Identify & Fix Muscle Imbalances & Injury Risks

Perform with Dr. Andy Galpin · Episode 28 · June 24, 2026 · Transcript

[MUSIC PLAYING]

Dr. Andy Galpin
The science and practice of enhancing human performance for sport, play and life. Welcome to Perform. I'm Dr. Andy Galpin. I'm a professor and scientist and the executive director of the Human Performance Center at Parker University. I want you to imagine for a second that I could increase your best race time ever by seven or eight seconds by only increasing your ankle range of motion by a single degree.

You don't have to actually run that exercise because that's been done scientifically, and it turns out to be true. To put this in context a little bit, that seven seconds might be what it takes for you to finally cross below that 24-minute mark if you're an elite male running your best 8K time, or maybe you're a woman, and you're trying to finally get below 20 minutes in that 6K. But remember, that's only for a single degree change.

Imagine how much you could improve if we got 2 or 3 or even 4 degrees difference in that ankle range of motion. See, this is not just about ankle range of motion. In this particular case, what we're talking about is reducing the asymmetry or the difference in range of motion between the two legs.

Most of you have seen this classic Vitruvian man, right? Leonardo da Vinci's perfect symmetry between the human body, and it's romantic for us to think about that. And in fact, in the early 1900s, we thought that the symmetrical human was the perfect thing to be. If you looked at an athlete, you would pick the one who was the most symmetrical to be the most successful in all sports.

But that turned out to not be true. In fact, the wonderful writer David Epstein, if you've ever read his tremendous book, The Sports Gene, outlined and talked about how the body type explosion happened recently after that, where we started to realize some sports and activities require asymmetry and, in fact, are given a huge advantage when limbs aren't the same length and when the body doesn't work exactly the same way on all sides.

Today, we're going to dive into this because there's also the reality that shows people that have asymmetries, particularly in their lower body, increase their injury risk by as much as 35%. So which is it? Do asymmetries help us, or do they hurt us? We all have them. The most common one is what we call handedness. You're right-handed or left-handed. That exists in every human.

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Well, at least about 98% of us. That other 2% can use both sides pretty equally.

For over 5,000 years, we've been acknowledging the fact that we at least have some different skill on one side of our hand versus the other side. And the general rule of thumb you're going to hear is 10%. Now, I want you to remember this number because we're going to come back to this over and over and over again today.

The difference between one side of your body, front and back, top to bottom, left or right, as long as it's within about 10%, then you're fine. But we actually know scientifically that's not the case. And in fact, if you look at the research on this, one recent review came out that looked at over 6,000 athletes and found that across 30 studies, about a third of the research found that asymmetries led to more injury. About a third of the studies found it wasn't relevant, and then about a third of the studies said, we actually don't know. Could be somewhere in between.

People are really confused right now. We see these other studies. One of my favorite ones in this entire field looked at almost 300 Jamaican kids, Jamaica, of course, being arguably the most dominant sprinting country in the world despite being really small. And it found that symmetry, specifically just the size of things like their wrist, the size of their ankle and their knees predicted not only was faster in the 100-meter dash but who was also faster 14 years later.

And so we have this confusion. What's going on? Should I be symmetrical, should I not? If so, how much is too small? How much is too big? And what in the world is going on with symmetry and imbalances? And so we're really left with two confusing points-- one, when does an asymmetry become dysfunctional or problematic and get us in that injury case? And is it normal or potentially even advantageous?

And then the second major question that comes along with this is, OK, if I have a problem, what do I do about it? If you were to google this right now, how do I correct asymmetries or muscle imbalances? 95% of the things you would see would be either, A, do more repetitions on one side, lift more weight, do more volume, and that's not untrue. But that's not the whole story either. The other thing you might see would be do, quote unquote, "corrective exercises," kind of small bodyweight exercises, or with tiny elastic bands that somehow correct movement patterns and asymmetries. Again, not wrong, but not the complete story either.

So my goal for today is quite simple. First, I want to talk about when asymmetries matter and when they don't. And then second, I want to talk about how to correct them if they do exist. And from there, we'll get into the second part, which is our classic three eyes. We'll talk about how to investigate them, what to measure and how to identify and what to look for. We'll get into our second eye, which is interpret. How do I know when these asymmetries matter and when they don't? And then our third and final of course, is intervene, which is how to correct them.

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Now, while I love all their products, I'm incredibly excited about their new Fiber+ prebiotic. Almost everyone is seeking more energy, improved recovery, and better performance, but most people are missing a key foundation to their overall health, and that's getting enough good fiber. In fact, 95% of Americans are failing to hit the recommended daily amount of fiber.

Fiber powers gut health, which we know drives long-term performance. Proper gut health allows for better nutrient absorption, energy stability, recovery, inflammation control, and much more. I personally simply mix a scoop with their cinnamon flavor and some water every night, and by doing so, I make sure I'm covering any gaps I might have in my daily fiber intake that I try to get through eating a balanced, whole food diet. If you'd like to try Fiber+ or any of Momentous' best-in-class supplements, just go to livemomentous.com/galpin and use the code "GALPIN" for up to 35% off your first order.

Again, that's livemomentous.com and use the code "GALPIN" for up to 35% off your first order. So in the real world, we will often say things like symmetry, but scientifically, you're going to use the term asymmetry. You also will see things like literalness. Again, think about your right hand versus your left hand, one side on lateral being more dominant than the other. So those are key phrases to pull up out. But you can really think about the question of symmetry and balance from three distinct areas-- morphology, quality, and functionality.

Morphology is the size and shape. Is one muscle bigger than the other muscle? We will often refer to this as a single muscle, right? My quad is bigger than my left quad, but really that is a group of muscles. OK, but we'll leave that small distinction alone for now. People will talk about this from the perspective of top versus bottom. This is a classic, and I'll apologize right now. I've made fun of people plenty of times in my life.

But this is the giant upper body and chicken legs. OK, this is what we call a top down asymmetry. So the top part of your body is much bigger in terms of muscular size than the lower part of your body. I didn't find a single piece of compelling evidence to suggest that actually matters. So we're not going to talk about that at all anymore with the one exception, of course, being if you are in an aesthetic sport like bodybuilding, then of course, it matters.

What you will see that's more important, though, are things that are called front-to-back asymmetries, things like the back of your shoulder being smaller than the front of your shoulder. If you're from the athletic training or physical therapy world, you'll know classically the

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quadriceps, which are the front of your legs, to hamstring, the back of your legs ratio. One is significantly larger than the other one. You're potentially at risk for knee or more specifically, hip injuries.

And then, of course, you have, the more obvious left to right. So is my right leg the same size as my left leg? So both those two areas, front to back and left to right, have functional relevance, right? Whether this is optimal performance or injury prevention, we have a lot of literature on that. That's morphology at the highest level. Quality is an emerging area. It's something only been studied in the last decade really.

But now, we're looking at things like the amount of damage intracellularly, the amount of fat infiltration. Now, here, I want to be really clear. We're not describing the amount of body fat. What we're talking about is the amount of fat inside each muscle cell, not even in between the more connective tissue. That's the place where we're starting to learn more and more about that actually being arguably the most relevant factor of all the big three here, especially for things like aging and quality of living.

Last year, a paper came out, indicating that for even a single 1% increase in fat infiltration within skeletal muscle, this increased the likelihood of coronary dysfunction by 2% and heart event risk by 7%. So again, that's just with a single 1% increase in the amount of fat in the muscle tissue itself. So really important and newer area. And we'll discuss this a lot more later on.

And the third big area is functionality. This is where most of the research exists. And because of that, the vast majority of the confusion exists. But we're going to get through that, and I promise you're going to walk out of here today with a pretty clean understanding of where the research lies and what's actionable are important to take away from that.

Big areas are things like what we'll call motor control or motor skill. This is a classic. If I asked you to kick a ball, which foot would you be able to have the most control with? Which one would you be more accurate with? That's motor control and motor skill. If I gave you any kind of a performance task, throw a baseball, throw a dart, you would have one side that's more skill-driven than the other. You also have things like physical strength. So maximum force production. You could look at this from the perspective of endurance in all kinds of ways.

You can look at it from a range of motion or flexibility or stability. I mean, the list really goes on and on. Any way that you would describe a muscle, a group of muscles, or in this case, a whole human movement pattern, you can look at this from the perspective of functionality. So we can look at how well I can balance on my right leg versus my left leg. I can look at when I'm doing a pull up, do I shift to one side versus the other?

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Or when I'm doing a bench press, does one elbow wobble and the other one doesn't? Running mechanics, cycling, swimming, flaring, bouncing to one side, you'll find research on all of these, and they are very similar, but they're actually giving you distinct and different information. And so the relevance to that information is what we're going to have to describe so you understand what types of asymmetries are OK, which ones are advantageous, and which ones are deleterious and, potentially, I'll even say it, dangerous.

So now that we've got a broad understanding of what asymmetries mean and why we're going to describe them as that rather than imbalances, we can now get into more specific discussion of the one that is the most common. That's the laterality and the dominance in your mind. I want you to just be thinking, right hand versus left hand. What's important about this is the fact that there are two different types of laterality or dominance.

There is a skill dominance, which I've described multiple times now. This is, can you do a fine motor movement really well? Can you write with your hand? Can you perform precision, surgery? Those are skill-based things. And then there's also what is called force dominance. Now, the force dominant one is exactly what you think of it is strength. Typically in sporting or Athletic related endeavors, we have a difference between our force dominant side and our skill dominant side.

