

# pmpc038

**Dr. Kendall Williams (Host):** [00:00:00] Welcome everyone to the Penn Primary Care Podcast. I'm your host, Dr. Kendall Williams. So, we've all managed it, most of us have had it, and I imagine a large proportion of us don't fully understand it. And that is back pain. It is the second most common reason patients present to physicians in this country. About 80 % of people will have a severe back pain episode in their lifetime. So, it's very common, and I don't know that any of us really know much about it. So, I trained in internal medicine. I have some sense of what is also learned in family medicine programs. I think we all learn management algorithms for managing back pain. And we follow those in our practice. But, you know, I'm not sure we really understand what's going on here. So, I wanted to invite some folks on to talk about that.

So, here with me today is Dr. Jon Yoon. Jon is an Assistant Professor of Neurosurgery at Penn. And he's the Director of the Minimally [00:01:00] Invasive Spine Center. Jon, thanks for coming.

**Dr. Jon Yoon:** Thanks for inviting, Kendall.

**Host:** I also have from the other side of the spine paradigm, from the orthopedic side, is Dr. David Casper. Dave is an Assistant Professor of Orthopedics at Penn. He is the Director of Clinical Research in Spine Surgery at Penn. Dave, thanks for coming.

**Dr. Dave Casper:** Kendall, thanks so much for the opportunity. I appreciate you taking this on and letting us get a chance to shed a little light on a difficult topic.

**Dr. Kendall Williams (Host):** Well, I really appreciate you having me. This is somewhat selfish. I've been struggling with back pain this whole week. I've been walking around very stiffly. I see patients late on Monday evenings. And I had one patient that's an emeritus professor at Penn. And we finished up the visit and I couldn't get out of the chair. And he was so kind, this late 80s-year-old gentleman coming over to me to help me get out of the chair. So, I'm struggling with this right now. It's very personal.

I actually want to delve into the anatomy here first and just understand the spine itself. And we can talk about the [00:02:00] cervical spine, by the way, and the lumbar spine. But obviously, the way I explain this to people is you got

vertebrae stacked on top of each other. The spinal cord runs between them in a protected tunnel, if you will. And you have these discs that sort of cushion everything and allow mobility. But well, let me let you guys talk about the anatomy of the spine, because you've actually held it in your hand and you know exactly what these things feel like. How do you explain the anatomy of the spine, Jon?

**Dr. Jon Yoon:** The spine, I think, is a fascinating sort of a construct. If you imagine that, if you look back-- I'm just going off the little bit of rail here. If you look at the whales, for example, horses, the primates, the orangutans and monkeys, and then humans, we all have vertebrae and they all have spinal cord that's housed. So, it's sort of a cross species that, you know, the whales just have a little bit bigger than us, but they have a cervical spine, they have a thoracic spine, lumbar spine, the sacrum.[00:03:00] And then, we all have a sort of basic neural structure that runs through. So, it's a very fascinating sort of a structure that houses the nerves inside and has the discs and has the bony structure to support the rest of the body. So, if you imagine a cervical spine and lumbar spine, thoracic spine sort of spans the head, the chest, thoracic, into the legs. So, it's a really big, broad anatomic structure that all of us have.

And I think the humans, unlike the whales and the dolphins, they don't really have a gravity because they live in the water. The monkeys get this too, interest in the gravity. So once the vertebrae were developed and maybe when we were swimming in the ocean and it became bipedal, so upright, there's a whole gravity effect that happens where all of us, we all be walking upright and then the gravity takes a toll onto the neck and the thoracic spine, lumbar spine, and that's how the diseases form.

So, the simple way to [00:04:00] really think about the cervical spine, thoracic is breakfast, lunch, dinner. The breakfast, 7:00, so there's seven cervical spine; 12 thoracic spines at lunch, and then the five, I have a pretty early dinner, so five lumbar spines, five sacrum, and the coccyx anywhere from three to five fused vertebrae. And that's a lot of joints. Unlike the shoulder joints, and Dave probably has a better expert at this, but all the other joints in the body are just one joints, right? The shoulder joints, hip joint, knee joints, ankle has a little bit more, the hand has a little bit more, but the spine has tons of joints. Each level has two joints on the side, and they're all connected to the level above and below. So, what that means is that it has a lot of flexibility, so it allows you to move in all different directions, but it also means that it can break at all those spots. So, if your spine breaks, it could be at the level adjacent to it, or it could be a level below. Your nerves [00:05:00] are also running in there. So, there's a

lot of complexity of anatomy, which makes the disease difficult to diagnose and also difficult to treat. And I'll let Dave kind of speak to that.

**Dr. Dave Casper:** I think that's spot on. Truly, the spine's goal is to keep the head over the pelvis. And I'm sure everyone's heard the term scoliosis before. And really, all that implies is a curvature of the spine. But oftentimes, we can have patients that have scoliosis and as long as their head remains over their pelvis, oftentimes patients do quite well with that. And the issue is, as things start to shift or move and the head all of a sudden becomes either it's forward, sideways, you begin to operate at a mechanical disadvantage, and that's where patients start to run into issues with back pain and other sorts of problems. And the other goal of the spine is really is a conveyance of the neural elements, meaning transmitting the neural elements from the brain out to the extremities.

