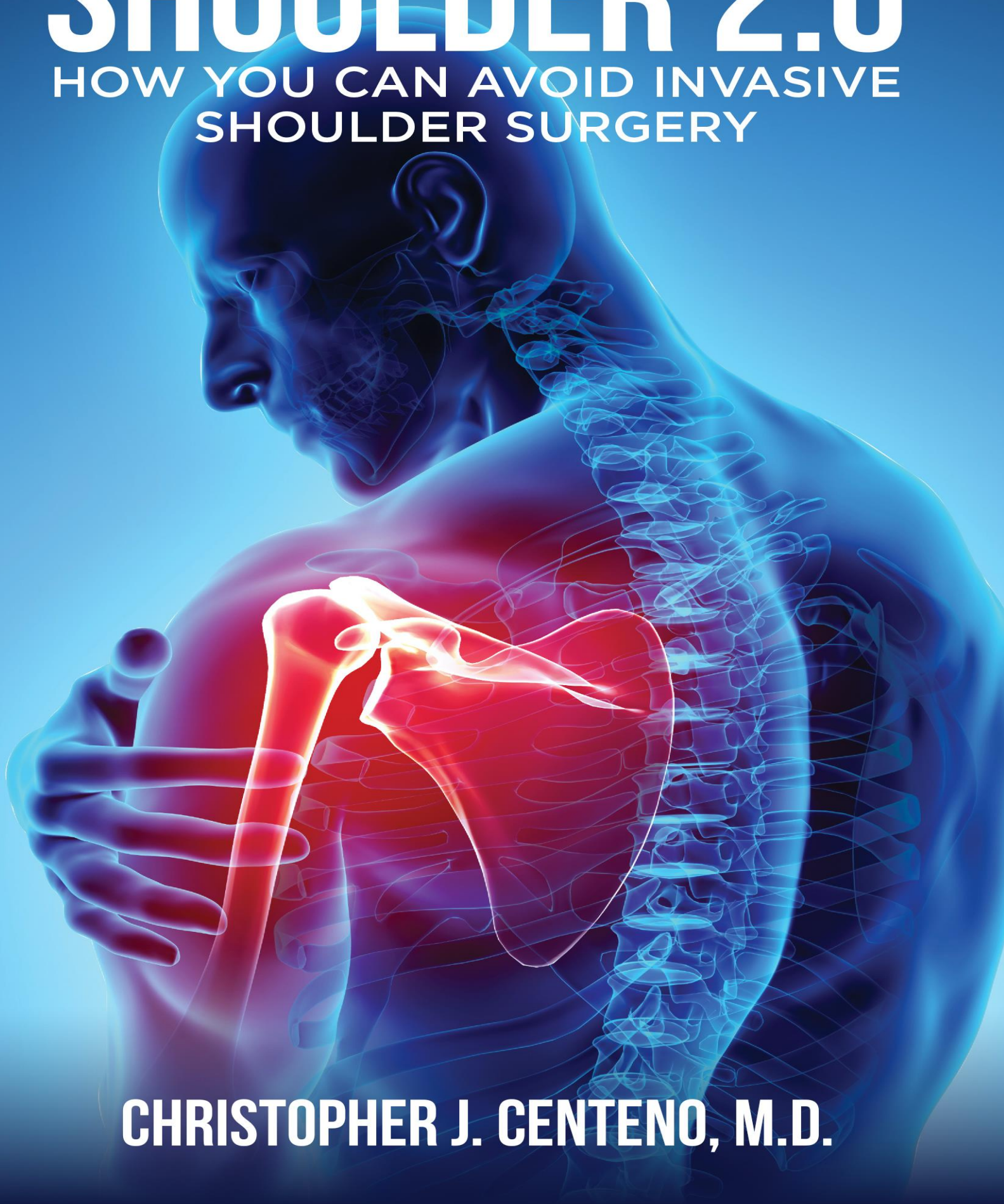
SHOULDER 2.0

HOW YOU CAN AVOID INVASIVE SHOULDER SURGERY



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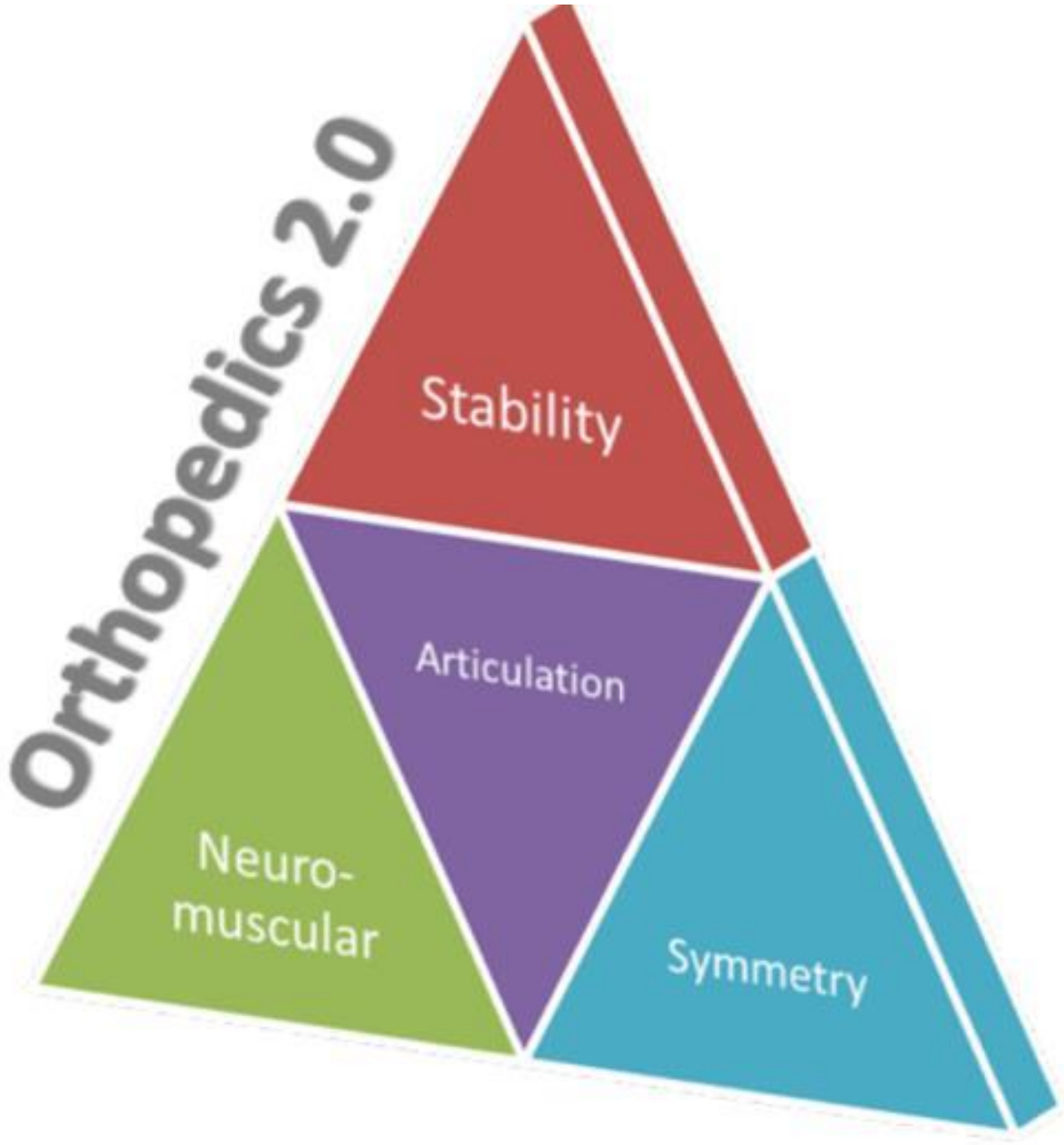
Contents

Introduction



Disruptive technology surrounds us. Uber, automation, self-driving cars, the Internet of things, Google, and so on have all spearheaded rapid change. This book details how the world of shoulder surgery will be upended by a new medical specialty called Interventional Orthopedics. Let me explain.

As a society, we simply perform way too many shoulder surgeries. If most shoulder surgeries went away tomorrow, many hospitals wouldn't be able to make payroll. Yet, what if I told you that 70% of these procedures never needed to be performed—and, instead, could be replaced by a precise image-guided injection of orthobiologics?

What is precise imaging guidance? Rather than using surgery to implant something that may help tissue heal, a highly trained physician can see precisely where he or she is injecting by using specialized equipment. This means a less invasive and more pinpoint procedure. The two most common ways to target an injection are through ultrasound and fluoroscopy. The former is highly effective at soft-tissue imaging, allowing a doctor to see a rotator cuff tear for example. Fluoroscopy is better aimed at imaging bones and deep structures; so, to help prevent an unnecessary shoulder surgery, a damaged bone or a deep structure—like the labrum—may be injected.

What are orthobiologics? These are tools that can be injected to will aid or prompt orthopedic tissue-healing. The list includes platelet-rich plasma (PRP), stem cells, serum-based products, and scaffolds. Much of these can be made from your own body, what we physicians call autologous.

So, what can this new technology help? Here's a short list of shoulder problems:

- Rotator cuff tears
- Labral tears
- SLAP lesions
- Shoulder arthritis
- Shoulder instability
- Separated shoulders
- Biceps tendon tears
- Avascular necrosis or osteonecrosis
- Frozen shoulders

This book and its big brother (Orthopedics 2.0) is part of a two-decade quest to find what I have termed the "Unified Field Theory."

Physicists have long sought a single "theory of everything" that ties together all other theories into one grand explanation of the universe. I've sought to do the same for the shoulder and the entire musculoskeletal system. Many theories abound about how to diagnose and treat shoulder problems. Orthopedic surgeons have a surgical approach, family-practice and sports-medicine practitioners a conservative approach, chiropractors their own alternative approach, and physical therapists their own way. Within chiropractic, physical therapy, and alternative medicine, there are literally hundreds of wholly different theories about what's wrong with the shoulder and how best to address these problems. Having studied these differing approaches, I found a kernel of truth and interconnections between them. As the research in this field has

become more robust in the past 20 years, many of these concepts can now be vetted by scientific observation rather than intuitive guesses.

This book contains my own theories based on several decades of reading and observation and offers a method to organize that information for doctors and patients alike. The reader should note that while many of the components of this new theory are supported by rigorous scientific research, the whole package as I present it has yet to be studied by what doctors call "level-I evidence"—where randomized controlled trials have been performed concluding that the treatment approach has been found to be effective. Having said that, most of what physicians and healers do today for patients with shoulder problems has not been supported by level-I evidence; this includes joint arthroscopy, ligament repairs, rotator cuff surgery, arthroscopic and surgical debridement, chiropractic adjustments, acupuncture, massage—and, most of all, physical therapy. These surgical and nonsurgical approaches all lack the type of rigorous scientific support (level-I evidence) that shows they are effective. In fact, when some of these procedures have been studied in controlled trials, they have often been shown to be no better than placebo surgery or no surgery. For example rotator cuff surgeries and arthroscopic shoulder labrum repair have been shown to have no benefit.

This is an Internet book that is not 118 pages long but really several thousand pages long. How is that accomplished? By publishing this book on the Internet, I can easily hyperlink to in-depth blog posts, scientific abstracts, and other references so the reader can delve deeper into any subject. In addition, my goal is to allow patients to submit questions and feedback so the book can be updated and improved. Making this book better is as simple as clicking a link. To submit questions or ask for clarification on any part of this book, send an e-mail to the author by clicking here.

What is Orthopedics 2.0? In particular, Orthopedics 2.0 doesn't refer to the discipline of orthopedic surgery or its successor. While orthopedic surgery may well be used as a part of Orthopedics 2.0, Orthopedics 2.0 has a bigger focus beyond just fixing one part of the shoulder. We focus on each part of the shoulder as it is interconnected to the whole.

While the focus of this book is nonsurgical, there will always be situations where the best approach is surgical. What will likely occur over the next one to two decades is a slow and steady movement toward less-invasive orthopedic-type procedures—what we call interventional orthopedics. This is identical to what's occurred in other areas of medicine, such as cardiology, with fewer invasive open-heart surgeries and more X-ray-guided catheter procedures.

Interventional orthopedics represents the shift from "shoulder salvage" to "shoulder repair." When the focus shifts to repair, the amount one needs to know increases exponentially. The pyramid at the beginning of the introduction outlines what we use to evaluate the shoulder and whole body. While I use stem cells in daily practice, it's important to note that helping patients is often not as simple as injecting magic stem cells. This book details the system our clinics use to decide which procedures and therapies to apply.

The problem with repairing the shoulder lay in its complexity. Think about your car. You know there are critical components to keep it running. The wheels should be aligned or the car won't go straight, and the tires will wear unevenly. The connections between the wheels, the axle, the drive shaft, and the engine must be flexible and allow for fluid movement. The engine, as it turns the drive shaft, has to be well-oiled. As the engine cranks up to even faster speeds, the connections had better be stable or the whole thing will fly apart. Finally, your engine has miles of wiring and small computers on board to monitor the whole system and to regulate the activity of the engine, brakes, gasoline usage, and monitoring systems.

Now think about your shoulder: its bones, joints, muscles, tendons, ligaments, and nerves. The same principles that apply to your car apply to your shoulder—alignment, good joint connections, stability, and sound wiring (nerves and minicomputers that impact everything from the timing of muscle firing to the information about joint position). Regrettably, the standard surgical approach too often solely focuses on bringing the car into the shop to replace a few worn parts—or shave them down so they fit a little better—without considering how the parts got that way in the first place.

Now, let's look at that analogy. If a 40 or 50-something-year-old patient who lifts weights every day is suddenly diagnosed with shoulder arthritis, shouldn't we ask ourselves why only the right shoulder was impacted? Could it be that for years the right shoulder was getting worn down due to poor alignment (or instability in the right side)? We'd all accept this premise at face value with our cars; a misaligned front wheel and axle could cause the right front tire to wear faster than the left. Yet for some reason, our medical-care system often ignores why one joint wore out faster than another. The reason: if the plan is to replace the joint, who cares?

Yet, what if we wanted to save the joint? Would it matter more? Absolutely. This is the reason for the Ortho 2.0 approach and for this book. When the shift is moved from replacement to repair, we must ascertain how the joint got that way: if the joint is stable, if the surrounding muscles are firing correctly to protect the joint, whether the alignment is correct to support a healthy joint, and if the wiring is in order.

While stem cells are a great advance and represent a cutting-edge tool, their use without considering “the whole” doesn't get patients where they need to be, having a shoulder they can count on for years to come. In this book, we'll look at all parts of the Orthopedics 2.0 paradigm listed above, as my partner coined the term, SANS: Stability, Articulation, Neuromuscular, and Symmetry. Sans, in Latin, means “without.” And the purpose of this book is to leave you Sans Pain.