Here's an example. Take badminton. If you've ever done that sport before, let's say you're right handed with your badminton. Well, what you realize is in order to make your move or to hit the shuttlecock, you actually have to step forward with your right leg so your right leg will balance and break your body so that your right hand can reach the tool that you're hitting. Now, in this particular case, your right leg is jamming into the ground and breaking your entire body, so your right leg becomes much stronger and almost always much larger.

So in this particular case, the right hand and right leg are both the skill-dominant and force-dominant. But if you contrast that to, say, soccer, what you're going to see is someone who might be kicking with their right leg, because they're more skilled there, will be bracing hard with their left leg. So the left leg will be the force dominant side and their right leg, or even right hand if you were a pitcher. It's the same thing. So any Major League Baseball fans out there, if I'm a right-handed pitcher, that's going to be my skill side, my right hand.

But my left leg is still smashing into the ground and that's going to brace my body gives me the trajectory backwards, which allows me to actually throw the ball forward. Golf is the same way. If I swing right-handed, the vast majority of force comes out of my left leg pushing me back, which is a little bit counterintuitive, but you get the point. There, that I think laid the foundation for what we're really describing.

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Hopefully, you have a better understanding of what we're even talking about when we say things like asymmetries and imbalances. Trust me, friends, I could go on and on about the terminology here. But I'm going to skip past it and go to our next big section, which is why these asymmetries develop in the first place because once we understand why they're here, we have a very clear roadmap about when these things matter, when they don't, and exactly what to do about them. So why do asymmetries exist?

We've had a wonderful model for about 60 years called the Van Valen model. That name doesn't matter, but it really breaks down asymmetries into three major buckets. More recently, a fourth one has been added. But here's what it really means. There are things in your body called directional asymmetries. Directional asymmetries are genetically driven. We all have them. And they are all going to-- well, almost always be the exact same.

These are things that happen in your body that are supposed to be asymmetrical. This is the fact that your heart is not in the center of your body. It's actually off to the left and slightly twisted. Your spleen, your liver, different parts of your body are asymmetrical, but they are that way predictably, and they are the same in basically all humans. The second one-- and I apologize, this is a terrible name-- but it's called anti-symmetries. These are also genetically driven, but they're unpredictable.

If I see a newborn baby, I can predict which side of their body their liver is on. I can't predict if they're going to be right-handed or left-handed, but I know it's going to happen. That one's important. We already talked about that a little bit, and we will come back to that. Third one are called fluctuating asymmetries. These are actually environmentally driven. Typically, these are small random deviations that are a result of external pressures.

Generally not good for you. Generally not a good thing. These can be seen in things like your nostrils being asymmetrical, your ears being different, again, often associated with poor childhood development. Not really in the scope of today's conversation. So we'll leave those off. So those are the classic Van Valen top

Three. The fourth one that's been added more recently that I love are called sporting asymmetries. These are repeated movement-induced adaptations. It's skill development, friends. You did something. A whole bunch of times, and you caused an asymmetry to occur. This is most of the stuff we're thinking about. This is muscle size. This is motor control. It's range of motion. It's all that classic stuff. So what does cause these things more reliably? It's asymmetrical demand.

I mean, that's really as simple as it gets, friends. You're doing something either because your training program is not balanced. I know as-- I think I was 14. I woke up one day in my bed and

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my right shoulder was killing me. I didn't specialize in sports. I played every sport. I played every position. I was wildly different in what I did outside, and my shoulder was killing me one day and I couldn't do anything on the court, and I don't know why. And it got really bad.

I eventually went in and found out I had a torn labrum in my shoulder, and I had to play the entire basketball season, not being able to lift my right shoulder up. And then I had to play the entire baseball season having to throw underhand, and I could swing and hit, but I couldn't throw a baseball and eventually had to get shoulder surgery.

When I looked back, the lifting I was doing at the time, I was doing all pressing, benching and things like that, and all the training that was in the pull-ups and the bent rows and all the pulling stuff, I would just skip all that stuff. There was no major injury. I didn't land. I didn't tear anything. I literally woke up one day and was like, why does my shoulder hurt? And something in my arm was torn. That was an asymmetry I completely caused.

In this case, it was a front-to-back asymmetry in my exercise program. I was doing way, way, way too much pressing for my pulling. Other things that can happen that are probably one of the most common ones are injury compensations. You've all probably experienced this. You get hurt in one place. You compensate by moving differently somewhere else, which may be way up or down your body chain. But that can cause short- or long-term asymmetries to develop.

And then the third big category here are what I'll call just movement deficiencies or technique issues. This is your mobility and flexibility. This could be strength limitations. In fact, some of the people that I respect the most in this field will generally refer to these as stability issues.

So when you see a shoulder moving poorly, it's generally not a strength issue. It's a stability issue. This is when you'll see things like the classic myofascial chains. In season 2 of Perform. I had a wonderful discussion with a friend of mine, Jill Miller, and she talked a lot about the fascia and how there are these relationships. And these things have been documented, though, in fairness, there's a lot of skepticism and mysticism, I'll just say in this particular area.

But there is some research support, suggesting things like if you improve your ankle range of motion, your head position can change. There's been other studies connecting your hamstrings to your neck, your foot, especially the bottom of your foot, to your hamstrings, and so forth. There are planes of connective tissue that run throughout your body, and they don't just run from the left side all the way up the left side. They can cross over.

Folks again in the physical therapy side of the world will know exactly what I'm talking about here. This is the upper cross syndrome. This is the fact that not only can your right ankle determine your neck, but your right ankle can determine your left shoulder. And way more

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complicated and interesting stuff can happen past this. We have these things, right? So if you're moving asymmetrically in, say, a shoulder, it may be something else in the kinetic chain that's causing that to happen, especially if we've got some sort of myofascial issue going on.

If we've got a limitation in performance then or limitation in stability or endurance, this is when that symmetry, the entire chain starts to express itself. This is commonly shown in things like what's called the bilateral force deficit. So a friend of mine, just a true legend in this field, Mike Boyle, he and I disagree pretty heavily on this one, but Mike has been-- just I can't express how much he's contributed to the field, so I'll always appreciate what he's done from that. But the bilateral force deficit suggests this.

Let's imagine you can do a leg press with 500 pounds on your right leg, and you could do it with 500 pounds on your left leg. If you then do both at the same time, 500 plus 500 should mean you should be able to do 1,000-pound leg press. Mike has been advocating for as long as I can remember, decades now, that most people won't hit 1,000 when they do that.

They'll probably hit something like 800 or 900. That's the bilateral force deficit. So you have a lower amount of force you can produce when two limbs are contracting, even though independently, the sum of that should be much higher. And there is plenty of research to support. Bilateral force deficits do exist-- however, what I've argued and I have published a paper on this as well, though granted it was probably a decade ago-- is that bilateral force deficit is about twice as common in people who are either untrained or generally weaker than their age-matched cohorts.

What I'm getting at is it does exist. And so for some people, that's really informative. That's a type of asymmetry. Others, we could say, well, just get stronger, and it probably goes away. And in fact, if you look at bilateral competitors, so these people that are in sports where you're using both limbs equally at the same time, easiest example would be powerlifters. People who are training in the squat exercise and competing in the squat exercise, so not field sport athletes or anything like that, they often have a bilateral facilitation, meaning 500 on the right leg, 500 on the left leg.

But when they got both legs going, they can do 1,100 or 1,200. So there is a bilateral force deficit. It's important for some. It's not as important for others, and it's actually irrelevant for some other small group there. The last big, broad category of things that cause asymmetries are just movement patterns themselves. This is your lifestyle.

If you're a plumber, and you're always screwing or drilling on one side, you can expect that side that's always turning in a particular way to be different, so your vocation, and then certainly if you're in a sport. If you're in a repetitive sport, let's imagine golf where you're swinging

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thousands of times per week the same way, we're going to cause asymmetries that didn't exist. Maybe some were there to begin with. But we took them even further because of our direct exposure to repeated asymmetrical demands.

One thing to note on this is, there's some evidence, though not much-- and we need more of it to see if this holds true-- that those who specialize in sports early cause more asymmetries, and then therefore and direct evidence on top of that are our injured more during and even after their sport.

So I think this is one of those lines, even if we're not worried about the research on specialization, which just since we're here, it's generally not a good idea, especially prior to the age of 14 or 15. You really want to be careful about specializing in sports at a young age, wit probably gymnastics being the one exception. And I'll probably light the whole world on fire with that statement. But you get the point.

One of the reasons why is because of this-- if you specialize early, this evidence indicates you'll have more asymmetries, which indicates potentially more injuries down the line. Now, we also need to keep in mind that depending on the sport, if we're talking about a sports participant, asymmetries may be a part of the game. That's OK.

If you look at things like asymmetries in your legs with jumping, most of us, if I said, can you jump equally high on one leg as you can on the other leg? Most of us are going to say, no. You have one leg, you jump higher. That's totally normal. Research on this suggests that amount of asymmetry with jumping is like twice as high in trained jumpers. No surprise, right?

You take a high jumper, they can jump way higher on their dominant jump leg than their non-dominant leg, way higher or way more of an asymmetrical difference than a normal person. But if you compare that to, again-- we'll go back to our powerlifters who both train and compete in squatting, they actually will jump pretty much equally on both legs because they don't have any asymmetrical training exposure.

Everything they do is both legs in the same spot at the same way, where the high jumper is everything they're doing is one leg jumping higher every time they're doing their skill sport. I think we've gone enough into the background of understanding why these things happen. I'd like to transition now and get into our first I and start talking about part two of how do we measure these various forms of asymmetries, when do we know that they're good, bad, or indifferent, and then finally, what we're going to do about them when we find them, and we identified we want to make a change.

