

Genicular Traumatology with Dr Kevin Stone

Ologies Podcast

December 16, 2021

Oh hi, hey, hi, it's the lady at the COVID swabbing clinic who always has the best scrubs with, like, holiday llamas on them, Alie Ward. And actually, I'm not her because that lady does exist at the Burbank COVID clinic drive-through... and I love her every time I see her.

Okay, let's talk about your shitty knees. Let's talk about Jarrett, your Podmom's shitty knees. So, in late August he was vaccinated, he was in a small pod of jiu-jitsu folks starting to train again, he has a brown belt, two stripes, so close to his black belt, was so excited to get back into the sport he loves. He was grappling, took a wonky fall, heard a pop and... here we are folks; terrible pain, swelling, MRIs, busted ACL, surgery, physical therapy, and now he's two months out, he's still healing.

Luckily, a friend of his family happens to be this world celebrated surgeon who has pioneered knee reconstructions, and gotten a bunch of patents, and fixes everyone from pro athletes, to actors, to actual ballerinas. This surgeon is also in the Bay Area and very out of network, but he understands how to get athletes back on their feet. So we packed our bags, we stayed with Jarrett's wonderful mom, Christine, for a two-week blur of general anesthesia, and Tylenol, and ice, and pain, and crutches, and rehab.

But amid all that fun, why not record an episode? I feel like most people I know have kind of an on/off relationship with their joints, and I found myself looking at these knee diagrams wondering what was going on in there. And luckily, Jarrett's surgeon, who is this athletic, soft-spoken, and deeply knowledgeable knee celebrity, if you will, was down to sit on a porch this October afternoon in his neighborhood in the Redwoods, just north of San Francisco.

So, he studied internal medicine and orthopedic surgery at Harvard University and then went to this place called Stanford University to study general surgery. He's written books, and done TED Talks, and educated people all over the world on this stuff. People who call him Doc include the Marin Ballet, the US ski team, dance companies, rugby teams, pentathletes, and of course, my hoosband. So, I was like, "Hey, hi. Can you explain knees?" I'm pretty sure he was like, "Okay. Yeah, you make a podcast. Sure, okay, that's fun." But little did he know that I would lob one million of all of our knee questions right at his face.

But before I ask him your questions, patrons, thank you for supporting the show, like a beloved crutch, since before the beginning. Anyone can join that club for a dollar a month. You can also send this episode to a friend, or rate, or subscribe, or even review because yes, I do read them and weep, happily. And this week's fresh review is from MaryMamaSunshyne who wrote:

I started listening when pregnant with my fourth little guy, especially on my trips to and from doctors' appointments, and your podcast helped mellow me out to get me through a post-miscarriage pregnancy. Now, fast forward and come to find out that apparently Ologies is the magic that mellows out my pandemic baby, who hates car rides.

So, MaryMama I'm super sorry your first child's sentence is going to be about butts or have the F word, but you're welcome. Also, *Smologies* episodes, they're released every two weeks, they're classroom and kid safe.

Okay, Genicular Traumatology. Genicular means 'of the knee' and the root in Latin means having knots or bent. And traumatology comes from the Greek for, 'to twist or to rub'. And Jarrett was like, "I mean, pretty spot on. The study of twisting and rubbing knee injuries. Boom." So, we talk about

joints, tendons versus ligaments, robot doctors, cartilage donuts, physical therapy, self-surgery, joint juices, sporty injections, donor tissues, pig legs, if weight has any effect on knee health, types of arthritis, how to make exercise like play and then how to play forever, which is the title of his new book, bionic body parts, biologic ones, the best exercises for healthy knees, creaking, popping, locking, bending, biking, walking, and if knees are the worst. Also, some of these asides go off on some stories that maybe you'll remember forever... I couldn't help but include them. This episode, it's a wild ride. You never knew your knees, but you will right now. So, pull up a seat or go for a walk, and get ready for an episode that we all *kneed* so much, with orthopedic surgeon and researcher, Dr. Kevin Stone.

Alie: Dr. Stone, can I get you a water or a tea or anything?

Dr. Stone: Water is good.

Alie: Yeah! Okay, we got that in spades.

Jarrett: All right, have a good interview.

Alie: We'll be right out here.

Jarrett: Do you want me to close the door, for sound?

Alie: I think it's fine. If you hear us and you want to chime in on anything as a patient... People are excited to figure out how their knees work and how most of their knees don't work.

Dr. Stone: So, it's Kevin Stone. It's he/him.

Alie: Cool. And *Dr.* Kevin Stone, do people call you Doc a lot?

Dr. Stone: They do.

Alie: Hey Doc! Do you think that's like an informal thing because they see you a lot, that you're not just like a surgeon who works on them while they're in twilight sleep? You see them follow up and stuff.

Dr. Stone: Yes, and the structure of our clinic is that our rehab team is right next... all on one floor. So, I'm floating around seeing them when they're rehabbing, when they're on the bike, when they're working with therapists, and so it's a very familiar environment.

Alie: I know when Jarrett had surgery, you called him to check on him like every day after surgery. He was like, "Oh, thanks, I'm doing well." You called me just to let me know how he was doing. So, do you feel like that's important, to have that kind of relationship, to check on people, make sure that you're not just cutting them open and saying bye-bye?

Dr. Stone: Yeah, the fun of what we do is to try and convince people to become athletes for life. So, if I can convince them to use their injury as an excuse to become fitter, faster, stronger, which is the phrase we like to use, than they've ever been, then it's a fun relationship for a lifetime because, number one, yes, I get to know them immediately after surgery and check in on them and make sure they're doing okay. But then number two, I get to see them as they come back for what we call Stone fit tests, which occur at 1 month, 3 months, 6 months, 1 year, and then every year thereafter because we want to figure out how do we help somebody become better than they've been before?

Alie: So, better than when they first came to you.

Dr. Stone: Yeah, so using that injury as an excuse to become better. We've got a whole rehab team, we're going to take a moment of your life when you're going to be really focused on your knee, shoulder, ankle, or whatever we fixed. And so, we can use that moment to engage you fully in your fitness program, in your diet, in your mental attitude. So, in order to do that, you need to have trust that I'm on board with you, not just during surgery, but immediately afterward and then forever.

The fun of what we get to do is that when we fix things and watch people go back and do... whether it's an Olympic sport and win a gold medal, or whether it's just to be able to go to the grocery store, but we get the feedback when they come back for their sport fit tests and show how they're doing and see how they are in life. So yes, to answer your question with a long-winded answer, that immediate phone call post-op, the next few days, and bonding with them during that little window of time when it's kind of scary, is a really important time.

Alie: Yeah, it definitely works. Now, obviously you were not born an orthopedic surgeon, you became one. How did you decide that cutting open and fixing knees, being a knee and a joint mechanic, how did that even come about?

Dr. Stone: So, probably two big events. One is that I went to college as a government major. *[laughs]*

Alie: Oh! Okay.

Dr. Stone: Then was playing soccer and tore my knee while playing soccer as a freshman, at Harvard. And in the training room after the brutal surgery at that time, I watched the orthopedic surgeon roam amongst the different athletes and check on them, the way I get to do now. And I so admired that environment and the ability to be around athletes who were trying to come back, the ability to help somebody who has broken something where you can fix it and they can get better, was just... clearly, I knew that that looked mighty attractive. So, that was the first major thing.

The second major thing was, unfortunately, that surgeon took out a key structure in my knee called the meniscus cartilage. I'm sure we'll get a chance to talk about that some more later. But that structure is critical to how the knee functions. And so, years later, I was out for a run with my mentor at the time, and he looked at my bowlegs and said, "You know Kevin, if you could ever figure out how to replace the meniscus, you'd make a big contribution to orthopedics." And in my typical Harvard arrogant way at the time I said, "Great I'll do it; you pay for it." *[Alie laughs]* That started out my entire research career around replacing tissues in people's bodies.

Aside: Augh, cut bangs, text your crush, ask someone for millions of dollars to learn how to replace parts of bodies. That's apparently how the world works. But how do knees work?

Alie: Let's get into it. Let's talk about what a meniscus is. I tried to study this before you got here so that I would not be a total dolt, but I understand that there are three bones involved in the knee. I'm going to let you start. What are we even looking at?

Dr. Stone: Okay. Well first of all, you've had some other folks on your show who have talked about the heart or the kidneys or other things, and let me just prioritize; the only purpose of the heart is to provide blood flow to the knee, *[Alie laughs]* so you need to understand our sense of priorities. Let's just get that straight up front.

Alie: Spoken like a true knee surgeon. *[laughs]*

Dr. Stone: Exactly, that's number one. Number two, in normal walking, you take 1 to 3 million steps per year at up to 5 times your body weight, depending on the height of the step because you're coming down on one leg and if you're coming down from a height it can be 5 times your body weight. So, for your knee joint to be able to take that many cycles and that many repetitions and not wear out, it needs to have some pretty unique structures inside it.

So, the key structures, that we'll probably get a chance to talk about and I'm sure your listeners would like to know about, are number one, the two types of cartilage. First, there's the articular cartilage, the shiny, white surface on the end of bones. When you crack open your chick wing, that white shiny surface, that's articular cartilage. And when you get arthritis, it's wearing away of that white shiny surface, down to the bone.