Chapter 1: Interventional Orthopedics and the Regenexx Difference

So, interventional orthopedics can do all of these great things, but what is it? Additionally, what is it not? Let's review our topic as well as explore the Regenexx difference in the field of regenerative medicine.

What Is Interventional Orthopedics, and Which Doctors Can Do This?

Interventional orthopedics is fast becoming a new medical specialty that is highly different from surgical orthopedics. It is the use of highly precise image guidance, as explained above, to place substances that heal tissue into the specific locales where tissue damage lives. However, few physicians in the world are trained in these complex procedures.

First, placing a needle into a specific spot using imaging guidance is not something your surgeon has been trained to do. In fact, as an instructor and founder for the Interventional Orthopedics Foundation (IOF), some of the worst physician students I taught were orthopedic surgeons—simply because this type of precise injection is not something they have been trained to do. In addition, nothing about orthopedic surgery or arthroscopy makes them any better at the task; and in some ways it makes them worse, leading them to believe their image-guided injection skills are better than they really are.

Second, the average family doctor, internal medicine doctor, or other subspecialist is also not trained in this area. More concerning is that we see many nurse practitioners and physician assistants performing injections in chiropractic offices who also don't have the background to do this work competently. So, if these doctors can't do what I'm about to describe here, who can?

At the IOF, we have put together criteria for the types of doctors allowed to walk in the door to train. Basically, these are doctors who understand how to guide a needle under imaging guidance. They also need to be the type who can be retrained in how the musculoskeletal system works—because interventional orthopedics involves getting tissue to heal instead of cutting it out or sewing it back together through surgery.

A surefire way to find a properly trained physician in shoulder-focused interventional orthopedics is by working through the Regenexx network. This is the only provider network on earth trusted

by many Fortune 500 employees to perform these procedures on their employees to reduce the rates of invasive orthopedic surgery.

The Regenexx Difference

When we first pioneered orthopedic stem cell therapy for shoulders in 2005, we were the only physicians in the world doing this type of work. The last few years have seen a multitude of clinics opening for stem cell therapies from arthritis to ALS to COPD to MS. Yet, while some of these clinics do a good job, but most are not legitimate. This begs the question, what are the key components of a reputable clinic?

1. Treatment-registry tracking of patients
2. Guidance of the injection
3. A focus on orthopedic problems
4. Candidacy grading
5. Published research
6. A customized approach to the processing of your tissue
7. Dosing
8. A clinical training and certification program for affiliates

Treatment-Registry Tracking of Patients

Any new therapy that is a standard of care needs to have data collected—even if it looks very promising from the standpoint of patient experience (e.g., a doctor says it has worked well in other patients). This means that standardized questionnaires are sent to the patients at set time points to see if they have less pain, more function, or any complications with the procedure. This is a huge commitment on the part of the clinic and the doctor and is vital to establishing legitimacy.

As an example, right now we use a nonprofit that has a clinical research organization (CRO) quality, customized software to assist us in collecting data on the patients we have treated. They have multiple full-time employees to collect data. Regenexx employs a full-time biostatistician to analyze this data. When we report the data, we must enlist the help of expensive physicians to call patients who haven't responded to their questionnaires to make sure we have sufficient data to report. While we have a full-time biostatistician, we must also use more expensive doctor-time to help our biostatistician decide what's clinically meaningful to analyze. Most importantly, we transparently report our registry data online so that everyone can pull up a real-time extract (updated monthly) of the patient results in our registry.

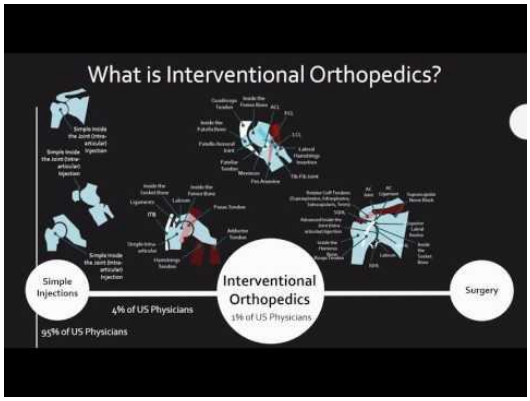
How can you tell if a clinic is doing what we do? They will have data from their patients that they have collected and reported, usually on an annual basis. Why is it important to see that clinic's data? A procedure like this may produce very different results in a different doctor's hands. In addition, the clinic will be able to tell you exactly how it collects its data, who collects it, how often, and so on. For example, a proper treatment registry collects data at set time points like

one month, three months, six months, one year, two years, three years, and so on. If all you get is a call from a nurse, like you would after any common surgery, then this isn't nearly enough.

Guidance of the Injection

The manner in which we deliver stem cells as part of interventional orthopedics makes a dramatic difference. While delivery into an arm vein (IV) is attractive because of the low level of expertise needed to deliver cells, studies have consistently shown that adult stem cells delivered in this fashion are trapped in the lungs (pulmonary first-pass effect). Of even more concern is a recent study showing that for patients considering the use of stem cells to treat central nervous system (CNS) disorders, only about 1 in 200,000 cells injected via an IV route reaches the brain and central nervous system (1.5–3.7% made it past the lungs, 0.295% made it to the carotid artery, and 0.0005% made it past the blood-brain barrier into the brain).

At this point, until these pulmonary first-pass issues are worked out, credible stem cell delivery is local—and that is what Regenexx does.We place cells directly into the tissue or into the arterial circulation that directly supplies the tissue. In addition, based on our clinical experience, for orthopedic applications (and likely for others), it's hyperlocal, meaning that placement of cells into one part of the joint may provide results; whereas, nonspecific placement in the joint may provide fewer results. This illustrates that imaging guidance is vital to place cells into joints.

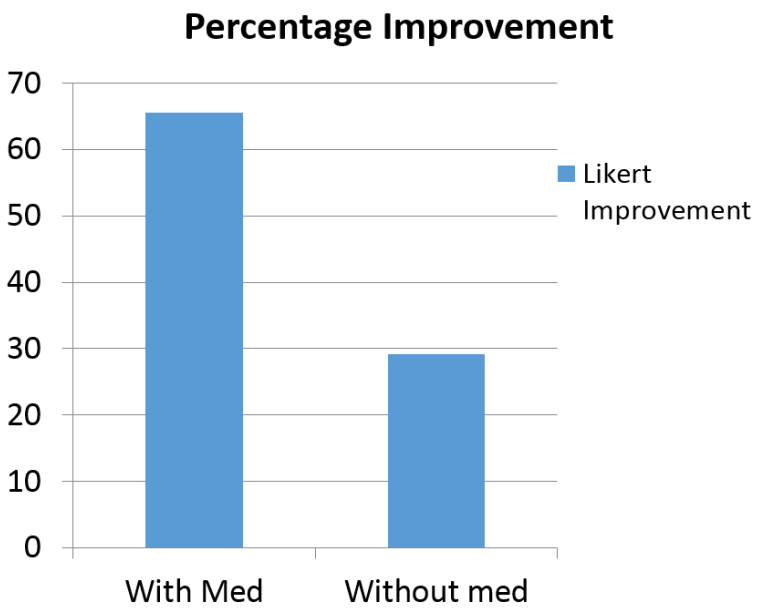


What does imaging guidance look like? The doctor uses either ultrasound or real-time X-ray (a.k.a. C-arm fluoroscopy) to direct the needle to a specific area. This is not a skill that the average family doctor or even orthopedic surgeon knows how to do. In fact, it requires additional training that can take months to years to master. The video here explains the differences between a simple joint injection and the type of precise placement that experienced interventional orthopedics doctors can perform.

A Focus on Orthopedic Problems

Figuring out how to maximize the effects of stem cells is critical. Let me give you an example. Early on in our experience, we added in the use of a billionth of a gram of a common medication based on many research papers showing that it helped stem cells create more cartilage. We then had a natural experiment where we were able to compare patients who didn't have their cells exposed to this very low-dose medication versus those who did. The graph to the left shows how much better the patients who got the medication did; as a result, this medication became standard to our protocol. This is just one example of how little things make big differences in how stem cell procedures are performed.

At Regenexx we have many patents that cover our proprietary procedure. All of these are specific tweaks to improve the ability of our procedure to help patients. Thus, it's not credible for a clinic to offer therapies for 10 different diseases that have little to do with each other. Credible clinics focus in on one or two body systems and perfect their treatment protocols. This is why we've kept our hyperfocus only on orthopedics and why we continue to do the basic science needed to improve our treatments.



Candidacy Grading

There is no medical procedure available (including stem cells) where all patients are great candidates and expected to do well. For over a decade, we have been offering stem cell treatments, and during that time we have graded patients with regard to candidacy. These good, fair, or poor candidate grades have literally dissuaded hundreds of patients who were considered less-than-stellar candidates from undergoing the procedure.

Several years ago, after we had enough outcome data on the Regenexx-C cultured procedure, we lifted those grades as the statistical analysis didn't show that more-severe arthritis patients did any worse than patients with mild arthritis. However, we kept them in place for the Regenexx-SD procedure as the literature on platelet rich plasma did show that while PRP worked well in mild arthritis, it often failed in patients with moderate and severe arthritis. In addition, the same holds true for knee microfracture. Again, we turned away hundreds of patients because adopting a conservative candidacy system was the right thing to do.

In 2012, our first registry analysis of Regenexx-SD showed that these candidate grades roughly followed the outcome (patients then considered "poor" candidates with severe arthritis generally had less robust outcomes than those who were "good" candidates with mild arthritis). So, we continued to try to convince many patients with more-severe arthritis not to undergo the procedure.

In late 2013, we again ran the data with more knee cases in our registry. Interestingly, as the numbers of patients being tracked increased, the association between severe arthritis and poor outcome didn't hold up, meaning that the severe-arthritis patients who chose to do the

procedure anyway had about the same outcome as the mild-arthritis patients. Thus, after many years of turning away hundreds of patients, we now feel comfortable in the statement that the Regenexx-SD patented knee stem cell procedure and its three-part treatment process works as well in severe-arthritis patients as it does in mild-arthritis patients.

So, ask the clinic about your candidacy. Is it good, fair, or poor, and why? Is anyone considered a poor candidate? For example, based on our existing registry data, if you have hip arthritis and are over the age of 55, you're less likely to do as well as someone who is younger. However, this doesn't apply to shoulder arthritis.

Published Research

In any new procedure, research should be published as the data becomes mature enough. We have always prided ourselves in submitting our data to peer-reviewed journals for publication. This takes an immense amount of work as any single publication often goes back and forth for months to a year before it's in a form that will appease reviewers. I encourage you to ask if the clinic's providers have research that they've published. Be careful here as this is a prime area for bait and switch; I've seen clinic websites that show research that has nothing to do with the stem cell type or procedure the clinic is using. For example, showing research done by someone else on bone-marrow-isolated mesenchymal stem cells when the clinic actually uses fat stromal vascular fraction (an apples-to-oranges comparison). Ask the following: Where is your data on what you do? Where can I find publications with your name on them? Ninety-nine percent of the time, you'll find that the clinic has no such data.

A Customized Approach to the Processing of Your Tissue

Every patient is unique, yet many clinics use automated one-size-fits-all machines to process tissue because the capital and time investment is less. Most of these machines treat every sample as if it were the same, yet every sample is really quite different. Hence what comes out of the machine is often not processed based on the individual characteristics of that tissue, so the stem cell yields are compromised. In addition, for bone marrow, all commercially available machines on the market today discard valuable stem cells that the Regenexx-SD procedure retains. Ask the clinic providers if they process your tissue by hand or if they use a small bedside machine that will treat you like a number rather than an individual.

Dosing

The fact is that almost all clinics have no idea how many cells they're injecting into your shoulder. Why? The automated bedside machines they use have no ability to count the number of cells. In no other area of medicine would this be appropriate; however, somehow in stem cell treatments, it's still the norm.

We published research several years ago that demonstrated that in shoulder arthritis patients, we needed a minimum of 400 million total cells in the sample to help the patient achieve the

best outcome. Thus, every Regenexx clinic counts the cells and determines their viability (the percentage that are alive). This helps us advise patients as to whether they have enough cells to do one, two, or more joints. In this regard, every other clinic is literally flying blind.

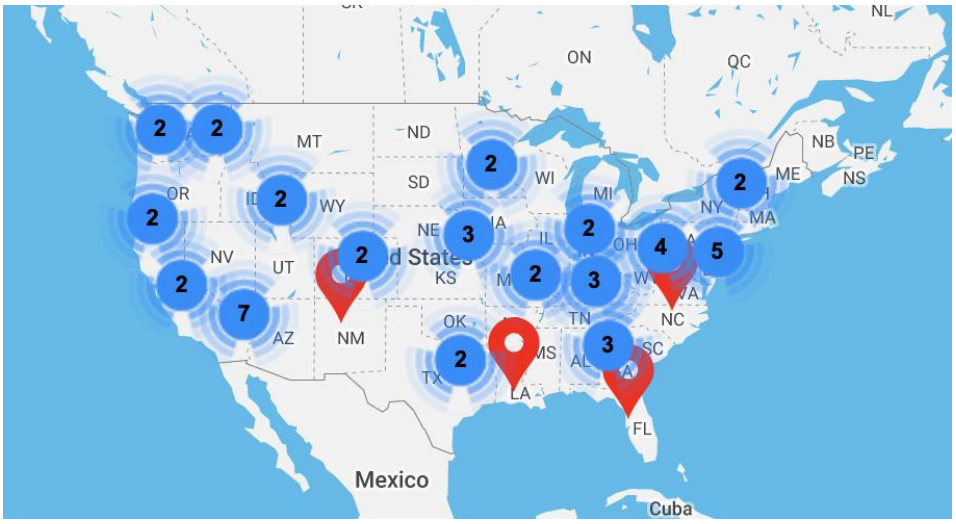
A Clinical Training and Certification Program for Affiliates

There's a saying in medical training: "See one, do one, teach one." Regrettably, it refers to the practice of physicians often having very little experience or training before working on patients. The "wild wild west" of the stem cell world exemplifies this problem.

Here's a real-world example. A few years back, I met a physician at a conference who was using bone marrow stem cells. He was describing his cell harvest technique from the back of the hip and mentioned that he took 100 cc of bone marrow from one site. I stopped him and asked who had taught him to do it that way? It turns out that a physician who visited our clinic (and was never trained by us) in 2007 had taught him this was the correct method. Yet, what that physician had seen was us taking six-to-eight much smaller volume samples because our own research and that of others had shown this increased the number of stem cells in the sample. The doctor who had visited simply didn't know why we were taking so much time to get so many samples, and the doctor simplified the technique to a single high-volume sample. In the process, he also dramatically reduced the number of stem cells. He then went out and taught this inappropriately modified technique to hundreds of physicians! Not good.