**Host:** So, let's go into a little bit that can go wrong. Jon mentioned gravity is against us as it is with knee joints and [00:06:00] hip joints as well. So, you have the vertebrae, hard vertebrae stacked on top of each other and attached to the processes in the back that protrude out. Posteriorly, you have the ligaments and muscles. So, some amount of back pain that folks have is akin to just spraining an ankle, right? You can sprain your back. I drove to Florida a couple years ago and I came back and I was happy that I got out of the car and my back didn't feel too badly. And then, I was cleaning out the car and I felt it. My back just gave way as I was trying to pick up a candy wrapper or something my kids had left on the floor. And it almost felt like an ankle sprain, and it lasted a few days. I never had neurologic symptoms and it went away. And I had thought that was ligamentous. But how much of that are you seeing? Before we get into the bones and discs, what about just the outer muscles and ligaments?

**Dr. Dave Casper:** Kendall, I think, probably the most common and oftentimes what a lot of our primary care providers are seeing, physical therapists, and I think what's important to understand at the back, similar to your experience, is it's very good at [00:07:00] accommodating at the time of injury, meaning oftentimes patients will push themselves, they'll lift heavy furniture, they'll engage in an activity, and over a prolonged period of time, they feel fine. But then, maybe later on that night or the next day, they're miserable, and their back's bothering them, and they can't necessarily put their finger on it. But what I will tell you, similar to you picking up the candy bar, is really the back gets to a tipping point where it says enough's enough. And typically, I find that's exactly what you said. It's often the soft tissues, it's the muscles, it's the ligamentous attachments. It's more of those surrounding soft tissue structures that are really the culprit of that kind of pain.

**Dr. Jon Yoon:** Yeah. And then, I think that's why the musculoskeletal ligaments sprain is hard to diagnose. There's no imaging that we can say and say, "Oh, that muscle looks like it's sprained." And so, 70% of the Americans have some type of back pain in their lifetime. A lot of those patients do not require surgical intervention to treat that, because most of that [00:08:00] is from the muscular pull or the ligamental sprain. So, I'll say that 90%, 99% of the back pain is really caused by that. And treatment for that is just conservative therapy, rest, NSAIDs, physical therapy, and stretching and rest. And then, they'll self resolve. Maybe 10%, 5% of those back pain is due to the discs, nerves, or a fracture that requires a real deep dive. And that's when the MRIs and further workups, x-ray is needed.

**Host:** Yeah. I think they usually want us to give about 12 weeks of conservative management before we even think about MRIs, as long as there's no weakness and other things that we'll get into. So, let's kind of go in a little bit further into the spine and talk about the discs themselves. And I think we're also starting broad in the sense that what we've talked about as far as ligaments and muscles can happen to anybody, right? And at any age. And disc disease can happen at any age, right? But because of the [00:09:00] effects of gravity, Jon, you mentioned, does occur more often with age, but can we just drill down on the anatomy of a disc, what goes wrong with a disc, and so forth?

**Dr. Jon Yoon:** Yeah. So if you look at it from the sort of basic anatomic of the disc, I tell this to patients quite a bit, Dr. Scholl, you know, it's a jelly inside. So, there's a nucleus pulposus, which is mostly water. And it's got structures that kind of hold onto the water in the middle, and that's the soft part, and that's the nucleus pulposus. And then, surrounding that is the annulus fibrosus, which is a type of collagen that is interlaced, so that it contains this jelly inside this fibrous tissue. And then, we have it at every level of the bone. So between the cervical spine, C4-5, for example, we name the discs based on where they're adjacent to. So between the C4 bone and C5 bone, there's a disc. And then below that, the same thing. So if you imagine that you're going to be walking around, maybe [00:10:00] running outside, every time you run or walk and you hit your foot on concrete surface, that shock that goes through the impact on your feet gets transmitted all the way up to your spine, right? And the role of the disc is to absorb that shock so that when you're walking, all that shock doesn't go directly to the bone and fracture it, or maybe it goes to the nerves and it injures a nerve. So, a disc is really like a suspension in the car or something that--

**Host:** Shock absorber.

**Dr. Jon Yoon:** Yeah, shock absorber., exactly. So that every time you take a pound onto the surface, you don't go into a neurological injury. But they take the pounding so that it can be injured. And that's when people get nerve impingement from it or other diseases.

**Host:** if I were to pick up a disc and put it in my hand, it wouldn't feel like one of those little soft stress balls, people. That's too soft, right? it's harder than that, right? But not too hard. How would you compare it?

**Dr. Jon Yoon:** That's an interesting question. I don't think I [00:11:00] ever held a normal disc. You know, usually the ones that we are operating on is a diseased disc. And when the disc becomes diseased, it becomes more like a shrimp meat. It's not a fully well hydrated tissue. It looks like sort of like a dried sort of a white meat. But we do see the difference between the older patients and younger patients. Younger patients, when we operate, and then they have a herniated disc, theirs look like it's a little bit more well hydrated, it's a little bit more plump. But yeah, I don't know how it would feel to feel the normal disc between my hands.

**Host:** Any thoughts there, Dave?

**Dr. Dave Casper:** Yeah, I'll have to give a shout out to one of my partners here. Dr. Harvey Smith is probably one of the foremost experts on disc pathology you recently had a publication in science about three weeks ago on a biologic disc patch, but he has a lot of basic science research into disc pathology and biomechanics if anyone wants to do a deep dive.

