



Thoracic Outlet Syndrome - Ref212

with Rob Patterson

February 2nd 2022

TRANSCRIPT

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Steven Bruce

We're here primarily to talk about thoracic outlet syndrome with Rob Patterson, who is a physio of nearly 40 years standing. He specialises in this subject, but of course he does all sorts of other physio stuff as well or has done in his past. He lectures on the subject, and it's his mission in life to spread the word about Thoracic Outlet Syndrome, which I'm sure you learned about in college years ago, probably. And I suspect that there is lots of new stuff, which it will be worth us having a look at over the course of the next 90 minutes. Anyway, one other thing which will become apparent as we go on here, Rob is visually impaired, which gives us the opportunity to talk about the communication issues that that brings to the fore in clinic, not whether you are visually impaired, but how perhaps you might handle visual impairment in your patients. And when I say visually impaired, Rob's given me permission to say that he is blind, he can see light and shade, but he can't make anything else out. And that obviously presents a number of challenges. Anyway, let me introduce him. Rob, it's great to have you with us. And I'm delighted. We've had a great chat already. I'm delighted about what's ahead of us this evening. You founded I think, the Thoracic Outlet Syndrome Center of Excellence, is that right?

Rob Patterson

Yes. Yeah. Along with some others. Yeah.

Steven Bruce

So what does that do? Is it a single institution?

Rob Patterson

No, it's a growing body of passionately interested people. Mostly clinical, but some non-clinical. So at present, we have a president and co-founder Louis Shakinovsky. And then we have a number of surgeons, a plastic surgeon. We have two vascular high volume Thoracic Outlet surgeons in the US, one in New York, one in Los Angeles. We have a surgeon in Bristol, two surgeons in Wolverhampton. We have a researcher in Oxford University and a radiologist in Bristol, but it's growing. It's growing.

Steven Bruce

I didn't hear any manual therapists in that list of people, are you the only one?

Rob Patterson

Well, I'm probably the primary diagnostician within the group. There's, because my patients tend to come from all over the UK and overseas then I tie up with manual therapists of all stripes, closer to a patient and so on. So they will come to us for diagnosis workup, and sometimes preparation for further care, but probably as a minority of people who are within easy traveling distance of our clinic who actually come for further care.

Steven Bruce

So in addition to all those experts, can people be affiliated to the Centre of Excellence?

Rob Patterson

Yeah, I mean, we are very, very open to people who share the same passion as us. And we've tended to be a group of people who are sort of pushing the boundaries and trying to make quality care more

available. Because when we started, we know the Thoracic Outlet Syndrome Center of Excellence has TOSCOE not Tesco, but, so when we founded TOSCOE, you know, we were really keen to address what we found to be a backlog of patients who were then at the later stages of the neurological subtype of Thoracic Outlet Syndrome at the time. So sadly, the vast majority of these patients needed surgery. So that was our initial goal, rather than to set up the sort of protocols for conservative care that is growing increasingly now. But at the time, we had people coming in anything between six and 20 years post onset of symptoms, and unfortunately, the majority of them were way past the point of any conservative care benefiting them. So they really needed surgery.

Steven Bruce

I don't have your experience in manual therapy. I qualified in 2000. And I do remember being talked about Thoracic Outlet Syndrome, but there was only one thing, it was called Thoracic Outlet Syndrome, we even talked about the structures involved. I don't remember anybody sounding particularly passionate about it. So what sparked that in you specifically, Thoracic Outlet? Yeah, well, you were calling it TOS earlier on. What do you call people who've got it?

Rob Patterson

I don't know. No, no. So patients experiencing one of the subtypes, so we will categorise them that into those that have neurological thoracic outlet syndrome, one of the forms of pec minor syndrome, and then venous thoracic outlet syndrome with its subtypes, and arterial thoracic outlet syndrome with its subtypes. But basically, they're all under this gross umbrella term Thoracic Outlet Syndrome. So I've been interested in it as a diagnostician since the late 80s. I was invited to join something of an experiment where a group of orthopedic surgeons and radiologists agreed to mentor a physiotherapist and the experiment was to see if a physiotherapist could be trained to do everything. An orthopedic surgeon carried out in clinic but obviously not in theater. So the ideal at the time was to be trained with all the imaging technology. At the time it is predominantly CT, but MRI was really coming in at a rate of knots at the time, X rays, ultrasounds, and to be trained in injection therapy. That was the original goal of my training. And then a group of universities got together. And then they were going to look at me, the surgeons who agreed to take part and 300 patients. So basically, I think it was a three-year study in total and they looked at a large cohort of patients who were randomised to either see a surgeon or to see me. And then the idea was to compare and contrast the effectiveness, the satisfaction and the cost. So this was published a few years later.

Steven Bruce

When was this? When was the study?

Rob Patterson

So the study was probably around 89 to 93, somewhere around there. But I don't think it was published for a year or two later, by the time all the data was put together. And you'd think I remember the title, wouldn't you, but it was something like breaking boundaries between orthopedic surgeons and physiotherapists, something like that, or merging boundaries. So it was a bit of an icebreaker at the time. So within that role, I became predominantly a diagnostician. So I would go from orthopedic clinic to orthopedic clinic, averaging anything between 80 and 100 new patients a week. And I would see follow ups. But these were generally following investigations, and in preparation for surgery or post op. So I was outside my physiotherapy role at the time, they were very keen to have me as another pair of hands doing

injections. But at the time, my sight was just beginning to fade. And I was getting a little bit less confident looking at MR and X ray images as I was actually being trained to do it in more detail. And I thought, you know, I can't absolutely see what was on those vials. So I said no, I think I'll call it a day on the injections, I'll just call one of the team in from next door to do that when it's needed. And I'll just concentrate on the rest. So within those clinics, I would run spinal diagnostic clinics, upper limb diagnostic clinics, trauma clinics, lower limb clinics. And I got to the point I thought, hang about, I'm seeing some of these people going round and round as if they're on a roundabout, and you know, you'd have a massive pile of notes. And they would be divvied out between the team, the consultant, the senior me, and I thought I know that name. And I would grab that patient and say, can I see that patient, I'm sure I've seen them in another clinic. And it was someone with some form of persistent upper limb or cervical brachial syndrome that was actually going round and round. And I had thought that I had diagnosed these patients as having neurogenic thoracic outlet syndrome back then. And the team that actually cared for thoracic outlet syndrome was in another hospital. So I would write to that consultant and then never hear anything back. So the boss would get the letters as to what was happening, but that sort of communication drifted down to the underlings, you know, so I thought yeah, I'm doing a good job. All these patients are being seen and cared for. Some of them referred to my physiotherapy colleagues for physiotherapy care, all within the NHS. Some referred to surgery. But it was latterly that someone within my private practice rung up and said that they were a surgeon, and they were losing the use of their hands. And I thought oh gosh, okay, so I met with the surgeon a little while later, and I made the diagnosis of bilateral neurogenic thoracic outlet syndrome and neurogenic pec minor syndrome. Now this poor surgeon had already had six upper limb operations as many of my patients will have done. So the cubital tunnels were decompressed. The carpal tunnels were decompressed and then because of instability due to muscle weakness, stabilisation of the first CMC joints were performed, and symptoms persisted, muscle wasting persisted. There were five nerve conduction studies, were normal, X rays were normal, MRI, cervical spine, normal, MRI brachio plexus normal. So I thought, yep, absolutely, neurogenic thoracic outlet syndrome. Of course, I remembered who I used to refer to within the NHS, I referred to that same professor of surgery. He refuted the diagnosis and said, well, I'm not absolutely sure what it is. But it's as is often the case, but it's not thoracic outlet syndrome, talking about a crisis of professionalism. So I can remember the telephone call from the carpark. Rob, he said it isn't thoracic outlet syndrome, are you absolutely sure? And I said, a big lump in my throat, yeah, just about to go down the pan? No, I'm absolutely sure. So we are going to have to find someone else. At the time, this person had see in one of the more senior brachio plexus surgeons in the UK, seen some of the very, very renowned and competent upper limb surgeons, after all, the patient was a surgeon. And so it turned out that the way forward would be to see a high volume, very competent thoracic outlet surgeon overseas. So the surgeon picked was a vascular surgeon in Los Angeles. And within a few weeks, the tickets were bought, and the patient was off to Los Angeles. So the diagnosis was quickly confirmed. And then TOS decompressions were performed, super trans auxiliary decompressions and pec minor tenotomies, bilaterally, one side and then two weeks later, which is very, very quick, two weeks later the other side. And then within eight weeks, the patient was back to full time practice, operating and back to sculpting. And then there's an ongoing recovery because the amount of changes within the muscles and the surrounding tissues, you know, further recovery took years to be honest. But you know, an excellent recovery has been achieved. So that put me in a real dilemma because the process that I thought was in a reasonable shape in Bristol obviously wasn't. And so I thought the patients aren't being served. What's happening to all those other patients? And I managed to trace some of the other patients, and they had been told that they had