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of sodium, potassium, and magnesium, but no sugar. Hydration is critical to performance, both physical and mental, and countless studies have shown that even a slight degree of dehydration, even as small as 1%, can lead to decreases in physical output and mental performance. We also know that electrolytes are critical to proper hydration, which I've been harping on for years.

But you can't do that proper hydration by only drinking water, especially if you sweat a lot. You need to get the right amount of electrolytes in the right ratios, and that's why I'm a huge fan of LMNT. In fact, many of you might remember that I featured LMNT in my YouTube series on hydration nearly six years ago.

I featured LMNT in these videos because their blend of 1000 milligrams of sodium, 200 milligrams of potassium, and 60 milligrams of magnesium really is unique and different than any other electrolyte on the market, and it has great scientific support. I use LMNT on nearly a daily basis, especially when I'm doing really hard training in the heat and I'm sweating a lot. If you'd like to try LMNT, you can go to drinklmnt.com/perform to claim a free LMNT sample pack with the purchase of any LMNT drink mix. Again, that's drinklmnt.com/perform to claim a free sample pack.

As is typically the case, but really so here, bad data is worse than no data. If you can't collect data on asymmetries really well, you're far better off just not doing it. And the reason is your chance of false flags are way too high. I'll go through this really quickly if you need to take a 10-second mental break, because you don't care about this part, I understand. But for those that do, I do want to say this pretty quickly, the testing considerations, if you're going to test yourself or someone you're working with for asymmetries, they are different.

The very first thing you need to figure out is, of our big three types of asymmetries, morphology-- again, that's muscle size-- quality, or functionality, which one are you even testing for? You'll be stunned. But a lot of the times when we hear practitioners and people talk about asymmetries, they treat all three of those as the same thing. And as I've described with the study we did in my lab and plenty of other examples I've given, they are very distinct. They're telling you different things entirely.

And so first, ask yourself the question, what am I trying to test? Then from there, we have factors like age, sex, which right now, don't appear either one of those, to me, major drivers internally of asymmetry. But you always consider every factor you can, right? We have experience level. I've given you multiple examples of this already. Highly trained athletes are going to have more likely, more magnitude, more serious asymmetries where an untrained person or someone maybe not even trained in that exact test will perform differently.

Are you doing a test over your normal range of motion? Are you doing a test at your normal

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speed? You see what I'm getting at? If you start walking away from anything that's not normal for you, then we're going to see something different. There's actually been some really cool studies that have looked at things like test a highly trained bench presser at 50% of their one rep max, and you won't see any asymmetries in their ability to activate the muscles in their shoulder, chest, and abdomen and things like that. But then you slap them with 90%, so almost their maximum, and the asymmetries start flying off the chart.

And so simple things like that, right? So much of this field of asymmetry and balance does everything at body weight or light loads. But when you do it heavy, when you do it fast, when you do it to fatigue, those can completely change your findings, so what we call dependent variable. Are we looking at muscle activation? Are we looking at range of motion? Are we looking at a single muscle group or a group or a movement pattern?

All of this should be something you're considering. Now, you will not have the ability to do all of it. So what I would beg of you is pick one or two or three things that are most relevant to you in your context and come up with good standardized systems, but then just keep in the back of your brain. I'm not seeing the full picture here. So that said, what are our best practices for our three big areas?

We'll start off with the first one, morphology. I promise, this is the last time I'll remind you. But morphology is muscle size and shape. This has traditionally been pooh-poohed in this space and for good reason. Or if you look at just the size of someone's muscle, you don't have any idea how it operates. You don't know how it contracts. You don't know its range of motion. You don't know how it gets tired. Or you don't know anything about how it functions.

And most of the time, in real-world settings, we're worried about functionality. But the nice part about it is, it's way easier to standardize. Your muscle size will almost always be your muscle size. When I was describing functionality earlier, and I told you it can look, it can be totally different on the right side and left side and scale and force. There's infinite tests there. Muscle morphology has like one. So I don't have to make sure that I'm doing the right day and the right load and the percentage and what technology and all those other variables.

So it's actually for us come to be way more stable of a metric. It's way less difficult to standardize, rather. And it enables us in the same time to look at quality because we have images. So the way that you can do this at home, this is a basic tape measure. Just make sure you're really careful with the parts of the body that you're looking at and especially the landmark you're using. A bunch of ways you can do it, but just pick a standardized place. More likely, if you have access to it, you can use something like a DEXA scan. What's nice about a DEXA? Pretty cheap, pretty affordable. They're getting more available. So people can do them without a prescription. And they'll give you generally things like your right leg versus your left leg.

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So they don't give you muscle by muscle, which is kind of a limitation there. It's a pretty big limitation. But it could be better than nothing. Really, more likely, if you're going to take imaging here, you're going to use an ultrasound or an MRI. Now, those have always been really, really expensive, but that is coming down and is becoming more realistic. From there, we can now start talking about our second category of tissue quality.

I told you before, this is an emerging area. I'm going to discuss fat infiltration the most. But keep in mind, there's some really cool stuff going on with just the connective tissue, the muscle itself, and the fat infiltration I'm talking about here is the fat inside the muscle cell, not your body fat. This is not something a DEXA scan can pick up.

Why this matters is only recently have people started to identify that there's a connection between your neural health and the quality and that those are likely performance limitations. If we find a bunch of fat inside your muscle cells, very often, there's some restriction also in the upstream neurological pathway.

And even if there isn't, that fat in the muscle cell, almost always compromises performance of that muscle cell. It may not be the fact that you're not trying as hard. It may not be the fact that the muscle isn't as large. But if a bunch of fat is in the place of the muscle where it's supposed to have myosin and actin, and the part of the muscle that contracts, that size is not made up by good, strong contractile tissue.

It's made up of fat, which means, it can't contract. And so your performance drop in that muscle or part of the muscle is because the fat that got built up there. The amount of fat in your muscle is not necessarily driven by your body composition. In fact, I think one of the more interesting places we're seeing this now is, it is oftentimes a result of a previous injury.

Again, it is true, generally, if you have more body fat, oftentimes, this comes with more fat in your tissue. But those can be completely independent. I'll give you a great example. A friend of mine, Doug Larson, he recently got a scan done, and he found that one of the small muscles in his hip was about 45% smaller on his right side than his left side.

And when they looked at the amount of fat, the fat on the right side, about 25% of that muscle was fat. On the left side, it was less than 5%. And I smiled immediately because I remembered, and he knew immediately that about 10 years ago, he dislocated his hip, I think during judo or wrestling practice. Now, he doesn't have much hip pain or problems, but he started to realize, oh man, occasionally I get a, b, and c going on.

And it was no surprise at all for us to see we've got a previous injury. He had worked around it. He had strengthened all the other muscles around that joint. So they were hyper strong and

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picking up the slack, but that muscle actually hadn't properly reattached. It was still partially torn.

So it was not getting neural activation. It was not getting turned on, not being exercised for a decade. So it started to fill up with fat, and it shrank. So that is a classic example of what I'm talking about. An injury 10 years ago that was, on the surface, completely rehabilitated, was actually giving us clues of some pretty major dysfunction. We have seen a very, very similar thing with countless professional athletes, which is why one thing we're doing right now is going bonkers, getting a bunch of baseline scans of people, even when they're healthy, so we can start to see and look out for anything like this in the rehabilitation process.

So this quality or as again, we'll typically refer to this as fat infiltration is important. Other things while we're here that are interesting are things like the fascicle length. If you-- any muscle physiologists out there the geometry and then something called pennation angle. So remember, you've got bones on your body, and your muscle moves those bones.

But the orientation of the muscle to the bone is meaningful, meaning this-- let's imagine you have a bone laying straight in front of you, and you have a bunch of muscles that connect that bone lying next to it, if the muscles run parallel to the bone right next to it, when they contract, that's going to barely move the bone. However, if the muscles were run perpendicular, so the muscles go right into the bone making a T, now, when it contracts, it's going to move the bone very differently.

That angle, in this case, if it's a T that angle is 90 degrees. If it's parallel that's 0 degrees. That angle, called the pennation angle, determines if you're optimized for velocity or strength. The more you go in one direction, the least you get of the other. And so we classically see this. We see some muscles that are oriented in line with the bone. And then we see some that are oriented perpendicular to the bone.

And again, that generally means they're hedging for force or they're hedging for velocity. What we're seeing a lot now is this pennation angle can be altered or disturbed by things like fat infiltration, by things like asymmetries. And so we can gain force or speed, depending on what we're looking for, by just kind of getting these pennation angles back to a normative state. I know I went a little deep in my muscle physiology there, but I will not apologize. That is my passion. You are here at your own accord. You can suffer through some muscle physiology in our conversation.

OK, back to business here, This, is a tough one, right? You don't have a lot of low cost or widely available ways to look at muscle quality. Imaging is coming down. I know that there are even some handheld ultrasound devices that are becoming more and more affordable. This has been really cool. It's allowed us to do research on the field.

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Instead of having to go to a hospital, you can actually literally take these on to football fields or pitches or courts or whatever, but they're still very expensive, several thousand dollars, if not more. Traditionally, the way we would look at this is actually via like a muscle biopsy. For most people, since you don't have access to a biopsy, is potentially an ultrasound, which is, again, somewhat reasonable or that MRI device.

What we're doing now is with our program called optimum muscle, you can use the Springbok scan, which I've talked about many times in this show in the past, but it's a 45-minute MRI scan. You can do it almost anywhere in the US. In fact, they have multiple sites over the world. You sit in this scan, and it makes a 3D model of 140 muscles on your body. So you can start to see all those asymmetries going back to your morphology. I told you the best way is MRI. This is how we do it.