But I will tell you when I'm trying to talk about discs and disc pathology to patients [00:12:00] in clinic, I use the crude example of a jelly donut. When patients are younger, typically they have a very robust jelly donut. They have a lot of jelly in there and that's really the nucleus pulposus. And the reason that younger patients often are the ones that have big disc herniations is the fact that they have this gelatinous material which can herniate out.

And then as we age, the morphology of the disc changes, and oftentimes that jelly turns into more donut. So as we get older, our donut starts to squish down more, the jelly fades away, and it just turns into more and more donut type material. So really, that aging process is really what takes away the viscosity of the disc that Jon was talking about and kind of causes the transmission of forces through the spine to vary as we age.

**Host:** So, young people can have pathologies of their discs, right? I mean, there's a couple famous athletes recently, you know, Ben Simmons, who played for the Sixers, had some back issues. I think they were disc related. So, in terms of where this sits, it sits between the vertebrae, but it does have a [00:13:00] little bit of squishiness to it, so it can herniate out, right? And put pressure on the nerve root, which is coming out between the vertebrae as well. And we call that a radiculopathy and that can happen at any age, right?

**Dr. Dave Casper:** That's exactly right, Kendall. Oftentimes we do see it in those younger patients, however, just because the herniated material actually is typically more of that viscous type material. So if someone has a nice gelatinous nucleus, what ends up happening is typically it stems from intra abdominal pressure, increased hoop stresses across the disc. They get a tear in that outer annulus or that outer donut, and then they squeeze some of that jelly or nucleus pulposus out. And then by that, putting pressure on a nerve root, you get an inflammatory reaction which causes that kind of searing leg pain. Typically, those don't cause back pain, although occasionally they can really. It's more of a radicular leg pain transmitted in the dermatome of which the nerve it affects.

**Host:** And you guys will operate on those patients My impression is [00:14:00] it can be a simpler problem to solve with not a large surgery. And I see it's not unusual that one of these athletes or one of my patients gets operated on maybe earlier than the typical course. Jon, maybe you can speak to that.

**Dr. Jon Yoon:** There was a good study that looked at this randomized control study that looked at how do you treat the herniated disc the first time. Do you do a conservative therapy or do you go to the surgery? Basically, the conclusion is that it's okay to try the conservative therapy, but you need to have a sort of observation. They can't be lost to followup, meaning that they got to do a proper monthly visit, make sure they're not getting any weaker, but they're getting physical therapy, NSAIDs to closely monitor their neurological function.

So, what I typically do with the patients that are coming in, they have clearly a symptom of a radiculopathy, but they haven't tried a conservative therapy [00:15:00] for at least 6 weeks. But I'm okay with extending that to 12 weeks. As long as they're a reasonable person, they can follow up and they have support at home, they can get the physical therapy, then I'll try the conservative therapy.

Now, the exceptions are that if they have a weakness, and if it's L5 radiculopathy, then that corresponds to the tibialis anterior, which dorsiflexes the legs and the ankle; and then also extensor hallucis longus, which dorsiflexes

the big toe, if there's a clear correlation to the disc herniation to those muscle groups that are weak, then I'll offer surgeries upfront because in those cases, the nerves do three things. They're very simple. They do the pain, they do power and they do numbness and tingling. So if they have just a pain and numbness, I'm okay with trying the conservative therapy and letting their body sort of heal itself.

But if it starts to affect the power, if they have an asymmetric motor exam, then I'm more concerned [00:16:00] that, "Okay, this is something that is affecting all three functions of the nerve." And by taking the chance of conservative therapy and delaying the surgery, that person may do worse in the long run. So, that's how I practice. But if they have reasonable motor exam and they haven't tried the conservative therapy, herniated discs can resolve by themselves. And then, that's what the randomized controlled studies do show.

**Host:** Yeah. And when they resolve by themselves, Jon, is it that the disc kind of shifts back into place, the herniation resolves, or is it that the body just accommodates to this thing pressing on it, the nerve accommodates?

**Dr. Jon Yoon:** Yeah. So, there's no exact timeline how long that takes. But if you do image someone after their symptoms have resolved, you know, about three months or so, the disc can shrink back. So, maybe it was 7, 8 millimeters, it could half in size. And then if you do it again in another three months, it could completely go away. Because those herniated discs, [00:17:00] they don't have any blood supply. So eventually, nucleus pulposus can just dissolve by themselves.

Now, again, everyone's biology is different. Some people have these chronic disc herniations that become calcified and they could harden and they may not change in size. But I'll say that most people, young person, if they have a herniated disc, their symptoms resolve and they repeat the imaging in about three months, most of those disc herniations are gone.

**Host:** Dave, do you want to jump in with anything here?

**Dr. Dave Casper:** Yeah. I think Jon's spot on. Usually, I tell patients if I see them in the acute period, meaning they've herniated within the past week, I tell them that 80% of those patients typically get better without any type of surgery. It's tough. Oftentimes we might treat patients a little bit differently than we treat ourselves. You know, if I was miserable with a radiculopathy, it'd be hard for me to wait six weeks. You know, if I couldn't work, if I couldn't operate, that'd be a tough thing to put up with.