As a result, the Regenexx Network of physicians, whom we have officially trained, is the only stem cell provider network in the world with an extensive and mandatory clinical-training program. This is highly structured course-work that is taught in part through a nonprofit and in part by Regenexx.

First, rather than taking any willing provider, we turn down about 8.5 out of every 10 physicians who want to join—because they don't have the right skills to practice interventional orthopedics at our level. Second, the few providers who we do accept are extensively trained in a core-skills checklist of procedures they must know. In addition, treatment

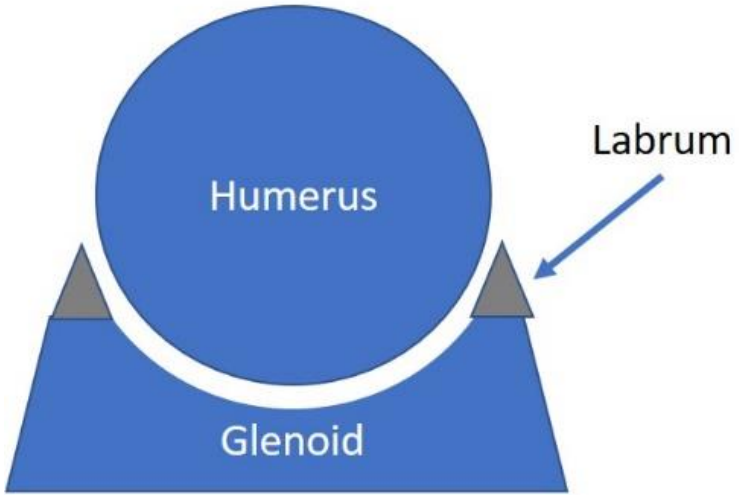


of any area (e.g., shoulder) has both a didactic education and hands-on demonstration of skills in a cadaver lab.

Regenexx Network physicians use the platelet procedures (Regenexx-PL and Regenexx-SCP) and same-day stem cell procedures (Regenexx-SD) and have in-house processing labs so they can customize the tissue processing to meet the needs of your sample. They also are part of our treatment registry. This means the outcomes we report include our own data plus the results obtained by our network providers.

The days of receiving injections of toxic substances and invasive surgeries are now over for the vast majority of patients with shoulder problems. Now, let us learn how your shoulder works by understanding about stability, the joints, the nerves and muscles, and the symmetry of it all, or our SANS approach.

Chapter 2
Building a Shoulder



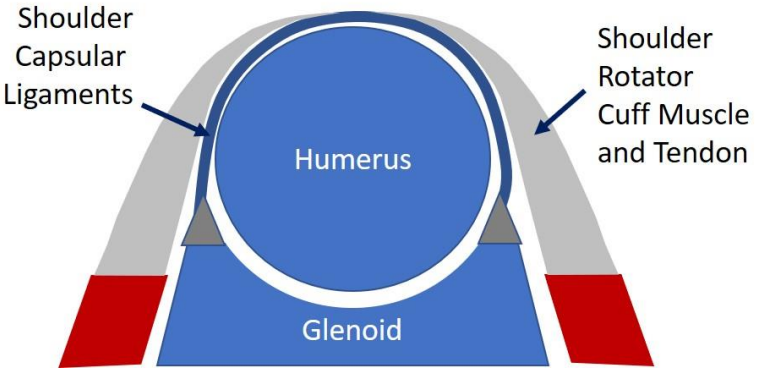
In order to understand common shoulder problems, allow me to show you how your shoulder is built and how it works. We first need to construct a shoulder from scratch.

The shoulder is a shallow ball-and-socket joint. The ball is called the humerus bone, and the socket is called the glenoid. The lip around the socket is called the labrum, which is Latin for "lip." The good news about the shoulder being such a shallow joint is that it allows for maximum motion. The bad news is keeping the shoulder ball in the socket becomes more difficult. Hence, a major job of the labrum is to keep the shoulder ball inside its shallow socket.

In order to reduce the friction in the joint and to cushion the bone, the humerus and glenoid are covered in cartilage.

Keeping the Shoulder in the Joint Takes a Few Different Tricks

Your shoulder is a marvel of stability engineering. In fact, its ball-in-a-shallow-socket design make it the most mobile joint in your body. However, all this mobility comes at a price as the shoulder is inherently unstable. The body's constant struggle to keep the joint stable can cause problems when there's injury or degenerative disease.



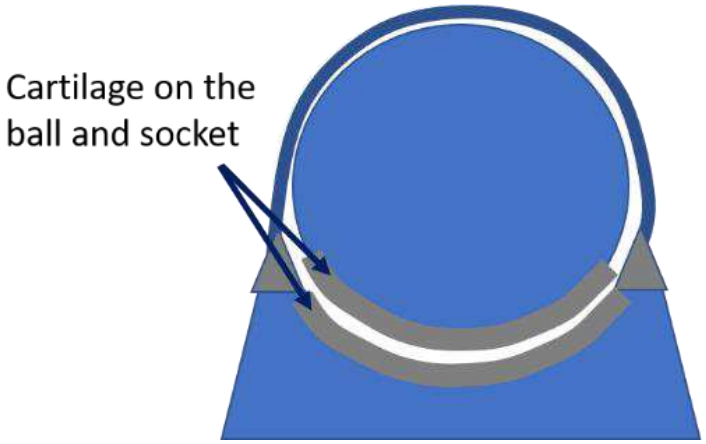
In addition to the labrum, the ligaments and rotator cuff help keep the shoulder in place. The capsular ligaments are part of the

shoulder capsule, which is the covering of the joint. They stretch from the labrum around the joint and have some redundancy to allow the shoulder ball to rotate. The rotator cuff muscles also make their way around the ball to help hold it in place.

As you might imagine, if the labrum, ligaments, or rotator cuff tendons become damaged, the shoulder can become instable or sloppy. Extra motion can wreak havoc with the joint, beating up cartilage or the labrum. One of the most common afflictions we see in painful shoulders is an unstable joint.

Cartilage

The main shoulder joint has cartilage on the ball and socket. Its job is to act as a smooth surface that produces lubrication (synovial fluid) and allows the joint to easily rotate and glide. This cartilage is made up of cells which sometimes undergo trauma, which is called arthritis.



Your Shoulder Isn't an Isolated Machine

One of the more difficult notions for patients to understand is that, while modern orthopedics tend to cut the body up into small parts, this isn't quite true. In fact, it's the opposite of how your body functions. Let me explain.

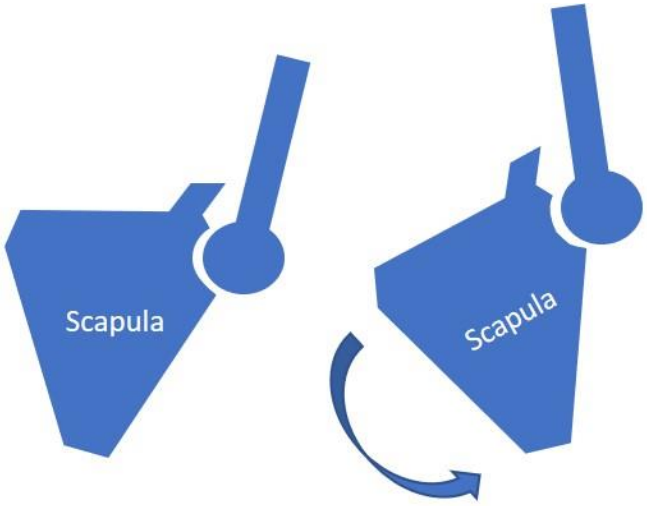
Your shoulder exists as a machine to allow your arm and hand to interact with the world. Hence, one end of that machine is also made up of the elbow, wrist, and hand. The shoulder also anchors into your core, into the rib cage and spine—and what happens in these parts impacts your shoulder. For example, if you have a bad wrist, it will change the way force is distributed when you're lifting weight, and these forces can transfer to your shoulder. If you have a bad neck, this can also impact your shoulder. Everything is connected.

To understand this concept better, we must continue building our shoulder machine. Your shoulder ball-and-socket joint is part of the scapula bone, also known as the shoulder blade, which maximizes the range of motion of the shoulder.

Yet, even with its shallow joint, the shoulder joint itself (the "glenohumeral joint") can only move so much. However, one way to allow more motion is to tilt the joint up. This is shown below.

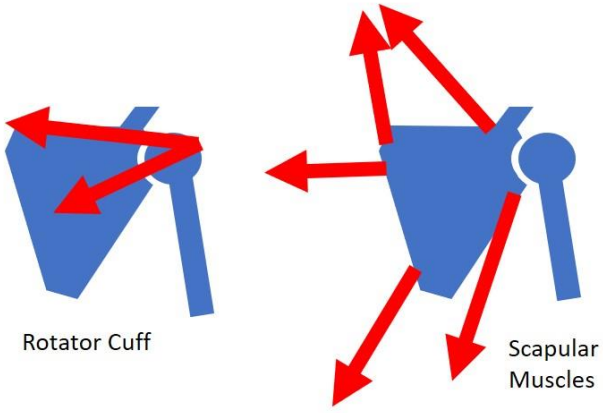
This design allows the scapula to maximize forward and backward arm motion as well. To do this, the scapula floats on the rib cage. Hence, when you reach forward, it shifts forward, and when you reach back, it slides back on the ribs.

However, this type of construction can have some problems. If, for example, the scapula doesn't move with the shoulder joint, this can cause impingement—meaning the shoulder joint rubs against the top of the scapular bone (called the acromion). Hence, something has to both control the glenohumeral joint and the scapular motion with precision and microsecond timing as you move.



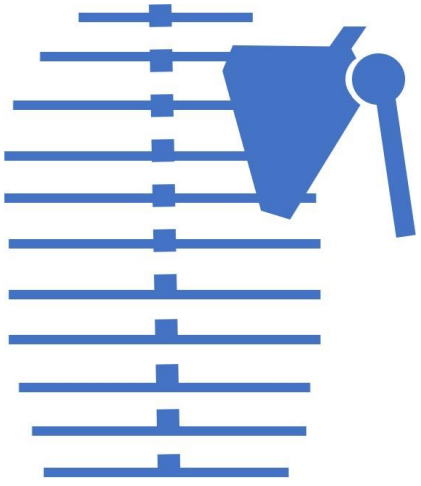
The scapula rotates up to increase shoulder range of motion.

Now, let's meet the shoulder muscles.



Muscles of the shoulder

The muscles around the shoulder fall into two major categories: the rotator cuff that move the ball in the socket, and the distinct scapular muscles. These two muscle groups have to work in harmonious concert or stuff starts clanging around. As you can see at left, the scapular muscles are attached to that bone in many different directions, allowing the bone to rotate up or down and slide up or down or forward or backward.



Consequently, when the rotator cuff muscles aren't precisely synchronized with the scapular muscles, problems arise.

How precise is this symphony of muscular activity? It doesn't take much. If one muscle lags by one-tenth of a second or more (about the length of time it takes to blink), your rotator cuff tendons get beat up!

The Core

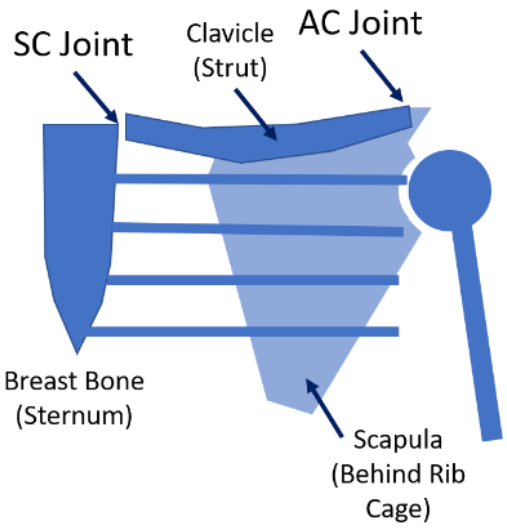
The shoulder blade sits on the ribs and glides against this foundation. In addition, muscles firmly keep it attached to your rib cage. The ribs attach to the spine bones (vertebrae).

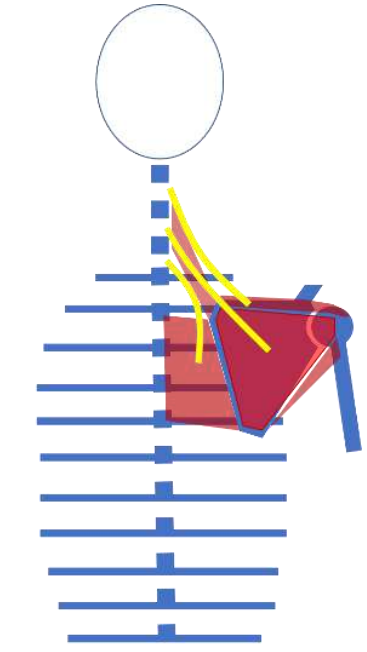
Hence, what happens in the shoulder can impact the ribs and vice versa. For example, if you have a scoliosis (a side-bent spine), the ribs rotate with one side forward and the other backward. Thus, the shoulder blade on the forward side will also shift forward, shifting the shoulder joint forward, putting increased stress on the rotator cuff muscles. The shoulder blade on the other side, of course, shifts back with the ribs on that side.

Since the base of support for the shoulder blade is the rib cage—and the ribs attach to the thoracic spine—the spine and the shoulder are intertwined. Hence, what happens in the thoracic spine symbiotically impacts the shoulder. For example, at Regenexx, we've seen irritated nerves in the thoracic spine caused by bulging discs influence the movement of the shoulder blade and shoulder joint.

The Struts

The shoulder blade on the rib cage tends to want to slide forward, so it needs a strut in the front to hold it back. That strut is called the clavicle (collar bone). That strut connects to the sternum (breast bone) and a part of the scapula known as the acromion. There are two joints at each of these connections. The SC (sternoclavicular) and AC (acromioclavicular). These are held together by strong ligaments that also help to control motion of the shoulder.





The "wires" (nerves) in the neck go to the muscles in the shoulder.

