

**JONATHAN T.** Chronic exertional compartment syndrome is a really interesting problem. It affects males and females equally.

**FINNOFF, D.O.:** And it's usually around the 20-year-old age group. But certainly it happens in teens, and it can happen to people over 40 years of age.

And essentially, with chronic exertional compartment syndrome, as you're exercising and your muscles swells, it starts to increase the pressure inside of the muscle, and it can cause a severe pain. And if it presses hard enough, it actually starts to squeeze the nerves inside of that compartment. And so people can sometimes get numbness and tingling and even foot drops or weakness associated with it.

The most common compartment to be affected is the anterior compartment. And the second most common, it depends on which literature you read, but it can either be the deep posterior or lateral. And then more rare is the superficial posture compartment. And it's very common that there's more than one compartment involved in this. And it's very commonly bilateral.

So people will come in, and they'll say, the front of my leg is killing me when I run. The most common activity that aggravates it is running. So it can be field sports or track and field athletes. It's also pretty common in our military personnel because of marching.

So people with chronic exertional compartment syndrome usually complain of pain and pressure in their leg. And it can be circumferential because all the compartments can be involved. But usually it's isolated to the compartment that is involved.

And so they'll have no pain at rest. And as they exercise, at a certain point or a certain intensity, they start having this pressure and pain. And it builds and builds and builds to the point where they cannot continue with that activity. They have to stop. And again, they can have neurologic symptoms when it gets up to that severity. But then they stop and they rest, and it goes away.

So when they come in and see you in the office, you do a physical examination, and it's normal. They don't hurt anywhere. They can point to where they have this horrible problem that stops them from running. But they have, essentially, a normal physical examination.

Now, as far as diagnosing chronic exertional compartment syndrome, one of the unique things at Mayo Clinic is we have an in-MRI exercise protocol, where we can do a scan of somebody's legs and then have them exercise in the MRI using a special plexiglass, non-ferromagnetic apparatus. And then we look at the swelling inside of their compartments immediately after exercise. And so from a non-invasive means, we can diagnose chronic exertional compartment syndrome.

But the traditional way of doing this is by using a compartment pressure monitor, which involves a very large needle being poked into the various compartments and measuring the compartment pressure at rest and then at one in five minutes after exercise. So it requires somebody who knows how to use a compartment pressure monitor and the right equipment to do it. It's not that hard of a test, but it is an uncomfortable test. So it's awfully nice to be able to offer people the non-invasive test with an MRI.

Treatment for chronic exertional compartment syndrome can be surgical or non-surgical. Traditionally, it's surgical, and I'll go into that in a second. But more recently, there have been some papers that have talked about a variety of non-surgical treatments. The most common one, and the least invasive, is altering running patterns.

So remember I said that the most commonly affected compartment is the anterior compartment? Well, if you're running and you're a heel striker, as your heel strikes, you have to slowly lower your foot to the ground. And that's an eccentric load or an eccentric contraction on those anterior compartment muscles. So that causes a lot of stress in that area, a lot of blood flow, and contributes to chronic exertional compartment syndrome. So through gait retraining, you can change somebody from a heel striker to more of a mid to forefoot striker so that when they land, they don't load that anterior compartment, and that actually has been quite successful.

Another non-surgical treatment, but one that does have some invasive nature to it, is doing botulinum toxin injections. So essentially, if the cause of chronic exertional compartment syndrome is this muscular contraction and the vasodilation in the muscle, and all that need for the metabolic demand inside of the muscle with the energy requirements, if you reduce the amount of muscle contracting, then you just don't have as much bloodflow to that area. Plus, if you do a botulinum toxin injection, you'll get some atrophy. So it just debulks the compartment as well. So through the combination of decreased metabolic demands, you have less swelling and decreased bulk of the musculature, it reduces pain and symptoms from chronic exertional compartment syndrome.