psychiatric or psychological problems. They had been more or less labeled as chronic pain rather than remediable problems.

Steven Bruce

Is this still going on?

Rob Patterson

Sadly, yes. Yeah, very much so.

Steven Bruce

My question to you is going to be, when I went, years ago when I did all this, it was made clear then that it was questionable whether this syndrome existed in the minds of, certainly many in the conventional medical world, but possibly quite a few actually, in my own osteopathic world, and I can't speak for physios. Is it less uncertain now? Clearly it is in your mind.

Rob Patterson

It is in my mind, but what you're referring to goes back to an American neurologist called Will Bone. And he published what he described as his diagnostic criteria. And he said there was something called true neurological thoracic outlet syndrome and disputed thoracic outlet syndrome. And he made the division as many neurologists continue to do, but you can only have neurological thoracic outlet syndrome, if you've got abnormalities on nerve conduction studies or on EMG. And then disputed was basically everyone else. And so as a consequence, this term disputed very quickly became psychological. And so not only were there issues around patients being operated on and harmed by low volume surgeons, or treated when the diagnosis probably wasn't correct by other practitioners, that the whole thing started to become rather patchy. And so the Americans picked up somewhat before us. But certainly, within the surgical community in the UK, we've been slightly long time catching up, really, I mean, it is getting there. And since the publication of new diagnostic criteria, about five years ago, this is now particularly myself and my colleagues who are keen to share it, being accepted increasingly. So, you know, there's a common language and a common description. So our patients are now no longer said to have, you know, scalenus syndrome or costoclavicular syndrome or other things, you know, they're all being given a very useful similar description of neurological thoracic outlet syndrome, arterial or venous or combinations of these things.

Steven Bruce

The names are fairly self-evident, but would you like to just quickly explain the difference between neurological, vascular, arterial and maybe give us the incidence of those relative incidents?

Rob Patterson

Yes. So the latest publication on incidence is that venous thoracic outlet syndrome. And I'm really referring there to the more dramatic onset, which is known as Paget-Schrotter Syndrome. So that's when you get a clot in the subclavian vein, which is compressed by a variety of different structures within the anterior scalene space. So that's vetoes. And we're probably looking at about one per 100,000 per year incidents, maybe a little bit low. But that's thought to be roughly the idea. I think in the UK, that takes us to 720 or 750 a year, something like that. There are many, many more patients with venous thoracic

outlet syndrome that have McCleery's and McCleery's is the term given to non thrombotic intermittent occlusion of the subclavian vein, so that the patient will have swelling and discoloration and temperature change and heaviness and discomfort that will come and go. And the old name for that was effort thrombosis. So it would be classically the person who would say, oh, my arm is swelling after exercise, and given me Jeff but then it goes down again, it comes up and down. You know, sometimes that's the prequel to a thrombotic event, but sometimes it can go on for for many months and years.

Rob Patterson

You have to have symptoms. So you can have congenital abnormalities. You can have positional occlusion, you can have as many cervical ribs as you like, that doesn't make the diagnosis, there's got to be demonstrable symptoms.

Steven Bruce

But usually after exercise?

Rob Patterson

Usually after exercise. So that's Venous Thoracic Outlet Syndrome. Just for interest, venous thoracic outlet syndrome is thought to have a coincidence with neurological thoracic outlet syndrome of five to 10%. So those within TOS, about five to 10% of those will also have VTOS. So then the rare wrist form is arterial thoracic outlet syndrome. So the diagnostic criteria for ATOS is quite strict. So it's not thought or described as just intermittent occlusion of the subclavian artery in elevation, because large numbers of the population will lose their pulse in various positions of arm elevation are not an entirely normal physiological phenomenon. So the loss of the pulse in elevation isn't ATOS. But there has to be disease, or significant symptomatic compression of the artery, such as an aneurysm or an embolic event, or compression to such an extent that they get through ischemic problems in the limbs. So that's arterial Thoracic Outlet Syndrome. The incidence is below one per 100,000 per year. So there is no figure for it. It's too rare. Then, by far the most common and certainly the most common that we see is neurological Thoracic Outlet Syndrome. So the divisions that we see in TOSCOE would be 90 approx. 95% NTOS, approx 4% VTOS, and about the remaining 1% ATOS. But of course, that's very different from the early incidents, the prevalence in all honesty, no one knows because the diagnosis are generally made so late, then it's very difficult to calculate the prevalence because when we looked at my last 300 patients on our database, even the earliest to diagnosis was six years. And the latest to diagnosis was over 20 years. So, you know, if you group all those together, the prevalence is going to be huge. So generally, I always say, there's an awful lot of undiagnosed patients with Thoracic Outlet Syndrome out there in the community.

Steven Bruce

Okay, so that might be worrying, that might not, some of those undiagnosed patients might never have symptoms, perhaps. Or is that not possible?

Steven Bruce

So therefore, if you're going undiagnosed for 20 years, and maybe they're getting the wrong diagnosis, as well, during those 20 years, and possibly in some cases, getting inappropriate surgery or whatever else. What are the likely consequences for those patients?

Rob Patterson

Yeah, sadly, 41% of the patients that we see in TOSCOE have already had an ineffective surgery. So whether that's a cervical decompression, with or without fusion, multiple shoulder operations, cubital, tunnel decompressions, carpal tunnel decompressions and a variety of other procedures. So that's 41% of people. So that's a very sad misdiagnosis or on occasions treating comorbidities, but the primary diagnosis remains. So those patients are sadly all too common. If we refer to VTOS, then if that is undiagnosed, so within the first 14 days, which is the time that you could safely and effectively provide thrombolysis, so either just chemical or mechanical thrombolysis, so the clot will coagulate to such an extent that it probably won't be thrombolised. So they will remain on anticoagulants with the hope that that clot will slowly dissolve. And if it doesn't, then you rely on the collateral circulation under the measures to help the patient cope long term. If there were the surgeon who is very familiar with operating TOS, then of course, they can have a decompression, which increases the odds of that vein opening. If the VTOS is complicated, as some of my patients are, then they can suddenly have pulmonary emboli or mini strokes or other thrombotic events. But it's predominantly pulmonary emboli. But that's the big threat. With ATOS, the worry there is that they'll throw off and rely into the upper limb, and then they'll get the worst-case scenario is that somebody will lose a finger, a hand or a limb due to ischemic changes, due to untreated or unrecognised emboli. Fortunately, very rare.