We base a lot of our evidence on something called the support trial, [00:18:00] and that was kind of what I think Jon was alluding to. I think it's very reasonable if someone has pretty miserable pain within a couple of weeks. I'll offer them a followup with one of our injection specialists to see if they'd like to try a steroid injection. Oftentimes, that can decrease the inflammation. If they don't have inflammation, oftentimes they don't have pain. But I think it's often tough to counsel those patients that are absolutely miserable right after it happens that, "Hey, you know, 80% of these get better on their own." But I'm in agreement with Jon, usually, you know, if they've failed conservative treatment at around that six-week mark, I think it's very reasonable to offer surgery.

**Host:** You know, if I remember that trial, at least what's taught to us almost everybody was better at six months, but the folks who got surgery were better quicker. And if that becomes a priority, then surgery becomes an option, right?

**Dr. Jon Yoon:** Yeah, that's correct.

**Host:** Can I ask the two of you, because you're the people to ask, what do you actually do during the surgery and how big a deal is it? Jon, it's posterior, right? It's a posterior approach or is it anterior?

**Dr. Jon Yoon:** [00:19:00] Yeah. There's multiple ways to get at the disc. Now, there's anterior approach, lateral approach, the posterior approach. So many different ways to do it. And then also, from the posterior approach, you can do it through a small tube with a microscope, or you can make a midline incision, open up the nerves, or you can do it through the endoscope. So, there are many different approaches to take the disc out.

And my preferred way to do it, I feel passionate about minimally invasive spine surgery. The whole goal of the MIS is get the job done without destroying everything on the way, right? It's kind of like sniper options. If you have a bad guy, just take out the bad guy, but don't destroy the buildings. So, one way to take the disc out, and let's say if you have a single-level herniated disc on one side, so again, the spine has two sides and it's got multiple levels. But if you have a one-sided problem and a one-level problem, minimally invasive option is a very good option where you don't have to open [00:20:00] up both side. You can really target that one level that's herniated out. And typically, those patients tend to be younger because they have no other disease at the other levels. And as Dave said, those people tend to have a very big disc herniation that's very obvious. So, those patients have one-level disease with unilateral symptoms. They respond very well to a minimally invasive option. Now, there's many different definitions of what is MIS.



And so, there's two different options in my mind. There's a tubular approach where you make an incision off to the side that you're operating on and you insert these circular metal tubes that dilates the tissue out of the way. So, you don't cut any muscles, but you displace them. And then, you can do your bony work. So disc is coming from the back of the spine, so you have a skin, you have a muscle, you have a bone, and the nerve, and then, the disc is below the nerve, [00:21:00] so you have to sort of go through all this anatomy to get to the disc. And then, you take the disc out. And then by the time you pull out the tube, all the muscles sort of fall back into place and you close. That's one way.

There's a tubular microdiscectomy, which has been around for about 20 years. And that's a very good option. The other option now that's been more popular is endoscopic approaches where you do the exactly the same thing. You put a small tube. But if you put an even smaller tube, and then instead of using the microscope, it's kind of like laparoscopic. It's very similar. You call it endoscope, because you're not inside the body cavity. You actually push the water out. And you do exactly the same. You can drill the bone, move the nerve out of the way, pull out the disc. So in my mind, I think those two are sort of the discectomy options that are minimally invasive.

**Host:** And when you remove the disc, you're just removing the herniated portion, right?

**Dr. Jon Yoon:** Yeah. You're removing not the entire disc, but you're just removing the portion that has come [00:22:00] out. Now, it's rare to have a completely sequestered disc fragment. Usually, the disc fragment has some origin inside the disc space. So, what we typically do is we identify that, remove that piece of disc that's outside the bounds of the disc. But then, you often have to go inside the disc to make sure there's no tail that you're missing.

**Host:** Dave, you may know this more, but, you know, I was talking with one of your colleagues about cartilage surgeries in the knee. And you know, if you remove too much cartilage, his point was, if you have a meniscal injury, you remove cartilage, you really kind of accelerate the loss of cartilage. And so, you end up with OA or degenerative arthritis earlier and so forth. Do you have that similar phenomenon in the spine as well if you trim too much of the disc that you may accelerate arthritis in that area?

**Dr. Dave Casper:** Absolutely right. I think part of it too, unfortunately, is that once you herniate a disc and you disrupt the annulus or that outer portion, the way in which force is transmitted through the disc is no longer the same. So, we know that [00:23:00] whether or not we do surgery on a herniated disc or we

treat it conservatively, those patients are set up for more arthritic changes at that disc level at an earlier age. So unfortunately, once a disc has herniated, you're probably set up for some early stage arthritis at that particular level.

**Host:** We had referenced this, Jon, just to kind of put a summary on this herniated disc discussion. The symptoms are going to be sciatica, radiculopathy, all of these words that we use, that transmit that nerve impingement down the leg. Jon, you had mentioned it's usually L4-L5 or L5-S1 are the vulnerable areas. Is that right?

**Dr. Jon Yoon:** Yeah, that's the most common levels. The low back, that's sort of the transition level from the lumbar spine to the sacrum. So, if you imagine that at each transition level, the cervical to thoracic, thoracic to lumbar, lumbar to sacrum, those transition levels do have a little bit more stress. Because if you image someone [00:24:00] that flexes forward and extend up, most of the motion is between L4 to S1, and then the cervical spine, the cervical-thoraco junction, lumbar, and then the thoraco-lumbar junction, and T10 to L2. So, those are the levels with the most motion, and we assume that that's probably where a lot of the forces are applied so most people would herniate between L3-L5 to L5-S1.