Again, conflicts of interest, I have financial ties to this company, and I use it all the time, but this is exactly what I do. So take that information for what you will or what you won't. But that scan is pretty easy. You lay in the machine. I get all 140 muscles digitized. I can look at asymmetries. I can look at size. I can look at that fat infiltration and more and more and more.

All the results come back normalized for age, sex, and even sport, as well as sport position. If I remember correctly, they've scanned most of the NFL players, a huge percentage of NBA players, lots of English Premier League players. And so we can look at these from the perspective of high performance or general population.

From there, we're going to transition to our third and final category, and that's functionality. This is an unlimited field. There are an unlimited number of tests. So functionality-wise could be anything from a sit and reach test, a flexibility test, anyone that you prefer. You could use something called a goniometer. It's a little device, really cheap, probably $25. And you can measure the degree of flexion or extension of any joint. They're all over the place.

Those things would tell you basic mobility or flexibility. There are plenty of movement screens. Probably, the most classic one is called the FMS, or a functional movement screen. It's been around for a really long time. It's used all over the place. There's been plenty of research on it. Some of it is good. Some of it's showing it's not so great. But to me. It shows you basic movement patterns across the body.

What's nice about something like an FMS, it's not muscle-isolating. It's trying to give you an indication of symmetry with movement patterns. Imagine doing something like this. You're on all 4's, and you reach your left arm out in front of you, and you put your right leg behind you so that the only thing on the ground is your right hand and left knee. And then you do it the opposite. And what you're looking for there is, did you fall when you were on one side versus the other?

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Similar things of doing an Overhead Squat. And do you go further down on one side of your knee versus the other side? So again, we're trying to look at now functionality from a whole body movement rather than a muscle specific strength or muscle specific range of motion or ability to activate that muscle. You can also use things like a force plate. I described those earlier, but these are ultra-sensitive scales that go many digits past zero, and that can give you tons of variables to pay attention to.

When I first started, those things were like $35,000 each, and now, you can get a hold of them for a couple hundred dollars. I don't have any relationship, but I have used VALD, V-A-L-D. They make a ton of these. They make them for your grip strength. They make them for your legs and your upper body and all kinds of different ways.

So these are a little bit more consumer-friendly. If you are at a good strength and conditioning or performance facility, they've probably got VALD or somebody else. You can also use bigger machines called isokinetic dynamometers, things probably more likely to be in a research setting. You can look at muscle activation via what's called EMG, little electrodes placed on your muscle that tells you how much you activated them or not.

You could look at motion like Greg Rose does at Titleist Performance Institute with cameras. This is called motion capture. So we put little dots on all of your joints and then film you doing your thing, and we can look at exactly how you're producing force and when you're producing it and the range of motion and all those things. Really common ones for non-sport situations or honestly even used in athlete research are things like the Y balance test or the star excursion. You'll see this as SEBT. These are little balance tests where you balance on one leg and you let's say you're standing on your left leg. You reach your right foot out in front of you as far as you can and tap the ground.

And then you reach that right leg behind you and tap the ground. And then you reach it to your right side and your left side, and then you do it with your right leg on the ground and your left leg pointing. And you're looking at more than these four centimeter differences between them or whatever the case may be. You get the point here, right?

So you could get an endless list of low cost or no cost, moderate cost, and then I've even again included some research-quality stuff from isokinetic dynamometers to motion capture and force plates and everywhere in between. So you can get your question answered here however you would like for functionality. What's most important, regardless of what test you're doing for morphology, quality or functionality, it's the interpretation.

And friends, this is the tricky part. So when do these asymmetries matter and when do they not? Let's dive do that next. As I stated at the outset, I think it's best to frame this entire question in

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two pillars-- performance and injury risk. Performance-wise, the question is ultimately this-- is this asymmetry hurting my performance or aiding it? And then from an injury perspective, pretty obvious. Is it increasing, reducing or not having any meaningful insight into my injury risk?

We need to understand this, though. Injuries are a result of countless variables. Asymmetry is only one of those many, many, many variables. So while we look at the research here, it might be easy for us to give it a little bit of a hard time because it's not incredible. You're not going to see any study that says, oh my gosh, this small asymmetry promises injury.

But that'd be unrealistic because as I've stated, your training, your nutrition, your hydration, your sleep, your previous injury history, your age. So many things go into non-contact injuries. There's no way an asymmetry alone could describe all of that risk. So I want to make sure I stated that at the outset here. So let's start going through it though. What do we know about asymmetries in muscle size and muscle quality. And I'm going to lump those two together for now in those two categories performance and injury risk.

Well, the first question you want to ask yourself if you identify a legitimate muscle size asymmetry is-- is it even real? The classic example I'll give here is take your trap muscles, those muscles kind of behind your neck, between your neck and your shoulder blade. We'll see this really commonly. In fact, if you look at me, you'll probably notice one.

And you might see things like, wow, my right trap is way smaller than my left trap. So then if you go to Instagram or TikTok or YouTube rather, you'll see, wow, do more trap raises or shoulder shrugs on my right side? Well, you could do that to you're blue in the face. And it probably won't do any different because in this case, they're not actually bigger. They look different because something else is injured.

So in other words, if you were to look at me on camera, and now, those of you watching and let's assume my shoulders were perfectly straight, parallel to each other. If I had an injury, say, in my neck, and I shrugged my left shoulder a little bit to protect against that injury, that would make my left trap look significantly bigger. It's not. I'm just shrugging my shoulder.

So what you may be seeing with muscle asymmetries is actually just postural differences, injury protection. So before you go doing an eight-week block where you put 20% more volume on one side of your body, make sure you actually have a morphological difference. Another thing we have to pay attention to, and you'll see this when people get really lean, you'll see huge asymmetries, especially in things like your lat muscles and your abs. Abs are the easiest one.

Almost nobody has a perfectly symmetrical six pack. That's normal. Remember, your bones aren't perfectly symmetrical, so the way that your muscles are start and stop on your body won't

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be the same distance. They won't have the same shape. They will look different simply because of anatomical structural things that you got no control over.

So our first stop on this journey, in terms of interpreting whether or not we actually have a problem, is making sure that we're not one, just seeing differences in posture, and then two, making sure it's not just anatomically driven. Other stuff that we've learned from probably has come more from general population and aging-related research in terms of morphology and asymmetries. And when they matter, I'll just call the general population. These are typically people who are either sedentary or maybe recreationally active at best.

And we'll see things like lower-limb muscle mass asymmetries when they exceed 3.5%, the injury rate starts to really climb. And specifically one of the papers I mentioned at the very beginning here was one found that increased your risk of injury by up to 35%. And this actually makes a ton of intuitive sense. If you have a muscle that is larger than the other complementary muscle, this is almost surely going to result in movement dysfunction.

Because movement is skill-driven, that isn't necessarily as problematic as the whole muscle itself being larger because I can correct a skill really quickly, but a muscle itself being much bigger or smaller than the other one means something significant is potentially going on.

Another kind of a similar story here, one paper found an increase in asymmetry by 1% Increased injury risk up to 83% in women. So you can see the point there. And I wouldn't get too bogged down in like 80% injury risk, 35% injury risk. The point of it is here, these small asymmetries, 1% 3%, are making a meaningful and what we'd call a clinically meaningful difference down the line.

Remember, at the beginning, when I said 10%? Well, here's some pretty compelling evidence that when it comes to muscle size, unless you have a reason for it. And even then we might argue, but 3.5% difference in size between-- like muscles, especially in the lower body, that might be something you want to consider correcting and not just leaving alone. From the aging research, the biggest thing that stuck out to me in reading a lot of those papers was the size, the fat infiltration, and the connective tissue quality. That stuff can predict what are called functional outcomes.

In other words, I can look at how much fat is in your muscle if you're over the age of 50. And I can predict your balance. I can predict your walking speed. I can predict your flexibility and your strength for the third or fourth or maybe fifth time now. These areas are getting a lot of scientific attention right now because they're trying to help us figure out, well, what is actually happening with aging muscle and the fact that that component can explain and directly predict how you walk, how you move throughout the world, to me, is very compelling to pay attention to.

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We also have to acknowledge then that that morphology, that quality stacks very differently than functionality. And as I said, but I really want to reiterate this point. I could actually make a compelling case. And I have so in my own brain, at least. Because of the functionality stuff is so wildly context-dependent, I actually think morphology might be a better place to pay attention to.

Now, let's go back earlier, and I was saying like, the math is different and the standardization, and if it's fast or slow or strong, and what test you're doing, it makes it so hard to standardize, it's almost impractical. And so what I've told you just candidly, what we've been doing and, here you go. Here's our behind the scenes secret. We've actually turned so much more to the morphology because I know it doesn't tell us about how the muscle functions, but because it's so much easier to standardize. Bad data is worse than no data.

And so we have turned to at least getting quality data, even though it's being limited and using that muscle size and quality imaging stuff. Because of that, when I see a muscle morphology or symmetry or quality asymmetry, my threshold for action goes much lower. I shared a second ago, there's some evidence that 3.5% is low. If I see a 3.5% difference in your strength, I don't care at all. But for muscle size perspective, I might matter.

There's also been a really cool study that came out that I wanted to share. This was just out, actually, I think, in February of last year. It was a comprehensive review and meta-analysis looking at upper body asymmetry, and that caught my attention. As I mentioned, most of the stuff being done here is on the lower body. But it looked at almost 90 studies. And what's cool about it is-- and I'll put this paper up. I think it's open access. And so you can download this chart and look at it yourself.

