

**ZACHARY**

Yeah, I don't have any disclosures related to this talk. And the goal here is really to understand the difference

**GORDON:**

between cervical radiculopathy and cervical myelopathy and then differentiate when initial conservative treatment is appropriate versus early referral for surgical evaluation. And each one of these topics is an hour or two lecture in and of its own, and the treatment for each one can be several more hours.

But in a nutshell, cervical radiculopathy is a compressed nerve root and the signs and symptoms related to the nerve root itself. Cervical myelopathy is a spinal cord dysfunction. It's pressure on the spinal cord with dysfunction of the cord and all the subsequent symptoms that we'll talk about. And remember these two are not mutually exclusive. It's very rare to see somebody who is purely myelopathic, who has no radicular symptoms. On the other hand, most people with cervical radiculopathy don't have spinal cord compression. But it's really important to evaluate these people and determine whether or not there are myelopathic features.

So just as Nick was talking about having pain in the leg being referred from a pinched nerve in the lower back, the same thing is true of cervical radiculopathy. It's pain that radiates into the neck, into the arm, and it usually follows a dermatomal distribution. This is due to pressure on the nerve and each nerve being responsible for certain motor and sensory functions. And that occurs in a fairly typical pattern, but like anything else, it doesn't always present that way.

You can have motor, sensory, reflex abnormalities in the distribution of the nerve. You can also have it in the distribution of a neighboring nerve, or what we think of as a neighboring nerve, because not everybody has a perfect brachial plexus. Not everybody has the same neural anatomy, but we think, for the most part, most of us are the same.

So this is an illustrative slide of the typical nerve root distributions. It can help you diagnose where the problem might be. It can help you correlate whether or not a disk herniation or some foraminal stenosis, narrowing or pinching of a nerve, is actually the nerve that's symptomatic. So if you're close, you know, the same or one nerve root off, you could have high confidence that this is the disk that's creating a problem. But if somebody has pressure, let's say on their C4 nerve root based on their MRI, but they only have a little bit of tingling in their ring finger and their small finger, you might want to consider this might not be a neck problem to begin with.

But the basic pathology, the basic anatomic problem here is that there is a compressed nerve root. And this is coming from either a herniated disk, it's coming from bone spurs, typically arising from the uncovertebral joints or the corners.

There's no pointer around on, I don't think, is there? No.

So the corners here that are circled on the slide on the right, where we see a lot of the ridging here, that can compress the nerve in the foramen. You can also get stenosis just from loss of disk height. We see some people that have very collapsed disk. And if you think about the space for the nerve-- looking at the picture on the left here-- as a function of not just front to back width, but also top to bottom width, if that disk is completely collapsed, the home for the nerve, the hole, is compressed top to bottom. And we see some narrowing and symptomatic stenosis from that as well.

You can have narrowing in the foramen, and the nerve is leaving the spine. You can also have pressure on the nerve right as it's leaving from the spinal cord. The picture on the right here, this is almost pathognomonic for a cervical herniated disk. If you come in the room, or you meet your patient for the first time, and they're sitting with their hand over their head like this, you can almost be guaranteed they have a cervical disk herniation. It helps take some pressure off of the nerve by alleviating the weight of the arm.

Again, history is important. These are usually not traumatic episodes. Most people just wake up one day, and their arm hurts a little bit. It's a little tingly, and then it kind of slowly progresses from there. Again, not always dermatomal. And beware of the patient that says, my shoulder hurts. They come in. They go, you know, my shoulder is killing me. And they grab their trapezius muscle. This is almost always their neck. And when they grab their upper arm and say, my arm hurts, this is more likely to be shoulder, but again can still be coming from the neck.

Sometimes we don't see people with any arm pain at all. They can have cervical radiculopathy and just have a lot of periscapular pain referred between their shoulder blades. And if you go back and think about that first picture, some of the lower nerve roots and even the C4 nerve root kind of coalesce and overlap around the scapula.

So this is an exhaustive chart. I think the slides are going to be distributed at some point, but I'm happy to give this to anybody. Kind of going through the entire cervical anatomy and where we typically see things.