Steven Bruce

Somebody who's gone undiagnosed for 20 years has probably been to see somebody about their symptoms during that time and possibly been to see a physio therapist, an osteopath, chiropractor, because it will feel like a physical or musculoskeletal problem. That means that there's an awful lot of us missing this diagnosis or who are referring on and the diagnosis is being refuted by other medical professionals.

Rob Patterson

Yeah, I mean, I suppose it'd be fair for you and your audience to know that I'm not seeing people who are developing symptoms a week ago, a month ago, or even two months ago. As far as I know, there's a huge volume of patients out there who were being very successfully treated by chiropractors, osteopaths and physiotherapists, because, of course, they will never come to us. So, the patients we see will tend to be middle to late stage, but I'm referring to neurological form there, rather than one of the vascular forms. And they will have undergone many unsuccessful forms of treatment. Some as many as 20 practitioners. It's not unusual, and that surgeons, osteopath chiropractors, multiple physios, you know, under there sports physicians and the like. So, you know, the end result for some is pretty gross loss of arm function and chronic disabling pain.

Steven Bruce

Right. Do you want to run through the mechanism of this occurring, you were talking earlier on about the scalene triangle, weren't you, as being sort of centre of focus.

Rob Patterson

Yeah, can we have the scalene triangle slide up. We are dancing with elegant uncertainty in terms of the etiology. And very often you only absolutely know when you're in there exploring with surgery, because the number of structural variations in this area are legion. That's partly what makes it such a complicated

condition. So there's three sites of compression, the first site is within the scalene triangle. So the boundaries there are the posterior margin of the anterior scalene, the anterior margin of the middle scalene, and the superior margin of the first rib. As there was listening, we will know. So we've got the roots of the brachial plexus, coming through, so C five to T one, and then that is mixed in with the subclavian artery. So if there are abnormalities were the congenital or acquired within that scalene triangle, then you can get either neurological Thoracic Outlet Syndrome, or arterial Thoracic Outlet Syndrome, I can touch on the type of abnormalities if you like, let's just go on to the other ones for a moment.

Steven Bruce

Yeah, please.

Rob Patterson

So the type of abnormalities can be, you know, multiple forms of congenital issues. So you can get sickle formation where you literally get a sling going from the middle to the anterior scalene, that forms a sling for the artery and the nerves to have to travel over. There's a huge variety of piercing abnormalities, where we would like to think that the plexus goes through the scalene triangle, but no such luck, part of the plexus, some of the roots may go through the substance of the middle scalene, or through the substance of the anterior scalene, that could sit quietly for years until some trauma scars it up. And then you'll get a cicatrix or a contractile scar formation that eventually strangles the route, forming Thoracic Outlet Syndrome. And you can get a huge variety of other abnormalities such as a fourth scalene, called a scalinus minimus, or no scalene space at all, that's always quite nice, and you think, Gosh, how did they get through in the first place, but some people just don't seem to develop a scalene triangle. So my radiologist measures these for me during ultrasound evaluation, and the range or the, if you like, the parameters of the scalene triangle can be anything from zero up to 24 millimeters. So on the one hand, you could drive a family car through there, on the other hand, there's no space at all. Most of our patients come in at under six millimeters, with or without any of these abnormalities. So you can also have changes of course within the artery and changes, you can get a number of other congenital abnormalities of the plexus itself or acquired scarring or intra neural edema, all these things can be detected with a very experienced radiologist. If we go from there to the next site of compression, which is the costoclavicular space, so this is an open-ended triangle with 80 backs, where the clavicle and the first rib meet and then it opens up laterally. So through there, we have all three structures. And we find that is predominantly the vein that tends to be compressed within the costoclavicular space because it travels anterior to the scalene and posterior to the clavicle. And whereas you may have a centimeter to a centimeter and a half space there normally, for this five-to-nine-millimeter vein to travel through, if you get any acquired scarring or hypertrophy of the anterior scalene in a weightlifter or hypertrophy of subclavius likewise, then these dimensions can be narrowed to a critical level that the vein literally has nowhere to go. And then once again it starts to scar up and form a cicatrix, a contractile scar that eventually strangles it and causes the occlusion. The nerves on the artery can also be compressed there, but they travel that little bit more posteriorly. And so there's less go up for them to suffer significant compression within the costoclavicular space. And then the next site of compression is the subcoracoid space. So this is the boundary by the coracoid above the ribs, below the pec minor in front. And there's a fascinating variety of congenital abnormalities that can predispose someone to this. I sometimes, in lectures on this say that, you know, you can have a genetic factor that loads the gun, and then acquired

factors that eventually fire the trigger. And so you may have a second or a secondary pec minor, you may have altered course to the pec minor. There's many, many pec minors that seem to have rather an attraction for the shoulder itself, rather than just the coracoid. So you get expansions of the attachment and thickening of the ligament. But nonetheless, you can compress any of the three structures in the subcoracoid space. But it is predominantly the descending nerves that tend to be compressed within the subcoracoid space.

Steven Bruce

Can I have a feeling for what proportion of Thoracic Outlet Syndrome is treatable through manual therapy and won't require surgery or is that too difficult to assess?

Rob Patterson

Well, no, if we look at the literature, and most of the literature comes from the US, and as you read, you will read that these patients are diagnosed very often within the first six to three months, certainly treated within the first year or so. And so within that population, the quote is that about 80%, and I'm referring to the neurological form here, not either of the vascular forms, because that's a different world altogether. So the neurological form may be successfully treated in about 80% of cases. The problem we face or certainly we face in TOSCOE is perhaps scaled, in that the vast majority of our patients are way beyond that. And so the chance of conservative care helping when you're in two years and multiples of years, of course gets fewer and fewer, that would benefit and we're into neurological deficit and difficult to change issues by then. So the earlier it's diagnosed, the more likely conservative care is to benefit it.

Steven Bruce

Okay, so we're going to get on to diagnosis in a moment. Can I ask you a few questions from the audience?

Rob Patterson

Yes.

Steven Bruce

Right. So there have been a number of questions come in about the various tests. We'll talk about those in a moment with our model this evening. Pierre says, where can we find the criteria for diagnosis of Thoracic Outlet Syndrome and inclusion, exclusion elements, particularly relating to neurogenic versus radiculopathy related presentation.

Rob Patterson

All of that isn't covered in one article. But the diagnostic criteria is open access article online. And it's been published by the Vascular Association, the American Vascular Association. So if someone was to, of course, I can give you the reference for this, you can post it afterwards, actually, rather than me telling your audience to Google it. I'll give you the reference afterwards. It'll make it a lot easier. Yeah, but it's available online.

Steven Bruce

There's also isn't there, a wonderful book published a couple of years ago called Thoracic Outlet Syndrome. You wrote chapter 50.

Rob Patterson

Thank you for reading it.