But what was really interesting about it is they looked at a bunch of different tests by joints and by movements, and it gave amazing charts about the level of asymmetry in different parts of the body. And what stood out to me is, in general, places like the shoulder, it is really common to have a 15% to 20% difference in strength between your, say, your right shoulder and your left shoulder.

And anatomy nerds and movement nerds will recognize the terminology. But this included everything from internal to external rotation. It looked at adduction and abduction and flexion and extension and lots of different movement patterns in the shoulders. And all the studies combined, really common, 15% to 20% asymmetries. But when you looked at other parts, like the elbow and the wrist, those came crashing down to typically more like 5%.

And so if you're going to really dive hard in this area, if you're either struggling with a shoulder or elbow issue, or you're working in these areas, I think it would be prudent for you to pay attention and say, OK, maybe my threshold for action in the shoulder is higher. Maybe if it is 10% or lower,

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I let it go. But if it's 10% or lower in the elbow, I don't let it go because that's more meaningful, because it's normal to be actually almost perfectly identical between your right elbow and your left elbow.

Your wrist, your forearm, your fingers should be really close to symmetrical, but it may just be something like our shoulders aren't meant to be that symmetrical. And so I would maybe call that more, quote unquote, "normal." I could go on lots of papers in this area, but I want to highlight that for people that are really into these fields but also to let you know, again, if you're trying to interpret this context of, when does this matter? When does this not matter? You probably need to go joint by joint and movement by movement.

If that is completely unrealistic over your head, that's totally fine. At the end of this the section, I'm going to give you my very short bullet list that I think is something that all of us could use, going out of here. But I wanted to throw this in for the people that really do care a lot about this, whether you're practicing in this field, or you're really struggling to get past an injury, or you're trying to perform at your absolute best. Some of you a-types out there just want every little nitty gritty thing. And so I didn't want to gloss that over and skip that out.

I also want to talk about this in terms of injury risk. You're going to see a little bit different answers, whether you're looking at athlete groups or non-athletes. And I want to hit both pretty quickly. The first thing I want to talk about are what we call movement-based things.

So one thing that I've actually was thinking about a lot in preparing for this show was the classic stigma of pushing versus pulling. Whenever you're pushing something away from your body, like a push-up or a bench press. We call those pushing exercises a squat, a leg press. Pulling exercises generally mean you're coming closer to the implement, or you're bringing that implement closer to you. These are bent rows. These are biceps curls. These are Romanian Deadlifts or a pull-up or anything like that.

Oftentimes because of people like me who did all pressing, and we only worked on the muscles we can see in the mirror, we end up with these anterior injuries. So the shoulders oftentimes roll forward. We get shoulder injuries because we're not symmetrical front to back. That pulling side, those muscles you can't see in the mirror are what are called our posterior chain. So anterior is front. Posterior is the back.

Oftentimes, you'll hear in the weight room, good coaches, good trainers will say things like, at minimum, we're doing a one-to-one push to pull ratio. But a lot of times you'll hear two-to-one. And this is two pulling for everyone pressing. There's no real evidence for that number, but I actually like it as a coaching tool. This is a difference between what we call an is and an ought. The "is" is the data. There's really no data saying, you should have a two-to-one pull-to-press

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ratio.

But what I think you ought to do, based on my experience, based on the fact that most people tend to skip the pulling exercises if they're short on time or tired, and they tend to make sure they get those bench presses in. At least, the males and the females tend to get their lower body pressing stuff in. I think as a two-to-one rule, it's a good coaching tactic to get people to make sure they at least overemphasize the pulling side.

And far, in fact, I don't know if I've ever in my life heard of somebody who developed such a demand for pulling exercises that they cause a shoulder or knee injury because they did too much pulling. It's almost always a pressing issue. So at the same time, here, we're in the section where we're trying to interpret asymmetries. It is not appropriate to think people should be equally strong or have equal endurance during pressing movements as they have with pulling movements. We see this confused often.

And if they do have an imbalance, that is not a problem at all. In fact, you can explain this almost exclusively by their limb lengths. The Vitruvian man says your width span so your fingertip to your fingertip is identical to your height. That's what perfect symmetry is. That's why that circle around that old Italian guy works perfectly. Now I am a negative 2, which means my arms are actually 2 inches shorter than I am tall. This gives me a very large advantage when I press, because I don't have to bench press and move the weight very, very far because when I'm fully extended, that's 2 inches less work than it is for you if you're perfectly balanced.

So I am really good, relative to my own self, at pressing exercises. I'm a far better squatter than I am a deadlifter. I can leg press way more than I can any kind of RDL or pulling activity. I can bench press far better than I can do pull-ups. You get the idea. If you have different limb lengths, and you are a plus, in fact, I think the average NBA person, NBA or WNBA, is somewhere between 6 to 10 inches plus.

I know there's classic examples of people that are like 7 feet tall in the NBA that have 8.5 feet wingspans. That's how you refer to it. Jon Jones, one of the best combat sport athletes of all time, in part, was extremely difficult to beat because his reach was inches, if not feet, longer than any of his opponents. It is a huge advantage for pulling.

Why? If I had 8 inches longer arms, and I went to do a deadlift, my butt doesn't have to go nearly as low down because my hand can reach the bar. As it stands now, I got to go all the way down like I'm squatting all the way on the ground, literally to reach the bar. That makes it really hard to deadlift. I've got to do a lot more work and a really bad mechanical position. Long femurs, short femurs, your femur to shank to waist ratio. In fact, you'll see this.

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Good distance runners have really short torsos, and their hips are really high. In fact, the old joke that you'll see a lot is, you can see a good distance runner who's maybe 5 foot 8 inches tall, and you stand him next to Michael Phelps, who is 6 foot 2" or probably something like that. And they probably both wear 32-inch jeans. The runner has longer limb lengths than he should for his height. Good swimmers have way lower, shorter legs but long torsos.

And so you can't tell the difference. If you look at this from the biomechanical world, you see this. Again, oftentimes, people will do fun things like they'll have two people sit down on a chair next to each other, and you can take a picture of them, or you can see that their heads are at the exact same level, and then they stand up and one person is 8 inches taller, the other person, because limb lengths are different.

What I'm getting at with all this stuff is these will determine your balance between your pressing and pulling. That's not a functional asymmetry that we care about that is almost exclusively driven. Well, obviously, it can be driven by your training, but it is highly driven by your limb length and your levers. And that is not a type of asymmetry that we should be overcorrecting in coaching.

So we leave that one alone. Others that are more actionable in terms of movement pattern are things like the functional movement screen. The research on it, as I said before, is not incredibly compelling, but if you understand the limitations, I think it actually is helpful. There have been plenty of studies on it. Some say, it does predict injury. Some say it does not. If you perform poorly on a movement screen, so again, think of this as five or six or eight exercises you do. And we're not doing this to maximal strength. We're not doing this to maximal endurance. We're looking at the quality of your movement, is the way you step forward over a rope, the same on your left side as the way you step forward over your right thigh.

There's no speed component. There's no fatigue, there's no force or strength component to it. That's why we're calling this, quote unquote, "quality." I've mentioned the FMS several times, but there's a bunch of these movement screens. FMS certainly has the most research behind it. If you perform really poorly, like if you were to imagine getting a letter grade and you got a D or lower, you're very likely or much more likely to have an injury because of movement quality.

But if you're at a B, and you go from B to an A, you actually really shouldn't anticipate any change in your injury risk. If you are untrained, you probably don't have great symmetry. If you're highly trained, you probably do better on these tests because they're pretty easy human movements, and you're an athlete, or you're really skilled and you can compensate. So when you kind of just give the research some context, and you don't just read it abstract by abstract or put it into an AI filter and actually makes intuitive sense. So for things like that, the general rule we have is if you score a C or lower, making up what a C would be, right? But just like if you're in

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the middle to lower part of it. You should probably address that if you're above it.

I'm not worried about it. Why? Because it wasn't done at load. It wasn't done fast. And all the other limitations we talked about. So we should think of these as screens. That's what it's called, right? It's a screen. It's not an end all diagnostic. It's a screen for really bad movement. And if that happens, you should correct it because you are probably increasing your chance of injury or dysfunction somehow.

Today's episode is sponsored by David. David makes protein bars, unlike any I have ever encountered. They have an amazing 28 grams of protein, only 150 calories, and 0 grams of sugar. That's right, 28 grams of protein and 75% of its calories come from that protein. This is 50% higher than the next closest protein bar.

Honestly, it's the best tasting bar I've ever had in my life by a mile. And their newest bar, the David bronze bar, tastes incredible as well. While I often talk about the importance of getting 1 gram of protein per pound of body weight for things like muscle health and recovery, and the promotion of lean body mass and satiety.

The reality of that is, for most people, getting that 1 gram of protein per pound of body weight is really challenging. However, David makes that easy. Their bars taste incredible. The gold bar is packed with 28 grams of protein with just 150 calories, and the bronze bar has 20 grams of protein, also with just 150 calories. I eat one almost every single day and always have two or three with me in my backpack when I'm traveling. And I'm like, literally mean always. It probably sounds funny, but I eat them as dessert all the time.

When you try them, you'll know exactly what I mean. If you're interested in trying these bars for yourself, you can go to davidprotein.com/perform. Again, that's davidprotein.com/perform. This then leaves us with our final category of functionality. So what do we know about the relationship between overall asymmetrical function or performance and injury risk. And now, we've got a can of worms to unpack, friends, because there's an enormous amount.

So I'd like to try to do my best to summarize the landscape of the research and not go into any specific area in extreme detail. To get us started, remember, there's a difference here between skill and force. And so most of the ThinkResearch is brought into two big categories. The first is what I'll call strength and force. Typically, the test you're going to see here are leg extension tests. You're sitting in the machine at the gym and you're lifting your leg out in front of you as heavy as you can. Grip strength is you literally take an implement and squeeze as hard as you can.

