nick Birch**

Does it work?

**Susie**

Well, I don't know if I'm on the placebo or the actual thing, but the hot flushes have subsided a bit, so possibly.

**Nick Birch**

There are lots of gynaecologists and endocrinologists who think that actually, if you are menopausal, you should go onto HRT automatically. And that's very interesting because there's controversy about that as well. But the symptoms of menopause, of course the hot flushes are one, but there are so many symptoms of menopause and they can be highly distressing and very difficult. So, I hope it's working for you.

**Steven Bruce**

Nick, do you think that this report would be of use to the people who are monitoring Susie?

**Nick Birch**

Yeah, I mean, she's going to get back that, I can send it by email and so she's welcome to take that and they can take a look at that and see what it adds to it.

**Susie**

Yeah, because I did have to have a DEXA scan before and I will have to have another one at the end.

**Nick Birch**

Do you know what the results were?

**Susie**

Normal, as far as I know.

**Nick Birch**

It'd be very interesting to compare them. If you want to do that, we can we can have a Zoom consult and look at your DEXA results and we can look at your REMS results and see where they are. I'll leave that to Steven to sort out.

**Steven Bruce**

Now our next victim, our next model, is Brooke. Brooke is actually an osteopath who works in my clinic and, in fact, holds the clinic together. Fantastic. And you might recognise her if you've been a member for a while because she has been a model here before. Thank you for coming in, Brooke.

**Nick Birch**

Right, do you want to jump up on the couch? Okay, so big towel, maintain dignity. So, let's just do that. So, if you just slide those down. So, we get the legs just at shoulder width again. Let that one rotate out. That's lovely. That's fine. Let's just put that over there so I can get to the hip.

**Steven Bruce**

What difference are you expecting here?

**Nick Birch**

So, Brooke is a couple years younger than Suzy. So not menopausal. That perimenopause is going to be different from the perimenopausal and postmenopausal because of the influence of oestrogen. So without oestrogen in your body or with decreasing amounts of oestrogen, you're going to have less of a healthy set of bones because oestrogen is so important for bones.

**Steven Bruce**

Brooke, have you got any reason to be concerned?

**Brooke**

No.

**Steven Bruce**

Do you reckon you're healthy? Do you do a lot of exercise?

**Brooke**

I try.

**Steven Bruce**

What do you do?

**Brooke**

Classes at home.

**Nick Birch**

So, the risk factor that you might have is if you have any family history of osteoporosis, because otherwise you're perfectly healthy. We've been through those questions and so we know that you're not at major risk. Okay, so just find the outside. There's your trochanter just there, which means the neck of femur is going to be here. Point the probe in the right direction, coming up over the trochanter. So there, we begin to see the

bone, that nice bright signal, come across the front, there's your hip. So, the one thing, of course, that this can't do is it can't look at somebody who's had metalwork in their hip nor can DEXA, that's exactly the same. So, if you'd had a fracture, or hip replacement, then we'd have to do the other side. So, since you've had neither, that's fine. So, what you can see there on the right-hand side, again, as with Susie's you can see the femoral head, that little gap there with the acetabulum, and then we're shining this at the femoral neck, and then on the left-hand side underneath the red line is then that's out towards the trochanter. And hopefully, what we'll get is a nice acquisition straightaway. So, you almost had your 160 million ultrasound bounces. Okay, that's a good start, because now the machines thinking and we have actually nicknamed this Sophia, because it's a very well made, very beautiful piece of machinery, but like Sophia Loren somewhat temperamental at times and also being Italian. Sometimes it's a bit frustrating because you do the scan, you think you've got a great acquisition, and then machine goes no. Particularly actually, in athletic women, runners are really the case, who've got really big muscles. So, you've got big muscle, the machine finds it quite difficult to distinguish between the compressed muscle and the bone. And that's quite a challenge for it and what I have to do is to press very hard on it. So that can be quite uncomfortable. This looks encouraging.

**Steven Bruce**

So funnily, the viewers couldn't hear what Brooke said she does in terms of activity. You're not a runner, is that right?

**Brooke**

I used to be a runner, yeah.

**Nick Birch**

Okay, so your bone density -1.1, you're literally only just outside the normal zone, just outside. And that, again, more to do with your body mass index, because your body mass index is in the normal range. If your body mass index was, say 28, it'd be much higher. Now we do the spine. So your body mass index, 22.4, it's a tradeoff. Higher body mass index, better bone density, but higher risk of other conditions. So you know, everything in life's a tradeoff. So, I'm just resetting the FRAX calculation again, and then it comes up with a very low number, which is fine. So, let's get this spinal scan done. So, if I just de-gel you there. Okay, so if you'd like to pop that up, I'll pop this underneath.