Now C5-6 and C6-7 by far are the two most common levels that we see involved here. And that would be compression of the C6 and C7 nerve roots, respectively. So a lot of times people are complaining of numbness, tingling in their thumb and index finger, along with pain going into the forearm. We can pretty much guess where the problem's going to be. Same thing if they have weakness in their triceps muscle. Some people are athletic and might do push-ups. They can start to notice that, my arm is feeling kind of weak when I try to do my normal exercise. These are two very common complaints that we see.

In terms of special tests on a clinical exam, we always talk about the Spurling sign. And what we're trying to do here is recreate the pressure on the nerve, or worsen that stenosis. So just like in the lower back, when patients bend forward alleviates pressure on their nerve. The same is relatively true in the neck if you have the person extend their neck and look towards the side that's painful. Traditionally, this was done with axial compression of the head as well, but you don't even need to do that. If they look up and towards the side of pain, that creates focal narrowing of the neural foramen on that side. And we're hoping that recreates their typical daily pain. And that's a very sensitive tests for picking up cervical stenosis.

So plain x-rays are kind of the workhorse of any orthopedic condition, any musculoskeletal condition. Even though it's the least sophisticated picture, we get a lot of information from it. We can see what's going on with that patient's neck in real time, with gravity.

Always upright x-rays are going to be the most helpful. You never want to get supine x-rays unless you're looking for someone who has just sustained a traumatic injury. But, in general, upright x-rays can tell you alignment. You can see the normal cervical lordosis. You can see if there's any instability or spondylolysis. You can detect if there's any deformities.

Looking at oblique x-rays can be helpful. Oblique x-rays they'll give you on the right and left side will show the neural foramen on profile. And you can see, sometimes there's a lot of foraminal narrowing you can pick up just on the x-ray alone.

Flexion-extension x-rays can also be very helpful if you're not sure if there's some underlying instability. Patients with rheumatoid arthritis and other autoimmune conditions can develop instability below C2 and their cervical spine. If you just get a static picture, you might only be getting a part of that information. So having them bend and extend can show you that there's instability there.

In terms of neural imaging, MRI as is the gold standard test here. We pretty much go right to the T2-weighted sagittal images, so we're looking at the patient from the side, as we would on a lateral x-ray. The spinal fluid is going to be your white signal in the tube, and the black ribbon is going to be your spinal cord. And you could see abnormalities, such as disk herniations. You can see the height of the disk. You can see if there's an abnormality with the spinal cord itself.

And for patients who can't have an MRI, but we want to know what's going on with their nerves, we can get a CT myelogram. Again, these are invasive tests, so we don't like to go to this first. This is an injection of dye into the spinal fluid and then a CT scan afterwards. But we get a similar looking picture.

People who can't have MRIs are people with pacemakers, people that have other types of implants, such as spinal cord stimulators, bladder stimulators, things of that nature. Some of the newer models are actually MRI compatible, but it's hard to convince our radiologists of that. Anybody who has leads or metal near vital structures, no matter how safe the manufacturer says it is, our radiology colleagues don't like to run them through an MRI.

But typical imaging, top left corner here, is going to be a normal axial section. So again, we're looking at a T2-weighted image, and we're trying to see how much space is available for the nerves. Again, I wish I had a pointer here. But off in the corners, you can see the disk in the front, which is at the top of the screen, and then the facet joints, or the two structures on either side. And that white signal kind of symmetrically goes out beyond the uncovertebral joints and into the foramen. That's what a normal foramen looks like.

The top right is a picture of a herniated disk that's compressing the spinal cord a little bit. But, more commonly, we'll see radicular symptoms with that. That's the nerve being compressed at its takeoff, on the left side of the screen, or the patient's right. And then the bottom is a section of the same patient through the same disk with bony stenosis. This is an uncovertebral osteophyte. And you can see this kind of lobed pattern off to the left side of the image, or patient's right side. And then the myelogram on the right showing that that's actually a bone spur.