The other major category are what I'll call power or functional jumping tests. These are often

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things like a single leg hop, a countermovement jump, something like that. OK? So that's the main two ways these things have been tested. After poring through this stuff, here's what I basically found. If you're looking at athletes, eight of the 10 studies in this area, the ones that were done at the highest quality, found positive associations between the amount of asymmetry and either strength or power and injury risk.

So more asymmetry more likely to be hurt or more likely to get hurt. That should tell you something even. More directly, there were six studies that looked at unilateral jumping. This is jumping on one leg at a time. In the six studies that looked at that metric and looked at injury. Five of those six found a positive association. So to me this is very actionable. I would strongly encourage having your individuals or yourself jump on one leg, doing some kind of unilateral jumping test and looking at the amount of asymmetry, and we'll go over the actionable magnitude later.

But that one seemed to be pretty clear. Those that have the more asymmetry in their ability to jump on one leg are more likely to eventually get hurt in their lower body. We don't care about upper body injuries. It's not really related unless they are specifically trained in unilateral jumping. And again, this is when you get in the research, you're like, oh, that actually makes sense. If you look at a basketball player who only jumps on her right leg, he's probably going to have a more asymmetrical thing.

But if you're looking at a player who's in a symmetrical sport, we shouldn't be seeing huge asymmetries in the right and left leg with jumping. When we turn our attention to non-athletic populations, almost everything we're going to see here is what we'll call aging. Every study defines aging a little bit differently, but oftentimes, you're looking at 50 years old plus, sometimes 60 plus. But I think it's really helpful. It's not that these things don't matter in 40-year-olds.

We just typically don't do research in people that are either not athletes or not over 60. The middle-aged people just get kind of left out to dry. That's not just for asymmetry research. That's just science in general, but topic for another day, as we say. What have we learned here? There was a really compelling study that found 60%, again, 60% of older adults who fall had an asymmetry of more than 10% and lower body power.

To me, that's extremely actionable. We start to see this in individuals. 60% of these people are going to have a fall. You can google the consequences of falling, especially after the age of 60 or 65. And it's bad news. So we want to avoid that at all costs. OK, with that being said, by far the most researched in this entire field is the relationship between hand grip asymmetry, strength, and aging-related variables. If you thought you were tired of people talking about grip strength as an overall health metric, I'm not going to make your life any easier.

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What's really interesting here, again, I want to specify we're talking about hand grip asymmetry. The things I'm about to share with you are true, independent of them being a generally strong or generally weak person. That matters. You've probably heard that at length. If you haven't, grip strength is a really nice predictor of overall health and vitality, but the asymmetry one being significantly stronger or weaker than the other one matters a lot.

More directly here, I found more than 25 studies that have looked at health consequences of hand grip asymmetry in the last five years alone. A lot of them coming out of Ryan McGrath's Lab. Awesome stuff there. I'll put a link to all of his stuff, but I only say 25 because I just stopped looking after that. I don't know if there's even 50 or more studies in the last five years in this space.

It just didn't end on PubMed. So I was like, OK, I get the gist of it here. I had no idea. I knew this was a thing. We've been talking about this in our coaching practice for a long time now, but not to this extent. I also have to jump in and say something. Many people are pushing back on hand grip strength right now because it has become over specific. We don't need to be training our grip strength as the most important variable.

Most of the time, something like grip strength is just a crude proxy of overall health. It's a crude proxy of general strength. But in this particular case, as I said now several times, this is asymmetry, and this is independent of being generally strong or generally weak. So there's some important things to pay attention to here. We've been doing asymmetry grip testing for a long time. That doesn't mean again, we spend most or all or big chunks of our program working on asymmetry to be perfectly balanced. But I think you'd be silly to ignore it as well. Why?

Look at the research. Around half of the people that are generally tested have a hand grip asymmetry of more than 10%. So it's really common. And going back now to our handedness conversation makes sense. It can be a skill dominant thing. It can be a lifestyle dominant thing. OK. Some grip asymmetry is fine.

When you look at the aging research, though, that number climbs from 50% of people to upwards of 75%, and we have mechanisms here that start to matter. For example, you'll see the same population-wide type of data here with asymmetry as you do general weakness. So you see things like two to three-fold increased risk of sarcopenia. This is the accelerated loss of strength and performance in muscle with aging. It's not good.

I'll reiterate for the 20th time here. It's not just that your grip strength is weak. It's the fact that it's asymmetrical that has this doubling or tripling of our increased risk of sarcopenia. I could list off the diseases and disorders, and I would never stop. It falls, cognitive disorders, a functional limitations walking speed all cause mortality, cardiovascular disease, respiratory disease,

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cancers COPD, multi morbidities, if you're likely to be on five or more medications. I mean, it just goes on and on and on. And most of these are simple correlational analyzes.

They're cross-sectional. They're, again, also just predicting whether or not you're kind of a healthy person or not. But it's more than that, right? One of the papers actually found specifically for every 0.1 increase in hand grip asymmetry ratio. So a 0.1 increase in the difference between your right and left hand found that older adults had a 26% increased likelihood of falling in the future.

So we're seeing this directly translated into functional outcomes. And where I'm saying this is not just hey, you're finding a strong person or a healthy person versus an unhealthy person, is because these are actually now popping up as early predictors or early detection for eventual muscle weakness, specifically in things like neurological development cases. So a phenomenal paper I looked at, looked at a blood marker called plasma cell adhesions. This is an indicator of many bad things happening. We'll just say it that way.

And those neural cell adhesions were 20% higher in people that had greater than 10% asymmetry. And so what we're starting to do is connect the dots here is my point. Yes, some asymmetry is just normal. Some weakness is fine. But past that, it can be predicting overall neurological health, motor function control.

If then we start to go up the chain and look directly at markers in the brain, and those are also coming down, we can start to piece together what are the mechanisms here and what are just simply correlation. We don't know it at this time. We have to learn more. But I think, as I said, it'd be a little bit silly to ignore this. It's an easy test to do. It is almost costless. Hand grip dynamometers are very cheap.

They don't require a warm-up or much standardization, your hydration status, and just all those other variables that go into a lot of the other functional tests for asymmetry we talked about, they're easy to overcome with hand grip. So yes, I'm with you. I don't want you to lose the forest for the trees. Let's not overinterpret the magnitude or overprogram our health and fitness and our strength and conditioning, more specifically because of a grip strength test.

But that doesn't mean we should ignore the variable either. I'll move off of that soapbox and round us out here with our last component to help us interpret this asymmetry testing data and talk about the landscape of physical performance. So when we look at this side, which maybe is a little bit of a wordy way to say, do asymmetries help hurt or independent of actual physical performance? Well, it depends, right? I've been setting that answer up for a long time now.

But symmetrical sports likely need more symmetry to maximize performance. The easy

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examples, running and cycling. When you look at change of direction type of sports, then symmetries and muscle don't tend to matter as much. I actually think it makes quite a bit of sense. I'm not moving in the same exact way every time. So if I have subtle differences between my sides, it's probably going to come out in the wash.

However, if I'm trying to do the exact same motion over and over and over again in the same pattern, ideally getting the same amount of force and energy on both sides. Symmetry starts to matter more so when you see the data conflicting, it's oftentimes because of that. What's the style of exercise tested or the type of athlete? I'll reiterate symmetrical sports probably need a lower threshold to determine acceptableness of asymmetries.

You should be more symmetrical, lowers your injury risk, and enhances your performance. Let me give you some specific details. I like this paper that came out, and it looked at all the studies that qualified for this particular review, and it looked at performance, overall function, morphology, as we've described, kinetics, and kinematics.

That's kind of how you're moving through space, the forces you're producing, the angles you're producing that and so forth. Very similar to our approach here to try to look at all aspects of performance. And here's the summary-- about 30 of the papers included found no significant relationship between the amount of asymmetry and all those different areas and how they performed in their sport. 16 found that asymmetry negatively impacted performance, and one found that it was actually a benefit.

So if we look at the totality of this, we're looking at 47 studies, at best, being asymmetrical is neutral. One found it helped, and the other 16 found it hurt. So another way to say this is 46 of the 47 studies found that asymmetry either didn't do anything or hurt.

To me, friends, that's your answer, the easiest example I think I can give you here to wrap your head around this, and then we'll kind of summarize everything, and I'll give you some specific numbers that I think are best to walk away with here, is that the energy leak area. So let's just imagine a cyclist or a runner for now. Some really cool studies have been done here that ranged from data analyzes and theoretical models to actual direct human testing, some high-powered analytics, and some really cool stuff that's been done.

And I'm going to condense it all down in just a couple minutes or less here. But what we're finding here is greater than a 5% asymmetry creates a measurable detriment in performance. You will see people run slower times. I continue to say that performance in this section, I apologize. I should have outlined what I mean by that. But actual sport performance in this case, running. You run slower if you have an asymmetry that exceeds 5%.

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And here's exactly why a 10% difference in either step time in the case of running or ground contact time, the amount of time your foot spends on the ground, if that is 10% longer on one side, one foot versus the other foot, that will result in somewhere between a 4% to 8% increase in metabolic cost. Other studies have looked at a very similar thing and actually looked at force production, so not just the amount of time you spend on the ground, but the actual force you're producing in the ground.