Aside: Quick visual, so there's cartilage coating the femoral condyles, AKA, the nards of your femur, as well as the top of the tibia and fibula shin bones. And between them, lie two C-shaped cartilage wafers, kind of like airplane neck pillows.

Dr. Stone: The second type of cartilage in the knee is a fibrous tissue called the meniscus cartilage; there's a medial one and a lateral one. And those things distribute the force inside the knee. So, when you walk those 1 to 3 million steps per year at up to 5 times body weight, that force gets distributed by the menisci so there's not one area that wears out. So unfortunately, when you tear one or somebody takes one out, it becomes dysfunctional, and you concentrate the force and start the wear process.

And then the other last key structures that everybody wants to know about of course are the ligaments inside the knee. You often hear about the ACL or the PCL and you hear about the medial collateral ligament and the lateral collateral ligament. So, these ligaments, you can think of as guide wires. So, you think about the marionette and the guide wires that make the marionette work; if one of those strings is broken, the arm on the marionette doesn't... it's floppy, right? Doesn't work so well. And that's true inside your knee. And so, if you tear that ligament, any of those ligaments, the knee doesn't flex and rotate in the normal pattern. And just like a car tire that's out of line, the tire wears down quickly down to the steel rim.

So, your knee wears down quickly to the steel rim when either the ligaments are torn or dysfunctional, or the meniscus has been removed or is torn. And that wear and tear is what we call post-traumatic arthritis, it's the most common kind of arthritis that people get and it's what really wears out the knees. Much of my career, and many of the things we'll talk about today are, how do you prevent that from happening?

Aside: So, the two most common kinds of knee arthritis, you got your osteoarthritis, which is a breakdown of that slippery cartilage from wear and tear, or injury, or infection. And then there's rheumatoid arthritis where the lining of the capsule that holds all your knee parts gets broken down by your own sneaky, jerky immune system. So, "Thanks Dick, I was using that!" you want to scream at your immune system, and I understand.

So yes, you have your femur, your tibia and your fibula shin bones, there's that patella kneecap, you got your LCL on the outside of your knee that connects the shin bone to the femur bone and it hurts like a goblin when you foam roller that, but it's also kind of so good. You have a medial collateral ligament, MCL, on the inside of your knee. And then your PCL ligament is on the backside, and then your ACL, the anterior cruciate ligament, running inside diagonally. Which is why we are up here recording this. It is a ligament that is not fun when it snaps. Is it a ligament? I guess yes, ACL, yes.

Alie: And what about a ligament and a tendon, what's the difference there?

Dr. Stone: So, the ligaments connect the bones, and the tendons connect the muscle to the bones. So, you have a patellar tendon in the front of your knee, and you have an ACL in the middle of the knee which is the ligament connecting the bones.

Alie: And you have to work on all of them, right?

Dr. Stone: All of them.

Alie: When someone injures their knee, and they hear a pop, and they know that they're screwed [*laughs*] ... That happened to Jarrett. What are they hearing? Are they hearing popping, tearing? When there's an injury like that, when you tore yours in soccer, what was that experience like?

Dr. Stone: Awful. There's an intrinsic nauseating feeling when it happens. [*Alie squirms*] So, when a patient sits down and says, "Hey Doc, I twisted my knee, I heard a pop, my knee swelled," they have a 90% chance of having torn one of the key structures in the knee, either the ligaments, the meniscus, or damaged the articular cartilage. [*scream of pain*] And that tearing leads to swelling, leads to nauseous feeling, leads to that instability, leads to all the problems that occur.

Alie: What about your meniscus? Did you ever get one back? Did you ever say, "Hey, I've figured it out! Let's put a meniscus back in there."

Dr. Stone: So, yes, I figured it out, but no I wasn't able to do it to myself. So, at the end of the day, my knee wore out and I had to have a partial knee replacement, which is what we do for people when they're down to bone-on-bone. So, it turns out that if you wear out your knee so the bone on the femur and the bone on the tibia are now rubbing against each other, that's what we call severe arthritis. And about 80% of people who are told they have severe arthritis and need to have a total knee replacement, actually don't.

Alie: Oh no.

Dr. Stone: They've worn down usually one part of the knee, not the entire knee. And depending on how much they wear it determines on whether we can do a biologic knee replacement, that we can talk about some more where we replace all these tissues, or whether or not we can do a partial replacement, or resurfacing.

Aside: So, in a partial, they'll go in and say, "Okay, this part of the femoral condyle, the femur nards, needs a new surface." So, Dr. Stone will do a bunch of imaging, make a computerized 3D model, and then perform the surgery outpatient, using a frickin' robot. And then, on the new surface, they smack some metal or plastic over the worn-down area, but they keep the healthy stuff as it is. It's kind of like having a tooth capped with crowns. But if things are not looking good, if things are more like "Nhhh" it might be a denture situation up in there.

Dr. Stone: We just put a cap over the worn-out part and a tray on the tibia, just on the worn-out part, not touch any of the rest of the knee. It's an outpatient procedure under robotic control and it's much easier for patients than a total knee replacement.

If they have totally worn out their knee, down to bone-on-bone or in multiple spots, then we do a total knee replacement. But even that's completely changed from what your parents' total knee replacement was. Now when we do that, it's an outpatient procedure, we use a robot in order to do it extremely precisely, we don't need to use cement anymore,

so the body can grow into the implant and the implant can become part of the patient. And therefore, we let our patients go back to running, climbing, and skiing and doing all the sports they want to do that previously they were told not to do after they have a partial or total knee replacement.

Alie: And is that like, terminator metal? Is that titanium? What kind of materials are you seeing put into knees to get them back in shape?

Dr. Stone: Sure. So, two big groups, the biologic replacement or the bionic replacement. If they're in a bionic replacement, that is metal and plastic, it's usually cobalt chrome on the femoral side and titanium on the tibial side, with a high molecular weight polyethylene tray in between which acts as the new meniscus.

If it's a biologic knee replacement, something we call the BioKnee, then I'm putting back in a new meniscus, regrowing the articular cartilage using a combination of growth factors and stem cell recruitment and all the cool things we're doing these days, rebuilding their ligaments, and creating a new biologic knee joint.

The big discussion of animal tissue versus human tissue. So, right now, we're only using human tissue. So, it will come back, the use of animal tissue to replace ligaments and meniscus was work that we spent 15 years doing and developed the first new successful pig ligament for people and I have people still skiing on those ligaments today.

Alie: Pig ligs, as they're called.

Dr. Stone: Pig ligs! We ran a successful clinical trial in Europe but for right now, it's all human tissue.

Aside: Okay, so to recap there are knee replacements that resurface using metal or a high molecular weight polyethylene, and then there's biologic, which Dr. Stone says can include stem cells injected into animal tissue or human cadaver tissue, which is beautiful and spooky, and relies on really generous donations from folks who are no longer with us. So, why do they use only that if it's harder to come by? Well, it turns out that it's one thing to be a brilliant surgeon, and compassionate doctor, and author, and innovative biotechnician, but when running animal trials there's a whole other bag of worms about needing to raise funding for research, a whole business thing, that's a real pain in the meniscus.

Alie: Now, you have some patents in this field, is that true?

Dr. Stone: Yes.

Alie: Can you give me a quick rundown on some of the patents you have? And what was that like applying for a patent and being like, "Dang, I really did do a lot of innovation in this field."

Dr. Stone: The first ones that I wrote were around a collagen scaffold for regrowing the meniscus. I remember at that time, back in the late '80s, when we tore them, they were taken out. My feeling at the time, the challenge from my mentor, was to figure out how to replace it. And so, at that time I thought, "Well if I don't have the right materials to replace it with, maybe I can stimulate the body to regrow it." So, I designed a collagen scaffold which could be sewn into the meniscus and other tissues, then you could tweak the tissues with growth factors and other things and stimulate the meniscus to regrow.

Alie: Oh wow.

Dr. Stone: And that actually was a successful approach, came on the market eventually. It's not currently on the market as we're going to build a new, better one now of a stronger, better collagen.

Alie: Now when you had knee surgery... This is a question from my dad, Larry Ward, [DJ airhorn] wants to know if you're like: Can just numb me up locally or put me in some kind of twilight where you have one eye open because as one of the best orthopedic surgeons on the planet, do you want to be able to work on your own knee or are you just like, "Put me out let me know how it goes"?

Dr. Stone: Yeah, so we did that for quite a while where patients would stay awake and comment on their surgery while we were doing their surgery and it turned out to be more of a distraction [*Alie laughs*] and not a big benefit. What's happened in anesthesia is that the drugs have gotten so good and so short-acting now, and the procedures are pretty quick, so most people go off and take a nap for 20 minutes, or a half an hour, or an hour and don't have the old hangover effects that we all used to have from anesthesia in the past.

Alie: And talk to me a little bit about the evolution of human knees. Obviously, we started off as crawling critters, and evolutionary-wise, are we still pretty new to walking upright? Are our knees still evolving to be a little bit more robust, or do you think evolution has found the final perfect mechanism?