Steven Bruce

I haven't read it. But you wrote chapter 50, which tells people a lot about the size of his book quite apart from anything else. And usually when I see this sort of thing, I have the physical copy of the book that I can share but it costs over 100 quid in some sources.

Rob Patterson

I knew I should have brought one.

Steven Bruce

It could be a signed copy that would be great. So that's Pierre's question. Yeah. Sunny says, what do we need to do to get the patient to correct medical diagnosis when we suspect Thoracic Outlet Syndrome? Are there NICE criteria that we can refer to?

Rob Patterson

Yeah, there are two NICE articles on Thoracic Outlet Syndrome. But because these are performed by surgeons. In fact, the same surgeon, the first one, a hand surgeon in London, and the second one, that same surgeon and his son, they tend to orient it towards surgery. And so the publications in the Cochrane Library really, they're not too helpful in terms of diagnosis. But they are very helpful in stating the scope of the problem and the dilemma faced by patients with Thoracic Outlet Syndrome. And they really talk about the absence of any quality evidence. There is no NICE guidelines, but the newly published criteria that we will be touching on anyway, that is available online.

Steven Bruce

So would you expect in this country, first of all, would you expect a GP to know what you're talking about if you said this person should be investigated for Thoracic Outlet Syndrome? And if you then, maybe you went direct to an orthopedic consultant? Would they know what you were talking about and accept?

Rob Patterson

I think I answered that question of yours inadequately moment ago. So with regard to early onset neurological Thoracic Outlet Syndrome, no medical workup is required. It's a purely clinical diagnosis. And so, further investigations are not required. So your average patient will not need X rays, MRIs, nerve conduction studies, ultrasound studies and the like, basically, because the whole thing is an elegant negotiation with uncertainty anyway, even when you've got the test results, then if you don't have somebody late in the course of the condition, and they don't have a rather advanced case, such as Gilliatt-Sumner hand, when they've really got wasted intrinsic and weakness and clawing, you know, that is end stage, neurological Thoracic Outlet Syndrome, that obviously needs surgery, and it might even be too late for surgery. So, you know, most who don't have detectable neurological abnormalities don't need

medical workup. So most of us then would not, I mean, I do the workup myself, because I have the privilege of investigation rights. But on average, most patients don't need it anyways, because most of my patients present much later.

Steven Bruce

Thank you. Daniela has asked if there are particular age groups or other groups, which are particularly susceptible to Thoracic Outlet Syndrome.

Rob Patterson

Yeah, all three syndromes tend to dominate within the young, productive working age group. So it does get rarer as you get older, probably they cluster between 25 and 40 as those that present most readily. The Paget-Schroetter, which is the thrombotic occlusion of the subclavian vein tends to have a predilection for young male weightlifters. And you know, and they will classically present in their 20s. So, you know, depends on how long they've been lifting, but it'll be a variety of different athletes are those that use their arms vigorously. The ATOS, tends to be those that already have some form of congenital abnormality, not necessarily a cervical rib. In fact, we don't see many cervical ribs. So we're predominantly seeing fibrous bands, or anomalous first ribs, or anomalous scalens as a cause for this. But they will be expressing symptoms early in life, but the diagnosis is normally not made until later on, or until there's a critical event later on.

Steven Bruce

When you say abnormalities with the first rib, does that mean that it's just perhaps elevated slightly out of position and therefore amenable to mechanical repair or adjustment?

Rob Patterson

Yeah, it's more the shape of it there. So, you will get a variety of first ribs in that they can have a rather flat straight profile, or a very curved profile, or it may have not fully formed, and some first ribs are joined to the second rib. And some first ribs have some form of cartilaginous or partial cervical rib coming down on to them. So there's a variety of congenital abnormalities associated with the first rib. Occult fractures is another one.

Steven Bruce

Sarah asks if, you talked about all those patients who have not had any help from the interventions they have already been given, are there common characteristics to those people who don't respond to these interventions?

Rob Patterson

So these are the surgical candidates then. I think the most common unfortunately, the most common characteristic is misdiagnosis.

Steven Bruce

And, of course, I want to come on to those because we're going to think it is that it isn't and other people might...

Rob Patterson

But to be fair I have no great awareness of any misdiagnosis within the physiotherapy, osteopathic and chiropractic community. As far as I know, all the patients with neurogenic Thoracic Outlet Syndrome, or the vast majority are being treated very successfully. And I'm seeing the minority that come through the gate, who actually have the various types of congenital predisposing factors that eventually need a surgical workup or some of the enhanced rehabilitation programs with Botox and injections and the like that we provide. So it's really hard to know, how many are out there being successfully diagnosed and treated by other professionals. Because of course, I'll never see them.

Steven Bruce

Yes. We're going to go and have a look at this on our model in a second. So one last question, Wallace says, is ultrasound examination more useful than MRI? And of course, you said that this is only useful for those few relatively few cases that aren't amenable to manual therapy.

Rob Patterson

Yes, yeah. MRI can be useful if you are uncertain of the diagnosis. So, depending on the age of the patient and their presentation, particularly those that are over 30, then as part of a surgical workup, not a conservative care workup, because remember, they don't need imaging as a preparation for conservative care. But if I'm working somebody up for surgery, then I'll almost always cross sectionally image their cervical spine to see if we have a competing diagnosis. So we'll come to the diagnosis criteria in a second, but make sure they don't have any root compromise or a comorbidity. When it comes to imaging the brachial plexus MR can be useful with enhancement. So you know the various forms of enhancement, the venogram or arteriogram. But the most useful there is to be performed in the Superman position so that they're in elevation. So you already have a slight narrowing of the costoclavicular space so that you can show up any assessment of the paraneural, or any impingement upon the brachial plexus. Most, even the more advanced neurogenic Thoracic Outlet Syndrome, and they are imaged in the neutral anatomical position will look normal anyway. But of course, sometimes we have to be sure that we're not looking at a primary nerve tumor, or a secondary tumor or any other type of disorder. So in terms of exclusion, then imaging is really, really helpful. In terms of the workup for neurogenic Thoracic Outlet Syndrome. If you're wondering, is Botox going to be helpful? Is surgery going to be helpful? Or if you're left with uncertainty, any more than your uncertain anyway about the diagnosis, then if you have access to a really experienced and TOS sensitive radiologist who is used to imaging around that area, then a good evaluation of the scalenes, the brachial plexus, the subclavius and the subcarocoid space is really, really helpful.

Steven Bruce

With ultrasound?

Rob Patterson

With ultrasound, but in combination with targeted lidocaine and bupivacaine blocks, which we can come back to as part of the diagnostic process.

Steven Bruce

So should we get up of our chairs and go and have a quick run through what we should be doing to identify this in clinic?

Rob Patterson

Okie dokie.

Steven Bruce

Right. We got Jack. Jack is sitting, before we go on, we chose not to undress Jack. But if he had, he would have experienced these wonderful clinical armor covers that we've got. The Covid friendly covers, which are really lovely and soft and warm. And yes, we do have some in stock. We don't make much of a profit on these, but we have got these in stock. So Jackie's a steelworker. So he's no stranger to heavyweights, but I think we can probably say he's not a bodybuilder, are you, Jack?

Jack

No.

Steven Bruce

No, you're not, right. Right. So I'm going to leave it to you then, Rob, to tell us what we would do to identify a thoracic outlet problem in this patient.