And that 10% asymmetry leads to 2% to 4% increase in metabolic power. So in theory, you could have one or a combination of the step time or ground contact time and/or force. And now your metabolic cost has gone up somewhere between 2% and 14% The numbers are getting really big here. The R value in these studies is ranging in the point eights. Remember, 1 is a perfect correlation. 0.8 is extremely high. And so I did some back of the envelope math for you here. And this is kind of what you're looking at.

The asymmetry cost here is about a 1% increase in ground contact time-- again, difference between the two-- equals 0.354 calories per kilogram of body weight per kilometer. Now, I know all of exactly what that means, but just for fun. What's that actually mean? Something like a two to three increase in caloric need per kilometer. Now you're probably thinking that's nothing. But I'll reiterate that's per 1% asymmetry.

If you're at 10%, which is our threshold, you got a 10x that number. So a 10% asymmetry, which would be, quote unquote, "normal," that's right on the area of someone might start caring about it or not would lead to a caloric expenditure of 30 extra calories per kilometer or about 300 extra calories per 10K. That's somewhere in the neighborhood of 1,200, maybe 1,500 extra calories needed for a marathon.

1 degree of difference in ankle dorsiflexion led to PRs in men during the 8K, in women during the 6K of about 7.6%, and all I had to do was give you a 1-degree change in dorsiflexion of your ankle. It's exactly what I'm talking about. So to summarize that section, here's what I'll say. The 10% rule of asymmetry is an OK heuristic at the highest level, but it is scientifically shaky.

I prefer the following-- if we're looking at muscle size and quality, I kind of will break this down into red, yellow, and greens. If you're under 5% of an asymmetry, the difference between sides of the same muscle or muscle groups less than 5% muscle size, I'm calling that green all day. That's exactly how I coach. We don't really take action on that, meaning I'm not going to ask them to do exercises or do anything different to change that.

If they're in the 5% to 10% range, I don't know if this will increase their injury risk, but it almost certainly reduces performance, and it's not worth it to me. So I'm taking action on the yellows, 5% to 10% for muscle size or quality. Anything above 10 I'm calling a red flag doesn't mean,

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we're stopping them telling them they can't play this year, but it does mean this becomes a very top tier training priority for us.

When I go to muscle function in any of the ways we describe it, I give them more latitude than I do for morphology. Red, instead of being 10%, is now 20%. And then think about this. If I asked you to throw a baseball, very few of you, if you could throw 100 miles an hour with your right hand, could throw 80 with your left hand. So some of the tasks are going to be really asymmetrical and others a little bit left.

You shouldn't have a 20% difference in your leg extension test on your right leg versus your left. That's too high. So you got to have some context here. But that's why I'll set it as high. That's a red flag. Yellow is 10% to 20%. And anything less than 10%, I'm going to call green. Again, highly dependent. We also need to keep in context. Are we a symmetrical athlete or are we an asymmetrical athlete. So as I'm looking at those, red, yellows, greens for function and morphology, if you don't have a specific reason to be asymmetrical, you should probably try to minimize it.

Another important note, the amount of asymmetries you'll find in the upper body are way less than the lower body. Typically, the amount that you'll see is twice as often twice as frequent, twice as common in the lower body. As I mentioned, it matters more in active people than inactive people. So what you'll consistently see, asymmetries don't really increase injury risk in people who aren't active.

But as soon as you become active, whether you're an athlete or just an exerciser or a human mover, that asymmetry is going to rear its head now. And this makes a ton of sense. You have a small asymmetry, but then you're actually doing something with your body. You're just giving that asymmetry more exposure. You're more likely to either make it worse or something bad to happen.

But if you're not using it ever, well, geez, of course, you don't get hurt. The threshold for peak performance is probably lower than minimal injury. I've said this multiple times, but I'll be explicit here. If you want to minimize your injury risk, you can probably have your threshold a little bit higher.

But if you want to perform at your best, you need to keep addressing those asymmetries even after you've eliminated or reduced injury risk. So when I say threshold is different, that's what I mean. So if I look at somebody, and we have an asymmetry in a performance test of 8%, I'm probably not worried that they're going to develop an injury. But I'm going to look at this and go, well, we're not as efficient as we can be. We're wasting gas here. We're burning extra fuel. Let's get more efficient so we can run at our best.

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So if you don't care about performing at your best, then I would maybe stop at the injury thresholds and do your best. But some of you out there do. I know. I get a ton of comments and messages about people that are like, man, I'm trying to be my best here. So great, I would continue to press then on those asymmetries and work to try to get your best performance. The last final thing I'll tell you is, regardless of athlete or not, morphology or functionality, skill or force, whenever you're over 20%, it's probably bad. We can boil it down to as simple as that.

So if you've done any kind of test of any kind, the ones I've recommended today. And that number is more than 20%, we should probably address it. How do we do that? Let's dive in to intervene right now and talk about what we know exactly about reducing, improving, and otherwise treating muscle imbalances and asymmetries.

I got to start this by giving you fair warning. Much of what you're about to hear is my personal opinion and coaching practice, because there are exactly zero high-quality randomized controlled trials showing that correcting a specific percentage of an asymmetry reliably prevents or reduces or eliminates pain or injury entirely.

If you're coming at this from the physique and bodybuilding lens your solution sets, you're going to hear is basically more volume. You're assuming that the problem is muscle size, maybe muscle strength. But most likely, that's what we're talking about, which is fine. If you're from the lens of the physical therapy realm, you're going to hear that corrective exercise. You're going to be told to move slowly to move and correct patterns, probably do body weight or very light loads and learn to move better.

Again, totally fine. We look at the research. It's going to be pretty thin in all of these areas. You might be surprised to hear plyometrics is one of the most studied areas in this entire field. Really nice review that I was able to find actually looked and found eight randomized controlled trials that had about 150 participants in it. So not huge studies, not a lot of them.

In general, what they'll find. Unilateral plyometrics is generally more effective than bilateral plyometrics. What I mean by effective is how well do they reduce the asymmetry? How effective are they at bringing you back to balance between the two sides? Unilateral plyometrics almost always will significantly decrease the asymmetry, meaning my training, is I jump on my right leg, and I land on my right leg. I don't jump from both.

I don't jump from one to land on the other. That's what unilateral training is. And so really, when I looked at this for the lower body, plyometrics seemed to really do the trick. But what's really happening here is an interesting physiological phenomenon where when you're jumping and landing, it's very different than doing a bodyweight exercise for stability or a more traditional corrective exercise because moving slow and moving light is good, but it doesn't create the

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same neurological demand as moving fast and landing with load and force.

So the brain has to rapidly mobilize more motor units. It enhances neuromuscular coordination and control, thereby reducing sports injuries oftentimes. You also have to learn to control bilaterally through the torso. So you jump up and land on your right leg. You have to control the entire body. You have to control the hip and the shoulder and the neck and your posture and all you forward or backwards. And so you've got a balance component to it. You've got an ankle stability component.

You've got a whole cascade of things happening up and down the chain that are not just about the local muscle. This is why these things differ than just doing things like your traditional leg extension strengthening test. So it's the jumping and landing and the coordination aspect that gets more of your nervous system engaged, which means we correct the force performance.

And ideally, if we had any bilateral force deficit before, we continue to reduce that and work on that because we're getting impact across the entire system, not just the local muscle itself. Now, I'm making sure to be clear here, this is not scientifically validated. But what I did do is talk to a ton of people that I respect. These were Division I strength and conditioning coaches to running coaches, physical therapists, scientists, and a bunch of people that just said, like, what do you actually do?

When you have somebody come in that you're working with aging young, athlete, non, what does that actually look like? And so what I've done is I've compiled together kind of this five-step program here. I'll put this out there to you and do with this information you will. But when we have identified either a muscle strength or size asymmetry that we want to correct, the first step is what I'll call pre-exercise.

So this is the stuff that you do prior to your workout. So start off with either some sort of soft tissue or mobility, flexibility. This could be a foam roller or the equivalent, whatever you use. And to make sure that the joint is able to move the right way, it's supposed to. You want to be able to move symmetrically. If we're already starting from an inability to get our joint in the right position, it's going to be hard for us to train that in the right position.

You'll hear a lot of coach speak here of saying like, make sure you can access the joint or you can own the movement. That's kind of what they're referring to. Can we actually get into a symmetrical position? So that oftentimes means we will do some-- again, I'll call it soft tissue or mobility work. And then follow that up immediately with pre-activation, specifically on the weaker side.

So maybe I'll just give you an example so you can kind connect the dots as we walk through

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this. But let's say we've got an asymmetry in our right shoulder versus our left shoulder. We'll start off with maybe a foam rolling, our right pec muscle or our front shoulder and opening that up. And now, all of a sudden, my right shoulder can move at the same degree of extension or abduction or adduction or whatever the case is as my left shoulder. Great.

Then I'll activate it. Maybe I'll do a specific exercise on the weaker side to make sure that muscle is turned on and activated and ready to fire. I could certainly do it on my stronger side as well, but I really want to emphasize it on my weaker side. Make sure I have access to the position, and then make sure the muscle is ready to go. Step number 2 is what I would call exercise selection.

So this is in your programming itself. So hedge more of your programming towards unilateral exercises should make intuitive sense. If you're doing all bilateral exercises, again, this would be a barbell bench press. Both arms are moving at the same time. Maybe hedge a little bit more. But you don't have to go all the way to unilateral. So switch the barbell out to maybe two dumbbells so that both arms are still working even at the same time, but they're working independently, so that weaker side is not being helped out by the stronger side.

You also want to make sure that you the exercise equipment you select. In this example, I just gave you barbell versus dumbbell allows you to do both unilateral or isolating loading. So again, two dumbbells in my hand. They're both going up at the same time, or I do one up then down and then the other side up and down. So that's unilateral or isolating. Either way, modify your exercise selection to allow a little bit more of that type of loading strategy.