Dr. Stone: So, it's an interesting comment because what's beating us first, evolution or our own advances in sports and activities? So, everyone wants to play sports more, harder, faster, and live longer and do them. So, could evolution ever catch up to the rate in which we're advancing our sports and our desires? I have a book coming out this December called *Play Forever*, and it addresses some of these issues; how do we adjust our sports and our desires to our bodies? And to adapt our bodies to be able to hopefully drop dead at 100 playing the sport you love. [*Alie laughs*]

Since evolution won't go fast enough to help all of us who are here now, it's our job on the science side to, number one, improve the techniques. Number two, improve the materials, and number three, to accelerate the healing. So, for instance as you know personally now, why does it take a year for an ACL injury to be operated on, the tissue replaced, and the patient to come back? Why does it take so long for the body to recover? Why is there so much stiffness? Why does the tissue take so long to remodel? And what can we do to accelerate that process?

While it won't be evolution that does it, it will be our addition of growth factors, stem cell recruitment factors. Because your body has billions of stem cells and there's no reason why we can't figure out – which is what we're doing in our research lab now – why we can't figure out how to add just the right factors to migrate all of your body's stem cells to that site of injury and accelerate the healing.

Alie: Aha, so say, "Hey! We need you over here! Rebuild this." It's kind of like calling the landlord when you're like, "We've got a drip here, get the contractor over." What is a growth factor exactly?

Dr. Stone: So, when you have an injury, your body, you have bleeding and the blood usually contains a host of proteins, and those proteins are commonly both growth factors that are factors that stimulate the cells to turn over and lay down new collagen; there are factors that are anti-fibrotic to stop scarring, there are factors that are anti-microbial to prevent an infection. So, what we want to do is use these factors, which we call growth factors, to

stimulate the healing, to turn on the cells, to have them lay down new collagen, to have you heal without scar as fast as possible.

Aside: If you're like, "What is a stem cell?" Well, they're really whatever you need them to be, kind of. Stem cells can turn into more stem cells [*"Very meta."*] or they can differentiate into blood cells, brain cells, bone, and muscle. It's kind of like if you were in a game of UNO, a stem cell is like a wild card. Oof! What a treasure, coming in clutch.

Dr. Stone: There are other factors called cytokines which are, again, proteins usually that help recruit your body's own stem cell-derived self-repair cells, which is what we're calling them with a very complicated name, because we've learned that the stem cells aren't really the cells that come and do work, it's their progeny. So, we can stimulate stem cells to create more progeny, to migrate those cells to the site of injury, and accelerate healing. So now, with almost every injury that I see in my office now, and almost every surgery that we do, we add stimulating factors to the site of injury or to the tissue that we're transplanting in order to accelerate that healing process.

Alie: So, does that cause more targeted inflammation to, sort of, recruit better healing? Does that blow up the knee a little bit more?

Dr. Stone: That's actually an interesting question you know, why would growth factors turn on more swelling, right? It turns out that some of them are more anti-inflammatory, or what we call immunomodulatory, they shut down inflammation, and others stimulate cells to produce more hyaluronic acid, the natural lubricant of the joint. So, the body knows how to titrate that if you have just the right combination, as I call it, the right chicken soup, [*Alie laughs*] where all the components are in there together and the chicken soup tastes great, but if you're missing salt, it doesn't taste so good. So, you need to have that right combination to not produce inflammation, but to stimulate healing.

Alie: I always think of joint issues like arthritis as a rheumatological issue and an inflammation issue. How much of the knee injuries and pain that we're having, how much of that is inflammation versus traumatic injury from soccer or jiu-jitsu, for example?

Dr. Stone: So, when we hear the word arthritis, 97% of arthritis is either osteoarthritis, genetic from your family, possibly, [*"Thanks, Grandma."*] or post-traumatic arthritis, you had an injury, you damaged the cartilage and it started to wear out. 3% of all arthritis is what we think of as inflammatory arthritis or rheumatoid arthritis, all those inflammation diseases that are fortunately these days being treated with very potent drugs. But it's not the section that I deal with; I deal with that 97% of post-injury arthritis.

Alie: And you have a lot of athletes on your roster too. What happens when there's an athlete who is paid to run, and jump, and go laterally, and use their knees, and they blow something out? How... I mean, there's so much at stake, their whole career. How do you even go about treating that? I imagine mentally it's got to be really difficult.

Dr. Stone: So, I'll tell you a fun story about that one. Because the person is deceased, I can use his name now, otherwise I wouldn't. So, one day I get a phone call from a very famous movie director, and he said, "Kevin, Robin Williams has just twisted and injured his knee. It's costing me \$450,000 a day for every day that he's off the set. How fast can you fix it and how long is he going to be out?"

Aside: The director? Francis Ford Coppola. Also, on the way to and from taking Jarrett to physical therapy for weeks after the surgery in the city, we would pass through a bridge in

Marin County, its upper arch has this faded rainbow and there's a freeway sign next to it noting that it is the Robin Williams Tunnel, which honestly kind of hurt every time.

But back to it, knees should not hurt too much, per millions of years of evolution. Right?

Dr. Stone: So, knees are designed beautifully, I'll give you a fun example from what we know from the animal kingdom. So, an elephant, 15,000 pounds or more, can run up to 30, 40, sometimes 50 miles an hour, lives for 60 years, almost never develops arthritis. Their cartilage is unique, it's a little bit thicker than ours, but it's still wonderful material and similar to our own cartilage. Your ankle joint almost never develops arthritis even though it's a tiny little joint that your entire body is on, unless you fracture your ankle or tear your ligaments and it's unstable. So, the joints, the cartilage in the joint is a brilliantly designed material; it's 5 times as slick as ice on ice, if it is not injured.

Alie: [*whispers*] Oh my god.

Dr. Stone: On the running side, run forever as long as you use good mechanics, short stride, great sneakers, prefer soft surfaces, all the good thoughts about good running mechanics are important to know.

Optimizing your weight is pretty critical and the reason, as I mentioned before, you're going to take 1 to 3 million steps per year at up to 5 times your body weight. And so, a 10-pound weight loss can be up to 50 pounds 1 to 3 million steps per year, that's a lot of force. So, optimizing your weight is one of the critical ways you can keep exercising and not damaging.

Picking multiple sports so that you don't become a one-sport athlete. If you're going to be a runner, for sure mix in biking, and pool, and weightlifting. Try to mix up your sports as much as possible. We know that resistance sports are the only way, especially for women, to counteract the osteoporosis that occurs with aging. So, you've got to hike the stairs, don't take the elevator, you need to do resistance exercise, weightlifting is particularly the best way, hill climbing, hiking. Do whatever you can to really load the muscles and the bones. And that's true even if you've had a joint replacement.

Aside: And just a quick circle back that yes, there is so much research on biomechanics and physics and the effects of body composition and muscle mass on the development and the prognosis for osteoarthritis. I was literally up until 4 in the morning last night reading meta-analyses on it and summation: there's just so much research to support that.

But I also wanted to acknowledge that weight optimization can be a challenge if you're in pain to begin with, or you've experienced factors like trauma, or lack of access or care, which exacerbated or, pardon the pun here, kicked off a weight struggle to begin with. It's also worth noting that not everyone who would call themselves fat, which is an acceptable term in the body-positivity community, struggles with their weight. Many are just fine the shape and size they are, and their knees are fine, and they struggle with maybe a knee-jerk diagnosis and the stigmas sometimes faced in healthcare.

Also, metrics used to assess health are not one-size-fits-all either. BMI is a really loose gauge for determining body composition. It was actually invented by an Austrian scientist who wasn't actually a medical doctor. But even a legit modern MD can tell you that of course, BMI does not tell the whole story, ask any body builder, or me the day after I eat soy sauce... I'm a talking sponge, with hair. But knowing that, some blanket medical guidelines might be less breezy to take in stride.

And I asked on Twitter in the middle of the night last night. I was like, “Any folks have thoughts about size and knees?” I heard all kinds of responses. From @Lordofgoats_ said:

6'1", been over 300lbs for the better part of my adult life. Yes, weight is killing my knees, and it's getting worse with age. It's more tolerable with good low-impact exercise (road biking). Anti-inflams and water help too.

And Nancy, who is a scientist said:

Personal anecdote: my knees hurt more when I'm heavier. Currently at a moderate weight for me (BMI 27) and they are mostly happy but occasionally gripe at me.

And J Hesby chimed in to say:

Overweight and 42-year desk career. Losing weight and moderate activity both helped. But I played a lot of basketball younger. Best exercise now is the bike.

And someone named Mixed Meridians said:

From my personal experience, the right exercise is also important. This begins with learning to stand and move safely. Qigong and Tai chi, yes! Yoga if you have an instructor who understands anatomy and challenges and can teach you modifications. Ditto for strength and balance.

Graham shared:

Hi! I've had knee problems most of my adult life, and it's been fascinating to watch how I was treated as an athletic 18-year-old vs a fat 32-year-old. Most recently, I tore my meniscus, and the first doctor I saw didn't even do an exam, he just told me to lose weight/quit soccer

Someone on Twitter, Marina, suggested that doctors take a more compassionate approach. Something along the lines of, “studies do show that weight plays a role in this but don’t focus on that as the cause.” Causation does not always mean correlation. It’s important to treat potentially weight-correlated issues as medical conditions first, bringing up weight as one of many possibilities.

And ultimately, I was pointed in the direction of a biomedical researcher and engineer, Dr. Deena AKA @ItsBrokenKnee [phonetic] on Twitter who wrote:

Hi, did my PhD evaluating osteoarthritis related knee pain, bone, body mass and distribution and bone mechanics. Simply put: it's complicated. It's a lot going on in that joint related to osteoarthritis and you can't just attribute pain to mass and activity.