Rob Patterson

Okay, so I think what may be most useful there, because of course, your audience will be very used to examine the cervical spine, the shoulder, the shoulder girdle, the elbow, and the rest. So the thoracic outlet stress test that we will be covering in a moment. They are basically a small component of a full upper limb evaluation. So is it okay if we literally just go to the specific Thoracic Outlet stress tests because they're probably the one that people will know. So we use a number and I'll go through them bit by bit but if your audience wants any further explanation about each of them, then of course, we can do that. So it used to be called Eden's. Now, for simplicity it's called the costoclavicular compression test. So we are looking to approximate the clavicle to the first rib by asking the patient to retract and depress, I won't use those language obviously for the patient. So pull your shoulders back and down. And I assess the patient into position. And depending on what symptoms we are looking to reproduce or replicate, then we will ask the patient because this is a provocative test, does this reproduce any of your familiar arm symptoms? We're not interested in neck and shoulder symptoms, because there will be muscular pulling and ligament stretch and the like and that can offer us nothing. So we're really looking at neurological phenomenon in the arm. So they may say, oh, you know, I'm getting some of my pain, some of my paraesthesia, some of my numbness. And then we'll say, is that really familiar? Is it your symptom? And if you say, no, I've never felt that before in my life. So they've got symptoms, but it's negative, or it reproduces the patient's actual symptoms. And then I will ask them to grade that on a nought to 10. So how bad is that, Jack? If nought is no pain whatsoever, or no pins and needles and 10 is the worst pain or the worst pins and needles?

Jack

I'd say five or six.

Rob Patterson

But already.

Jack

Yeah.

Steven Bruce

How long are you holding it for?

Rob Patterson

Two minutes. Yeah. I mean...

Steven Bruce

We didn't explain to Jack, it's going to be uncomfortable.

Rob Patterson

I was checking if you're in one piece before we started. So that's the costoclavical compression. In some articles, it is done in standing. And they also look at the volume of the radial pulse. But in all honesty, so many people in that position lose their radial pulse anyway, then they really have such low sensitivity and specificity. There's no point in adding that in. But I say it because that's how it will be read in some articles.

Steven Bruce

And that's how many of us were taught years and years ago.

Rob Patterson

Yeah, it's a solid modification of AdSense then, which we no longer use. So, costoclavical compression test, so is positive or negative on the basis of the accurate reproduction of the patient's familiar symptoms. So can we move into the modified upper limb tension test, which is looking to see if we apply a stretch ischemia to the brachial plexus. Do we get reproduction of the patient's familiar symptoms? Can you pop your arms, pretend you're an aero plane, forth out straight fingers, bring them back to there. So we've got a slight stretch on the plexus and a subtle compromise of the thoracic outlet. This is called stage one. And I'll be asking the patient, can you tell me if you're experiencing any of the symptoms you want to get rid of? So any of your familiar symptoms? And if you are, can you give that a grade on naught to 10? And I will prep them with a naught to 10 system beforehand? Am I safe to assume you're perfectly comfortable?

Jack

Yeah, I'm comfortable.

Rob Patterson

Okie dokie. So can you now, pop your wrist backwards and try and point your fingers up towards the ceiling? Now almost everyone will experience some form of neuro stretch. So that's not the positive test. So, are you experiencing any of your familiar symptoms with stage two. And we only really need the tiniest bit of extra stretch. Because once you put a nerve on more than 5% stretch, you're already dropping

its blood supply. By the time you get to 8% stretch, you've dropped it a lot. By the time you get to 12 to 14% stretch, then you really are damaging nothing anyway, so we don't need an awful lot of stretch. Are you okay, there, Jack?

Jack

Yeah,

Rob Patterson

It's not giving you any untoward discomfort?

Rob Patterson

And then stage three is then what we use for differentiation and to get more information. So we'll add further stretch. So can you please tilt your head to the right, trying to get your left ear to the left shoulder, so I don't prime the patient? Can you register how that feels a second, and then bring it back up? And then tilt to the left? And tell me how that feels. And then do that once again. And I want you to tell me what happens to that discomfort you're experiencing in your left on your right arm as you tilt to the right. So the right arm, do they stay the same, increase, decrease?

Jack

No, no, no. It increases.

Rob Patterson

Increases and on the left?

Jack

That decreases.

Rob Patterson

That decreases. Back you come and then go down the other way. And what happens in the right as you do that?

Jack

That increases.

Rob Patterson

And then on the left.

Jack

That decreases.

Rob Patterson

Thank you very much, okay, and ease it back down, because we'll be going on, that was a jolly good workout there.

Steven Bruce

I have a good clinic I can refer him to.

Rob Patterson

So if that was positive, so it could be positive at stage one, stage two or stage three, the more irritable the nerve, and very often the earlier it is in the course of the condition, the more likely you are to get a positive at stage one or two, the less irritable the nerve, then you're more likely to get something at stage three, and the literature they say that you will pick up about 80% of patients with this. By the time patients are into the late stage of the condition, then I think it's starting to get less positive anyway, either, because the vascularity of the nerve is already compromised and so it's harder to compromise the circulation within the nerve, or the nerves are stiffer and they're not moving and they're less yielding. And they're actually getting less irritable, the more they're becoming damaged. So very often, not every time of course, but very often, the more advanced the patient with NTOS, the less positive that test becomes. So with NTOS, it's all about tilting away in full stretch as a positive. Of course, if you get a tilt towards, and it increases the pain that muddies the water. So you know, you're actually putting less tension on there. And you're actually thinking, have you got to a cervical spine component, because you may have picked that up on your spurlings or on your other cervical tasks. So that's the modified limb tension test. Then we would do Wright hyper abduction maneuver. So Wright was a surgeon who realised that with abduction, the neurovascular bundle would be stretched and compromised under the coracoid. So he first started describing it as part of the variety of pec minor syndromes. So this one we do palpate radial pulse. So Jack's got a lovely, full, steady pulse. And then can you actively bring your arm up to the side with me? So you're palpating and can you tell me Jack, if you experience any of your familiar arm symptoms as we go up there?

Jack

Yes.

Rob Patterson

Okay. You mean, no?

Jack

Yeah.

Rob Patterson

Bring it back down again.

Steven Bruce

Perhaps we should explain it. As far as we're aware, Jack doesn't have Thoracic Outlet Syndrome. He's getting into character here.

Rob Patterson

Okay, so now, remember we're using this predominantly as a test for NTOS, but the drop in the volume of the arterial pulse is something of a surrogate marker, but it's not used as a diagnostic tool in and of itself for NTOS, it can just add to the evidence that makes you think that really probably is some

compromise to the neurovascular bundle, that adds to your level of suspicion that you have a condition. So a positive test there is the reproduction. And so often, patients will say, yeah, that's giving me my arm pain, and my hand is tingling. And sometimes, interestingly, they love an arc, where they get slightly less, then there's a pause, and then it all comes rushing back again, but a minimum of 20% but I think probably a lot more, drop their pulse at around 90 degrees, and they don't have arterial Thoracic Outlet Syndrome. It's just the way they're built. If I was suspecting arterial Thoracic Outlet Syndrome, rather than NTOS where the presentation is different, then that would be a positive sign. And we would look to support that with various types of imaging. So that's Wright hyper abduction maneuver. And then the last one is the elevated arm stress test that people will have perhaps in their training known as Roos test. So can you, I generally say pretend you're in a bank robbery, and hands up, palms facing forwards and bring your elbows back for me. Now, if we are suspecting a comorbid venous thoracic outlet, just remember the patient will have that top off. So you know we are looking for changes in colour, changes in the volume of the superficial veins. We're looking for Urschel's sign, which is the formation of veins across the chest and across the front of the shoulder and then I...