**Steven Bruce**

How long does a DEXA scan take to conduct, Nick?

**Nick Birch**

About half an hour. Difference between this and the DEXA scan is that because the DEXA is done by the machine and usually a very well trained and qualified technician, but they don't know what the results are until after it's done. So, they have to have what's called post processing. And that's when they then decide what your results are, so they can't talk you through it. So, this is immediate results, point of care really is point of care. And so, there's our L3, so we can see those vertebrae very nicely. You've just had a

borborygmus, a gurgle. The only thing that can really stop this system working well is intense bowel gas because ultrasound can't see through gas. Sometimes we do see people who it's just impossible to get a decent acquisition of the vertebrae. But if you try a few times, what often happens is that the probe will move the gas around, out of the colon, push it to the side. So, we can then get a reasonable view of the vertebrae.

### **Steven Bruce**

It appears the stream didn't go out straight away for some strange reason, Nick, we had some questions in which I know you answered in the beginning. One of them, I think from Belinda is could you explain the difference between DEXA and REMS again?

### **Nick Birch**

Yeah, so DEXA is an X-ray based technology, it uses a low dose of X-ray to take a picture of the hip and spine, and then by comparing the amount of X-ray absorbed between soft tissue and bone, it then can tell you what the bone density is. It's a fixed device, obviously most commonly in hospital, and you need to have a specialist room, a physicist to make sure that the equipment's working every year, you've got to have a specialist technician and there's also the post processing after that. It's accurate, it's reproducible across its systems. So, if you have a machine that's produced by Hologic, for instance, that will be the same, the results on that will be the same anywhere in the world. But it might be different from GE. And so, they're not consistent across platforms, but within platforms they are. It's the most studied bone density measurement technique, millions and millions of data points around the world. The same applies for rem's, difference being this is portable, it's therefore point of care. It's reproducible, both across the system, because it's only one system. And also, it's independent of the operator. The only thing that distinguishes it from DEXA otherwise, is that it hasn't yet got the millions and millions of data points because it's only got several hundred thousand. There are about 300 machines in the world that are being used at the moment actively. But we're keeping stuff and I've done now, about 1200 scans in the last two and a half, two years and all that data is - woah, first green bone! Yeah! - All that data is kept and we feed that into the Echolight databank. So, Brooke, your bone density in your hip is slightly below average, but your bone density in your spine is a bit less below average and is nice and green. So that's good. Okay, let's de-gel you. It'd be very nice if there was another use for this gel, but unfortunately, there isn't. Okay, so let's maintain dignity and just get you to pop your things back on. Okay, let's go and have a chat. So, comparing with Susie, because you're 10 years younger, you're 41, Susie's 52, very similar body mass index. But your premenopausal, only just got to the end of the plateau, which comes after peak bone mass. So, you're not yet on that downward slide that's going into perimenopausal. The only risk factor for you in the last 10 years, probably, for reduction of bone health was birth. You lose about 5% of your bone density during pregnancy. Because the parasite that is your baby, sucks the bone out because they've got to have some calcium from somewhere. But you put it back on very, very quickly. If you've got normal oestrogen, it comes back on very quickly. So, for most women, it isn't a big issue. But there are some conditions in pregnancy. So, there's regional osteoporosis in pregnancy, you can get osteoporosis in pregnancy, I've seen a few women with that, but they're particular conditions. So, let's look at your femur first. So, here's your femur. Now, you're literally only just below that green zone. Okay, and this is what we'd expect because of your body mass index, so your T score -1.1, if



you recall a T score compares you to the normal healthy 30-year-old so that is 1.1 standard deviations below the average, which is about just over 10% below the average. And that's what you'd expect for a nice healthy person like you and your Z score that compares you to the other people your age. Now this middle line here, this black line here. That's what's called the modal value for the bone density according to age. Mode is slightly different from mean, but in the normal population they're very close. Mode is just happens to be the most popular value in that spread. So, -0.8 is about 8%, below average for your age, which is what we would expect, again, giving your build etc. So, osteopenia, once more, so we can see exactly where we're travelling because with Susie it was pretty much the same. Low risk on the FRAX of a fracture, but the prediction here, you're only just over 40 and FRAX runs from 40 to 90. So actually, these very end ages, it is less predictable. So, there's your fragility score nicely in the green, you've got a low fragility score, so you've got well-made bones, they're very tough, which is fine, you've been doing all your exercise, which is good. And then you're gonna have an R3 as well, because by definition, that's what it is usually. So effectively, what this is saying is you've got a similar fracture trajectory to Susie. But there's lots of things you can do to change that and knowing about it, and particularly actually, when you come up to menopause, because one of the things about the menopause is if you know ahead of menopause, you've still got plenty of oestrogen in the system. So, you can do lots and lots to improve your bone health. So quite similar reports, which is understandable. But this is nice, it's always very nice to see four green vertebrae. And that says, so your T score -0.8. So, this is the point about where the T score the cutoff is -1 between normal bone and osteopenia, yours is -0.8, your Z score -0.5. So, 5% below average. So, your spinal score is slightly better than your femoral score. And now, of course, what this means is that if we go down our FRAX calculation, that stays the same, because it's still low, but here's your fragility school, nicely in the green. And that means that when we put the two together, you can be an R1, so an R1 means you have less than 5% chance of a major osteoporotic fracture in the next five years, because you've got normal bone density and normal bone toughness. One of the differences, Steven, between this and DEXA is that DEXA can't do this. Even with a trabecular bone score, they don't have yet the information to be able to put together a composite score to give you a better fracture prediction. It's coming. There's no doubt about it.