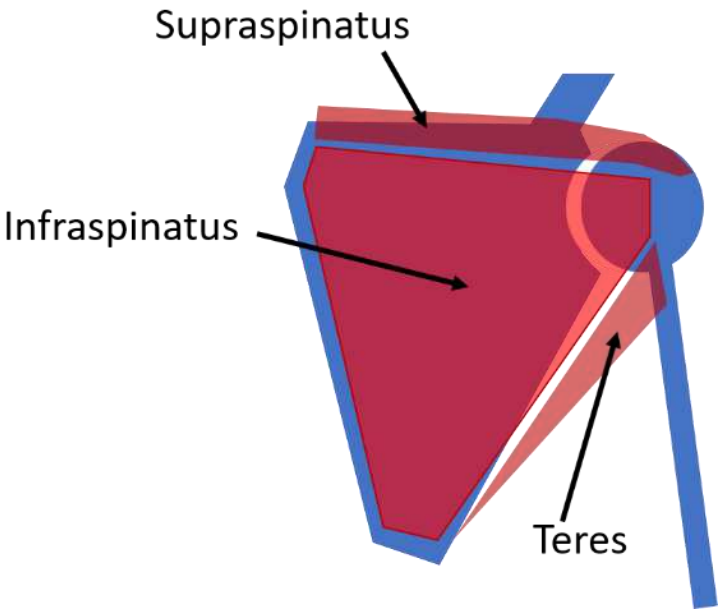
The Wires

We know that wires power motors through electricity. Similarly, if the muscles are the motors that move our joints, then the nerves are the wires that supply the power signals to the muscles; the two are intimately connected. Think about what happens if you cut the wire that goes to the motor: it no longer works. Or if the wire is frayed or shorting out, the motor only goes at half speed or starts and stops randomly. The same thing happens in your body; if the nerves aren't working at maximal efficiency— because they're irritated or otherwise damaged—the muscles simply

won't function well. And, for the shoulder, the "wires" that power the muscles are found in the neck.

This is a critical part of our shoulder construction project. Why? Because despite having little "neck pain," many people with shoulder pain really have an issue with the nerves in the neck. Yet this is often ignored. For example, an MRI is taken that finds some random old injury in the rotator cuff that isn't causing the shoulder pain or other issues, and the patient buys a shoulder surgery he or she doesn't need. For the cause lay in the neck.

A Focus on the Rotator Cuff Muscles

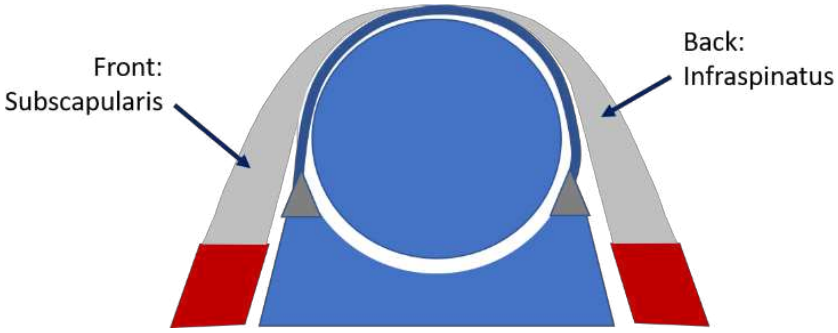


Now that we've built a shoulder, let's focus in the rotator cuff, the muscles that stabilize and locomote the shoulder joint. We have four muscles:

- Supraspinatus
- Infraspinatus
- Teres major/minor
- Subscapularis

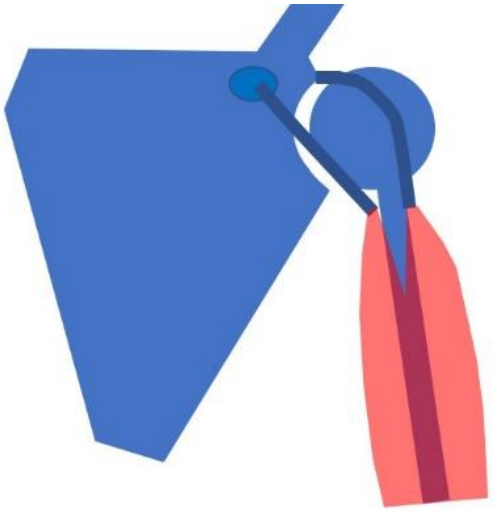
The supraspinatus is on top and is responsible for helping lift the arm out to the side and to the front. It helps kick-start the first part of abduction (arm out to the side and overhead), and then the deltoid and upward rotation of the scapula take it the rest of the way. This is the most commonly talked about rotator cuff muscle and the most likely to be injured.

The infraspinatus is in the back of the shoulder blade and externally rotates the shoulder (moves the hand outward with the arm at the side). This muscle is part of a complex of muscles in the upper back that help hold you upright. Increasingly, in our "looking-down-at-phones-and-devices world," the infraspinatus is strained, because when the head tilts forward, the shoulder blades and joints follow. The infraspinatus is the second most-injured rotator cuff muscle.



The teres major and teres minor are kind of the red-headed stepchildren of the rotator cuff. They don't get talked about much because they're less likely to be injured.

Finally, we come to the front of the shoulder and the subscapularis, found in the area behind the rib cage and anchoring into the front of the scapula. This muscle internally rotates the shoulder (moves the hand toward the body with the arm at the side). It's also commonly injured like the supraspinatus and infraspinatus muscles. This muscle injury is often felt with activities like push-ups, bench presses, and even holding a bag of groceries.



The tendons of the two heads of the biceps anchor at the top of the main shoulder joint at the labrum and at the front part of the shoulder blade (coracoid).

The Biceps

The biceps is an interesting tendon as it's not officially part of the rotator cuff, but definitely plays an major role in shoulder function. It attaches to the labrum high up in the joint as well as to the front of the scapula (a projection called the coracoid), pulling on the big muscle in the front of the arm. The main tendon (long head of the biceps) feeds through a groove in the humerus bone with a small ligament holding it in place.

The latissimus dorsi muscle connects the low back and the shoulder.

The Lat and Your Low Back

The latissimus dorsi muscle originates in the low back and travels all the way up to the humerus bone. As such, it's an incredibly important link between your shoulder and back and ties in what you do with your arms to your core. It also constantly yanks downward on the humerus, helping to keep it centered in the socket, opposing the pull of most of the rotator cuff muscles.

Because of all of this, strong and healthy "lats" and your low back can impact your shoulder. Meaning, a weak lat muscle will cause the shoulder mechanics to become sloppy. In addition, a weak lat also messes with low-back stability.

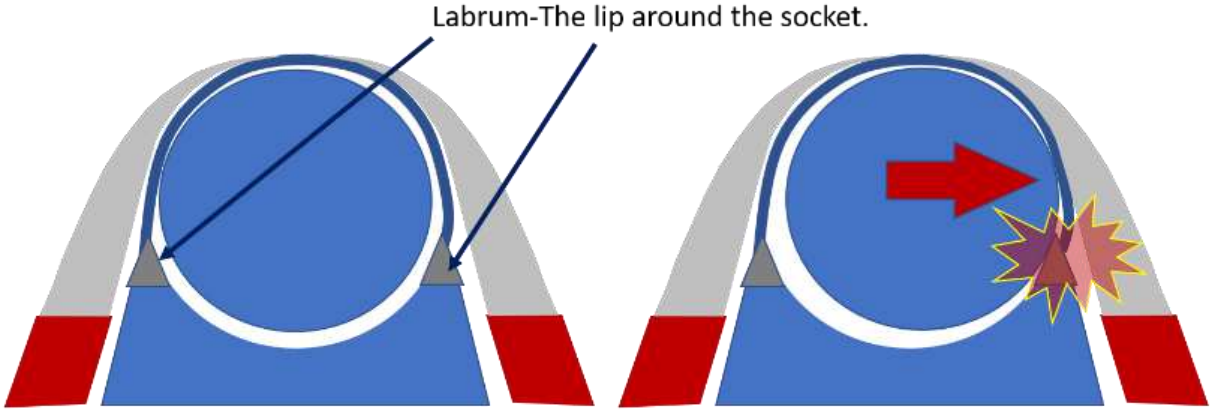
Now that we've built a shoulder, let's mess it up a bit to understand common shoulder injuries.

Chapter 3
Common Shoulder Injuries

I'll now go through the shoulder parts and pieces in the same order to teach you how the shoulder can get injured and what goes wrong. We'll cover the shoulder ligaments and labrum, cartilage, the shoulder blade, SC and AC joints, nerves, and the rotator cuff. Let's mess it up and learn some cool stuff.

Shoulder Instability

We've learned that the shoulder has ligaments that hold it in place—and one of the most common shoulder problems out there is instability. However, orthopedic surgeons often screw this diagnosis up. Why? Because, to them, instability is a binary concept, meaning either the ligaments are trashed and the shoulder actively dislocates or it's fine. However, instability is more commonly loose ligaments due to an old injury. This means the ligaments allow too much shoulder joint motion, wreaking havoc with the joint. Yet, somehow, this common condition routinely sails over the head of even the world's best orthopedic surgeons.



Loose ligaments in the shoulder joint can cause the labrum to get beat up by the ball in the socket which moves too much.

The good news? If this issue is found early, it can be treated by precise injections of stem cells or platelet-rich plasma. The bad news? Leave a shoulder mildly unstable like this and it will trash the cartilage in the shoulder joint and the labrum (the lip around the socket). Remember that the labrum is lip around the socket that also helps to stabilize the ball of the humerus bone. If there's instability, the labrum often becomes beat up and torn. This can also happen if there's trauma to

the shoulder, and labral injuries have become a favorite operating area for orthopedic surgeons. Later in this book, we'll learn why this is rarely required.

Arthritis

Your main shoulder joint and the smaller joints in the shoulder, like the AC and SC joints, contain cartilage that can wear out, leading to arthritis. When cartilage starts to wear down or is injured by metabolic syndrome (i.e., overweight, high blood pressure, and high triglycerides), that's called arthritis. As discussed above, a big cause of arthritis in the shoulder is instability.

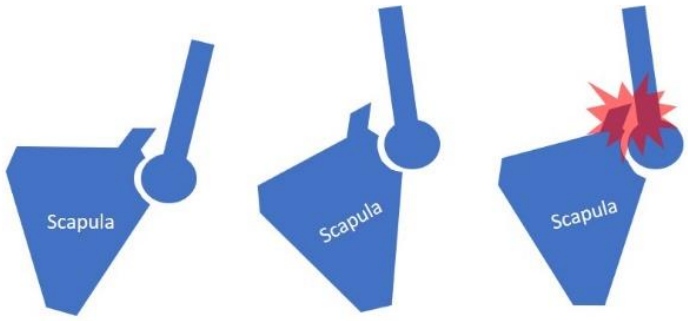
But why does arthritis hurt? What might surprise you is that it's not the lost cartilage that causes the pain, rather the toxic witch's brew of chemicals in the joint and the bone.

What else happens in an arthritic situation? The bone begins to get spurs (osteophytes), extra extensions of the joint that are your body's reaction to instability; they're trying to stabilize the joint and so removing spurs is rarely a good idea.

Shoulder Blade, Core Instability, and Impingement

Think of the shoulder as a symphony of movement that is timed to microsecond precision. Even a tiny delay in the firing of one or more of the muscles that control the shoulder blade can lead the humerus bone to knock into the acromion as you lift your arm above your head. This is called impingement, and it's a very common shoulder problem. The rotator cuff muscles run through here, so they often become damaged. And There's also a bursa, a lubricating sac, that helps the rotator cuff muscles glide past the deltoid muscle. When this gets inflamed and causes pain, its known as bursitis.

Remember that the scapula lives on the rib cage, where it's connected to the rest of your spine and core by muscles—and anything that happens in the thoracic spine (upper back) impacts the scapula and shoulder. So, what all can go wrong?



The scapula rotates up as the arm is raised above the head. If the scapular muscles can't coordinate to rotate the scapula, the humerus bone will run into the acromion, causing painful impingement.

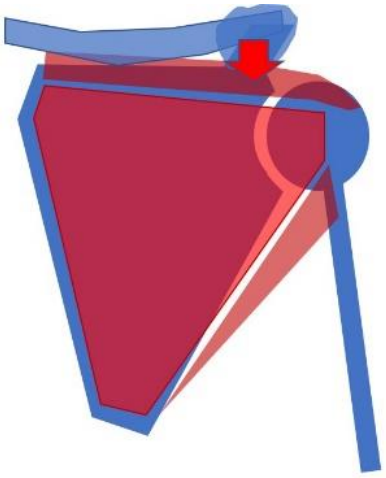
The ribs make up the rib cage, so abnormal movement in any of those that cross the scapula can cause problems (having a rib "out"). This can irritate the bursa underneath the scapula and cause pain and abnormal movement, leading to shoulder impingement. Again, it's all connected!

The thoracic spinal nerves that come from the spinal cord and tell many of the deep upper-back muscles what to do can also be irritated due to a disc bulge. These can also cause the muscles that move the rib cage to fire abnormally, and this can also lead to scapular and shoulder-movement issues. Again, what happens in the core impacts the shoulder.

Problems with the Struts

The AC and SC joints can also develop issues. The most common cause is damaged ligaments that hold these joints together, and the most common of these is what's been called a "separated shoulder." This is when trauma tears the AC ligaments and the clavicle gets "separated" or disconnected from the scapula. However, this is just one of the many issues that can happen here.

Much more common is a condition where the AC ligaments have been stretched over the years, becoming loose. This allows too much movement in the AC joint, and this can lead to wear-and-tear type arthritis. Since arthritis means bone spurs, the AC joint can become enlarged, and this can put pressure on the rotator cuff tendon below. This can cause more wear-and-tear in the tendons and ultimately lead to rotator cuff tears. (Please note that this issue of loose ligaments is not commonly diagnosed.) Again, to most surgeons, there can only be completely torn or intact ligaments, so this diagnosis sails over their heads.



AC joint arthritis putting pressure on the underlying supraspinatus (rotator cuff) tendon.

Also note that the SC joint ligaments can also be injured. This can happen with a fall on an outstretched hand or in a car crash. This issue is even harder to diagnose and found by even fewer providers. This can cause pain in the front of the chest where the sternum meets up with the clavicle.

Problems with the Wires

As discussed, the nerves supply the rotator cuff and scapular muscles and tell them when and how to contract and, for the shoulder, these come from the neck. Hence, if your neck has any issues that cause nerve irritation, then this will impact your shoulder. Does your neck have to hurt for it to cause damage? Nope.

Because your neck doesn't have to hurt very much to mess with your shoulder, we often see patients with irritated shoulders due to a neck-problems but the diagnosis gets missed. Orthopedic surgeons and other doctors focus on where it hurts (in the shoulder) and ignore the neck. Because many surgeons are specialized in areas, like the shoulder, and know little about

the spine, this aggravates the problem because operating on the wrong body part simply does not help the patient.