Steven Bruce

You'd be doing this from the front?

Rob Patterson

Well, because of my limited sight, I have...

Steven Bruce

Stupid question, Steven.

Rob Patterson

But it's a good question to ask because I was going to come to it. So I position the patient. And I very often check their pulses in this position as we start off, because so many people lose their pulse anyway, but invariably going to get some trouble. But my peer Ali joins me, and she can spot TOS at 100 yards by now. So she looks at the colour of the hands, the performance, the formation of veins. And I can talk about drop in position and fatigue and I communicate to the patient constantly. But Ali gives me the front view for the white hand sign, which is normally within seconds. And then you get a return to colour often between 30 seconds and one minute. And then very often you bring your hands back down, you get a hyperemia. But the white hand sign, sometimes associated with NTOS, you don't tend to get the white hand sign, which comes and goes with ATOS, because it goes white and stays white. So that's the white hand sign, so and then that will be carried on and timed accurately for three minutes. So make a fist and open and spread, and make a fist.

Steven Bruce

It is for three minutes?

Rob Patterson

And open and spread. And make a fist and open and spread, keep going.

Steven Bruce

We're going to make a cup of tea.

Rob Patterson

And I generally I'll be back in a minute. No, I don't. So that is done for up to three minutes unless the patient fails due to fatigue. Or says, actually, that pain is now going above six out of 10. And then in case they're irritable, and we already have a policy positive test. So a positive test then will be the accurate reproduction of the patient's familiar symptoms with and without colour, with or without changes in superficial vein formation. And it's timed. Pop your arms back down again, because it can become uncomfortable anyway in the normal population. And so the average time to the onset of familiar symptoms is about one minute, 45 seconds. So the articles that say that you do the Roos for one minute missed a large number of patients. So in most cases, it really needs that full three minutes to catch those that have the onset of symptoms later.

Steven Bruce

That's really useful because I suspect that many practitioners will be uncomfortable doing that test for such a protracted period of time. And to know that you're not going to catch them in under a minute and three quarters is very useful. Three minutes is a bloody long time to be sitting there, isn't it?

Rob Patterson

It really is, yes.

Steven Bruce

How uncomfortable was that for you, Jack?

Jack

Quite uncomfortable.

Rob Patterson

I leave that test till the very end of the examination. Because it can cloud everything that comes afterwards. I spend two to three hours with the patient. And so by the time they have finished that test, you know, they are more or less shot to pieces and exhausted, I will have an idea of their irritability. And so, you know, many of these patients won't be put through an aggressive examination. It'd be very delicate, but even those that are not irritable, and they say they have to lift weights for hours before they get the symptoms, it still gets tiring. By the time you've done a full multi system medical or physical neurological examination, poor things are exhausted.

Steven Bruce

Right. So we have two groups of people watching this. We have people watching through the website, and we've got people watching through Facebook. And I've just been told that the Vimeo team, the ones who are watching through the website, apparently all now got paraesthesia because they've been doing this for far too long.

Rob Patterson

That's only positive if that paresthesia is the symptom that troubles you and you want to get rid of.

Steven Bruce

And the Facebook team obviously I'm doing the job because they're not getting symptoms. I talked earlier on about Jack's occupation; he works in steel. And I think it started again, one group of these people, they get given silly names by the system. So Jolly Local. Thank you for the question. Jolly Local says, is there any particular job or professional sport where Thoracic Outlet Syndrome is more common? You mentioned bodybuilding.

Rob Patterson

Yeah. Anyone working with any heavy repetitive loads runs the risk. Those that work with their arms in elevation for any length of time, electricians who work on ceilings, painters and decorators.

Steven Bruce

Is that for shortening of the muscles or overdevelopment of the muscles as a result of that?

Rob Patterson

Yeah, both. So you do get adaptive change within the system. So shoulder girdle position changes, they spend a lot more time in the compressed position. But as far as we understand, the caliber of the thoracic outlet is compromised in elevation. And that's why elevation then tends to be the provocative factor for patients with all forms of TOS. You know, so anyone who spends time with their arms in elevation, but you will also get warehouse people, pickers, and those who are operating keyboards for hours and hours on end, I probably say I see more keyboard operators than those who work manually, to be honest.

Steven Bruce

It might just reflect the number of keyboard operators in the population.

Rob Patterson

Yeah, sorry. Yeah, exactly. But, you know, so that in itself is a risk factor. Variety is key.

Steven Bruce

Is there more you want to do with Jack?

Rob Patterson

I don't think so. No, I mean, they're the thoracic outlet stress tests. So if people want anything else in terms of the criteria when we go through it, and I'll be talking about criteria three, which is exclusion, if any of those stress tests for the latest ones for the cubital, the carpal tunnel, and such, like we can come back to those really if need be.

Steven Bruce

Okay. So, you talked about criteria there, exclusion criteria and so on. And that will be quite key to our audience's interest. What would you like to tell us about those?

Rob Patterson

So to help with research and communication, not in any means that it is the absolute final version of a diagnostic criteria, this team of surgeons and interested parties in the US got together and initially through a Delphi process, and then through advanced practitioner committee process, they put together four criteria for the diagnosis of NTOS. There are similar criteria for ATOS and VTOS. But they tend to be more relevant to surgeons than to us by and large, even though because of the nature of the position of my work, I see a fair amount of VTOS and a little bit of ATOS, that I don't use the criteria as regularly as I would do with a 95% of my patients, which is NTOS. So I spent most of my time dealing with NTOS in lectures and raising awareness of this criteria. And it's really so that we can all use the same language, perform the same tests and hopefully end up being able to say, this person has a high suspicion of NTOS, this person has a low suspicion of NTOS, this person is very unlikely to have and NTOS. So the criteria, can we have the criterion slide up? So criterion one, that refers to symptoms relating to the potential sites of compression. So we're really talking about symptoms in the region of the scalene triangle, or the sub coracoid space. So the patient, as the first part of criterion one, may describe local pain. So that's in the supraclavicular fossa, the upper anterior chest wall. And as part of that, the second part is the physical examination bit, which is tenderness over the scalenes, brachial plexus, coracoid or pec minor. So that's really, you know, inflammatory change at the site of compression. So, if a patient describes symptoms, and demonstrates tenderness that is accurate for their familiar experience, that gives a tick to criterion one. It might be interesting for people because I see so many patients with this just the sheer variety of presentations. So symptoms referred from this area so they can present with occipital pain, facial pain, paresthesia, cervical pain, anterior chest wall pain, patients will often say they'd been into A&E with a worry that they were having a cardiac event. And these things are amazingly common within this population. And if we were to see a patient with those symptoms alone, we couldn't make a diagnosis of neurogenic thoracic outlet syndrome because of course, we don't have any arm symptoms with just criterion one. But in the criterion that I put together, I sort of call, if we look backwards rather than forwards that would be pre-TOS in essence. So a criterion two refers to peripheral symptoms. So this is the experience and reproduction of neurogenic symptoms in the upper limb. So this may be pain, paresthesia, numbness, weakness, loss of coordination, even autonomic colour changes. So you know, you do get the white hand sign as I said which is not necessarily arterial involvement, but it's autonomic disturbance associated with NTOS. So criterion two, the patient will need to describe symptoms consistent with irritation or compression in the brachial plexus. So remember, we are now not looking at someone who looks like a carpal tunnel syndrome, or who looks like a cubital tunnel syndrome, with all the support of evidence for that, they will have been excluded before you come to this criteria. So we will have patients who have multi territory, multi-site pain, paresthesia, or numbness. And then with the performance of the stress tests, the four that we just looked at together, so to fulfill criterion two, some or all of the patient's symptoms will have been reproduced on one or all of those cluster of tests. So that's criterion two. If we have a positive criterion one and criterion two, we don't have a confirmed diagnosis. But we do have a high level of suspicion that we may be looking at neurogenic Thoracic Outlet Syndrome. So then we've got criterion three. And this is to demonstrate the absence of a competing diagnosis. So as your viewers will know, there's multiple causes for cervical brachial symptoms. So we've got the whole host of cervicogenic causes, we've got all the muscular skeletal problems around the shoulder girdle, the chest wall, the glena humeral, and then we've got the elbow, the wrist and the hand. And they can be just straightforward musculoskeletal problems that all need to be excluded. Then we've got the nerve entrapment sites. So your classic common ones are the cubital tunnel and the carpal tunnel. So one