She went on to say that pain is biopsychosocial, meaning there’s a lot to factor in.

Take home regarding mass and knee health: be as active as you can for as long as you can and as much as you are able to pain-wise, but don't overdo it.

After I saw that tweet, I tagged Dr. Rachel Zoffness from the Dolorology episode in this thread. As you can imagine, a Twitter friendship was born. And also worth noting that a lot of conditions can cause acute or chronic knee pain and the right diagnosis is important, as is good footwear. A few people said that getting the right shoes or seeing a podiatrist too helped them a lot and got them on the road, if you will, to a more active and happier lifestyle.

And myself, I used to love to run four or five times a week because you can turn up music and pound the pavement like boxing with your feet and I loved it. But true story, when I

launched *Ologies* in 2017 I stopped running like I used to, I just couldn't fit it in my day. And I also have gained an appreciation for homemade sourdough during the pandemic, and sure, my pants are a little tight but whatever. When we think about body composition, a lot of the times, it's really sexualized. How big is my butt? Can you see my abs? Does this look hot? And that's all appearance and that shit does not matter and it's nobody's business.

But I have to say that this conversation and working on this episode, looking at my body as kind of a biomechanical marvel, and movement as play, and maintenance for it as opposed to a sentence that I was served for neglecting my sneakers, has gotten me really jazzed to take better care of it in a way that feels good to me, both mind and body, better than anything else I've read or heard for years. So, I hope no matter what, you're feeling less pain, more happiness and, whether from an injury or wear and tear, that you do not need a knee replacement. But back to exercise. Even after having a little work done in there.

Dr. Stone: So, in the old days, doctors told patients after joint replacement, "Go home and rest your knee." It did two terrible things, number one, their muscles got weak and number two, their bones became osteoporotic. And so we, after we do a partial or total knee replacement these days, explain to our patients that the more they exercise, the better they're going to do, the stronger their bones will be, the better the muscles, the more they'll protect their joints, and we've never seen a joint worn out from exercise. So, all those years of doctors telling patients to rest the knee and protect it, we don't think is the right advice today.

Alie: Oof. Yeah, I was going to say, Jarrett went into your clinic, like, the next day to start physical therapy, (during which he cried). He said it was the hardest exercise he's ever done, just lifting his leg straight, and this is a guy who has powerlifted and grappled until he's choked to death. So, why is it so important to do PT and when do you know if it's just something that you have to do physical therapy on versus get in there with a knife and noodle around?

Dr. Stone: So, let me give you an example. For my ballet dancers, if they suffer a knee injury, an ACL injury or a meniscus injury, immediately in the recovery room, I have them extend their leg and see their line. [*Just want to be perfect.*] It's so important for their brain to see their line, to know that they're going to be able to come back to that beautiful extension that they're so good at doing, both men and women.

So, the reason the patients are in our clinic the next day after surgery is that they know immediately that they shouldn't treat themselves as an injured, wounded animal and hide in bed. Getting moving right away, mentally knowing that they can do it, having a therapist do manual therapy to push the fluids out of the swollen joint, to get them contracting their muscles right away, to get them moving through a range of motion, all of that can start right away and we don't let them get stiff and sore, which is natural after any injury or surgery, which will occur, but we want to have it occur in the least amount possible.

Alie: Right, so it's not like when I got my tonsils out and went home after surgery and ate gallons of ice cream every day.

Dr. Stone: I wish there was ice cream for the knee. [*Alie laughs*] That's what we have with these cold machines now, these cold compression machines.

Aside: PS, now there are these electronic contraptions that involve a hose and a cooler full of ice and water. Are they magic? A little bit.

Dr. Stone: They're like ice cream for the knee.

Alie: Now, are those pretty new on the scene?

Dr. Stone: They've actually been around for the last 10 years. They weren't as good as they are now. So, immediately after surgery, we use these ice compression machines that intermittently provide compression, pumping the fluid out, icing, which we do for 20 minutes each hour while they're awake.

Alie: Yeah, Jarrett was like, "I don't think I need one of those," and literally the next day was like, "Yeah, I got one." So, he's got one rented. It's like a blood pressure cuff that has cold water going through it, so you don't have to keep holding soggy ice packs. I realized that the bags of frozen peas I got him were not necessary after all. *[laughs]* I thought he'd need them. Can I ask you listener questions?

Dr. Stone: Sure.

Alie: Oh, we have so many good ones. Also, we donate to a charity every episode in your name. Is there a related charity or foundation or your own that you would want the donation going to?

Dr. Stone: So, the Stone Research Foundation is a public nonprofit, 501(c)(3), dedicated to the science of accelerating healing and reducing, treating, and preventing arthritis. We're driven on the research side and it's all through that public research foundation and you can find it at StoneResearch.org.

Alie: Great! We're going to do a donation to them. Woo-hoo-hoo!

Aside: So yes, a donation is going to StoneResearch.org and their mission is to pioneer new orthopedic treatments that accelerate healing and enable people to stay active through research, development, innovation, and education. They are an independent 501(c)(3) nonprofit. So, a donation went to StoneResearch.org thanks to sponsors of the show who you will hear about now.

[Ad Break]

Okay, this first patron-submitted question was asked by Alex Opp, as well as a few others.

Alie: Okay, questions. Mike Monikowski, Denise, and Abraham Livingston all wanted to know, Mike said: Do supplements like glucosamine or boron actually do anything or are they expensive placebos? Denise wants to know: Does drinking collagen affect the joints or do you just pee it out? Abraham, same question. Anything you can eat? You mentioned chicken soup, does eating a lot of collagen and bone broth, does that actually affect our joints at all?

Dr. Stone: So, let me answer that in two ways. Of all the supplements, we think that the best science is around glucosamine. It's been around a long time, there are plenty of good studies that show that it does get into the joints and into the tissues, it's a precursor for building cartilage. The most common thing we hear from patients over the last 20 years of giving them glucosamine is that patients say they feel less stiff after they take glucosamine. So, it's objective proof that the glucosamine is getting into the bloodstream and doing something.

Collagen, on the other hand, when you eat it, is a steak, it's digested quite completely by the stomach acid. So, taking additional oral collagen does not produce a benefit. Eating protein, which is collagen in proteins, amino acids, is an important part of your diet. So, we

generally advise patients to be on a high protein, low carb, low-fat diet, lean protein. That's probably the healthiest way to optimize your weight when you add at least eight glasses of water to it each day. The water part is... you think of supplements. We think water is the primary beverage that most people should drink. If you can lift the glass of water before you lift the fork, most people will find they feel a little full and it is good portion control. If you're an athlete, if you can use both water and protein as your primary food sources, you generally build muscle and stay healthy.

Aside: And Dr. Stone has written on this, most recently in his book *Play Forever* that was released literally yesterday. He writes:

Here's what you need to know: complete or quality protein is protein that has all the essential amino acids required for health. Lean protein sources such as skinless chicken or turkey, 90% or leaner ground beef, low fat or non-fat dairy, seafood, soy products, pork loin, and eggs are ideal. Incomplete proteins such as beans, oatmeal, barley, corn, nuts, and seeds are missing some of the essential amino acids and must be combined with other foods.

For good health maintenance, he recommends 0.8 to 1.5 grams per kilogram of body weight. So, do some beep-bop-beep-bop and you figure out how many grams of protein a day. He also says that for sick or injured people trying to build muscle, the recommendation increases to 2 grams per kilogram a day. But he warns that other health issues must be taken into account before introducing any dramatic increases in protein intake. Always consult your own physician before making any changes.

He's also written via some blog posts on his website, which is just like a treasure trove of orthopedic articles he's written, and he writes:

Fats and carbohydrates and sugars are also essential parts of diets yet most everyone gets an excess of both, and it takes an effort to get protein. But if it's consumed in the morning, protein carries most people through the day's activities longer than other choices. It's protein that builds muscle and provides the longest lasting energy supply, it helps the immune system resist infection, [Good to know during these times] and it also allows bones to build mass and helps your tissues repair.

So, he tends to recommend using carbohydrates and fattier foods as kind of a garnish to complement protein dishes and vegetables. So, washing down a chicken breast with a 2-liter of Mountain Dew is not good? No. It's not good.

And gird your bladders because one of Dr. Stone's posts is about to get you so horny for water. He writes:

Water is the ideal beverage; no calories, no sugar, pure taste, and an optimal source of hydration. There are millions of people who, if they drank water more often would save untold dollars while improving their performance.

Damn, this guy just managed to single-handedly be a water influencer. And working on this episode is the most hydrated I've ever been in years. I'm not kidding, I peed so much. I'm not mad about it.

And if you're wanting to up your glucosamine but, like Dr. Stone's patients, you don't want to kick back six big pills a day, that joint juice, which he no longer owns, can still do the trick. It has 1500mg of glucosamine and 200 mg of chondroitin per serving. And I wasn't

going to mention all that because it sounds like we must have just gotten free knee surgery out of it, and trust me, oh boy, we did not. This was very out of network and lots of money, but worth it.

But I dug around into studies and there was this one 2018 paper in the *Clinical Rheumatology Journal* entitled, “Effects of glucosamine in patients with osteoarthritis of the knee: a systematic review and meta-analysis” found that 67% of published studies showed that glucosamine was effective in reducing pain and osteoarthritic symptoms compared with a placebo. Also, joint juice, not to be confused with a juice joint, which is prohibition-era language for the klerb.