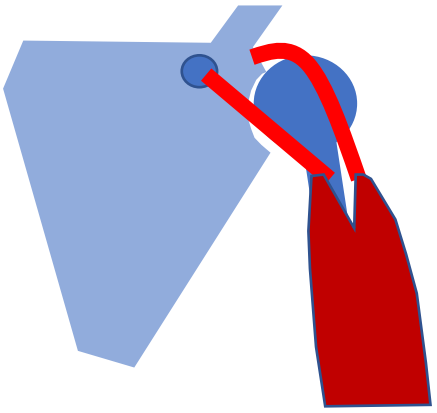
Rotator Cuff Tears

The rotator cuff muscles attach to tendons, and either through wear-and-tear or trauma, one or more of those tendons or the muscle can tear—causing pain and sometimes leading to weakness in the shoulder. When these tears don't heal on their own, the most common treatment is surgical repair. However, the issue of rotator cuff tears is not so simple.

First, many of us have tears in our rotator cuffs without ever having shoulder pain or problems. This may surprise you, but the research supports this fact. In addition, as we age, these asymptomatic tears seen on MRI become more common.

Second, even when there is a pain-causing tear and a surgical repair performed, research shows the biggest determinant of whether the patient reports relief and better function is the chemical content of the fluid in the area—and not whether the rotator cuff tear heals on MRI. Thus, the long-held idea that surgery can help by repairing the tear doesn't seem to be well founded.

Finally, the research that supports that surgery can help pain and improve function is not good news. One study shows that physical therapy worked better than surgical repair. Other studies illustrate how the retear rate (the tearing of the rotator cuff after surgery) is high. Further, recent research that looked at the results of 57 studies found that full-thickness rotator cuff tears improved with or without surgery. Did you catch that? With or without surgery.



Biceps Tears and Issues

The biceps muscle is the one you see in the front of your arm, yet it's also part of the shoulder complex. Basically, it connects the forearm to the shoulder and the core. It has two tendons that anchor in the shoulder blade, with one tendon attaching at the top of the shoulder and connecting into the labrum.

The tendon that attaches to the top of the shoulder joint is the one that commonly tears with the labrum. This is called a superior labral tear or also a superior labral anterior posterior (SLAP) tear. This can happen with either trauma or wear-and-tear.

Problems with the Shoulder and Low-Back Connection

Outside of body building, the most critical shoulder muscle is likely one you've never heard of. The "lat," or latissimus dorsi, muscle connects your shoulder to your low back—basically,

The latissimus dorsi muscle connects the low back and the shoulder.

connecting your upper extremities to your spine and legs. It's also a critical stabilizer of the low back called the thoracodorsal fascia, which acts as the strong covering of the back muscles.

The lat muscle pulls down on the shoulder and serves the important function of helping the humerus not ride too high. Why is this critical? The rotator cuff can get pinched when the humerus presses upward, leading to impingent. That pressure can cause wear-and-tear damage and lead to rotator cuff tears.

Chapter 4
Fixing the Shoulder with Surgery?

Shoulder surgery is often recommended when physical therapy doesn't work, but for shoulders this is frequently a bad idea. Why?

As discussed above, the shoulder is a machine that's precisely timed to millisecond-and-millimeter precision. Disturb this even slightly and it no longer works properly. Surgery is a bull in this china shop, regardless of how good you make it—and often disrupts the machine.

Let's take, for example, the length of a muscle. Believe it or not, the length of the tendon determines the strength of that muscle. This is called the length-tension relationship. A muscle works at maximum efficiency when it has a specific length, but if it gets too long or too short, it no longer works as well. So, what happens if we chop the torn part out and sew it shorter than it used to be? Less strength. This is a key reason why patients often report never regaining normal strength after rotator cuff surgery.

Now, let's take a tour through what we can do for the shoulder surgically—and why it's not working as well as you been told. You may be surprised.

A Really Big Study on Rotator Cuff Repair Shows Disappointing Results

The king of research studies is the "meta-analysis." It's when you take data from many high-quality studies and pull them all together into one giant pool. You then reanalyze the data with many, many more patients than an individual study because more patients mean more convincing results.

In fact, one meta-analysis was published on rotator cuff surgery that pooled data from 57 randomized controlled trials comparing surgery to physical therapy. And the analysis found that patients with rotator cuff tears who skipped surgery did just as well as those who underwent the invasive surgery. How did that happen? The bull in the shoulder china shop is to blame.

We must then ask: is there a better way? What if we could get the rotator cuff tears to heal rather than be repaired? That way we wouldn't need to sew anything and alter the normal biomechanics of the shoulder. We'd heal inside-out instead of outside-in; this is the fun stuff, and we'll get there soon.

Labral Repair Surgery Is Like Fixing the Ornaments on a Christmas Tree with a Broken Branch

We've covered how instability in the shoulder causes the lip around the socket (labrum) to get beat up. From examining many, many patients in the office with labral injuries, they almost all have instability that gets missed. The reason? The bright, shiny object syndrome. Since the diagnosis of instability requires movement to diagnose and an MRI doesn't show movement (see my videos below), you can only make that diagnosis via a comprehensive physical exam. What an MRI does often show is a labral tear—the bright, shiny object—and surgeons spending a lot of time reading the MRI cannot look away.

- Hidden Shoulder Instability and Labral Tears
- Using Stress Ultrasound Imaging to Measure Shoulder Instability

Accordingly, my tree-branch analogy illustrates how fixing a labral tear without fixing the root cause, which is the instability, is plain nuts. However, with almost every patient I see having undiagnosed instability, it is evident the phenomenon continues to happen all the time. Yet, how could an experienced surgeon who takes care of any professional or amateur team miss this? As stated earlier, the concept of instability is binary for surgeons.

Binary means that surgeons view a shoulder as either very unstable or perfect, without any middle ground or shades of grey. However, that is simply not what really happens regarding shoulder instability: most shoulders are "sloppy" rather than grossly unstable or flawless.

So, what needs to be done to fix this nuanced type of shoulder situation? Not surgery, which can lead to over-tightness in the joint, causing it to burn out by damaging the cartilage. No, in our years of experience at Regenexx, we have found that precise injections of either high-dose platelet-rich plasma or bone marrow-derived stem cells into these loose ligaments restore normal stability. No surgery necessary.

SLAP Tear Surgery

A SLAP tear is damage at the attachment point of the biceps tendon to the top of the shoulder joint, these tears often happening because of the instability described above. The surgery option routinely involves cutting off the biceps tendon and relocating it. Let's think about that for a moment: they are cutting off the tendon that anchors the main arm muscle! Does this not seem ludicrous? It does to us—and in our experience, roughly 70% of these surgeries are grossly extraneous and do not need be performed.

Shaving Down the Arthritis Pressing on the Rotator Cuff

When the AC joint gets arthritis, it can put pressure on the rotator cuff tendon below and surgeons believe this is what causes the rotator cuff tendon to tear. However, there is plainly not much research to support the veracity of this claim.

What is usually done to try to fix this surgically is that the surgeon will cut out a part of the joint and its supporting ligaments in a procedure known as an acromioplasty. The problem? Research shows that the surgery doesn't work and, in addition, can further destabilize the AC joint—this instability leading to yet more arthritis.

Shoulder Replacement?

The word on the street is that shoulder replacement surgery isn't quite as dialed in as knee or hip replacement, meaning that the procedure has "so so" results. Why?

The shoulder is a multidirectional joint and has almost exponentially more movement than the knee or hip. As stated previously, to make that mobility work, the shoulder joint is very shallow. As such, it's highly dependent on both ligaments and muscles for stability, but why can this setup be problematic? Because the rotator cuff tendons often generate as much or more pain as the joint, so cutting out the joint and inserting a prosthesis does nothing to fix the ripped up, painful tendons—and the pain rarely improves.

What About Steroids and Narcotics for Shoulder Pain Relief?

If you're reading this book and you haven't yet agreed to major surgery, maybe you've tried steroid injections or narcotics for pain relief. Perhaps you're just exploring all your options before you pull the trigger on these or other therapies. Let's explore why steroids and narcotics have big issues.

Narcotics

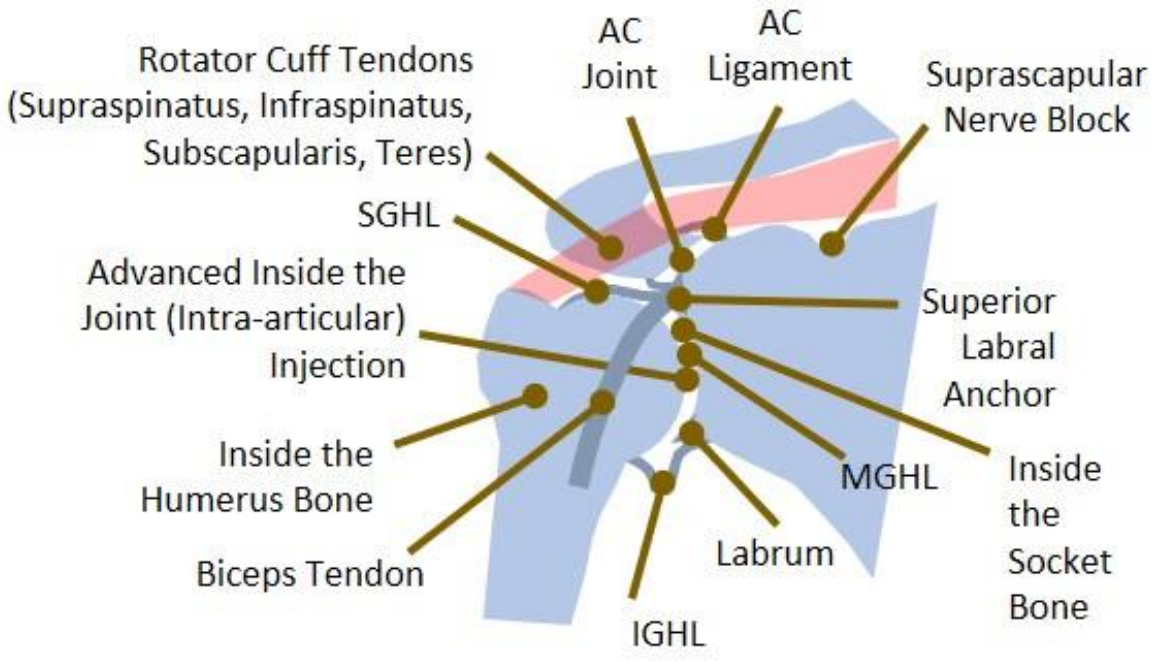
These powerful medications can help with pain temporarily, yet thanks to aggressive physician marketing by big pharma, we have a real epidemic on our hands. These drugs went from being barely prescribed to being routinely handed out in ever-increasing doses to patients with chronic pain. However, there are alarming problems arising: there's the well-publicized highly addictive properties with narcotics, leading to high death rates for starters and also recent research showing that they create more pain in the long run by rewiring your central nervous system.

Steroid Injections

Steroid anti-inflammatories are powerful drugs that suppress swelling and are commonly injected into arthritic shoulders to relieve pain for a few weeks to a couple months. Yet, numerous current studies argue that routine use of these drugs is bad medical practice, one that should and must be stopped. For, while high-dose steroids can relieve swelling, they also cause local cells to become dysfunctional and to die off. Study after study has shown that steroids are toxic to cartilage, damage tissue at the cellular level, and even decrease blood supply to the area, which is critical for healing. Additionally, these medications have been shown to markedly increase the risk of spinal fractures in older women.

Chapter 5
Is There a Better Way? The Interventional Orthopedics Approach to the Shoulder

What if I told you that in the next 10 to 20 years, most of the surgeries described above would be relegated to the dustbin of medical history and that interventional orthopedics will replace roughly two out of every three modern surgical procedures.



Cool stuff, huh. Shall we continue our discussion of what, exactly, is interventional orthopedics?

First, let's start with what interventional orthopedics is not:

- An orthopedic surgeon or nurse blindly trying to stick a needle into a joint and hoping it gets to the right spot
- A physician using ultrasound to perform a simple injection into the joint

What's the difference between these procedures and interventional orthopedics? Check out the image below. Using precise imaging guidance, a highly trained physician precisely places an orthobiologic substance into one or more of these areas to try to get tissues to heal. What kind of things are injected? We'll discuss that more acutely later in the book, but, in short, platelet-rich plasma or stem cells.

Can my family doctor or orthopedist do this? No, for each of these procedures take months to years to perfect. Further, they often require both ultrasound, a technology that uses sound waves to image the needle and soft tissues, and fluoroscopy, which uses X-ray to do the same thing. Ultrasound is better for certain types of procedures while fluoroscopy is better for others—and both skills must be mastered equally.

For a visual insight into what interventional orthopedics is and the differences between interventional and surgical orthopedics, watch my videos below:

- What is Interventional Orthopedics?
- What's the Difference Between Interventional and Surgical Orthopedics

What Are the Advantages of Interventional Orthopedics?

When precise needle-based procedures replace surgeries that use scalpels, good things abound. First off, recovery is much quicker because less trauma is inflicted upon the tissues. Secondly, since the patient isn't knocked as far back as they are by an invasive procedure, rehabilitation can focus on fixing the issues that caused the original problem rather than merely getting the patient back to square one. Third, complications are fewer and less severe.

The greatest difference, however, may be that the interventional orthopedics approach involves healing tissue rather than sewing it together, installing anchors, or cutting something out—restoring the natural biomechanics of the body rather than disturbing it. The body is a perfect machine, why not let it do its thing?

The Main Interventional Orthopedics Procedures for the Shoulder

What are the main procedures that define interventional orthopedics in the shoulder? Let's review these precise and highly technical procedures. It would help to define the word "percutaneous," which, in medicine, means a procedure that works through the skin rather than via surgery. Other percutaneous examples include interventional cardiology procedures, like balloon angioplasty. Let's apply these same concepts to orthopedics.

Percutaneous Rotator Cuff Repair

In this procedure, the doctor uses ultrasound imaging to precisely place a specialized needle into the tears in the rotator cuff tendons. Oftentimes, the doctor can find small tears that an MRI can miss. Why? When you inject something into a tendon while you're observing the area, if the tendon doesn't expand much, it's solid and strong. If you inject and the tendon blows apart, there are small tears at that spot.

The doctor uses this stress testing of the tendon to find all the spots that need help and then pokes small holes in the tendon to allow new tissue to grow through the area (like putting holes in the lawn in the spring). The physician also injects a healing orthobiologic substance. The degree of the tears will determine the best thing to inject, either high-dose PRP or bone marrow concentrate. Watch an actual Regenexx stem cell and PRP rotator cuff treatment in the video below:

- Stem Cell and PRP Shoulder Treatment

Who is a candidate for this procedure? As I've stated before, about 70% of all rotator cuff tears that are now treated with surgery can be treated this way. This is partial and complete rotator cuff tears that are nonretracted (meaning not snapped back like a rubber band). How would you tell? Regrettably, your MRI report often doesn't describe things in this way. However, we can quickly look at your MRI to tell if you're a good candidate.