### **Steven Bruce**

Is there any point in it though? Because if this can do it without any ionising radiation, then surely this is a better option. And it's better from the patient's point of view because, as you said, it is point of care, it's portable, it's smaller, I presume it's cheaper than a DEXA machine.

### **Nick Birch**

Actually, funnily enough it's about the same.

### **Steven Bruce**

But they're huge!

### **Nick Birch**

Yeah, they are but actually, well, it's not the DEXA itself. So, you can buy a DEXA machine for 40,000 pounds, and this costs about 40,000 pounds with all the software upgrades. The difference is that that's all



I'm gonna spend on this apart from some disposables. Whereas if I want a DEXA machine, that's the beginning of it. Now I'm gonna have a three-phase source, I've got to have a lead lined room, I've got to have a specialist technician, I've got to have a radiologist or radiographer to do the post processing, etc. Whereas this is just me. So, this is, you're right, this is cheaper, because it's point of care, although the initial investment, just upfront cost, is just about the same as the machine. All the alt costs are not there. So, it is very much cheaper. Well, actually, let's call it cost effective.

**Steven Bruce**

There will be competing interests in this, won't there? There will be existing organisations, who've got DEXA, so won't want to change, there will be manufacturers who want to keep selling DEXA. Which is likely to win this battle?

**Nick Birch**

I think patients are going to win and that is that the patients will vote with their feet. Because people have recognised and organisations such as the Royal Osteoporosis Society and the International Osteoporosis Federation, they will recognise that DEXA has its limitations. There's no doubt about it DEXA is very much 1990s technology, it's kind of come to the end of its, it's not at the end of its life by any means, but it's at the end of its development. It can't go any further. Whereas this can go a lot further. This is on the up. So, this is the new kid on the block and it's just beginning and in 10 years' time, when there are tens of thousands of REMS machines around, and there's hundreds of thousands of DEXA machines around the world, we'll begin to see that head turn battle. I think that none of the DEXA manufacturers are worried about this right now. Because they know that in the time that they're going to be executives, it's not going to get enough traction in the market.

**Steven Bruce**

How many manufacturers are there of REMS?

**Nick Birch**

One.

**Steven Bruce**

Only one? So, at the moment, you can't comment on inter platform liability or anything.

**Nick Birch**

No, it is the invention and is the IP of Echolight.

**Steven Bruce**

Brooke, what did you think about that? I mean, in terms of interpreting the pictures and all the stuff that Nick said, did that all makes sense, is it encouraging or otherwise to you?

**Brooke**

I suddenly thought I'm worried I'll get a hip fracture at some point.

**Steven Bruce**

Well that is partly why I asked it because as soon as someone says, Well, you know, your little dot and Susie's was quite close to the red line, you start to think 5% chance of a fracture, gosh, but then Nick turned it around, he said, 95% chance of not getting a fracture.

**Brooke**

So yeah, the spine is definitely better, definitely helps. But it's just certainly something to think about. And I've always sort of said, I don't need vitamin D, I'm outside all the time. But now you're just like, Okay, let's go and get some vitamin D.

**Steven Bruce**

Well, you need to watch the show we had with a vitamin D specialist, Simon Billings I think it was, because in this country after about September, you don't get vitamin D even if you're outside naked. If your shadow's longer than you are then you don't get vitamin D.

**Nick Birch**

The only way you get vitamin D is by taking orally.

**Steven Bruce**

And that doesn't mean stand in the sun with your mouth open.