Then individualize versus pre-set your exercises. A million examples here. But I remember years and years ago with an NBA player, really having a hard time developing his glutes. And for whatever reason, all the standard exercises weren't working. He just had a hard time accessing his glutes with glute bridges and hip thrusts and all that other stuff.

So eventually, his team found a really weird little position that he got in, and he felt a strong contraction in his glute, great, that was his new glute exercise. So the rest of the team were doing hip thrusts or something else. He was doing this weird little variation exercise. He had a limitation he was trying to work on an asymmetry. And rather than just doing a preset selection of exercises, you do this exercise for this muscle. You do this exercise for that muscle.

He was just tinkering with exercises until he felt a strong contraction in the muscle of interest. And he went with that. So think about the exercise, of course, but you really need to pay attention to the person themselves versus a preset selection of exercises. They don't guarantee a lot of activation.

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So get warmed up with your pre-exercise stuff appropriately. Then make sure that the exercise selection is giving you the ability to do more isolation work or more unilateral work, but not exclusively. Then it comes down to you actually being focused. Step number three here is what I'll call exercise technique. Again, there's lots of research here. But mindfulness probably taken the music out of your ear. You're not listening to podcasts. You're not listening to work transcription. You're not counting even repetitions or the load that carefully.

You're simply focusing on quality of execution. You're trying to make sure that right pec is being squeezed. You'll hear a lot of bodybuilders, will talk out loud to themselves, and they'll say little phrases and they'll be like, squeeze, squeeze, squeeze, squeeze, squeeze. Or they'll say right side, right side, right side, or whatever the case is. They'll use verbal cues out loud because at this point, remember, we're not trying to maximize muscle growth or strength or anything that.

We're trying to get a specific muscle or small group of muscles to do a specific action. And by definition, they're not good at it. And so if we get lazy, and we're too worried about our music, and we just start getting the barbell up, and we start using the stronger group, or in this case, triceps kick in too much when we're trying to develop our pec, then we're not getting anything out of the exercise that we're trying to get or we're not getting as much. That technique stuff is everything, friends.

If you're like, I've done the program, I've done the work, and it didn't give me the results, a lot of times, I'll be like, yeah, what were you doing during it? Were you really paying attention to quality, or were you worried more about outcome? Were you worried about how much weight was on the bar? Or were you worried about hitting the reps because that's how many reps it said on the sheet? Or were you distracted by other things? That's what matters most here.

I also-- in terms of exercise techniques, this is one of the times where I actually like to go slow or potentially even use isometrics, which means you're not moving at all. I like these because they expose or exaggerate asymmetries. You can't get away with that as much as if you're kind of moving fast and just getting through the movement and getting through the movement or the exercise. They'll also expose compensations and weaknesses that you may have even missed in your screen. Doesn't mean you have to do only isometrics or always go slow. But I would use it as a part of your process.

And then lastly, with your exercise technique, try to go through a really large range of motion, especially in the stretched position. Whether you fully lock out each rep-- OK, I can live without that if you don't like the lockout, but at the bottom position where you're most stretched, that's going to give you the most range of motion. It's also going to induce a lot of muscle growth and a lot of muscle strength. So really spend that time in good positions down there.

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So step one, we've activated the muscle and got it in the right spot in the joint. Then we chose the right exercises. Then we executed those exercises with the most intent we could. The fourth consideration here is general exercise programming. In terms of the order, which exercises you do throughout the day? I still start with your complex exercises. You'll see this a lot, and I've described it several times.

Sometimes just getting stronger eliminates or reduces asymmetries. So I start there. I start with the bilateral stuff. I start with the big compound movements, get those things done first, and then I finish with unilateral. I actually generally don't prefer to start with unilateral, even though I know what the asymmetry is.

I gave you what I start with earlier, activation and things like that. But when your actual workouts come, start with your complex bilateral stuff and then finish with unilateral. I'm certain you could do it the opposite. This is entirely personal preference. Do whatever you'd like to do there. But that's my rationale.

When you get to the second part of the workout, though, and you are doing the unilateral, start on the weaker side. And then you can finish with true isolation work if you want to do that. So you're going to do complex work. You'll do unilateral work. Again, one side versus the other. And then if you want to do isolation work specifically working on that one muscle group by itself, then you can do that at the very end. That's absolutely fine.

You don't need to be perfectly balanced and symmetrical every single workout. You want to think about symmetry of your muscles and muscle groups and actions throughout the entire week. I generally have a rule of thumb of I want at least everything moving once per week. I don't want it to go more than that without doing something.

But the big kicker here and potentially most practical thing that you can jot down in your notes, it's a volume game. So here's what this means. You want to get more work done on a given muscle or muscle groups throughout the week. You could simply add somewhere between two to five repetitions on the weaker side per set. So let's say you're doing our unilateral bench press. You're going to do a set of six on your strong side, and you do a set of 10 on your weak side.

Another way, you just do one more total set. So let's say I do three sets of six on my weak side. I do three sets of six on my strong side. And then I come back and do one more set of six on my weak side. Other people just do a total volume throughout the week, just accumulate, you know, 20% more volume on the logging body part. Some people just add one exercise per workout. I do the same reps. I do the same sets on all sides, and then I finish the workout with one exercise entirely dedicated to my lagging side.

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Some people like to do a little bit of a different variation, and they say, great, I do none of that, but I finished the workout with one set to failure 15, 20, 30 reps on the lagging part. Those are all just different little tricks to help you find some more volume on one side than the other.

If you have a mobility or flexibility limitation, one thing I've been using since as long as I can remember in my programming for athletes or even the non-athletes that I personally coach, I will do most of that mobility stuff during rest intervals. I don't really find it effective to do like a 20- or 30-minute mobility or stretching routine. What I'll end up having them do is, OK, do your one set of bench press. And then you're going to do some sort of stretching exercise or mobility exercise. So your rest intervals, rather than getting on your phone, you're stretching.

Now, maybe I lose a little bit of power. Maybe lose a little bit of strength. I don't care if my goal is to correct an asymmetry or muscle range of motion issue, that's a great time to do it. So we've gone over a lot of different stuff today. We talked initially about what asymmetries really are and why they happen.

And then the second part of our one-sided conversation, we walked into our three Is. We talked about how to test these, whether these are morphological or muscle size and shape differences, whether these are muscle quality or fat infiltration, or are there any range of functional or performance-based asymmetries? And then we got a little bit into understanding at what level do they matter? And what level do they don't?

And do they matter for maximizing my performance, or do they matter for my injury prediction? And we finished with a little bit of an outline of how we could potentially go about correcting these problems. But before you leave, I actually want to give you some additional resources for this. These are people who I learned a lot from in either the direct preparation for this show or just over the last decade or so. I've mentioned Greg Rose from Titleist Performance Institute multiple times, Eric Cressey.

Eric has a wonderful series of DVDs. Yeah, that's how old I was when I first saw these with Mike Robertson. I think it's called Assess and Correct. I don't even know if you can find these anymore. Dr. Charlie Weingroff I've been looking at his stuff on this for well over a decade. Phenomenal. He still has educational stuff out that he's actually releasing all the time.

So you can check out his stuff. Dr. Kelly Starrett really turned me on to the mobility and the movement side of this equation with his company, the ready state. Aaron Alexander has a completely different approach to this with his alignment method. And then, as I mentioned before, doctor Ryan McGrath, whose research I think is at North Dakota State. It's literally called the Hand Lab, who's done a ton of this hand grip asymmetry and other research. So those were seven people who I just found really helpful in this stuff.

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So to wrap up and give us a final conclusion, this is not an area only for athletes. I hope that I've laid out a case that this is an important thing for all of us to consider, whether we have ever participated in a sport or ever think we will ever again. These can have significant impacts in how we look, feel, and perform now, as well as the rest of our life.

Another important take home-here is the data, in my opinion, are overwhelmingly observational in nature and low quality, and we have few interventional or mechanistic studies. But I do not believe that should mean we should not take action. The key is to collect good data, interpret it with context rather than blanket rules, like as long as it's less than 10%, it's OK. There are skill-driven asymmetries. And these are probably good for sports.

The easiest example is I probably should throw harder with my right hand if I'm trying to throw a baseball than my left hand. We're going to see this mostly in the upper body, though, and it's probably less detrimental. Occasionally, if you are in a sport that requires foot skill, you'll see that. But most of the time an asymmetry in the lower body is problematic. So that's a functional distinction there. That is really actually pretty easy as a little more of a blanket statement.

Upper body asymmetries, if they're skill-driven probably OK. Lower body asymmetries, more reason to do more analysis, they're less likely to be OK. Asymmetries across movements that are intended to be symmetrical, that are gait-related, running, squatting, pushing, those are supposed to be even movements. If they're not, we should consider taking action.

And then finally, in my opinion, muscle size or muscle morphology asymmetries are a bigger concern than some of the functional and performance-based ones for the reasons I shared multiple times now. So I hope you gleaned a lot out of this. I hope you've run a run away and done some sort of asymmetry testing on yourself and that I hopefully reduced some anxiety or concerns you might have in with either the realization that you're a little bit of imbalances or differences. They're OK. They're totally normal. They're not harmful.

Or maybe we've given you a chance to actually improve and set some new PRs. Thank you for joining for today's episode. My goal, as always, is to share exciting scientific insights that help you perform at your best. If the show resonates with you, and you want to help ensure this information remains free and accessible to anyone in the world, there are a few ways that you can support. First, you can subscribe to the show on YouTube, Spotify, and Apple.

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[MUSIC PLAYING]

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