Percutaneous Labralplasty

Here the doctor can use either ultrasound alone or add in fluoroscopy (depending on which part of the labrum is damaged). The needle is guided to the tears in the labrum using imaging, and an orthobiologic is injected into this precise area of damage. In addition, given that the shoulder capsular ligaments are often loose, these are also precisely targeted to kick off a brief healing reaction that can tighten the ligaments. Again, the degree of the tear will determine which orthobiologic is used.

Who is a candidate for this procedure? In short, patients with tears in their labrum seen on MRI. Most labral tears involve small areas of damage in this structure with lots of instability, thus all of these can be treated with this procedure. Only the biggest tears causing the shoulder joint to lock may still need surgery.

Percutaneous Capsulorrhaphy

Unstable shoulders that dislocate or pop out of the joint can be disabling for patients, often limiting the suite of things they can do or ways their shoulder can move, the body's way to reduce dislocation events. Surgeons can go in and sew the joint capsule, or thermally burn it to shrink it—but these are highly invasive surgeries with all of the side-affects and setbacks we've discussed. With interventional orthopedics, the doctor uses ultrasound imaging to inject the

major capsular shoulder ligaments, like the SGHL, MGHL, IGHL, and posterior joint capsule. A host of ameliorants can be injected that will cause the capsule and ligaments to tighten down, including platelet-rich plasma or the patient's own bone marrow stem cells.

Who is a candidate for this procedure? Most patients who have recurrent shoulder dislocations, often even those who also have bone injuries called Bankart lesions. Only the most severe types of dislocation may be too much for this procedure, instead requiring surgery.

Percutaneous Biceps Tendodesis

When the biceps tendon is irritated, shoulder surgeons often try to cut it and reconnect it elsewhere. The interventional orthopedics approach is not to cut and reconnect, but to ascertain the cause of the issue and perform precise injections into the tendon to spur healing.

Who is a candidate for this procedure? Patients who have chronic biceps tendinitis or tendinosis without a complete tear of the tendon (if you have this problem, this causes a "Popeye" biceps, where the biceps muscle bunches up).

Percutaneous Shoulder Arthroplasty

Shoulder replacement is big surgery that simply doesn't work very well and the key to avoiding surgery is to not only inject the arthritic joints with stem cells, but also to inject the rotator cuff and other tissues that are beat up and causing pain. In fact, this last part is critical to the success of this procedure. In addition, oftentimes the shoulder has lost critical range of motion, so this procedure also needs to be combined with a capsular distension (see below for more information).

Who is a candidate for this procedure? Patients who have moderate to severe shoulder arthritis are often good candidates. However, those with large bone spurs that prevent motion may do well and report less pain, but they may not regain full range of motion.

Percutaneous Capsular Distension

Lost range of motion in the shoulder is often called adhesive capsulitis. This means that the capsule that surrounds the shoulder shrink-wraps around the joint, limiting the ability of the ball to move in the socket. To fix this, surgeons often place the patient under anesthesia and break up the scar tissue by manipulating the joint.

The interventional orthopedics version involves numbing the joint and then injecting growth factors extracted from the patient's own blood platelets into the joint using ultrasound or X-ray guidance. The goal here is to inject enough fluid to stretch out the shrunken capsule and then gently move the shoulder in all planes.

Who is a candidate for this procedure? Patients with adhesive capsulitis without large bone spurs preventing movement. This is the vast majority of patients with this problem.

Percutaneous SLAP Repair

The top part of the shoulder joint has an area where one of the biceps tendons attaches to the labrum called the superior labral anchor (SLA). This area can be torn or damaged, and this tear is often called a superior labrum anterior posterior (SLAP) tear.

Who is a candidate for this procedure? Tears of this type are graded from a type 1 to 4. The least severe types (1 and 2) can usually be treated with this needle-guided procedure.

Percutaneous Interosseous Augmentation

The humerus bone can develop areas of weakness seen on MRI that are commonly called bone marrow lesions or edema (BML or BME). These areas become stem-cell poor and as a result are also associated with the strength of the tendons that insert at this point. For example, research has shown that injecting bone marrow stem cells into these lesions can reduce the re-tear rate of surgically repaired rotator cuff tendons. In addition, this shoulder bone can more rarely develop a bone disease known as osteonecrosis (ON) or avascular necrosis (AVN). Again, the solution is to inject bone marrow stem cells, increasing the self-repair capability of the bone marrow.

Who is a candidate for this procedure? Candidates are patients with changes in the bone seen on MRI that indicate swelling or bone weakness (BML or BME). Patients who have larger bone cysts with changes in shape of the humerus bone are not candidates.

For patients with bone disease like ON/AVN, those with grades 1 and 2 are good candidates for the procedure, but those with more severe disease like grade 3 and 4 are poor candidates.

Chapter 6
Staying Away from Stem Cell Scams and Substandard Care

As the medical provider who performed the first interventional orthopedic procedures in the shoulder involving stem cells, I welcome the expansion of this field beyond our clinic. The good news is that we see some providers out there trying hard to do this work the correct way. But the bad news is that most of what is offered as shoulder stem cell therapy is simply a scam or, at the very best, a watered-down version of what we offer at Regenexx.

How to Determine a Good Provider

My job here is primarily to help you find a good provider, one that actually uses live stem cells and knows how to put them where they need to be to do the most good. Once we go over what to look for in a provider, I'll review some of the scams out there. Here we go.

Imaging Guidance

A doctor who knows what he or she is doing uses both ultrasound and fluoroscopy (X-ray) guidance to guide the needle to the specific spot it needs to go. In addition, that provider will have taken and passed a course in advanced shoulder procedures, like those given by the Interventional Orthopedics Foundation (IOF). What you must avoid is a doctor who blindly injects into the shoulder, without imaging guidance or proper training.

Nonsurgical vs. Surgical Practices

All too often these days, orthopedic surgical practices view adding stem cell therapy or PRP as a way to earn extra cash. Given that they get paid whether you do well with your stem cell procedure or you don't—and you end up getting a big surgery anyway—they have little incentive to hire the best doctors to help you avoid surgery. Therefore, the practice you obtain your interventional orthopedics care from should have a stark nonsurgical focus. For a thorough explanation of why interventional orthopedics isn't a skill shared by many surgeons, watch my video below:

- Why Interventional Orthopedics will be the Next Interventional Cardiology

Physician vs. Nurse or Assistant

Would you allow a nurse or physician assistant to perform your orthopedic surgery? I sure hope not, because none of these midlevel, non-physician providers are even permitted to perform orthopedic surgery. However, we have providers out there who allow midlevels to perform these complex shoulder procedures though they haven't the slightest clue how to perform what we've been describing in this book.

Chiropractic or Alternative Health Office?

We now have hundreds of chiropractors, acupuncturists, and naturopaths across the country who offer what they call "stem cell" procedures yet what would an alternative-health practitioner know about stem cells or interventional orthopedics? Not much. Additionally, many of these offices are running the "birth tissues scam."

Scams to Watch Out For

The Birth Tissue "Stem Cell" Scam

One of the biggest medical scams ever sold to the American public is that amniotic fluid and umbilical cord tissue injection contain millions of young and live stem cells, however the providers who run this stem cell scam usually don't know enough to vet the claims of the sales reps who sell this stuff to them. They often give seminars where they claim that since the number of your own stem cells declines with age, you need young and plentiful stem cells that can be found in amniotic fluid or umbilical cord blood or tissue. Wrong.

When a baby is born, he or she is surrounded by the birth sac which is filled with fluid. That sac is made of a tissue called amnion and the fluid is called amniotic fluid. During the end of a normal pregnancy, much of the fluid is filled with baby pee and poop but it also contains some living cells. The baby itself, inside the amniotic sac, is connected to the uterus through the umbilical cord, which contains blood as well as a tissue called Wharton's jelly, those tissues also containing live cells.

If you were to take these tissues directly from a live birth and rush them down to the lab and carefully process them, you could isolate some stem cells. However, this is not what's done. Instead, these tissues are often processed hours or days after the birth, a delay which kills the cells! Add in invasive processing, freezing, and the shock thawing in a doctor's hand prior to injection and these tissues have no living cells, let alone stem cells. Our advanced cell research lab confirmed this (see my video below) as did work performed by labs at Cornell and UC Irvine. This research also prompted the creation of a consensus document on amniotic and umbilical cord scams, signed by myself and other high-level physician and research experts in the field of regenerative medicine stating that the existing scientific literature does not support birth tissue products as safe and effective "stem cell therapy." Hence, if a medical provider is telling you that

he or she is injecting millions of live and young stem cells derived from amniotic or umbilical cord tissue, this is a scam. This is dead tissue. Period.

- The Deception of Amniotic Stem Cells

Can dead birth tissue heal damaged tissues? Possibly, but there is very little research on this topic in orthopedics. However, this doesn't stop these scamming providers from claiming that there is extensive research supporting the healing abilities of these tissue injections.

Many will claim that these tissues are "growth-factor rich," which means that they contain chemicals that by themselves can prompt a healing response. Regrettably, not even that part holds truth. For example, when compared to the growth factors found in your own middle-aged or elderly growth factors when made into a healing cocktail called platelet-rich plasma (PRP), the PRP commonly has higher levels of growth factors.

The Little Bedside Machine That Could

Many providers will use bedside machines to process the patient's bone marrow to isolate the stem cell fraction, the advantage being that these simple machines are easy for the office staff to use. The disadvantage, however, is that they do a poor job of concentrating the stem cell fraction and are thus not the most attractive choice.

The Magic Doohickey that Concentrates Cells Without a Centrifuge

Some doctors have begun using a specialized trocar to take bone marrow known as the Marrow Cellutions or Maxx Regen device. It claims to collect so many stem cells that concentration of those cells via a centrifuge isn't needed. Yet, when we tested this device, regrettably the claim proved false. So, the device, its promises, and the doctors who believe them, are solidly wrong.

Is Fat Where It's At?

There are two types of popular fat processing systems that call themselves a stem cell therapy. The first is stromal vascular fraction (SVF), which is where stem cells are isolated via an enzyme and a centrifuge. The problem? The FDA has declared this processing illegal, even though many providers still floating the risk. The second type is simply a device that chops up the fat, but the stem cells remain locked in their collagen prisons. This is called Lipogems and is not technically a stem cell procedure. Thus, so far there's limited data on whether either type of fat-based system works to help shoulder injuries.

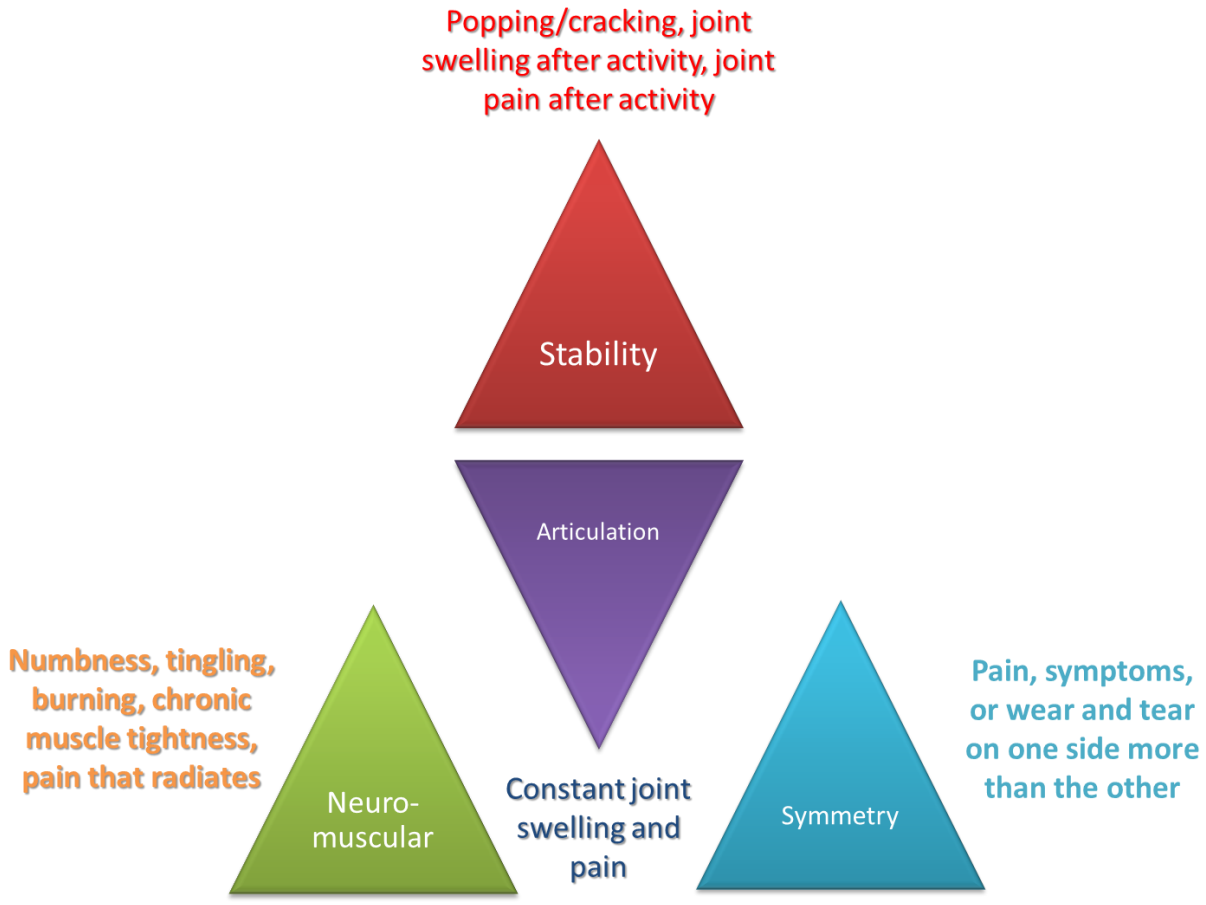
Cultured Cells in the United States

A promising technology is to isolate the stem cells from bone marrow or fat (or even birth tissues) and then to grow them in culture to higher numbers. This technology has some distinct

advantages for certain types of orthopedic problems, like severe hip arthritis or bulging low-back discs. However, generally, it isn't needed to prompt healing in the shoulder.

We offer this type of treatment in Grand Cayman, where the local laws allow us, through a licensed site, to culture the cells and grow more. However, this technology is not permitted in the US without a full drug approval and clinical trials per medical indication. However, that hasn't stopped some rogue clinics and labs from trying to do this here. These clinics will offer to take your fat or bone marrow and culture and then cryopreserve these cultured cells (freeze them for future use). However, this is all highly illegal. So it's not a matter of if, but when, that clinic and the lab get busted by the FDA and your cells become an illegal drug product that you can't legally access. To be blunt, stay away from these clinics and services in the U.S.