Okay, speaking of loud, so many of you patrons, including Laurinda, Dessirae Minetti-Hultin, Tony Vessels, Aubrey Nelson, Lina Zikas, Ruby, Erica Zalk, Careless Kitty, Megan Stingle, Anna Guzman, Adèle Maisonneuve, EdNoGG, Danielle Rosa, Silvia T. Christi Kazakov all had questions about our crunchy, creaky, poppy, squeaky parts, or as Michelle Chick called them: My favorite joint to hate, the knees.

Alie: Let’s get to noises. Aubrey Nelson, OtterApocalypse, and Jennifer Wysokowski all wanted to know: Truth or flimflam that popping or cracking your knees can cause problems later? And OtterApocalypse said: Why do my knees crackle like popcorn on the way upstairs but there’s not a sound when descending? Jennifer said: I get a soft crunchy sound in my knees when I go downstairs. So, what is that? When I do squats, they crunch and it’s terrifying. What is going on in there?

Dr. Stone: So, two major groups of noises in the knee. Snap, crackle, and pop for the knee. So, occasional pops and cracks of your joints are pretty normal and almost everybody has them. As long as they’re harmonious and not cacophonous, we generally don’t pay too much attention.

Aside: By the way, this noise has a name. It’s called crepitus and it comes from the Latin word for “rattle” and it happens when you get air bubbles in your tissues or when ligaments, those straps that secure bones to bones, or tendons, which attach muscles to bone, snap over your knee bones. It’s usually pretty harmless and painless... usually.

Dr. Stone: The grinding in the front of your knee though, going up or down stairs is usually your kneecap loading on the femur and that sometimes can be a sign of rough cartilage there or tissue getting caught. Generally, we ignore it as long as it’s not producing pain or swelling. If you come into the office and say, “Hey, I’ve got some noise there,” and we feel your knee and there’s a little bit of grinding but no pain or swelling with it, we’ll generally ignore it or provide a lubrication injection if it’s bothersome in any way. If there’s grinding associated with pain or swelling, then that’s damaging the cartilage and there we want to address it. And we can address it either with injections or surgery to smooth it down or regrow the cartilage depending on how bad it is.

Aside: Okay, so that lubrication injection is called viscosupplementation and it’s usually a gel form of hyaluronic acid, which if you listened to the Glycobiology episode from 2018, you’ll know is a carbohydrate that your body already makes, and it binds to water up to 1,000 times its volume. They inject about 2 mL of it right into the joint capsule around your knee. If they have any left over, maybe they can jam it in your face because if hyaluronic acid injections sound familiar, think Juvéderm and Restylane and other dermal fillers. PS, they won’t actually do that.

But trend-wise, medically, cortisone injections are passé and what surgeons, like Dr. Stone, recommend, is getting things all juicy with anabolic therapy or stimulating the tissues. He says that instead of injecting stem cells directly since we already have billions of them, but injected ones can die off quickly, docs like him use cytokines, which is what cells use to direct, as he calls it, a symphony of healing.

And patron Ryan Martin wrote in, said: Long-time listener, first-time question-asker. What role are plasma-rich platelet injections (or PRPs) playing in today's procedures? He wanted to know if the good doctor and his patients had any thoughts on that, Ryan has had three of them. So, I looked this up. So PRP, platelet-rich plasma injections, that's when they take your blood, they concentrate the platelets, which are tiny cell fragments that help clotting, they look for damaged tissue to repair. You can also call platelets thrombocytes for short, and these things are just chock-a-block with growth factors and cytokines. So, they do kind of one of those wolf whistles at stem cells and they say, "Hey, [*whistle*] get your asses over here, we got some tissue to fix."

But what about cartilage makeovers? Patron Shannon Patterson asked: When can we grow new cartilage in humans? Asking for a me. And Samantha Reyes shades knees, asked straight up: Why are they so injury prone? Mara Rosenbloom said that they tore their meniscus and didn't need surgery, but Beverly Sobelman wants to know, in their words: about snipping off all the jaggedy bits of cartilage like a shredded meniscus... theirs having been thrice torn. Which, ouch ouch!

Alie: How does the cartilage get shreddy like that?

Dr. Stone: Yes, remember that smooth surface that's five times as slick as ice on ice and can go 1 to 3 million steps per year? Well, that only works when it's white and shiny like the chicken wing that you crack open. As soon as you damage it, either by hitting it directly or by losing the meniscus and therefore there's more force concentration, or by tearing the ligaments so there's abnormal rotations and pivoting in the joint, any of those mechanisms will cause that smooth surface to now become rough.

If you damage it, we want to repair that surface right away and we've got very good techniques for stimulating the cartilage to regrow now. One of them that we invented back in 1991 was called articular cartilage paste grafting, it's like grouting a hole in the wall. So, if you have a hole in your cartilage, we want to fill that before it becomes too big a hole in the cartilage.

So, back to your grinding question, if there are no symptoms, we generally ignore it. If it's causing pain or swelling, we want to pay attention.

Alie: Is it kind of like dentistry? If you've got a knee injury, is it better to get it looked at earlier, so it doesn't cause you the equivalent of a root canal later?

Dr. Stone: Yes. So, best example of that is if you have a meniscus tear, you want the surgeon to repair it. If they have to take it out, you want them to replace it right away before you develop the arthritis that will certainly occur from losing the meniscus.

Alie: Like what happened to you a little bit?

Dr. Stone: Yes.

Alie: Now, your wife is also a patient?

Dr. Stone: Oh, she's been a patient a number of times, unfortunately, from ski injuries and other things. It's always challenging.

Alie: Do you operate on her?

Dr. Stone: I do.

Alie: [*gasps*] Is she like, "All right, a lot on the line here." [*laughs*]

Dr. Stone: Yes. But fortunately, there's no one else she trusts more.

Alie: I imagine.

Dr. Stone: And she knows that I would do anything possible to make it come out right. But it is stressful and there's lots of folks who think that you shouldn't take on the liability and responsibility of repairing a family member, and I think that that has validity as well. So, there has to be only certain circumstances when you or somebody feels like you're the best in the world at doing that particular procedure, then it seems like it may be the right thing to do.

Alie: Yeah, I would trust you.

Aside: But would you trust you? You know, my dad, L. Ward asked earlier if Dr. Stone is ever tempted to operate on himself and, obviously as your Grandpod, he's being cheeky. But this did not stop me from spending way too long reading old medical documentation of autosurgery. So please, grab my creepy, boney hand and descend for a quick diversion on surgeons who read their own Yelp reviews and were like, "Yeah, this is the doctor for me."

So, really quickly, in the 1920s, there was a German medical student who was like, "Yo, what if instead of cracking open a chest, we just jammed a tube through some veins to reach the heart?" And other doctors were like, "The fuck dude? No." And he told a nurse about it who was like, "I'm down to clown. That's a great idea dude, try it on me." So, he sedated her, numbed her up, and then he was like, "Psych! Too dangerous, I'm shoving this thing up my own elbow vein." And another doctor saw what was happening, was like, "You're trippin' dude, no."

And then a dramatic tussle ensued but this doctor, Werner Theodor Otto Forssmann, made it, jammed a two-foot-long catheter all the way to his heart, and then calmly walked himself to the X-ray department to get a gander at this handiwork. What kind of penalty did he get for this recklessness? Well, the Nobel prize. What a happy ending. Nnh, not really, he was also a Nazi.

But you know who wasn't? Ines Ramirez Perez, who was a woman living in a remote region of Oaxaca, Mexico. She was in labor, this was in the year 2000, with her ninth child and realized, this kid isn't taking the open-door option, she's going to have to make him a window. She sat herself on a stool, she took three shots of hard liquor, got to work using a kitchen knife and some skills she learned butchering animals, and that is enough detail. But she and the baby survived and later she was like, "Yeah, don't recommend that." But every March 5th I think we should all celebrate her son Orlando Ruiz Ramirez' birthday. I hope he gives her at least a card every year.

Also, there was a 1960 autosurgery by a Russian doctor on an Antarctic expedition who realized he had no choice but to break up with his bitch of an appendix, and he was the only person available on this icy continent to remove it. He described the pain that led him

to operate on himself. He wrote, "It hurts like the devil, a snowstorm whipping through my soul, wailing like 100 jackals." God, I wish this guy had a blog.

But the autosurgery, honestly, that sticks with me the most, last one I promise. Pennsylvania surgeon, Dr. Evan O'Neill Kane, who was not only the owner of Kane Hospital, but he was also a client. He too had an appendix needing ousting and he really just put the patient in inpatient because in peak passive aggression, or like the worst episode of *Under the Covers Boss*, he decided, "You know what, we're going to do it live. I got this." He did what anyone would do; he spent half an hour injecting himself with adrenaline and cocaine, did a little cut-cut snippy-snippy appendectomy. Maybe some of his guts fell out and he had to stuff them back in, to the horror of all of the other medical personnel but he gives himself five stars. In fact, becomes a repeat patient of himself. He operates on his own hernia a few years later.

But that's not all he's known for. I found out he also helped invent music therapy in operating rooms, bringing in a record player with some chill jams to help his patients relax. He also invented asbestos Band-Aids, and clear peek-a-boo windows for your skull. You know what? Not every idea is a good idea and that's okay.

"Let's get back to knees!" you're screaming at your windshield while I google fruitlessly for the 1917 paper, "Sheet mica plate for brain covering," which I never found.