So the natural history of these things is generally favorable. Long-term follow up studies show that the majority of the people, about half, do get symptomatic relief. They have one single episode, and it never comes back. And only about one out of four people will get worse. So generally speaking, these are quality of life problems. We tell people live with it as long as you can in the absence of weakness. And if you can't live with it, if nothing else works, we can typically help you surgically.

The problem with conservative treatment is there's really no good comparative studies on anything. So we don't know if this is natural history or if this is the treatment effect. So immobilization, if you take a good look at the literature, no effect on treatment. Traction, either home or with the aid of physical therapy, sure, it makes people feel better when they're having traction. But at the end of the day, doesn't have an effect. Physical therapy works great for neck pain. But in terms of radicular symptoms, when you really do a rigorous review, there's not any data to support it.

Medication-wise, anti-inflammatories have been shown to be helpful. The rest of the medications we use anecdotally have good evidence, in small series have some good evidence. They don't really make any long-term effects.

So we're trying to move people from the, ow, this really hurts badly into the 30% of people who kind of have mild residual symptoms. Manipulation, in terms of osteopathic and chiropractic adjustments, really no efficacy established. It's hard to do a sham manipulation to really do a good study. Keep in mind, about five to 10 complications per 10 million manipulations. And these can be serious life-threatening conditions. Vertebral artery dissections, strokes, and even death has been reported. So there's no evidence to support it, and there's a potentially rare, but serious complication. I usually advise against that.

Steroid injections, again, short-term help. There's no placebo-controlled studies, so we don't really know the true efficacy. Selective nerve root blocks can be helpful in terms of diagnosis. They might be more helpful for long-term treatment. But when all else fails, surgery can be helpful.

And we can talk about anterior versus posterior approaches, but at the end of the day, you've got to get the pressure off of the nerve. Cervical discectomy and fusion is really the mainstay of treatment here. Very high success rates, little bit higher success rate in the cervical spine than in the lumbar spine. It's best for one or two level disease, just because of the rates of fusions healing.

But aside from fusion problems, pseudarthrosis, or nonunion of the fusion, a lot of the morbidity of these procedures is related to getting to the spine through the front of the neck. So trouble swallowing, trouble speaking. Fortunately these are very temporary, but sometimes they can really last for a long time.

Cervical disk arthroplasty, or disk replacement, is a newer technique and it's thought that if we preserve motion at the segment, we can limit disease at the disk above and below the fusion. The outcomes are really equivalent to cervical discectomy and fusion. One or two level diseases is indicated and FDA approved. There might be an earlier return to work, just because you tend to immobilize these people a lot shorter after surgery. But we don't know a lot about the long-term wear.

So this is a young patient, bus driver. It's actually a worker's compensation patient of mine. Not the ideal candidate for surgery, but she's got miserable neck pain that's going into her left arm. And she has a soft disk herniation. And we did a disk replacement on her, and she went back to work at two and a half weeks, driving a bus. No collar and no pain medication. So they can be helpful in the right patient.

Posterior decompressions. The benefit here is that you avoid destabilizing the spine, so you don't have to do a fusion. The downside is you're not really getting rid of the problem in the first place. You're just trying to create a little more space for the nerve. If you allow the disk to move, you can still grow bone spurs. You can still have recurrent disk herniations. So it might be easier to get the patient out of pain. Younger people with multiple levels, this might be a good idea to try to buy them time. This is what Peyton Manning had, two surgeries before his ultimate fusion. It kept him going for a few more years playing football. But ultimately, the problem keeps returning and he developed recurrent symptoms.

So cervical myelopathy. Again, this is compression of the spinal cord. It's really the most common cause of spinal cord impairment in adults. It's really overlooked. It's a wide range of symptoms, gait instability, diminished sensation, hand dexterity problems. You can lose sensory function. You can become weak. You can have trouble getting around day to day. You can have bowel and bladder dysfunction. And anybody who has any other comorbidity, these symptoms are ultimately blamed on that problem first, before anybody bothers to look at their neck.