Chapter 7
Introduction to SANS



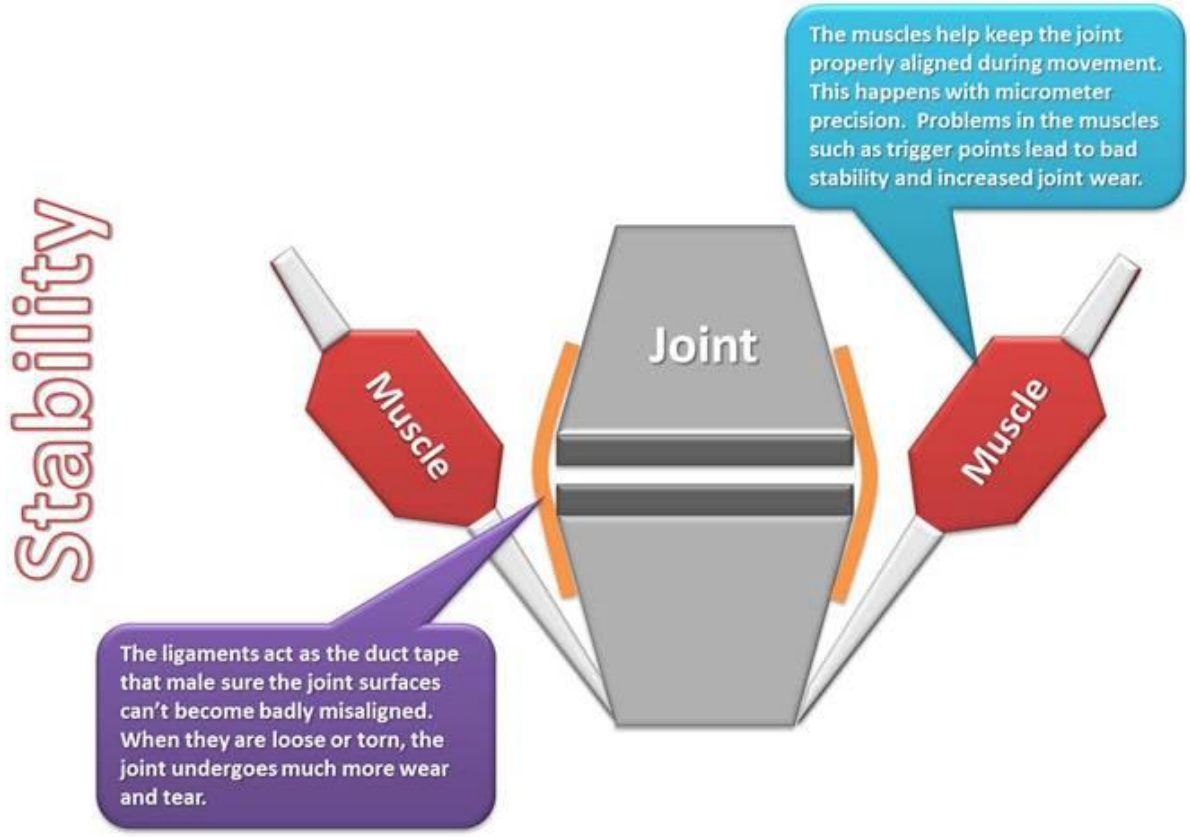
If you read nothing else in this book, read the next few pages. The words and infographics contained within detail our core message. Finally, the pages that follow this section describe the concepts in more detail. So if you're really busy, start here and end here for now. Read the rest later.

Our SANS concept breaks your pain problem into its four root causes: stability, articulation (joint), neuromuscular, and symmetry.

If you have chronic pain of almost any type, from shoulder arthritis to nerve pain and sciatica, you will be forever at its mercy if you don't understand its four parts. If you understand them, however, you can take control!

Stability

Your shoulder is made up of individual structures that fit precisely together to form a complex and sophisticated joint, one of the largest in the body. This, by its very nature, can lead to a mess if only one of those structures becomes unstable.



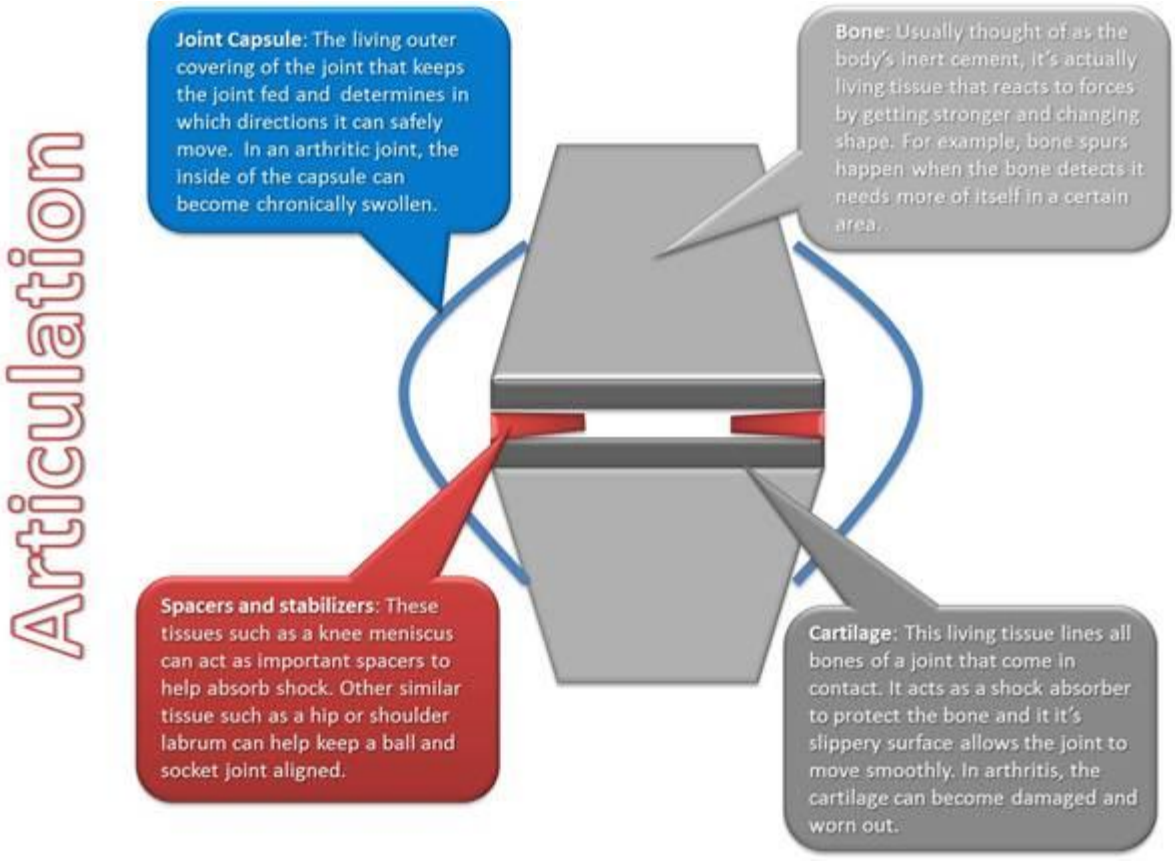
Your shoulder and other joints may have small amounts of extra motion that is literally slowly destroying them—but the real shocker is that many highly trained physicians and surgeons will likely never tell you about this instability, nor do many even understand it themselves. Even more concerning is that instability can generally be fixed with a few simple injections or exercises.

Stability means a joint that moves with the surfaces in general alignment, all the time. Ligaments are the living "duct tape" that prevents the joint from catastrophic failure. Your body also needs to make sure that the parts of the shoulder joint don't give too much when you stress the shoulder. Examples include when you lift heavy objects, especially overhead, or lift weights. On the other hand, muscles provide the slight adjustments that keep the joint surfaces in very

precise alignment as you move. In the shoulder, the muscles fire in a symphony of movement with millisecond timing and micrometer precision to make all of this happen in the shoulder. How do you know if you have a problem with instability? You may or may not feel your joint popping and cracking—this tends to happen when the instability is severe. Instead you may have pain or stiffness after activity. If you don't feel these things, your joint may be more stable, but it may have more subtle problems that lead to a more rapid progression of arthritis.

Articulation

This is a fancy word for joint. Your joints allow movement in very specific ways. Your shoulder has a different pattern of possible motion from your knee, which is still different from your wrist. A joint is generally made of two bones that come together and are cushioned by cartilage and by a spacer or guiding tissue (for example, a labrum in the shoulder or a meniscus in the knee). A joint is also surrounded by a tough leathery covering called a joint capsule and is further reinforced by ligaments. To remain active as you age, I encourage you to learn more about the status of your joints, as healthy joints are required for maximum activity.

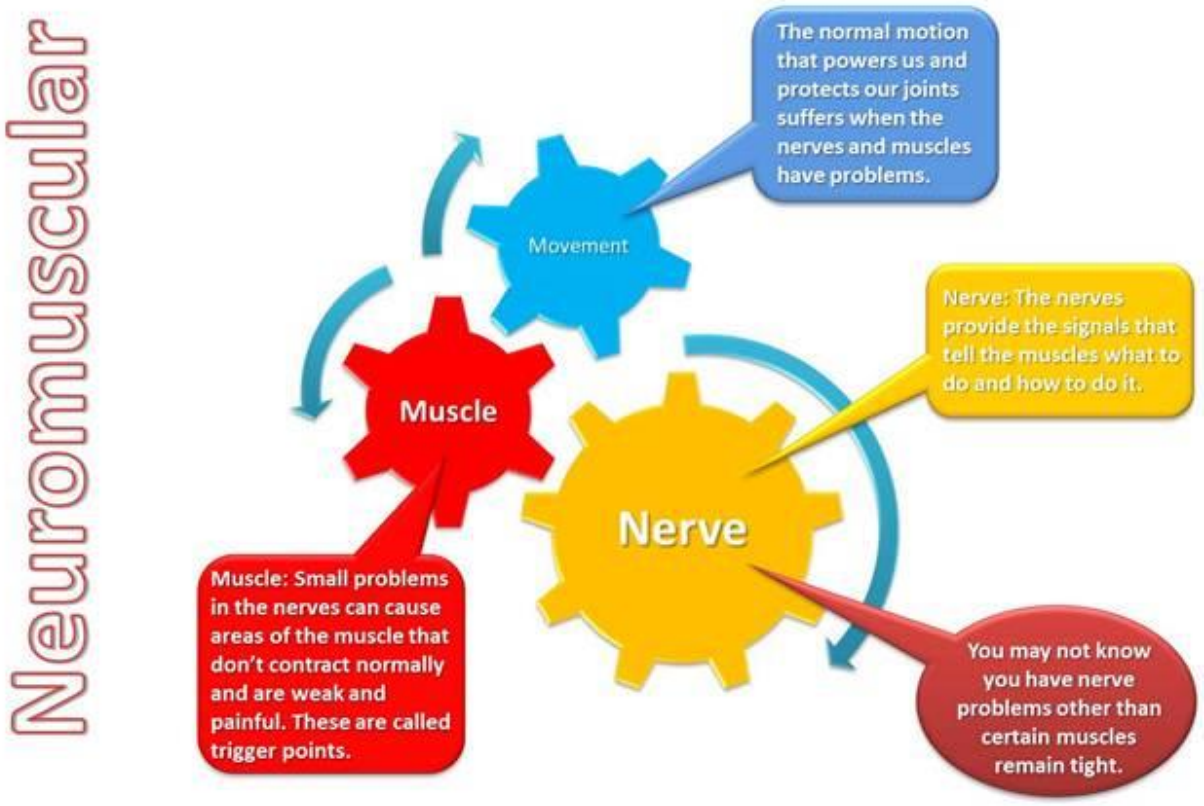


Everything you do injures your joints a little bit. The million-dollar question is whether they're able to keep up and repair the damage. Stem cells live in all our joints and are like little repairmen. As we age, there are less of these repairmen, so at some point, wear-and-tear can exceed the

ability of the joint to repair itself and arthritis begins. Many physicians have begun to supplement this repair capability using various technologies, including stem cells.

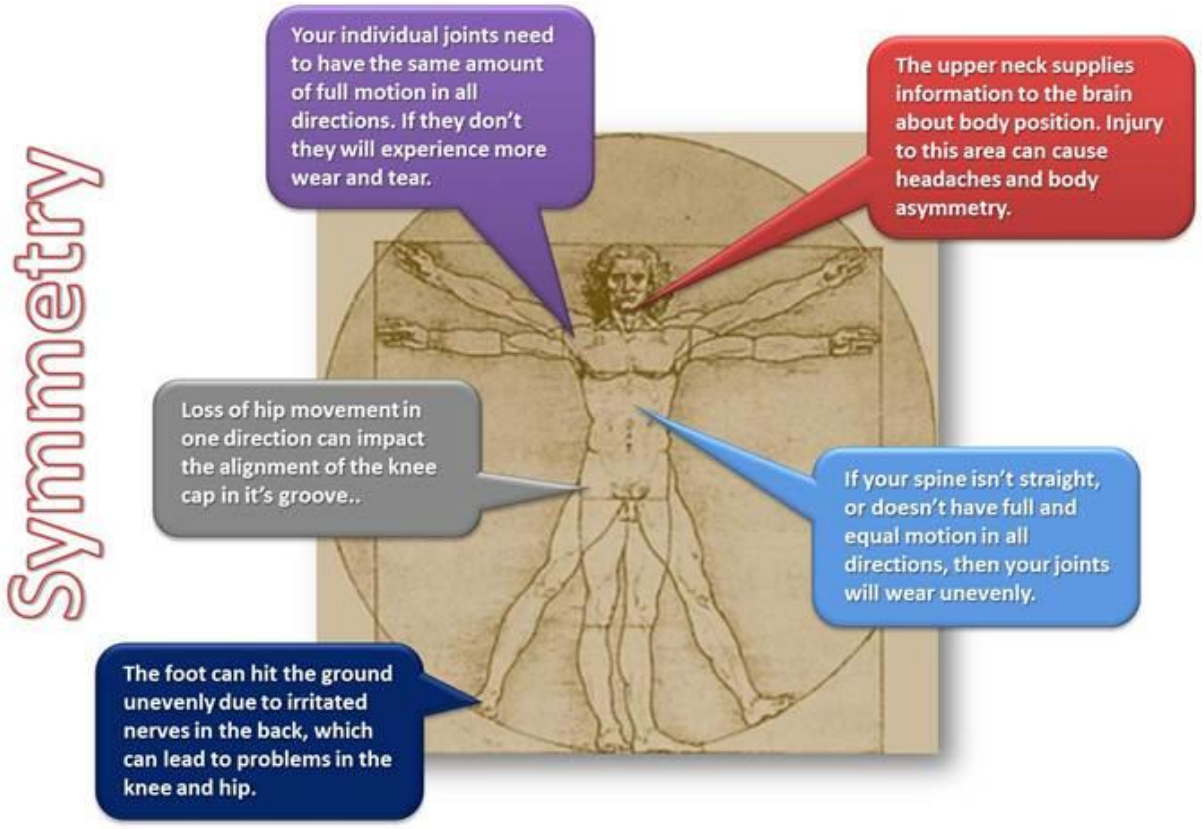
Neuromuscular

Your nerves drive your muscles, yet this fact seems lost on much of medicine today. We'd all accept that when the nerves are severed, muscles die (think Christopher Reeve's spinal cord injury that led to his severe muscle atrophy). Yet what happens when smaller amounts of nerve irritation are present? If you have a chronically tight or weak muscle in your arm or leg, you might not think it's due to an irritated nerve, especially one in your neck or back, but it may be. When the muscles are impacted, they develop tight and weak knots known as trigger points. All the muscle strengthening in the world won't help a muscle when it has lots of these trigger points; they need to be cleaned out before the muscle can work normally.