**Host:** So, you can have herniation of the disc. But over time, you do get degeneration of the disc, right? And this is just an age thing, like everything we've been talking about so far could have happened to a 24-year-old or an 86-year-old, disc herniation. But part of the effect of gravity that Jon had said, you get this loss of disc height, right? You get loss of disc sort of resilience, I suppose. It changes in character, becomes more shrimp meat-like and that in itself can cause pain even if it's not moving around, right?

**Dr. Jon Yoon:** Yeah. No one has really proven this, but I think it's really, all [00:25:00] of us lose elasticity as we get older. So, we all get stiff, it happens in your skin, it happens to our joints. So as we age, I think part of aging is probably losing elastin in our vessels, right? We get more hypertensive because our vessel walls become more stiff. We get wrinkles because, you know, our skin becomes more flabby. And the same thing happens to the joints and then the discs. So, we lose the water content. So, it's true that all of us get shorter, right? We get shorter as we get older. And we're actually the tallest in the morning. So, when you lay down at night, and you wait, you stand up, actually, your disc is distracted, right? So, when you stand up in the morning, you're a little bit taller. Right now, we're recording at 6:30, we're going to be a little bit shorter because that much gravity has done the toll on our body. So, this happens every day. There's a cycle of gravity that's working on your body. So

[00:26:00] yes, this shrinks, even if it doesn't herniate, that you have less material to absorb the shocks. And then, that can lead to a further degeneration and more back pain.

**Host:** Is the disc itself painful, Dave? Does the disc itself have nerves?

**Dr. Dave Casper:** It's a great question, Kendall. And I think what is difficult for us and kind of what we touched on with back pain earlier is that the answer is it can be. And the difficult thing is that two discs can look exactly the same on an MRI, an x-ray, and CT scan. And in one patient, it can be very painful, and in another patient it might not be. And I think our understanding of essentially discogenic back pain, or pain in the back that stems from the disc, probably isn't where it should be.

And so, those are the patients, oftentimes, I'd like to get your thoughts, Jon, that we can have some frustration with and that we're really trying to tease out what's the culprit of their symptoms. Is it the muscle? Is it the ligament? Is it the facet joints in the back? And those are two additional joints that oftentimes can be symptomatic and cause back pain. [00:27:00] Or is it the disc? And unfortunately, we don't necessarily have great diagnostic tools for some of those. And I can tell you, we'll look at x-rays all day of patients that have just terrible discogenic-looking disease. They have degenerative disc disease. Their discs are collapsed and they're totally asymptomatic in relation to that. So, I think long answer is that it can be a culprit of back pain. And it can be a culprit of other symptoms, but we have to be critical in terms of how we work that up.

**Host:** You mentioned the facet joints, and kind of doing a little tour through the anatomy, and we've been going through the disc so far, because I think that's a lot of what we see, probably, or at least that's maybe a lot of what we think we see. But you mentioned the facet joints. As the disc degenerates, I would imagine you get some more bony friction as well that can cause, you know, similar to what you might see in the knee or the hip, where that causes inflammation and pain. Is that right, Dave?

**Dr. Dave Casper:** Very true. And I think, you know, your analogy that you used earlier in relation to cartilage in the knee, oftentimes I'll try and make a similar [00:28:00] comparison in that, you know, you actually have three spaces or compartments in your knee. You have your patellofemoral joint, you have your medial compartment and lateral compartment. So, similar to each disc level, you have a disc in the front and then you have two facet joints in the back. So when we're talking about taking care of a problem at one particular level. Someone can have significant arthritis in their right-sided L4-L5 facet joint.

And maybe the other two areas are pristine, or perhaps they have significant disc problems, but their facet joints are fine. And because of that, it's exceedingly varied in terms of the treatment that we do for it. But you can certainly have someone that has a unilateral facet joint that's arthritic and inflamed and painful, and that can be the culprit of their symptoms.

**Dr. Jon Yoon:** And then, the facet joints also have what's called synovium, which is basically lubricant and just like the synovium joint fluid in the knees, we have it between the spine. So, it's contained in the capsule. And then, the spine joints are lubricated by those synovium. But[00:29:00] just like the discs, they do wear out over time. So when they wear out, that's when the joint surfaces can become bone on bone and they can cause a lot of back pain in the joints.

**Host:** Does facet joint pain present differently than, say, disc disease itself? I mean, it is most posterior, right? But I don't know if you can tell the difference.

**Dr. Dave Casper:** Yeah, I would say that it can. The difficulty with it is that oftentimes when patients are describing their symptoms, we have to be very focused in terms of not only our history, but also the physical exam and physical exam maneuvers. I will tell you, for me, though, the best diagnostic tool for facet joint mediated pain is typically injection strategies.

I find that oftentimes, you'll hear a story, you'll look at imaging. You'll say, "Yep, we have what looks to me like a pretty arthritic facet joint. I'm not sure if it's the disc. I'm not sure if it's maybe the facet joint. Let's try an injection in that facet joint." And oftentimes patients get significant relief with that, [00:30:00] that can be very much diagnostic.

**Dr. Jon Yoon:** Yeah. And then, I think it's really hard to tell in a discogenic back pain versus a facetogenic back pain. I think both of them, if you have a load-bearing maneuver, so like you're sitting down or laying down, both of them do get better. So when they stand up, both of them do tend to get worse.