**Nick Birch**

There's not enough sunshine outside after September, we're now into that zone where more than 50% of the days, you won't actually see more than 20% of the sunlight. And even though you only have to have sunlight on the head or on the arms for 20 minutes in a day. We're just not getting that. And of course, by the time it gets to November, December, cloudy, rain, cold, etc. And we just don't get it. So, at the very least, my recommendation is take vitamin D supplements from September through to March. My recommendation, I think government does support this, is actually that everybody should take it year-round realistically. Were you in Australia, at home, you'd be much more outdoors and much more exposed to vitamin D.

**Brooke**

Yeah, funnily enough. So, like, my parents are both on vitamin D supplements. Because although yes, there's a lot more sun, Dad's always in an office, mum's outside all the time. But you're taught from a young age to slip, slop, slap.

**Nick Birch**

That was interesting in terms of public health in Australia, because in the old days before myeloma and the other skin cancers were really recognised as being the public health issue they are, then there was very little

in the way of impaired bone health. But as soon as the slip, slop, slap then sort of came on, then it was you start to see that. So, it became very much more like New Zealand is, they're much further south, they just don't have as much sun as Australia. So yeah, it is interesting how you again have this tradeoff between one thing and another, isn't it?

**Steven Bruce**

Watch that recording of the show with Simon Billings, very, very interesting. And we had a question from Robert. And he said, how close is this to becoming mainstream? Which I think we just answered.

**Nick Birch**

It is mainstream. It's available. Paul Stevens is the UK and Ireland distributor. People can contact him and they can buy a REMS machine and get on they can do the training, you need to go do the training. Now in the world of COVID. Whether that's where you go down to the heel of Italy, and do it in Lecce, or whether you can do it locally in the UK. But actually, you need to have the understanding of how it works, what you're trying to do, you've got to do at least 20 scans under the supervision of someone who can train you to make sure that you can actually do it anatomically correctly. When I first started in 2018, I said okay, we have a freebie August, anybody coming through the door in August, gets a free scan, because that's my training route. And I do 120 scans in that time. And that's what I needed. Because then I got right on that learning curve. By the time we were into September 2018, I've done 120 scans, and I was there an able to do it reproducibly. So, you've got to do a lot of training to do it right. If you're an osteopath you can do it, if you're a physiotherapist, if you're a doctor, whatever, you do not need to have specialist medical training to do this. You absolutely don't.

**Steven Bruce**

And Rob also asked how many machines there are around the UK and I think you said 7. Robin has asked a useful question, let's assume that we have a patient who comes to us for whatever reason and they are in our estimation vulnerable and they think or we think they should be scammed. How do we how do we point them towards someone with a REMS scanner?

**Nick Birch**

Well, they can ring you and you can give them my secretary's number, that's fine. Okay, so I do clinics, the clinic furthest north I do is in Bradford, so I do clinics in Bradford Lincoln, Huntington, Coventry, Daventry, Olney, going south down to Winchester, south down to Palbury and Sussex, I travel so I take my clinic. So, what will happen is you'll find there'll be increasing numbers of people springing up with REMS machines around the place and because it's a point of care device, they will be able to have clinics. Worcester warriors, they come to see me because Brooke used to do sports medicine with them, but I went down and I scanned all of the Worcester County Cricket players one Sunday arly on with the piece. So, we took it to them and there was 12 of them and we scanned all them.

**Steven Bruce**

People don't need to come to me, you've got a new website haven't you?

### **Nick Birch**

Yeah, osteoscanuk.com it's all there and the various clinics are all there. So, at the moment, of course with COVID we're not doing stuff because people are concerned because of the issues with COVID. I'm doing stuff at my clinic in Stratton here in Northamptonshire, exactly the same as this with essential PPE, bits and pieces as needed. So yeah, it's a nuisance, but hopefully next year we'll get back on track and it'll get back to as it was.

### **Steven Bruce**

Okay. One question before we move on to Naomi, who's been sitting there very patiently waiting her turn at this. Someone's asked, given that we're all trying to diversify or reinvent ourselves, how difficult is it to train on this? You said, anyone can do it chiropractors, osteopaths, physios.