needs to be able to confidently demonstrate the absence of those, then we've got, so less common than the more generalised presentations like fibromyalgia. So when you look at the patient's body chart, say on the cervical brachial symptom questionnaire or on any other body chart that the clinician wishes to use, so, a patient will tend to have multi body part discomfort and a variety of other suspicious presentations that make you think this may just not be limited to the limb. So fibromyalgia needs to be excluded, CRPS, so complex regional pain syndrome can present with or as a competing diagnosis for NTOS. And then you'll get a variety of other much less common problems.

Steven Bruce

You said there, I mean, they're competing diagnosis CRPS, or fibromyalgia, the symptoms are not presumably going to be reproduced by the tests that you just did.

Rob Patterson

Unfortunately, they sometimes are, but you just don't get the whole picture. So you know, the picture will be wider, or it will be sufficiently different for you to think, hang about, this patient has actually got symptoms in their arm, their back their leg, and they're not sleeping, you know, they're low mood and there's a variety of other things that would make you think, hang about, there's more to this, because it doesn't mean that they can't have fibromyalgia and neurogenic Thoracic Outlet Syndrome.

Steven Bruce

No, of course.

Rob Patterson

That is unfortunately the case. And then the less common ones are brachial neuritis. Sadly, I've seen a number of extra brachial neuritis patients recently with COVID and with vaccination, and then you'll get post-surgical inflammatory neuropathies, you will get post trauma inflammatory neuropathies, you'll get stingers. You will get rucksack palsies.

Steven Bruce

I don't know if you need to explain what stingers are for some of the audience. Anyone who watches rugby will know.

Rob Patterson

Yeah, so a stinger is when someone's shoulder and head will be forced apart, normally by attack, classically it's rugby, so that you get a forced stretch to the brachial plexus, which temporarily disrupts its normal conductive qualities. So your average Stinger will give you a numb or a useless arm for a short while. And it's a naturally spontaneously resolving phenomenon, but sometimes they last longer. So of course, this isn't NTOS. This can be direct trauma to the brachial plexus, which is not NTOS. So as the stinger the same with the rucksack palsies. I mean interestingly, I think the only rucksack palsies I've seen have been in the military.

Steven Bruce

Many people stupid enough to carry such heavy weight.

Rob Patterson

Super heavy rucksacks, you know, and even to the point that they can no longer feel an arm and it's useless and they keep on going, you know.

Steven Bruce

Always useful to get to the target and not be able to use your arms.

Rob Patterson

They just didn't come back up to us. But most of the time, even with the rucksack palsies, you know, they are a spontaneously resolving phenomena, because they're compression overstretch phenomena.

Steven Bruce

Over what time would they spontaneously resolve?

Rob Patterson

Most will be hours, some will be days, those that last days into weeks, like the few have seen from Sandhurst, and they've gone on. And then when we've investigated them, we found that they've actually had predisposing factors that may have stayed silent for life, but their tissues have been tipped over the biological tipping point by the extra stress. So there's been, you know, the genetic and the acquired factors conspiring to express the symptoms. So they're the rucksack palsies that may present as an isolated non Thoracic Outlet event, or actually could turn into neurogenic Thoracic Outlet Syndrome. And then you'll get your tumors primary and secondary into the area with the older patient, of course, who comes in with chronic respiratory disease, long term smoker, and they say, well, I've got terrible pain in my chest, in my supraclavicular fossa, my arm is going dead. And we're more thinking of an apical tumor first pressing on the plexus rather than neurogenic Thoracic Outlet Syndrome. So that's, you know, that's a secondary and you can get primary nerve tumors as well. And then there are genetic factors where you will get the hereditary brachial neuropathies, the relapsing, remitting, or the progressive breaking neuropathies, but again, not to be confused with the compression disorder, which is neurogenic Thoracic Outlet Syndrome.

Steven Bruce

You're not making this simple for anybody. So there's a lot to think about.

Rob Patterson

They're not common, that's all in criterion three, but it's just that they are out there. And, you know, sometimes, you know, we as clinicians, you sort of think this doesn't smell right, it doesn't sound right. It's not behaving mechanically, it's sort of predominantly inflammatory. There's too much progressive neurological deficit for my liking. So you do see them sticking out, rather than your young athlete, who's saying I've got cervical brachial pain, and it came on after this event and such like, so, you know, they do tend to stand out. And I don't see an awful lot of those missed pathologies to be honest, there very few coming through. So hopefully criterion three then, that we have spent some time through a rather lengthy history and analysis of pre completed questionnaires and the patient's medical notes to demonstrate the absence of any competing diagnosis. So we have to be confident that there's nothing that can compete with us for the diagnosis. Not to say that there's not many comorbidities, because a number of patients

will have double crush syndromes, or other comorbidities for instance, there's no harm in recognising that somebody actually does have cubital tunnel syndrome and neurogenic Thoracic Outlet Syndrome. I had a young musician from Glasgow recently, and he had bilateral NTOS and bilateral cubital tunnel syndrome. Now, of course, the easiest and safest target is to go for the ulnar nerve first. So he was past the point of conservative care for his cubital tunnel syndrome, he was developing neurological abnormalities, and he was having problems coordinating his fingers. So I arranged for him to see an upper limb surgeon who decompressed and transposed his ulnar nerve. And then within four to six months, that did settle down really nicely. And as it happened, we had to do nothing about his neurogenic brachial plexus irritation. So you sometimes go for the easier target when you've got comorbidities. And it's certainly much, much easier to get surgery for a peripheral problem than for a central problem like, like TOS. So that's criterion three. Now, if you have positive results to criterion one, two and three, you can make as confident as you're able to at that moment, a provisional diagnosis of neurogenic Thoracic Outlet Syndrome, or, if all the signposts are towards the pec minor space, neurogenic pec minor syndrome or a combination of those. So if you're uncertain, and you're still left with a low level of confidence, or if you're thinking, do you know, this person is failing conservative care, I really need to augment this with something more. And in our unit, we augmented with a botox enhanced rehabilitation program, then we need to think, what's the anatomy like around the plexus? And is it likely to respond to further conservative care or surgical care? And if we're prepping someone for surgery, can we have a dry rehearsal for what this is going to look like if you take the scalenes and the pec minor off, you know, what's it going to look like? What's the outcome going to be? So that's when the neurologist will do a detailed inspection of the anatomy around the brachial plexus, do the measurements, put the scalene triangle measurements, any comment about any inter neural edema, and then the patient will be asked to perform the elevated Arm Stress test in the ultrasound room, record the symptoms and symptom intensity, then under ultrasound guidance, the anterior and the middle scalene will be injected with lidocaine and bupivacaine. So after a moment or two, the Lidocaine will take effect, the bupivacaine has a slower but longer action, which is useful for the patient to repeat the test at home, which is why we mix the anesthetics. So the patient will then do the elevated Arm Stress test again. And low and behold, for those that have contracted, scarred, and releasable scalenes, they will feel an awful lot better. And some of my patients will say that that's the first relief that they've had for many years from their arm symptoms. As they do that elevated Arm Stress Test, they started off, and they were collapsing after 30 seconds. And they're saying after two and a half minutes, they're still going strong, you know.