Anyway, people want to know about the pain factor. So, patron Ashley Oki, cut surgically right to the chase asking, very important: Why do my knees hurt all the time? And this was echoed in various degrees by patrons Leanna Shuster, Jesse Hurlburt, Pam, Lynn Hodnett, Elize, Alanna Richman, Olga, and Alli Barg who asked again: Why do they hurt so much? Seems like a design flaw.

Alie: Pain factor, how painful is that surgery? A knee surgery?

Dr. Stone: So, pain is very individual. Number one, we don't think there's any benefit to having pain so we want to do all the little tricks we can to help your husband and others not suffer from pain because pain causes you to freeze up, and to stop moving, and to be depressed, and all the things that we don't like. We want you to feel great about it and be moving and be active. We like to avoid narcotics whenever we can because of all their downsides and their inhibition of muscle function. But we have better long-acting injections, we have better patches, we have exercise right away, and soft tissue, and ice, and all those things. We have boosting up your attitude about your healing which definitely decreases pain. So, we find that people vary widely in their pain response to a procedure, and we respect their responses. Our job is to figure out what is going to work for that individual patient.

Alie: That's good to know. I think a lot of people figure, you get knee surgery, you're going to be on Vicodin for 6 months which is like... oyyy, not everyone wants that.

Dr. Stone: We hope not.

Aside: For more on what is pain, why do things hurt, what's acute immediate pain versus longer chronic pain, and how can outside factors reduce how we feel pain, AKA the biopsychosocial pain model, check out that Dolorology episode with Dr. Rachel Zoffness, herself a sufferer of chronic pain from an injury. She also has a workbook to help you understand your own pain and how social and psychological factors come into play when it comes to disability. The TLDR is it's not all in your head or imaginary, or made up, or your fault. And not all doctors get that.

I was actually really impressed after Jarrett's pre-surgery appointment, when he left Dr. Stone's office with a pamphlet written by Kevin himself, which explained that:

The surgery happens, all goes well, you begin your rehab, but a couple weeks later, you hit the skids, you've had it. You're sick of the soreness, the dressings, the ice machines, the knee braces, the PT appointments, you just want your life back. There's a name for this malaise, you have officially acquired ACL depression syndrome and a recent study documented that 40% of people who undergo ACL surgery experience clinically diagnosable depression.

So yes, of course our bodies affect our minds, our minds affect our bodies, and a good doctor knows that pain is real and that the big picture will get you feeling better faster and that psychology of a physical condition is not just for the birds, which is the worst segue I've ever done to read one patron question from Sarah Meadon who said: Do you know why some animals have knees in reverse? And Jacob Elsbree who asked: Why do chickens and birds have backward bending knees, and we don't? Which is better from an evolutionary standpoint? I'm still not convinced people are better than chickens, Jacob writes, which might be true. Another patron Maria responded to Jacob and said: They don't. What we see as a backwards knee is actually their ankles and their knees are further up, hidden under the feathers. So, thank you Maria for answering that question.

But you know what my favorite animal part ever is? It's the apian femorotibial joints... those are the bees' knees. Now, this is my show, I do what I want, I'm leaving it in. Okay, what else is weird? Your babies.

Alie: Let's talk babies and how weird they are. A lot of people including Jesse Hurlburt wanted to know: Why are babies born without a kneecap? Are they? Someone told me this once. Is this true? Do babies not have kneecaps?

Dr. Stone: Not that I know of, I think they all have kneecaps; they're just nice and small.

Alie: Okay, so they're not born without them?

Dr. Stone: Not that I know of.

Alie: Okay, that's some big flimflam that we've just debunked because for a second, I was like, where do they get them later?

Dr. Stone: So, let me explain, the kneecap is what we call a sesamoid bone so it's a very small ossification within the tendon. You have them underneath your great toe, you have one at the front of the knee. At birth, they're very, very small, that ossification center. And what happens is they grow, that center ossifies and becomes a real kneecap. So yes, it's not truly what you think of as your normal kneecap, but it is an ossification center, and it becomes that sesamoid bone.

Alie: Oh, but it's teeny tiny.

Dr. Stone: It's teeny tiny.

Alie: Catie Noble had a good question: Why do we have kneecaps? And why don't our elbows have elbow caps?

Dr. Stone: Super good question, Catie. So, if you look at the long lever arm of your leg, in order for your quadriceps muscle to lift your shin, it would have to be much larger if it didn't have the lever arm of the patella, the kneecap, right in between. So, by firing the muscle of your quad, loading that kneecap on the center through the patellar tendon, you can lift your

shin. That's why. In your arm, you don't have such a long lever arm, it doesn't need as powerful a muscle to extend your elbow, and you also can use gravity.

Alie: Is the patella kind of like a fulcrum in that sense?

Dr. Stone: Yes, great example.

Alie: Ahh! Physical indeed.

Dr. Stone: Archimedes, right away.

Alie: Good to know!

Aside: Physical and physics both come from a root word meaning nature in case you have a Zoom trivia night you need to win.

Now, tall folks, let's talk. ViolentBadger wants to know: Is there an actual correlation between being tall and having bad knees? How can I stop my knees from killing me in the future? And Grace Robisheaux and Leanna Shuster's 13-year-old daughter Sammy, both want to know about growing pains, leg length, and knees. So yes, physical physics.

Alie: Isle Van Meerbeek says: Does the ratio of lower leg length to upper leg length affect your likelihood to having knee pain in certain activities? And also, if you have more muscle on your upper leg versus your lower leg, does that affect your knee health at all?

Dr. Stone: Not really except to say that muscle balance is always helpful. So, folks who are doing one type of exercise exclusively, we really try to focus them on doing more than one exercise and becoming fit all around and having a balanced musculature.

Alie: I like the idea that if you are exercising and you are more fit, [*voice gradually lowers into a whisper*] you'll save money on knee surgeries later, because they're not cheap.

Dr. Stone: True.

Alie: [*laughs*] You're like, "I guess I'll go for a walk because I'd rather buy a boat than knee surgery." Okay, great question here. Mark Shipp wants to know: Do allografts, bone tendon bone grafts particularly remain the standard of treatment for torn ACLs? Are there new technologies on the forefront?

Aside: Also, so many people have FML ACLs, or loved ones who have snapped theirs, including question askers Mo Fo, Margret Shepard, Jennifer Green, Melea Holland, DreamTree CaliGirl, Nolan Childerhose, Pam, Kerry Constantino, and Keenan Dailey. So, they all wanted to know about ACL surgery. Many folks asked about donor tissue, AKA allografts versus autografts, like patron Kelly Olsen who has a donor tendon and Erin Sandvold.

Alie: So yes, grafting human tissue was a big question and Anna Rubino wants to know: Does the body reject cadaver tendons? If no, why not? And if yes, are there anti-rejection meds needed? Because if you get a transplant of anything else, you'd have to worry about your body saying, "Get out of here," right?

Dr. Stone: So, that's a great series of questions. So, let's start with the first principle. Number one, donor tissue. The person is asking about allografts and patellar tendon bone allografts. So, when you tear your ACL, we have a choice of which tissues to replace it with. We can use your own tissues, your own patellar tendon, which is called a patellar tendon bone, your quadriceps tendon, or your hamstrings tendons. Each of those tendons requires a second surgery so we're robbing Peter to pay Paul; we're producing a second injury to repair the

first injury. And intuitively, I think that's a terrible idea. I did it for the first half of my career because that's all we had.

But then what happened about 15 years ago is that tissue banks got very, very good at providing donor tissue. Unfortunately, it's usually a donorcycle, somebody who has fallen off their motorcycle at a young age and has donated their tissues. So then, once we have tissues that have been tested so we know they're not contaminated and that they've not been irradiated, so just fresh, frozen tissues. We can then use them instead of taking the tissues from the patient's own body. And these days, we can add growth factors and cytokines to stimulate stem cell-derived cells to migrate into them and accelerate the healing.

So now, when we rebuild knees, our preference is to use donor tissue. However, there is some data to say that the re-rupture rate of donor tissue is higher than the re-rupture rate of the patient's own tissue. And the reason for that probably is the wide variety of donor tissues that are there.

There is no rejection and the reason for that is since the tissue is dead, there are no live cells to stimulate another part of the rejection phenomenon. When you get a heart transplant or a kidney transplant, we have to keep that tissue alive, and therefore you have all those live cells and therefore you need anti-rejection drugs. In orthopedics, we have the luxury of having dead tissue, which we then want to recreate to be live, but we want it to be live with your own cells so we don't have a rejection phenomenon.

Alie: Is it vascularized at all?

Dr. Stone: Not at first. We have to stimulate the blood supply to grow into it, which is part of those growth factors and cytokines.

Alie: And how old usually is that tissue? Is it usually a recent donation or are you able to flash freeze it and keep it until it's appropriate for a certain patient?

Dr. Stone: Yes, the tissues are fresh frozen, we only use tissues from people under 40 years of age and healthy, but there's always a shortage of good tissues for orthopedic donation. So, everybody, if they can, should check off that little box on their driver's license saying they're willing to be a donor if they unfortunately have an accident. But for orthopedic tissues, we only use them from people under 40.

Alie: And it seems like there's, it's really appreciated by the donor's family to hear from someone who has gotten the tissue and to say thank you for this donation, thanks for facilitating it, this allows me to get back to my activities and things like that.