### **Nick Birch**

The audience we've got tonight are particularly able to train on this because they've got very good anatomical knowledge. So, if you've got really good anatomical knowledge of the hip and the spine, and particularly the spine when you've got spinal deformity. So, one of the things that DEXA really struggles with is if you've got a curved spine, because you've got scoliosis or if you've got spondylolisthesis or you've got some sort of spurs and bone coming out of the vertebrae, DEXA is really inaccurate when it's faced with that. This isn't. But if I've got a woman who's got a spine that curves, and I can see that I can adapt to that. And the nice thing about being an osteopath or a physiotherapist or a doctor who's got this knowledge, is actually you can see that and you can predict it. So, if necessary, you might think, okay, when I look at that person, their shoulders are slightly out, let's have a quick look at their back. Little lean forward test, have they got scoliosis? Yeah, I know if they've got scoliosis, I know I've got to adapt to that. So, I think an osteopath is actually in a perfect position, to train to use this, to actually then deploy this technology and to offer bone health assessments. But I would warn that if you are going to do that, then you're not going to get if you like a retail experience where somebody comes along and says, okay, what's my T score, they won't want that. When we first started, we thought that might be the case but actually it wasn't. So, I had to ramp up with my medical bone knowledge. And I now have a huge archive of material that I've been through and obviously absorbed. So, we could discuss all this stuff. So, all of these dietary bits and pieces, all of the stuff on menopause, all that I very quickly had to learn a lot of that or refresh my memory from years gone by. So, if you're going to do this, be prepared to put in a lot of hard academic work as well, to really understand bone health, bone metabolism, menopause, what makes certain women have certain bone densities and bone toughness's and how to explain that and being a really good communicator is actually very important as well. So, there's lots of things you need to do to do it. However, that shouldn't be a barrier. And I very much encourage anybody in the audience, who has got an interest in bone health if they want to do this. If they want to look at it, look on the website, go and have a look at the Echolight videos. There is actually a webinar that we did, Echolight have got a REMS Academy on YouTube. So, if you look at that there are some webinars there. Go and get familiar with it and see if it's for you.

### **Steven Bruce**

And you said the machine costs around 40 K, how much does training cost?

**Nick Birch**

That's it. That's all in. So, the price of buying machine is, you've got to pay for your airfare if you go to Lecce and pay for your hotel, but the actual training is part of that.

**Steven Bruce**

Somebody said that they're thinking of using their bounce back loan for this.

**Nick Birch**

Yeah, why not? Totally reasonable thing to do man. I think that would be a very good use of it.

**Steven Bruce**

Okay, should we move on to fishing?

**Nick Birch**

Right, let me get your details up. Here we go, new patient. No menopause, which is fine. What was the height? 170. 29.41, perfect. Naomi, you're only 33, because you're less than 40 we don't have to go through the FRAX. So, we cannot then predict, because that can only predict the risk of fractures from age of 40 to 90. So, we don't have to worry about that. So, we'll skip FRAX. Would you like to come and lie yourself flat on your back on the couch? And we'll get this done. Is there anybody in your family who's had a history of fractures or osteoporosis?

**Naomi**

My mother has severe osteoporosis.

**Nick Birch**

How old is she?

**Naomi**

She is 66.

**Nick Birch**

Has she fractured?

**Naomi**

She possibly has but like ribs, so they didn't scan them or anything.

**Nick Birch**

How does she know that she's severely osteoporotic? She's had a DEXA scan, obviously.

**Naomi**

I would imagine so yeah.

**Nick Birch**

I wonder why they did that. Because they normally don't do that. Is she local in Northamptonshire?

**Naomi**

Yes.

**Nick Birch**

Because normally in Northamptonshire, they wouldn't do a DEXA scan until you actually had a fracture. Has she got a very low body mass index?

**Naomi**

she has.

**Nick Birch**

Okay, so that might be it. So, can I get you to pop your jeans down to just above the knees. That's good. So, legs apart, shoulder width, left leg turned out. That's lovely, thank you. And clothes protected from the evil jelly. What you have to do really, is to get this just above the pelvic room there. Can we get you to put your hand just on there like that? Perfect. Because that way that we get full access to the trochanter.

**Steven Bruce**

Nami, question for you. This is quite detailed. Somebody has said what dye have you got on your hair because it's gorgeous?

**Naomi**

I couldn't tell you that the make of it, I'm afraid.

**Nick Birch**

Okay, so let's get going. So, there's there's your hip, Naomi, we can see that very nicely. So as with Suzy and Brooke, you're going to get 160 million bounces of sound off your left hip. So thankfully the sound is not knocking too hard. So, it's not going to do any damage to it and actually that the REMS is is not able to damage the body tissues at all. In the same way that ultrasound is completely benign, there's no risk of any injury or any damage at all. Very shortly we'll have an answer for your left hip. Do you do any sport?

**Naomi**

I do the occasional jogging.

**Nick Birch**

When you were younger, teen, early 20s did you do much then?

**Naomi**

I very much did not.

**Nick Birch**

So, it's quite important, I see quite a lot of elite sports people and it's always an it's always a balance between how much impact they do and then what they're eating and what their body mass index is and putting that all together. So, I've seen recently a rash of teenage girls and boys who've had low bone density and they've come up with bone stress injuries. So, they're actually injured their backs they've got broken bones because they've got low bone density. That's because they are underweight, low vitamin D, avoiding milk. So, you know dietary things in teenagers these days does appear to be a really big aspect of whether they get good bone. And of course, the most important years are up to the age of 30, because up to peak bone mass, you've got to build your bone. If you don't build your bone, if you don't get to peak bone mass, it's a plateau and then down after that.