Steven Bruce

So your four criteria, local symptoms, peripheral symptoms, absence of a competing diagnosis and that last one is the scalene blocks.

Rob Patterson

The scaling blocks and then you follow it by a pec minor block. So and then you do the elevated Arm Stress test for a third and final time. After the pec minor block, the patient repeats the elevated Arm Stress test three times a day, for the subsequent two days, completes a diary. I then compiled the evidence from the radiologist who gives me the scores and the initial results and the patient's scores and delayed results. And if that patient reliably reports a greater than a 50% reduction of their familiar pain, that's a positive test. So that fulfills criterion four. So if we've got 1,2,3, and four, we have the most confidence we can possibly have, that one, we have the right diagnosis, and two, that that person is likely to respond to

surgery. Remember, if we're only within the conservative care realm, we wouldn't be doing that anyway. We don't need to test that to provide conservative care.

Steven Bruce

Can I run some questions, perhaps, we're very close to the end of our time, I'm afraid Rob.

Rob Patterson

That was quick.

Steven Bruce

Yeah, it does go past quite quickly, doesn't it? Carrie says, is there any evidence for the value of manual therapy for Thoracic Outlet Syndrome. Now I guess let's talk about neurogenic rather than the other two.

Rob Patterson

Yeah, precious little with the other two. Unfortunately, no gold standard evidence. But anecdotal report, yes, definitely. Do some of my colleagues provide manual therapy, soft tissue technique within our clinic for those who are attending with us very close? Yes, definitely. And it's probably more within the realm of whichever technique a practitioner favours and finds reliable for releasing, relaxing and lengthening the scalenes, likewise with pec minor. But in truth the manual therapy is really an adjuvant to active rehabilitation, which would be addressing scapular dyskinesia, scapular posture, drooping, protruded shoulders, sloppy postures and such like, so it never stands alone. It would always be to augment what's happening actively.

Steven Bruce

There's a follow up from Carrie. I presume it's the same Carrie. Carrie says, with that in mind, is ergonomic positioning or ergonomic analysis of one's desk workspace or whatever else, is that likely to make a significant difference?

Rob Patterson

Definitely. Yes. Yeah, very much so. When you think that you can put a nerve on tension, up to 5% tension, then after that it starts to drop its blood supply. So if someone is slouching, and they've got their arms in a tensed position, so that their muscles are constantly contracted, and what we haven't touched on is respiratory patterns and other factors, how people are maybe overusing their scalenes or overusing their pec minor, then that compromise within that poor ergonomic position very quickly starves that plexus of its oxygen, and makes it more likely to go on to form fibrosis and develop symptoms. So to have someone within a relaxed, excellent posture is an essential and you know, for every patient, part of the management.

Steven Bruce

Pierre and Sharon have asked about alterations to structure. Pierre says he thought a key element of NTOS was also the wasting of flexor pollicis brevis in conjunction with the subjective elements that we were talking about earlier.

Rob Patterson

Yeah, if a flexor pollicis brevis has started to waste, then you know that you have sufficient damage to that brachial plexus, so that you almost certainly have moved from inflammatory fibrosis through demyelination into axon loss. So on the continuum, which can be popped up, which if it's useful to anyone, you're into late stage, which by the time you've got neurological deficit to that degree, then you really are thinking of surgical decompression, because there's precious little chance that anything conservative can be done for that patient. So any form of intrinsic hand wasting on that patient is already way down the line and in trouble.

Steven Bruce

And the audience are seeing the continuum slide at the moment, which if you're happy, we'll share the slides with them after the show.

Rob Patterson

Yeah, sure. Sorry. There's a lot more to that, but that's a snapshot.

Steven Bruce

Um, yeah. Somebody called RW says, how long is a short time for stingers?

Rob Patterson

In terms of a short time, well, if somebody is still complaining of symptoms following a stinger mechanism injury after four weeks, then it's, you've got to be begging the question, have they actually sustained structural damage to that brachial plexus? Or do they have any pre existing issues that that Stinger may be acting upon? So if you're over four weeks and drifting into six, and you've got neurological problems, then I'm beginning to think of arranging nerve conduction studies, an EMG.

Steven Bruce

Alright, we're very close to the end of the show, I'm afraid but I'm going to fire a couple of quick questions at you. Sharon says, can chronic NTOS lead to tendon contraction in the biceps or trigger finger?

Rob Patterson

Yes, yes, definitely, particularly within biceps, and I have a few patients who present with that, because as they extend the arm, it's so painful, they maintain the arm in alternative position. And some people will literally stay like that, putting the plexus in its shortest least tension position.

Steven Bruce

So it's indirectly due to the NTOS. One interesting question from Wallace. Wallace says, can the tests that you demonstrated be adapted to be done supine?

Rob Patterson

No.

Steven Bruce

Excellent. There's a good answer for you. Jolly Local, again, has asked if there's any relationship between NTOS or any of the thoracic outlet syndromes and torticollis.

Rob Patterson

No.

Steven Bruce

Excellent. And your final question for today, Vlad sent this question in ages ago. Regarding jobs, what did you mean when you said earlier on that productive males were vulnerable?

Rob Patterson

Within the productive age group, in terms of they're not too young to work, they're not too old to work. So they're within that busy, busy, productive stage of their life. So you know, particularly those that are working with their hands, basically. So loose description of a hard worker, productive.

Steven Bruce

Thank you. Carrie, I've just had a question from you. But I don't really have time to ask that one. I will put it to Rob after the show and I'll feed the answers out to everybody in an email subsequently. We've had 590 people watching this evening, which is quite a sizable audience for an evening show. And I said thoracic outlet syndrome was going to be interesting before we came on air, which is fantastic, but we, I suspect, are only a fraction of the way through what you could tell us, so assume I'm going to make a prediction here that we're going to have lots of people saying this has been brilliant and will you come back again, so I will put that to you over a beer after the show.

Rob Patterson

Yeah, gladly. Gladly. You know, I really enjoyed.

Steven Bruce

It's been fantastic. And one thing I did promise everybody was we're going to talk about the specific communication problems of dealing with someone who is visually impaired. And we just don't have time to do it, which is a shame, because actually, you could give us a really good insight into that. Rob, I'll shake your hand again, your hand again because we're out of time. But thank you so much for traveling all the way up here from Bristol.

Rob Patterson

My pleasure.

Steven Bruce

I look forward to doing it again in the near future. Thanks.