So I always tell people, beware of anyone who has carpal tunnel syndrome in both hands. Is that impossible to have? No, certainly not. But bilateral carpal tunnel syndrome, to a spinal surgeon or to a spine provider, is cervical myelopathy until proven otherwise. Anybody who's had carpal tunnel surgery that failed, it didn't get any better at all, should also think about their neck. Because it's very rare to have a failed carpal tunnel surgery if the diagnosis was in fact carpal tunnel syndrome.

So clinical history is the most important thing. You've got to really talk to these people and figure out what it is that's bothering them. They tend to have very prominent balance disruption. So neck pain, arm pain, all of the attendant symptoms can be cervical spine issues, but sometimes people just say my balance is off. They started using a walker or a cane. There's no really good reason for them to have done so. They could have fine motor disruption, trouble writing, doing buttons on their shirt, picking up change. Bowel and bladder dysfunction is rare, usually late stages, but sometimes people present with that as well.

And Tim Moore over at Metro taught me 10 years ago about Velcro shoes. He said, there's only two kinds of people that wear Velcro shoes, little kids and people with myelopathy. So if you see an adult in the office and they're wearing-- once he pointed it out, it's true. These people with bad myelopathy, they're wearing sweatpants and a t-shirt and Velcro shoes because they don't have the dexterity to do buttons, to snap together their jeans, to tie their shoes. So this is not an uncommon finding.

Remember gait, gait, gait on physical exam. Have the people walk heel to toe. Oftentimes, that's the first problem that you see when people have symptomatic cervical spinal cord compression. You tell them, walk heel to toe for me, like you're on a tightrope. They go, oh, no problem. We can do that. And then they stumble and fall over, and they're surprised more often than you are.

You can watch their gait to see if they have a broad-based ataxic gait. And remember that lumbar stenosis does not mean balance trouble. Lumbar disease can cause pain, numbness, tingling. It can make you want to sit down, but it typically does not affect balance. So it's not uncommon that people will have lumbar spine surgery, not get better, and then it turns out the problem was in their neck the whole time.

Late stages can be this myelopathy hand, where there's intrinsic muscle wasting. You could have finger escape of the other digits, where they kind of abduct, because you lose that intrinsic tone. So if you see somebody with this, you ought to be thinking about imaging their neck.

Hyperreflexia can be prominent on physical exam. Upper motor neuron findings, so things consistent of a compressed spinal cord. You can have clonus at the ankles, Babinski sign, which would be stroking the plantar aspect of the foot and the toes go up and fan out. You can check a Hoffman sign, which is in the bottom left here. If you flick the tip of the middle finger, you'll see the hand grasp. That's an abnormal reflex. And then this Lhermitte's sign, which is more of a historical thing, but you can check for in the office. If the patients are looking down, or they tell you, you know, every time I read a book, or I read my morning paper, my arms go numb and I have this shock of lightning that goes down my arms. That's all consistent with cord compression.

With imaging, we usually see congenital stenosis. So the tube is small to begin with, and then they just have normal aging of the spine. The problem is there's not enough space to accommodate all this extra junk, and so the spinal cord begins getting compressed. You can sometimes see a signal change in the spinal cord itself, which can correlate with just swelling, but in late stages, if it's permanent damage, we call it myelomalacia.

You have to be careful. There can be ossification of the posterior longitudinal ligament, which is a structure that runs down the back of the vertebral bodies. And this can become ossified, or turn into bone. This alters our surgical approach.

This is a recent patient in the office who came in. Another surgeon offered him cervical discectomy and fusion. And I said, we need to check a CT scan on you. Because, sure enough, he has an ossified ligament. And these are cases where you really don't want to go in through the front, even though it might be technically easier. There are very high rates of dural tears or spinal fluid leaks and a higher rate of spinal cord injury with surgery through the front. You can see this little mushroom looking thing behind the vertebral body is a huge chunk of bone in his posterior longitudinal ligament. And there's basically no space for the spinal cord there.