**Steven Bruce**

So, we've got a cross well into the green zone here.

**Nick Birch**

You've got lovely bone density in your hip, absolutely lovely, which is what we'd expect to get. So, we expect the same in your spine. One of the things about the freebie August was the frustration of doing scans, and because that was, what, two minutes. But when you're struggling, first time around and you're learning, it is important not to get frustrated, it's like learning to try to ride a bicycle. Once you've got it, then it's fine. It's easy. But trying to avoid, if anybody is interested in becoming a REMS specialist, avoiding the transmission of frustration to the actual patient is quite interesting.

**Steven Bruce**

Someone's asked, Nick, what a patient would expect to pay for a REMS scan?

**Nick Birch**

For me, first time round 150 pounds. So, they get a half an hour consultation, they get a REMS scan and we go through all their dietary stuff and their exercise and the risk factors etcetera. Which is around about two thirds of what my normal consultation fee would be if we were just doing a spinal consult. And it varies, there are people out there who will be doing just a basic REMS scan without any of the ancillary staff and they might be charging 60 or 70 pounds. So, it does vary, but mine, I hope is a reasonably good value-added consult. Okay, so there's your aorta down there, you can see that pulsing away nicely. And we just change the focus there. So, you see a beautiful picture of your spine there. Okay, the disc is this thing here, it's more prominent than the bones. And then if that's L4, that's L3, sliding up. We were talking about spinal shape earlier, you've got a tiny, tiny curve in your spine, which is really, really common in girls. So, if you look at all girls in the population, then that 16% have some sort of minor, spinal curvature. And in boys, it's about 3%. So, we expect to see it quite frequently. But there's a tiny, it could be the way you're lying, it could be just the

fact that you've got a little curvature, it's fine. But the nice thing about that, of course, is that because I'm used to seeing it, I can then modify the position of my probe. Keeping that aorta nicely in shape. You can see now the problem with gas. Did you see that little shadow coming down like a waterfall in the middle of the picture? That grey is causing the, now we're back on to nice clear bone again, that nice, shiny white stuff and that was a gas bubble just to the right, it's now disappeared off to the right-hand side. So L3, which is the most prominent of the lumbar vertebrae, when you're in the lying down position. There's L4. You can see the aorta just diving off into its bifurcation, going into the iliac arteries. Well, let's see what we've got. There's no reason at all why you shouldn't have four green vertebrae. And the machine's having a little think, as usual.

### **Steven Bruce**

I just had a question come in asking if you could point to what it is you're looking at in the image. Of course, now the image has disappeared, that's a bit tricky. You were mentioning as you were going through though.

### **Nick Birch**

So, what I'll do actually is I can I can fire up a presentation that I've got on the system because I've got a slide that shows you exactly what you're looking at. So, I can do that. So, we'll get Naomi's results all sorted out. Because if yours is all green, we're done on the talking. You're brilliant. That's it, that's fine. So, but for you, actually, this is really important, because for you going forward, knowing that you've got good bone density now, gives you I would hope, a phenomenal boost to say, I need to keep my bone density because I don't want to end up like my mother. All green! Now, will you promise me something? Don't go home and show your mom and do a bit of bone density shaming. That would be just cruel and nasty. Okay, let's de-gel you and then we'll put these up on the screen so they can see them.

### **Steven Bruce**

Nick, I have been asked here: Naomi you said, has good bone density? Do you think that is in any way related to the colour of her hair?

### **Nick Birch**

I couldn't possibly comment.

### **Steven Bruce**

Somebody has said, how does the resolution compare to diagnostic machines? I'm not sure what that means.

### **Nick Birch**

I know exactly what that means, it means B-mode. This is a perfectly straight forward B-mode ultrasound in one format and you can actually get, there's an added module that you can buy from Echolight that allows you just to run it as a diagnostic ultrasound machine and do all the normal ultrasound stuff. So, it's exactly the same resolution as a normal B-mode ultrasound diagnostic machine. But you have to turn it into mode.



**Steven Bruce**

Sybil has asked, and I kind of feel that this is exactly what you've been saying through these three scans, apart from the computational bells and whistles- her words- the machines capable of, is there a difference in sensitivity between REMS and DEXA at tissue level? She means bone tissue quality apart from the degree of mineralisation.