Specifically for the facetogenic pain, it tends to have a little bit more pain elicited by flexion extension. So if you stress that joint or lateral bending. So if you ask the patient, "Okay. Does it hurt when you try to pick up stuff from the ground or you turn your body, does that hurt more?" Then it points a little bit more towards a facetogenic pain. But again, so much of that facetogenic arthropathy and discogenic pain, they're so comorbid. It's hard to tease out just based on the clinical history alone.

**Host:** We're just going over pathology first before we get to surgeries and treatments. [00:31:00] The other pathology I just wanted to talk about is spinal stenosis, right? So, this is where the spinal canal itself gets narrowed. I had always thought of this as if disc shifts itself can cause spinal stenosis. But I always thought of this as sort of a chronically arthritic back that was causing bony changes, I suppose, that were causing now compression on the spinal cord. Am I thinking about that right?

**Dr. Dave Casper:** Yeah, Kendall, I think very spot on. Stenosis simply means narrowing, right? We use it and we'll read it in our radiology reports. And it seems complex, but stenosis just means narrowing. And you can have stenosis at different areas or locations within the spine. And oftentimes, it is caused by, as you said, arthritic changes where we'll develop bone spurs or hypertrophied ligamentum or other structures that are pushing on the neural anatomy.

And so, stenosis in and of itself isn't necessarily a problem, but it's when stenosis leads to inflammation, pressure on neural [00:32:00] elements that then become symptomatic. So again, we can see patients that really have significant stenosis on MRIs, but might otherwise be asymptomatic because it's accrued over a very long period of time and they've done a good job adapting to it. Whereas if someone has an acute disc herniation and they develop lateral recess stenosis in that immediate moment, they're going to be very symptomatic from it.

**Dr. Jon Yoon:** Yeah. And then the stenosis, oftentimes, unlike the herniated disc, truly herniated disc that's symptomatic, the stenosis kind of diffuse, because the people accrue it all the time, over time, and it doesn't really happen acutely. Unlike the herniated disc, where people, most of the time, they can recall, "Okay, I was picking up an object. Oh my god, now I have a pain."

Stenosis pain just kind of happens gradually overtime. So, typically, in the lumbar spine, it can cause neurogenic claudication. And the question that I often ask the patient, "Hey, do you feel better when you go shopping?" So, when they lean forward. [00:33:00] So if you lean forward with the stenosis, it relieves temporarily, opens up the canal just a little bit more so people can walk longer distance. So, they say, "Oh, yeah. When I go grocery shopping, I feel like I can walk longer." But by the time they stand up and extend and stand up upright, that closes the canal just a little bit more. And in which case, it can send a pseudoclaudication or neurogenic claudication pain where they have a terrible pain down the legs.

**Host:** Let's go over the surgeries you guys do to kind of deal with all of this. We talked about disc surgery. But there's something called a laminectomy, right? There's something called a fusion. What's happening in these circumstances? When do you do that?

**Dr. Dave Casper:** Yeah, sure. And think oftentimes what's difficult about spine pathology and spine treatments, Kendall, is that they're so heterogeneous. One postoperative spine patient may talk to another one and they had a different problem. And they also had a different surgery, but they're talking about, "Yeah, I had surgery on my low back," and it seems like that should be similar, but oftentimes it is not.

[00:34:00] We use terms like laminectomy or laminotomy. And typically, what those mean is the bone that we're taking away. So in my mind, there's decompression surgery, meaning we're taking structures away, such as the lamina. And then, there's fusion surgery. And typically, fusion surgery is done either for instability, meaning bones are shifting out of place. It's done for deformity, so to correct something, or it's done to stabilize an otherwise traumatic event. And I think oftentimes, the connotation of fusion surgery, especially from the layperson, stems from fusion surgery that was done historically for back pain. And I can tell you, nine times out of ten, that is not a great treatment option.

So really, when Jon and I are talking about fusion surgery, the implications behind that, we certainly appreciate. And if, for some reason instability or a bone shifting out of place is causing stenosis or narrowing, by simply taking off the lamina, we're not going to treat the underlying issue or the instability. So in a case like that, you might have to do something [00:35:00] like a laminectomy where you decompress those neural elements, but then also fuse those bones together to prevent that instability from progressing.

**Host:** When you open the lamina to give more space, right, do you just leave it open? And does that create instability itself?

**Dr. Jon Yoon:** In a stable spine, yes. So when you do a laminectomy, the lamina themselves, although it does provide some structural stability, there's a biomechanical study that, in the lumbar spine, the posture element, meaning the supra, infra, interspinous ligament, plus the lamina and the spinous process provides about 20% of the stability. And the cervical spine is a little bit higher because the facet joint is not as big. So yes, there is an element of what's called post-laminectomy kyphosis that happens over time. Because those structures do provide some level of stability.

But if we're doing the surgery in a [00:36:00] 60-year-old that doesn't have a bone shifting, there's no signs of instability, then we typically don't do instrumented fusion because their other facet joint and their muscles are compensating. So by taking away that sort of a offending hypertrophy ligament, we're decompressing the nerve, but we're sort of relying on the rest of the facet joint that's left behind to provide the stability for them for the rest of their lives.

Now, if people live up to 120 or 130, yes, I mean, you could see that in patients who have a laminectomy. If they live long enough, at some point, they can develop instability where the bones are stacked on top of each other. But then, maybe 10 years, 20 years down the line, the bones can start to shift. But yeah, right now, we don't put any other devices, anything like that in place of laminectomy.