So non-surgical treatment is OK. If they're very early in the disease, the risk of surgery versus the risk of waiting, does this get worse? The goal of surgery is to stop the problem from getting worse. Most people get some improvement, and they improve fairly predictably. But about one out of five people doesn't improve at all. And so we want to stop this problem from worsening.

So if you operate on these people earlier, this is one of those situations where people with early disease don't need to make huge functional gains to notice a difference. But people with late stage myelopathy need to recover huge amounts of function to notice a difference in the first place. So this is one of those instances where I really push people a little bit, if they're symptomatic, to operate on them earlier. Because we can really preserve and even restore function.

Anywhere between 20% and 60% of people decline after their initial diagnosis. This can progress very slowly over time. It can progress very rapidly. I'll see people who are fine one day and then two weeks later are in a wheelchair. Fortunately, that's not very common. But when these problems do occur, they don't resolve spontaneously. So it's incumbent upon us to recognize it, diagnose it, and treat it, especially when people are really having a hard time getting around.

So the goal of surgery is to decompress the spinal cord. Oftentimes, these are long segments. You can go anterior or posterior. However you want to get there and do the job, the results are the same. Complications are dependent upon the approach itself.

C5 nerve root palsy is one of those things that we might see and our physical therapy colleagues might see being referred from us. People can develop weakness in the deltoid and bicep muscle following cervical spine surgery. It's fairly common. Fortunately, it usually resolves on its own, but we like to get them strengthening that arm as soon as possible.

How am I doing on time here? Do I have-- OK.

So just a couple of quick case examples. This is a really interesting guy. 61-year-old male who actually was referred to me for back and leg pains. Miserable low back pain. His leg hurts. But the more you talk to him, he goes, yeah, you know, my balance has been off a little bit, too. And you examine him. And it's really important to do a good upper and lower extremity exam, especially if they notice anything with balance. This guy's hyperreflexic in all four extremities. He can't walk heel to toe. He's got a Hoffman sign. He's got clonus at both ankles. And his MRI of his lumbar spine showed disease.

And any reasonable spine surgeon would look at that lumbar MRI and say, we need to do something about this. It'll help your leg pain. But we got an MRI in his cervical spine first, and you can see predominantly between C4 and 5, and it doesn't project well here. He's got pretty severe stenosis and some signal change in the spinal cord itself, and kind of this circumferential-- oh, I'm sorry C3-4-- some circumferential narrowing and pinching of the chord. That C5-6 disk, a couple of disks down, it looks bad on the sagittals, but there's really no compression on the axial images.

So we did an ACDF on him, and he came back to clinic three weeks later. He's walking much better. And, interestingly, we find a lot of times, people with tandem stenosis, or cervical and lumbar stenosis, when you treat the cervical spine, a lot of their lumbar symptoms get better too. Because it acts as a double crush syndrome. The same nerves in the legs are the same nerves that are traveling through the spinal cord in the cervical spine. So he was happy with his results.

And this was an interesting patient that came in through the hospital about a year and a half ago. Really young guy, big guy. One month he hasn't been able to walk. He's stumbling around. His girlfriend found him down on the floor in his house, actually. He couldn't get up. He can't hold on to anything. He's very clumsy. He has a very weak grip. All the hyperreflexia Hoffman sign, clonus. And you could see all up and down his entire spine just severe cervical stenosis, spinal cord compression. The worst area between C2 and 3 and C3 and 4, you can see that little white spot in the spinal cord. That's that signal change I was talking about. Whether or not that's permanent damage or just swelling is really difficult to say. But this is a gentleman with OPLL, or an ossified posterior longitudinal ligament. And so even though these two patients present with similar problems, the treatment can be much different.

And this is a gentleman that needed a very large operation to decompress his spinal cord, posteriorly hold his alignment in place, rest the spinal cord.

So cervical spine, pain, radicular symptoms, myelopathy are common. Myelopathy is more common than you think. We just miss it a lot, so really watch people walk, and talk to them. Take a good history. Anybody who has cervical radicular symptoms or prominent balance, it needs a thorough spine history and physical exam. And so I look forward to the panel discussion, too, and thanks for coming, everybody.