Dr. Stone: It's a real gift. I wish in our country we had what's called an opt-in or opt-out. Right now, you have to opt in to become a donor and it would be so much better if you had to opt out. The reason is because people would not do it, they'd forget to do it, and everybody would basically be a donor unless they chose not to be and that would solve the tissue supply problem in the United States.

Alie: Also, how cool would it be if you're dead but then you're also winning Olympic medals?

Dr. Stone: There you go.

Alie: You're like, my knee tendon did that!

Dr. Stone: That's right.

Aside: So, Dr. Stone told me that so many lives are changed and saved by tissue and organ donation and that motorcyclists are one of the more common causes of fatalities for the donors, so much so that some people call really fast motorcycles, donorcycles. And I have never heard that term and I certainly understand why many people would have a harsh reaction to it. I asked Jarrett, who both has a donor ligament and has ridden motorcycles for years, and he said that acknowledging the risks that come with riding and the potential anguish that can follow those risks is a reality, kind of deserves to be acknowledged. Riding is scary and risky.

I went to look into this, I was reading a comment thread on Reddit in a motorcycle group about the term donorcycles and one rider wrote, "In the UK, bikes make up 1% of road traffic but are involved in 20% of incidents where someone is killed or seriously injured. No one buys a bike to be safe." Although there are some economic benefits; parking. My point is, if you can opt-in, the rest of us to save a life, do it. And thank you to any family who has facilitated tissue and organ donation from a family whose lives were changed by it, seriously.

And patron and philosopher Allie Rosser asked: Why use cadaver ligaments when we could be making super jumpers or runners by using cheetah or kangaroo ligaments instead? And that's a good question. Sure. They're working on animal transplants, and Allie Rosser, you're not going to swoop in and steal a gold medal with any kangaroo upgrade just yet, so just take a seat. And if you're Michael Swords, take a seat too, because you deserve a break too.

Alie: Oh yeah, Michael Swords had a great question: What can workers that stand all day do to protect their knees? Michael has inserts which seem to help but they want to know more. So, if you have an occupational hazard, how can you make your knees happier?

Dr. Stone: Super good question. So, number one, shoe wear. Having good shock-absorbing shoe wear is important. If you're using orthotics, try to avoid this hard, stiff carbon fiber orthotics because basically, Nike and everybody else spent tens of millions of dollars designing these very cool, shock-absorbing soles and then you go and put the street on top of it when you wear a hard orthotic.

Alie: [laughs] I didn't think about that.

Dr. Stone: So, avoid those hard orthotics, that's number two. Number three, moving and exercising. So don't stand still, see if you can move around all the time. Number four, we do recommend people use glucosamine because they feel less stiff. Number five, exercising in the morning before you go to work, getting the blood flow going, it really does seem to help a lot of people. And trying to get on a bike, spinning, doing whatever you can to get motion going. These are the key things, optimizing your weight of course, building your strength, this is how you protect your knees.

Alie: How do you feel about treadmill desks?

Dr. Stone: I think anything that induces people to move is helpful. Sitting is the cigarettes of the 21st century.

Alie: Oh, so true. How do you feel about high heels?

Dr. Stone: I love high heels.

Alie: Do they make you a lot of patients?

Dr. Stone: They actually don't. The foot doctors see the bunions, which I don't see. But we don't really see knee injuries or ankle injuries from high heels.

Alie: Okay. A few people had questions about patellar instability. Hope wants to know: Why does your patella float like that? They used to be a ballerina and something that happened not infrequently was someone would grab their kneecap instead of legs and it would just move. My niece also has patellar instability and had to get some surgery and it still dislodges. GaelicPearl wants to know why kneecaps dislodge. [*whispers*] What's happening there?

Dr. Stone: So, that's a really big question because a kneecap can dislodge for reasons starting at the low back, down to the feet. The angle of your hips, the angle of your bones, the way you stand, all of those things affect the angle of the kneecap in the trochlear, the groove of the femur.

Picking your parents badly is one of the other ways. [*Alie laughs*] So if your parents have given you genes that cause either shallow grooves or hypermobility of the collagen, called Ehlers-Danlos disease where people are much more flexible than others, then they'll have more mobile kneecaps. Almost all of my ballet dancers fit on some scale of hypermobility, and they all have quite mobile kneecaps, and unless they dislocate them then they're not a problem, usually.

When the kneecap dislocates though, that means you've torn the key ligament, called the medial patellofemoral ligament. Because you can't get the kneecap out of the groove usually without really badly stretching or tearing that ligament. Fortunately, these days, we've got a very good repair technique for that ligament and can put the kneecap back where it belongs. But again, if you've chosen your parents badly and have very shallow trochlear grooves, you may dislocate again and so, got to get pickin' better.

Alie: Gotta pick 'em better. What about in ballet, do people with hypermobility tend to be the ones who succeed in ballet? Or does it happen over time?

Dr. Stone: I don't think there's a correlation between hypermobility and ballet success. Ballet success is a magical interaction between artistry and physical ability. Very early on, when I started caring for ballet dancers in the late '80s, they were all smoking and had terrible diets and influenced by Balanchine and not particularly cross-training at all. Fortunately, the entire sport and art of ballet evolved so that we can now treat the dancers as athletes, not just artists. So, they can train as athletes, they can do cross training, they can optimize their diets, we got rid of the cigarettes. And by cross training, they can jump higher, land better, diminish their injury rate, come back from injuries faster. So, I think those are more important factors than their mobility status, and their sense of artistry determines their success as well.

Aside: And if you're like, I'm sorry, I grew up watching a lot of *Three's Company* reruns and not ballet, who is Balanchine? Well, I googled that for us, and he cofounded The New York City Ballet and also married a bunch of his dancers including one who was 16. So, I'm guessing, kind of weird culture around that scene, not a super healthy or safe vibe, but hopefully times have changed. And yes, patrons Hope, Patricia Denn, Lindsay Mixer who have been ballet dancers, I hope that you are plie-ase taking care of your knees, plie-ase.

Okay, this next one is a great question. It was also on the mind of Edgar Barrera, and I'm sure a lot of us out there who are like, "I never want to have knee surgery, thank you so much."

Alie: I thought this was a great question, Jolin Bloom wants to know: What is the best way for an overweight person to protect their knees while exercising to lose weight?

Dr. Stone: It's a great question and we counsel lots of patients over the years on how to get to their optimal status. I think most people find if they have access to a pool that it's a great way to train. You don't have to be a swimmer, just walking pool laps, if you walk side to side in a swimming pool and walk 20 laps and every day you walk side to side in chest deep water, a little faster than you did the day before, you'll have a great cardiovascular workout.

Also doing any of the other exercises. Particularly, I think the best single thing to do is to get a trainer. It's very hard to exercise hard enough to change your intrinsic habits, and yet, if there's somebody watching you and pushing you, you'll go harder than you normally would. They don't have to be superb; they just have to push you and it has to be an appointment that you can't miss. So, if you do that, you'll reduce your weight. Choose water as your primary beverage, diminish the carbs, and really change your diet and life.

Alie: And save money on knee surgeries. I mean, you're going to stay in business no matter what.

Aside: And so, if paying a personal trainer feels lavish, maybe consider it a health investment that will pay back so much including a boost in mental health, endorphins, longer life. And I just looked it up and according to Lessons.com, personal trainers start around \$25-50 for a half-hour session, maybe \$70 for an hour session, or more depending on what city you live in. Group classes can be under 10 bucks, or if you're able to safely join a gym, there are group class schedules there. YouTube has so many free workouts, there are even Twitch streamers who are dedicated to free, live group lessons.

And need I remind you of how much knee surgery costs in America out of pocket? It costs more than four used Priuses. And Jarrett, who partly blames his torn ACL from being unconditioned from not working out during COVID, says that kettlebell swings are really good for conditioning without putting a lot of strain on your knees, if you're looking to up your muscle mass and sharpen your biomechanic bod. So, get those pits sweaty, all your pits.

Alie: Leah and Natasha Bharj need to know if there's a name for the back of the knees. Natasha says, if it's knee or leg pit, I'd rather not know. What is the armpit of the knees?

Dr. Stone: *[laughs]* Well, in the back of the knee is what we call the posterior capsule, but most people notice it when they injure their knee and they get some swelling there called a Baker's cyst and that is fluid that tracks out from the injured part inside the knee, has nowhere to go so it pushes out the back and causes swelling at the back of the knee.

Aside: So, posterior capsule internally, or popliteal fossa. But in non-doctor terms, and you can throw this out there when a holiday dinner gets awkward and you need there to be words in the air, the official word for a knee pit is a hough. Like, hough. "I want to smell sexy, I just dab a little Chanel No. 5 on my houghs..." Okay.

Alie: Mara Rosenbloom wants to know... and I don't know if we covered this. I know that I asked but I'm not sure if I asked it about this in particular. They say: I had a torn meniscus and didn't need surgery but others I know with similar injury did. So, why do some people have to be surgically fixed?

Dr. Stone: It's a good question. *["Thank you."]* If the meniscus is torn, it no longer is functioning the same way it did before it was torn, so it's not absorbing the force and distributing it the

way a normal meniscus is. So, people usually get it repaired when it starts catching or producing pain. But the question is, should it be repaired even if it's not catching or producing pain? And fundamentally, there's no other key structure in the body that we let become dysfunctional and just ignore and hope that it won't cause a problem, because they almost always do cause problems. And so, what we're learning is that the meniscus is a critical structure, it needs to be repaired or replaced, or the knee is doomed.