**Dr. Dave Casper:** You know, I think the further advance within our field, the more we're understanding that preservation of the [00:37:00] posterior soft tissues is important. And we do have these studies that indicate we can remove up to a certain amount of bone and things remain stable, or we can take down certain ligamentous structures.

But I think that the further we look into it, the more we're understanding that truly preservation, and Jon kind of hit on this with his discussion about minimally invasive surgery, but the preservation of native soft tissues is very important. And the more that we can help to mitigate the removal of these, I think the better we can do in terms of stopping things like, "adjacent segment disease." And I know that's something that a lot of patients seem to really understand when they say, "Hey, you're going to fuse this level. What is that going to do to the other levels in my back?" And I think it's a very thoughtful question. And, again, we're probably just at the onset of understanding how we're going to mitigate that in the future. And hopefully, it's not with fusion surgery. But we have realized that again, doing things like multi-level open laminectomies may lead to other issues down the line. And so, I think we're trying to be a bit more [00:38:00] thoughtful in terms of preserving patients' own anatomy. That's a question I get all the time, Jon, is "You're going to do what? You're going to take off these bones in the back and you're not going to put anything in place of them?" Especially we get that in the neck as well, pretty often.

**Host:** So, I want to kind of circle back here and now focus, because now that we've sort of gone over the pathology and what's happening in the surgeries, kind of go back and say, "Okay, patients are coming in to see you." Let me just share with you how I think of back pain. I think of three, maybe four categories.

One is the person like me, who was picking up a candy wrapper and threw my back out, and a couple days later it was feeling better and it was stiff. That's a ligamentous muscle issue. Then, you have the radiculopathy patients, the sciatica patients that got pain going down the leg. That's pretty straightforward. Then, you have the patients that are sort of the chronically arthritic back, combination of sort of chronic disc degeneration, maybe facet joint degeneration. These are the folks you said that you never know exactly what's causing the pain. And then, the [00:39:00] fourth category for me, and you guys can add on other categories, are the spinal stenosis patients, right? The ones who probably have a chronically arthritic back, but actually have a symptom that is more specific, I suppose, than just pain, where they're really getting claudication symptoms, meaning they're showing signs that their spinal cord is being impinged by this degenerative process. Are those kind of the four categories you guys use as well?

**Dr. Jon Yoon:** Kendall, I mean, do you run a spine clinic on the side or something like that? I mean, I couldn't agree more with the four categories. But I'll add now with the recent opioid pandemics. And we can't ignore this either-- there's a huge population of patients who have been exposed to opioids. And they may have what you just said, one through four, so these are the people that have imaging, maybe they have herniated discs, maybe they have stenosis, maybe they're arthritic. But on top of that, they are sort of dependent on opioids. And these are some of the [00:40:00] hardest patients to treat, because even if you treat the underlying pathology like herniated disc and stenosis, arthritis, their pain is not resolved because they have opioid dependency. And I think that category of patients really, in the last few years, has really grown in size and sort of proportion of my population that I see.

Also, if I add in a sixth category I think Dave also mentioned there are people who also develop degenerative scoliosis. So, these are the people that have sort of incremental degeneration of their discs throughout the spine, so not just involving on one level, and then that really starts to affect their alignment. So as Dave said, our job of the spine is to keep the head upright in the center of the body, but they're shifted either forward or the side on both of them, their head may be shifted forward and off to the side. And these patients are very tough to treat with the medicines and conservative [00:41:00] therapy. And they represent a separate category of the patients. I don't know, Dave, do you have anything more?

**Dr. Dave Casper:** No. Honestly, I think that's great. When we think about spine patients, oftentimes we loop them into baskets and there's also a lot of crossover between those groups. You know, someone can have neurogenic claudication,



because they have spinal stenosis. But they may also have a component of axial back pain associated with a disc. And I think it's important when we start getting into the depths of surgery that we're critical with what we feel we can treat and can't. And that patient often will talk about our goals of surgery are to help your leg pain and help your leg weakness, but I can't promise you that your back pain is going to be any better. It's definitely something where our pathologies often can overlap, but it makes for a confusing picture, especially when we're trying to communicate effectively with patients.

**Host:** So, the two of you have both, I think in your respective spheres, aimed to do sort of the cutting edge stuff. Jon, I knew you as the minimally invasive neurosurgeon at Penn; Dave, you're involved in all the research. [00:42:00] What is the cutting edge here? I mean, with everything we talked about in terms of laminectomies and fusions, those surgeries have been done for maybe 50 years, maybe longer. But what's the cutting edge? What's happening that we should all know about.

**Dr. Jon Yoon:** Dave kind of mentioned, I think, honestly, we're sitting here because we're "experts" in spine, but we honestly do not know a lot about the spine starting with how to diagnose it, how to treat them best. I think a lot of these things we're sort of beginning to understand with the advent of the MRIs and maybe even more sophisticated imaging like SPECT scans. And these things still needs and requires a lot of research because it's not validated in randomized controlled trials and things like that. And technology is really improving beyond the evidence generation.

So, Dave and I We'll be sitting in a meeting and we're bombarded with new techniques that are coming out almost quarterly. So, I graduated residency and [00:43:00] fellowship six years ago. Within the last six years, there's been different ways to fuse a spine. There's different way to diagnose. I just met with a company that replaces the nucleus pulposus. They're doing a trial in Japan. And so, there's all this new technologies coming up. But they haven't been really been tested and validated in a really evidence generation fashion.