**Nick Birch**

Yeah, there's differences between most DEXA scans do not have a fragility score, they don't measure toughness, and that's at least half of the reason for people's fracture. So yeah, is the answer. It wins hands down over most DEXA, if DEXA has got trabecular bone score enabled, and I don't know how many units there are in the country, perhaps a handful, that do, they can give you the same diagnosis here. But most of them don't.

**Steven Bruce**

Do you have a clinic in South Dorset?

**Nick Birch**

South Dorset, no, but one in Winchester.

**Steven Bruce**

Winchester. Mel wants to know about South Dorset

**Nick Birch**

Haven't got one yet if she wants to set up a clinic in South Dorset. So, the one I did in Pulborough was with an osteopath down there a lovely lady, Rhia Pyart and so I've done it in osteopath clinics. And if she wants to talk to Sarah Pillage, who is our sales and marketing director through the website and wants to run one, then we can talk about that. Naomi, there you are, perfectly green bone. Now your T score because you are 33 you're allowed to have a T score, if you were 29 you wouldn't have a T score because you're below 30, which is our cutoff, but your T score is 0.5. So, you are 5% better than the average 30-year-old lady. And your Z score is 0.6 which means you're 6% better than the average 33-year-old. We know that there's no FRAX calculation because you're below the age of 40. Lovely, very low fragility score. So, you've got really tough bones, you're going to be an R1 on here. Less than 1% chance of a hip fracture due to osteoporosis in the next five years, basically there is virtually no chance. So that's lovely, which is great. What we haven't talked about is projection and Susie, what Steven pointed out for you was, if your result is here somewhere, not so far away from the red zone, what can you do about it? Because if you dive into the red zone, does that mean that you need to start taking alendronic acid and other bits and pieces? Well, not necessarily. Because if you are osteoporotic, you've still got all of the options to do the weight bearing exercise and to mix and match and make sure that all of what's getting into you is actually really optimised. If we look at Naomi's here, let's follow the trend line down, she's right on trend here for a spine. So Naomi, your spine is absolutely average for a 30 year old, is average for people your age, 0.1 is average. But your spine is not

going to become osteoporotic if you carry on as you are without changing things, and that includes the effects of menopause, until you're about 80. So actually, by the time you're 85, if you'll only just be there. If you were, for instance, to have something that alters the negative effects of menopause and there are drugs around that can do that and in time we probably will be able to alter that, you'll probably find your trajectory is actually going to be here. So, you won't become osteoporotic. There are some projections that I've made that if we can improve bone health. I didn't tell you what your toughness is gonna be. It's gonna be brilliant. Yep, you're green all the way through. And chance of major fracture less than 5%, which is gonna be really tiny. So, so you can go and tell your mum that you haven't inherited whatever it was that has caused her to have osteoporosis, which is which is lovely for you. And actually, you'll find it's lovely for her. Because one thing that parents don't want to do is to pass on to their children any frailties they might have, we always want our children obviously, to be a lot better than we are so.

### **Steven Bruce**

Hopefully you can multitask, David's asked in the athletic population with a stress reaction or stress fracture, how often would you want to review their bone density to monitor change?

### **Nick Birch**

If I'm monitoring it? Well, I'll show you. I'll show you that because that's exactly what this is. If he looks at the way he looks at the webinar on the REMS Academy, which is what this talk is here. What I talk about there is what's called the mechanostat, the mechanic staff tells you how bone responds to load. And basically, if you load your bone physiologically then you stay at the same degree of bone toughness and bone density, if you increase the loading, so you do some more sport etc, you will then improve that but if you overload it, that's when you get a stress fracture. Now, this is some stuff from Loughborough, that Nicholas Peirce and Katherine Brooke-Wavell produced in 2018, these are fast bowlers looked at by the ECB group. And what they showed was, this is using DEXA, that the bone density before a bone stress injury was up here, +2.8, was a very high level of bone density. As soon as they got a bone stress injury and then got shut down, it plummeted down to 1.7. Now this is a big enough gap that DEXA can manage to measure because DEXA is not very good at measuring small gaps, REMS is better. And then what they did was that they did sequential DEXAs going through till they actually got them to reload them as they went through the shutdown, they came back up and they're golden. Now we can use REMS, you can have a REMS scan every week and you could use that then to guide your rehabilitation from an injury. And some of the Worcester rugby players that I've seen in the past, we've done some of that we've actually done some sequential scans. So, we definitely can do that, you can do it every week, every day, you could do 10 times a day if you wanted to, because it's ultrasound and it's got no damaging effect whatsoever. So, the reality of it is we can measure bone density, the resolution of REMS is maybe 1-2%. So, we need to see a change of 1-2% before you know there has been a change. So, for instance here, you can see that, that if it's dropped from 2.8 down to 1.7. That's a huge change. We will see that very easy on REMS and then maybe scan them every month as they're going through their 16, 18-week rehab programme for their bone stress injury. So, let me just put up the pictures, because the viewer who was asking about what is it we're looking at. So, this is very much that. So, there you see the picture of the femur and the blue area is the acquisition zone. Well that is here, that's the neck of femur on that X ray. And when we're looking at the spine, the little bits of white stuff we're