So I have talked to you about how you can treat it with altered gait patterns, with different running, and the Botox. And then the most standard treatment is a fasciotomy. So with a fasciotomy, which is a standard surgical procedure, they essentially cut through the skin, the subcutaneous tissue, and the fascia along the entire course of that compartment so that it opens up that compartment and gives it more room to expand. And so essentially, you're not squeezing the musculature and nerve vascular structures in that compartment. The nice thing about that is that it's been used for a long time, and so we have a fair amount of data on that.

The bad part is that it's not a great surgery for a number of reasons. Number one, the success rate is actually not as high as one would expect. And it does vary based on the compartment. So the anterior compartment, which is the most common compartment, has relatively high success rate. It's usually in the 90s. But if you start getting into the deep posterior compartment, the actual success rate drops down into the 50s or 60s. So it's not nearly as successful.

The other thing is, is with that large incision, you certainly have the potential for complications. And the reported complication rate for fasciotomy is at 16%. That's significant. And those complications include, bleeding, infection, cutting a nerve vascular structure, wound dehiscence, fluid accumulation in that area, so a seroma. So a lot of different things can happen.

The other problem with the surgery is that the recovery takes time. Really, it takes somebody probably two to three months to get back to normal running activities. And that's a long time, particularly when you're talking to an athlete who has a season that's two to three months long. Suddenly, you're doing a treatment that takes him out of the rest of the season. They're not going to come back. Even if they did it right before the season, they've lost their entire season. And that's a big deal.

So moving more into the bridge between a standard surgery and a less invasive surgery, we've developed a new technique at Mayo Clinic where we do a very small 3 millimeter incision at the proximal aspect of the compartment. And we slide a thing called a meniscotome, a V-shaped meniscotome, through the skin. And then we cut the fascia under ultrasound guidance.

And this V-shaped meniscotome is almost like a long shish kebab skewer, and at the end, it has this little V-shaped thing. And so when you get it down through the skin, and then you get to the cutting tip on one side of the fascia and the other side of the fascia so it bridges it, almost like scissors and wrapping paper. And then you just slide it down, and it cuts right through that fascia.

We do it in the office with local anesthetics, so there's no fee for being in the operating room. They don't have to have general anesthesia associated with it. And since they only have a 3 millimeter incision, the chances of wound dehiscence and infection and bleeding and so on is much lower. And with all of that, they have a much faster recovery because you have way less tissue trauma.

So in-- our belief is that this is going to get people back to sport more rapidly and with less potential complications. And it will also be far less expensive for the medical system. And so we're really excited about this procedure.

We developed this and really honed this technique or perfected the technique in a cadaveric model. And we published a nice study on that, demonstrating that we could, indeed, cut the fascia. And I've recently submitted and had accepted a publication on a case report, just to get that out in the literature so people know that we're doing research on this. But we have over 50 cases that we're collecting data on right now. And after we look at the safety of this procedure, we're going to do a case control study where we compare our results of these 50 with 50 standard fasciotomies.

So in conclusion, regarding this procedure and chronic exertional compartment syndrome as a whole, I think this is an exciting area of new, minimally invasive, and even non-invasive treatment options that just hadn't been available to us before. And at Mayo Clinic, what I think is wonderful is we have the whole spectrum of physicians that can help evaluate and make the right diagnosis, because there are a lot of things that mimic chronic exertional compartment syndrome. And one of the most common reasons that somebody has a failed treatment is because they didn't have the right diagnosis. So by doing a team approach and looking for vascular, neurologic, and this chronic exertion of compartment syndrome diagnoses for their leg pain, we can make sure we've got the right diagnosis and then implement one of these new unique techniques.

And in the future, I really think that number one, we need to start validating this technique in other compartments. And number two, we need to start expanding some of our ultrasound-guided surgical techniques to other disorders. We are currently studying the release of adductors for people with chronic adductor tendinopathy, release of the IT band for IT band syndrome, de Quervain's tenosynovitis, trigger fingers. We just have all of these different diagnoses that we could do these new amazing, minimally invasive procedures that people essentially return to activity in a rapid fashion. And they're all done in the office-based setting.

We're really excited about the future of ultrasound-guided surgeries here at Mayo Clinic. And I hope that you found this very interesting.