So, I think that was kind of a long-winded question, but I think what I'm getting back is that the spine is a little bit of uncharted territory, even the people that has been doing this for a while. I think that sort of a laminectomy and fusion has been around for a long time. But in the grand scheme of things, the spine surgery really began in the 1940s and '50s. So, it hasn't been that long compared to general surgery, which has been done for over a hundred years. So, I think it's still in a sort of a nascent period. And I think there's a lot of development, I think, that will happen in the future because our diagnostics will get better. I

think that our[00:44:00] interventions will become more targeted, because we're going to be able to tell which patients will benefit or not benefit from the surgery. And I think that our interventions will become more minimally invasive, meaning that we will address the problem but without destroying everything on the way. And that'll be my thought. And Dave, love to hear your thoughts.

**Dr. Dave Casper:** Yeah. The only thing that I would add is I think we're moving in a direction, hopefully, of motion-preserving surgery, that the concept of still we fuse patients. And if you again extrapolate it to other joints, the idea of fusing someone's knee versus replacing it seems nuts. So, I think our goal is moving in the direction of motion preservation, whether that be with replacement or other types of surgeries. And then hopefully after that, moving in the direction, instead of using metal and plastic or metal and ceramic for our replacements, moving in the direction of biologic replacements. So if we can truly engineer somebody's disc and replace a disc with a biologic disc, I think, that's pretty far down the line, but I [00:45:00] perceive that being the direction things are going.

Also, to a certain degree, Jon, I'm sure you've seen this, is, you know, incorporating artificial intelligence into some of our decision-making, whether it's from alignment perspectives or those types of things. But I think we're still trying to accrue enough data points where we can really utilize that.

**Host:** You know, I think there's part B of this discussion that we could do that focuses on some of the non-surgical therapies. But I wanted to start here with you guys because it's important for us, I think, as internists and primary care physicians and family practitioners to understand sort of what does the end of the road look like for the patients we see, where could they end up? And then, we can sort of build in what's in between in terms of the other things. But this is an area of medicine. I don't think that most of us understand that well. So, I really appreciate you coming on and talking to us about it.

**Dr. Jon Yoon:** Thanks for inviting, Kendall. This has been fun and thank you for giving us, opportunity to talk about this.

**Host:** Oh, let me ask you another question, and this may be a little bit sensitive, but does it matter who we send patients to, Jon? I mean, you're a [00:46:00] neurosurgeon; Dave, you're an orthopedist. You guys obviously are very collaborative. Does it matter how we do that?

**Dr. Jon Yoon:** That's a great question. And I think there's two ways to become a spine surgeon is go to the orthopedic training and then do a fellowship and you can become a spine surgeon. You can go to the neurosurgery route and then do a fellowship and become a spine surgeon.

So in the beginning, I think this is a little bit of vestige of the past where neurosurgeons typically were focused on the brain and then the sort of a spine was a secondary thing they used to do because you know, "Oh, it's a lumbar disc. Take it out," right? And that's how the neurosurgeons used to do all the decompression, and then the orthopedics will come in and do instrumentation. And then, the intradural, like the tumors and things were left for the neurosurgeons, and the orthopedics did more of the scoliosis. And that was really of the past.

Now, the training of the neurosurgeon and orthopedic surgeon, there's so much crossover once you get to the fellowship level. And [00:47:00] once you get out into coming out in practice, in reality, Dave and I see the same people, you know, similar patient population. Once you're out in the community, whether you come from the neurosurgery background or orthopedic background, I think, all of us are sort of trained the similar way.

Now, I will say that the orthopedics do have advantage in terms of understanding the hip pathology and knee pathology, which are often called morbid, and then the shoulder pathology with the neck. So, the orthopedic training do prepare you to consider other joints. And in my training, I always try to spend time with orthopedic guys because I wanted to pick their brain, and they have an understanding of the bony anatomy and bone fusions knowledge, which I thought was always very good to learn from.

**Dr. Dave Casper:** Jon hit the nail on the head. Historically, there may have been some differences. And I think we're very fortunate here that we're so collaborative. You know, We have a multidisciplinary conference where Jon and I are lucky we get together as spine surgeons and we talk [00:48:00] cases and think that's a fortunate aspect of being here. My fellowship, Jon, I'm sure similar at yours, the fellowship I did was at Cleveland Clinic, and there were two neurosurgery residents and three orthopedic residents, and we all did the same fellowship and had the same training. But I do think from the current landscape today, things have melded together. I will tell you if I have a terrible intradural tumor, Jon, I'm still calling for your help, though.

**Host:** That was a great discussion. I really appreciate you guys coming on. I'll send up a followup email and find out if you're the folks to bring back for

discussion of the non-surgical therapies and we could kind of work through that because I want to go through that as well. But it was really helpful to hear how this all fits together from your perspective. It's kind of a black box for us, so it's really helpful.

So, thank you to Dr. Yoon and Dr. Casper for joining the Penn Primary Care Podcast. I thank the audience for being here and please join us again next time.

**Disclaimer:** Please note that this podcast is for educational purposes only. For specific questions, please contact your [00:49:00] physician. And if an emergency, please call 911 or go to the nearest emergency department.