looking at, this is the front of the vertebral bodies, L1 through L4. So, what we're looking at, these are the anatomical regions, what are called the regions of interest. And then this is the frequency graph showing exactly what the ultrasound has done, it's bouncing off your bone, and that big peak there, that then equates to the front of the vertebral body. And then the ultrasound penetrates for a depth around about one and a half to two centimetres. So, you take a nice big triangular chunk out of the front of the vertebra. And then that's our region of interest, that then gets turned into our frequency curve here. And that gets matched against the current library and that then gives you all your results. So that's on the REMS Academy, YouTube channel of that webinar. So, if you're interested go to that. Watch it, it's a 40-minute webinar.

### **Steven Bruce**

Quick couple of questions before we finish. Pip asked this question ages ago, actually, do you have anything you could say quickly about the risk factors and mechanisms of causation for anky spond and osteoporosis?

### **Nick Birch**

Yeah, the problem with ankylosing spondylitis is it traditionally was very much associated with osteoporosis because of the abnormal loading. Because the problem with ankylosing spondylitis is that you've got flowing osteophytes, effectively syndesmophytes, around the outside of the disk. And so, it's a very altered pattern of loading through the vertebral bodies and that's why they became osteoporotic. In recent years with disease modifying drugs, that's changed quite a lot. And I think realistically, if you've got somebody with a new diagnosis of ankylosing spondylitis, or another spondyloarthropathy, early diagnosis, good disease, modifying drugs, and then make sure they keep very active should minimise the risk for osteoporosis.

### **Steven Bruce**

You said something about alendronic acid. And we've been asked by Lindsey whether it's true they increase bone density but increase fragility?

### **Nick Birch**

Alendronic acid doesn't increase bone density, what it does, it stabilises bone density because it turns off the osteoclastic activity or reduces it considerably. So you still got osteoblastic activity, but she's actually is absolutely right and that is that your fragility is decreased because you've got this unopposed osteoblastic activity that produces immature bone because the osteoclast to be turned off, you don't get remodelling, so you don't get strong bone and what you have to have is remodelling. And so, this is why you get for instance, osteonecrosis of the jaw. You can get some temporomandibular joint problems and around the mandible and also the atypical fractures of the femur. These are failures of remodelling. So, it is an increase in fragility, without an improvement in bone density. So, they stabilise bone density. Now, this thing goes to what we've said earlier, and what all three of you have got. And that is you've actually got great fragility scores. So, if we'd gone back eight months before I had the upgrade on this machine, I couldn't have told you what your fragility scores were. All I'd say to you, Susie, was that you're fairly close to being osteoporotic, at some point in the future we need to do something about that, actually we now know is that you've got very good tough bone, and actually, I will have a completely different conversation with you. And then of course, the same with Brooke and Naomi. So, I think what we've now got is a better way to look at

alendronic acid and all the other bisphosphonates and how they work and what they really do and do they actually then have the effects on fracture risk that people have been looking for all these years.

**Steven Bruce**

Nick, thank you very much.

**Nick Birch**

Welcome.

**Steven Bruce**

Robin, you asked a question, which you told me is a genuine question about the difference between mountain biking and road biking and we're not going to talk about that now because we've run out of time, but I'll Nick in the pub later on and I'll send the answer to later in the week. Ladies, thank you for giving up your time. I hope you've enjoyed and benefited from the experience. So thanks again and we will get your report to you, Nick will get it to you, so you can share it with the people in your study.

**Nick Birch**

What I'll do is, if you can just give me your email addresses and I will send you the reports.

**Steven Bruce**

Brilliant that's been fantastic, hope you've enjoyed the show this evening and you've got some benefit from it, not least in how you can advise and communicate with your own patients about the sort of scans they should be getting and the nature of the risks that osteoporosis, menopause and so on presents to them. That's all the time for this evening. Thank you for your questions, if you asked them. Tomorrow we're looking at hip dysplasia and perthes disease, on Monday we're looking at vestibular rehabilitation. Next Wednesday we've got a case-based discussion and on Thursday we have the lovely Anji Gopal giving us a lesson on yoga for chronic stress. So lots more CPD coming your way from the Academy, hope you've enjoyed it this evening, but that's it. Goodnight.