Aside: So, says someone without a meniscus who launched a knee empire.

Alie: People need to recognize how important a meniscus is.

Dr. Stone: Correct.

Alie: Good to know. All hail the meniscus. Izalina Bittencourt says: What's physically happening when knees lock up and is there a way I can prevent it? I'm tired of tripping while walking lol.

Dr. Stone: Yes, so locking is one of the key mechanical signs that we listen to when we're talking to a patient. Because most of the time we can make the diagnosis of what's wrong with a patient's knee just by listening to the patient. Amazing, doctor listens to patients, right? [*Alie laughs*] But it's invariably true, if the patient tells you that their knee is locking, it means that something is getting caught between the femur and the tibia. Most commonly that something would be a torn meniscus, but it can also be a loose body, it can be a chunk of scar tissue. Something that blocks that knee from flexing and extending normally and generally we pay attention to that. So, if you're having locking, it's worth doing an MRI, doing a careful physical exam, and figuring out exactly what's wrong.

Alie: So, it's time to see a doctor, perhaps?

Dr. Stone: Yes.

Alie: Ha-ha!

Aside: And patrons Ayshia Yaeger, Jeffrey Bradshaw, and Jess Swann all had this question. Jess asks: Why shouldn't you lock your knees while standing? Number one, not great if you've got a tissue stuck in there, like beef jerky between molars. But also, I looked it up, and locking your knees while standing could invite orthostatic or postural syncope, that's when you cut off circulation and you pool blood in your lower extremities and then boom! Timber, we got a piper down. Not fun. Um, are we talking too much shit on knees?

Alie: last listener question, Yogo Mel... I want you to address this question and tell me if you agree with it. They say: Why do knees suck so bad? Seriously, the engineering sucks, evolution couldn't make them better. Do you agree that knees suck and the engineering is bad? Or do you think that we just... are we living too long? Because I would definitely be dead right now if it weren't for technology, and indoor plumbing, and heating, and medicine.

Dr. Stone: So... [*Alie laughs*] I think knees are a brilliant invention. As I mentioned, if you don't injure them, they can last forever. What else is five times as slick as ice on ice? What else can take millions of cycles per year? What else generally doesn't cause a problem, unless you injure it? So, is it the knees that nnhh... or is it the people? [*Alie laughs*]

The fact is that we are all pushing harder, we're doing more extreme sports, we're playing harder, we're playing more, we're exposing our bodies to higher levels of risk. So, if you're

going to do that, you have to train for that risk, you have to prepare for it, you have to try to prevent it if you can. The most common cause of an injury to the knee is a mental error.

Alie: Oh no.

Dr. Stone: And so, my skiers who were not paying attention for the moment or going too fast, somebody on a soccer field that just was thinking about their girlfriend or boyfriend or whatever... It's the mental gap when you make the move that you know you shouldn't have made. And if we can train both our bodies and our minds to be in the moment, in the sport, not on your cell phone, and really be there, then you'll dramatically diminish the number of injuries that occur.

Alie: So, the knees don't suck. [*"The court finds the defendants... not guilty."*] What about your work does suck? What's the worst aspect of being one of the top surgeons in the world? Or what do you hate the worst about knees, or recovery, or having to have your own knee surgery?

Dr. Stone: The worst part is scar tissue. So, we're driven to figure out how not to let people form scar, because after injury the body lays down disorganized collagen and that's scar. You look at your skin when you cut it, you form scar. Our job is to figure out how to induce the body to lay down collagen along the lines of stress so that the tissues look healthy, the ligaments look healthy, and the knee has a full range of motion. So, scar tissue and the loss of joint motion is our number one bugaboo. It's the thing that keeps us up at night, it's the thing I'm trying so hard to solve in our research. So, as we figure out which injections to give to people, a big part of figuring that out is which are the most potent anti-fibrotic injections. What will induce the least amount of scar? What will diminish the scar? How do you help that patient keep their range of motion?

Aside: So, you want your body to not do a sloppy patch job after an injury. And if you would rather buy a very expensive stay in a bungalow over the turquoise blue sea instead of knee surgery, well... treat 'em right when you got 'em. Use 'em, drink water, protein is your friend, ask yourself not what your knees can do for you, but what you can do for your knees. And if you love it, lube it.

Dr. Stone: One of the things that's dramatically diminished knee surgery for my patients is that they come in now and get a joint lube. So once a year, many of my skiers, sometimes twice a year, will come in, they'll have tremendously arthritic knees on X-ray, they look like they should have a knee replacement. And yet, each year, I've given them a combination of hyaluronic acid, the natural lubricant of the joint, and growth factors, these days from PRP, used to be from birth tissues but right now the FDA has put a pause on that until further studies are done. So, we combine these growth factors with the lubricant, and in many patients, they get six months to a year of tremendous relief. And they say to me, "Hey Doc, I'll let you fix my knee when those injections stop working."

And so, that is one of the great ways in which we're diminishing the role of knee surgery and permitting just by better lubrication, better growth factors, better recruitment of the body's repair cycle, we can diminish the rate of knee surgery for so many people.

Alie: That's got to be rewarding to watch too. What is your favorite thing about what you do?

Dr. Stone: Oh, seeing somebody go back to the sport they love, for sure. It's such a thrill. The surgery is fun, I love doing surgery, I love repairing things that are broken, but I most love seeing the patient return better than they've ever been.

Alie: Well, it seems like your patient's success rate is really high so that must be something that continues to reward you like that and you're great at it. When Jarrett came up to see you, it was like, *of course* you were the first person he was going to come see. But we came up from LA to see you and when it came to who is going to do the surgery, it's like, "Well, we've just got to be up there for a couple weeks to do PT." There was just no question about it. So, I'm happy that I could sequester you on a bench and ask you all these questions. [*laughs*]

Dr. Stone: Happy to help, anytime.

Alie: Thank you so much for doing this! Thanks for being such a great doc, Doc.

Dr. Stone: My pleasure.

So, ask smart people creaky, bendy, poppy questions because you'll never bend your knees the same, you'll say, "Hey, good job." If you want to know more about Kevin Stone, his website is linked in the show notes, it's StoneClinic.com.

Also, you can find us at AlieWard.com/Ologies. There will be a link to this episode in the show notes as well. We are on [Twitter](#) and [Instagram](#) @Ologies, I'm on [both @AlieWard](#). Thank you to Erin Talbert who admin's the *Ologies* [Facebook group](#). Thank you to Shannon and Boni, who handle our [merch](#). Transcripts are by Emily White of The Wordary. Bleeping is done by Caleb Patton and those are available for free, the transcripts and the bleeped episodes, at AlieWard.com/Ologies/Extras, linked in the show notes.

Thank you to Noel Dilworth for scheduling and Susan Hale also handles so much *Ologies* business. *Smologies* episodes are out every two weeks; they're clean and classroom friendly. Thank you, Steven Ray Morris and Zeke Rodrigues Thomas for working on those. Nick Thorburn wrote and performed the theme music. Thank you to Jarrett Sleeper, husband, Podmom, knee surgery survivor, and the whole muse for this entire episode. I'm glad we all know about knees.

If you listen to the end of the episode, I tell you a secret and, number one, there are so many long asides in this, I went down way too many rabbit holes and I didn't even include the fact that your elbow pit is called a chelidon and it is named after a swallow bird. Also, I have been adjusting my brain meds and it has not been easy, so stay tuned for an episode on ADHD wherein you might learn a little bit something about that and whether or not I have recently been grappling with a diagnosis of that. We'll learn more, but if you're like, "Hey, why have the last two episodes been up a day or two late?" Nnnhhh, Pops is struggling, but it's going to get better. Anyway. Thank you for being here, episodes will be up on time in the future... probably. Okay, berbye.

Transcribed by Aveline Malek at TheWordary.com

More links which may be of use:

Follow Dr. Kevin Stone's work on [Instagram](#)

His book, "[Play Forever: How to Recover From Injury and Thrive](#)"

[His links](#)

A donation was made to the [Stone Research Foundation](#)

[Effects of glucosamine in patients with osteoarthritis of the knee: a systematic review and meta-analysis](#)

[6 cases of autosurgery](#)

[Self-inflicted cesarean section with maternal and fetal survival](#)

[Okay but don't do your own cesarean probably](#)

[More autosurgeries](#)

[Joint Juice consumer reports](#)

[Dr. Stone's protein recommendation](#)

[ACL Depression Syndrome](#)

[PRP – platelet rich plasma](#)

[Dr. Werner Otto Forssman – heart catheter inventions ... and Nazi](#)

[Ines Ramirez Perez did her own cesarean](#)

["Fuck it, we'll do it live"](#)

[Dr. Evan Kane, a real spitfire](#)

[Ligament vs. tendon](#)

[Why do our knees crack?!?!](#)

[Knee-friendly fitness for folks of heavier weight](#)

[Under the desk elliptical](#)

[Other conditions that cause joint pain](#)

[Partial knee replacement for athletes](#)

["Plus size knee pain solutions" + exercises](#)

["What We Talk About When We Talk About Fat" book](#)

[The bizarre history of the BMI](#)

[BMI as a metric](#)