Symmetry

Why does one shoulder get arthritis and not the other? Sometimes these things are due to prior injury and sometimes to lack of symmetry. Our bodies are built to work well only when both sides are exactly like the other. When one of our joints loses normal motion, you can bet other parts will be impacted. When one leg, for example, is shorter or one ankle turns in more, again certain parts, will wear out faster. It's the same with the shoulder. Given how important left-right and front-back symmetry is, it's amazing more attention isn't paid to the problem. In order to get well, you must reestablish as much normal symmetry as possible.



In order to understand why you have chronic shoulder pain and how best to get rid of it, you must understand and deal with all issues in the SANS system. You must address any instability issues, problems with your joints, and irritated nerves and muscle trigger points, and, finally, you must get your body as symmetrical as possible. This book is a companion book to Orthopedics 2.0 and will explain the Orthopedics 2.0 approach as it relates specifically to the shoulder and the Regenexx procedures that can help address shoulder issues.

While everyone wants a quick fix, what this book aims to teach is that getting back to where you used to be is first about choosing the right technology to help, and second about fixing all of the

associated problems—like weakness in muscles, asymmetry, or poor stability that got you there in the first place. This process may take time beyond a magic-bullet shot or miracle surgery. Here are some examples of quick fixes that don't work, followed by some possible solutions.

Some doctor told me all I needed was a magic injection of fat, amniotic, placental, umbilical cord, or fetal stem cells and my shoulder would be fixed.

How is that supposed to work? Are these even the right kinds of stem cells? What are the right kinds of stem cells?

See these quick links:

- "Amniotic stem cells" (a.k.a fetal or placental) have become an epic case of widespread consumer fraud.
- Fat stem cells aren't as good as bone marrow stem cells at helping orthopedic problems.

I have pain in my shoulder(s), and my doctor said it's due to arthritis.

How did my shoulder get this way? It didn't just happen by itself. Was it an injury? Why can someone else get the same injury and not get arthritis? Can I slow down arthritis? Why does someone get it in the first place? Is there something I can do to prevent other joints from getting it? Is the pain in my shoulder really even due to a shoulder issue?

See these quick links:

- Shoulder surgery for arthritis doesn't work.
- What can I do to preserve cartilage?
- Why you may have shoulder instability and not know it…
- It Could Be Your Neck Causing Your Shoulder Pain

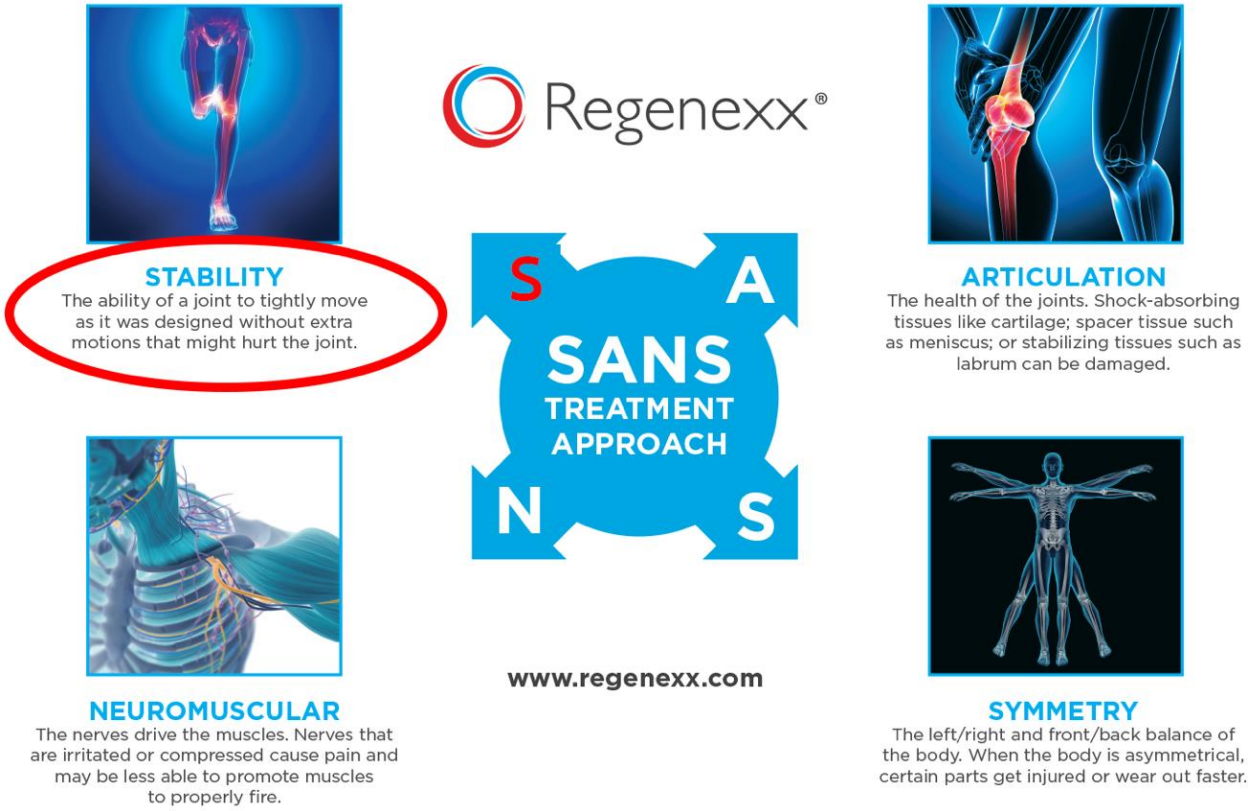
I have a torn or frayed ligament, tendon, or labrum.

If the tear was due to an injury, why did just that tendon tear? If not, what caused the tear? Why didn't it heal? Can I prevent other structures from tearing? Can it be fixed without surgery? Is surgery even a good idea?

See these quick links:

- Is a shoulder labrum tear causing my pain?
- Should I have shoulder surgery? Probably not.

Chapter 8
Stability



What does it mean to be stable?

Stable in a mechanical sense means resistance to falling apart or falling down. For your body, joint stability is a very big deal, yet you likely haven't been told the whole story, perhaps only about a very unstable shoulder that requires surgery to fix a completely torn and retracted ligament. Yet it's the instability you don't know about that could be slowly frying your shoulder joint, one movement at a time. Discovering which ligaments are loose, causing this kind of instability, called subfailure, may save you from a shoulder replacement or other shoulder surgery.

What is subfailure instability, how do you know if you have it, and why is it important? Subfailure instability means that the surfaces of the joint aren't kept in exact proper alignment during movement. When the shoulder surfaces uncontrollably crash into one another or even just can't be kept in perfect alignment, the shoulder wears down much faster than it would normally. An unstable part of the joint experiences many times the wear-and-tear of a stable joint, causing the formation of bone spurs. Since stability in many joints is the number one determinant of whether that joint will have a long, happy life or become "old" before its time, it's curious why more time isn't spent assessing this component of joint health.

Let's slice and dice joint stability a little further by separating the type you've heard of and that is usually easily diagnosed from the type that will slowly destroy your joints and will likely never get diagnosed. There are two major types of instability: surgical and subfailure, with surgical instability being less common than its more prevalent cousin, subfailure instability. However, surgical instability is usually the only type that the orthopedic establishment treats, meaning that a knee, for example, is very unstable and unable to hold itself together at all. In these cases, surgery is often needed to stabilize the joint. Examples would be a completely torn and retracted ACL in the knee. A true surgically unstable knee may need a new cadaver or artificial ACL implanted through surgery, but, regrettably, the new ACL may go in at the wrong angle and could likely cause more problems down the road.

Subfailure means that the ligament hasn't completely failed (torn apart like a rubber band) but instead it's only partially torn, degenerated, or just loose. This much more common type of instability often doesn't require surgery and is characterized by small extra motions in the joint just beyond the normal range. In fact, if you have this type of instability, you likely aren't aware you have this problem.

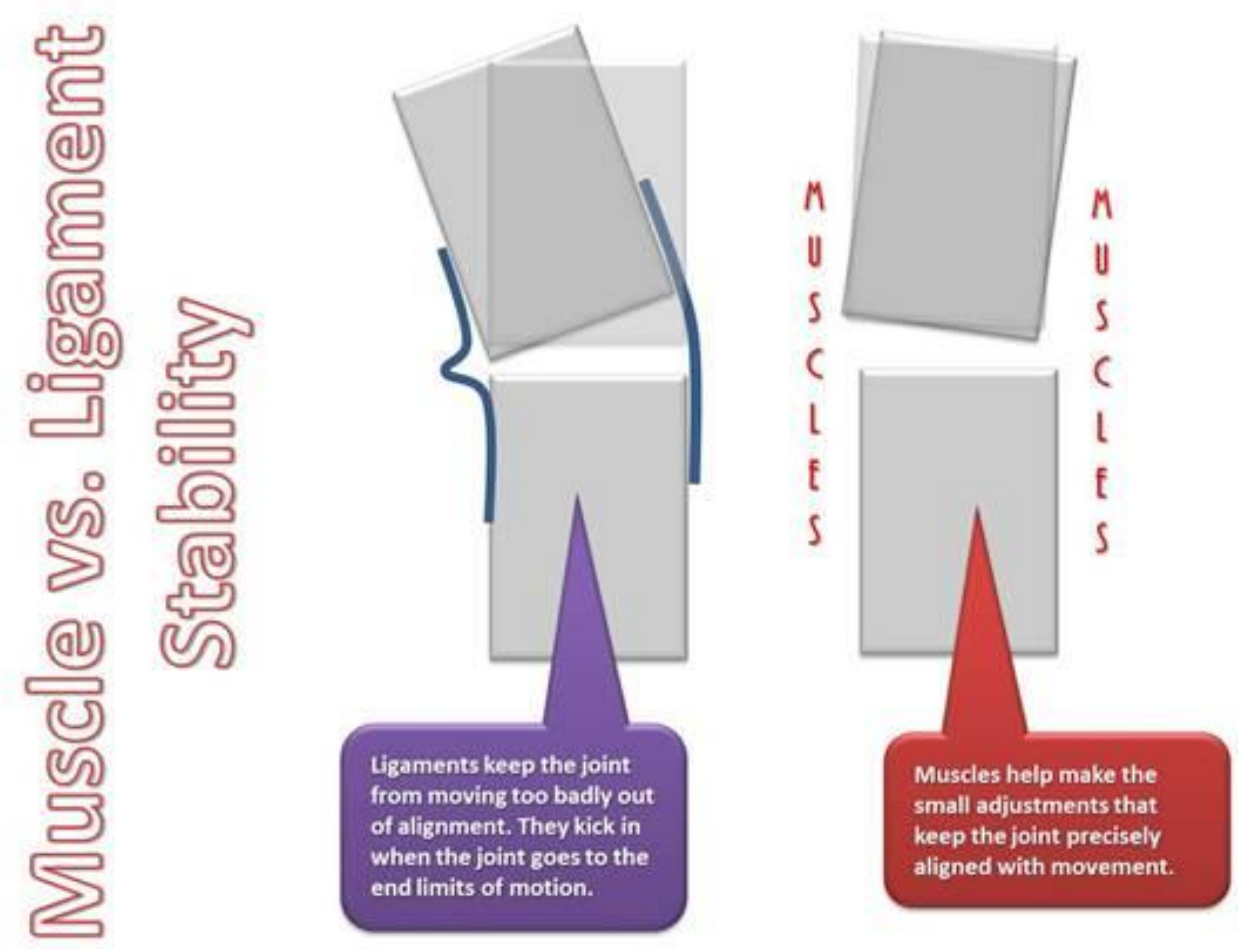
Our understanding of subfailure instability is younger and more immature, so while we have some diagnostic tests to detect this type of instability, our understanding of what is normal and abnormal is only now coming into focus. However, this type of instability is quite real, and it's a clear and long-term insidious drag on joint health. A good example is research showing that replacing an ACL in the knee will lead to earlier and more significant arthritis in that knee joint. Why? While surgeons take great care to make sure the replaced ligament is identical to the torn one, there is no way to ensure the replacement ACL has exactly the same specs as the original. The new ligament can be too tight or too loose or may simply not have the identical load-bearing characteristics of the original equipment. This can lead to small amounts of extra motion or compression in the wrong directions, which can slowly damage the joint.

More on Subfailure: It's All About Your Ligaments and Your Muscles

There are two types of subfailure instability: ligament and muscular. Passive ligament stability keeps our joints from getting badly misaligned; think of ligaments as the living duct tape that holds our joints together and without good adhesion, things can go awry. An example would be glenohumeral ligament in the shoulder, which helps keep the humerus bone in place. Without

this ligament, every movement would cause the joint to experience a potentially damaging shift. On the other hand, active muscular stability is made up of the firing of muscles that help keep the joint aligned as we move and represents the stability fine-tuning system. In this case, the rotator cuff and other shoulder muscles help provide a second layer of stability.

So how does this second layer of muscular stability work? Our joints tend to want to slip slightly out of alignment as they bend, twist, or slide, even with intact ligaments. As this happens, signals are sent to selective muscles that surround the joint so that they adjust and correct the alignment. Without this active system, our joints would be "sloppy." This muscle firing is the muscular symphony we've spoken of, with microsecond precision being the difference between the poetry of beautiful joint movement and an asynchronous chorus of potentially damaging "joint noise." The muscles provide the fine tuning, acting as constant stabilizers for the shoulder, keeping it in good alignment while we move.

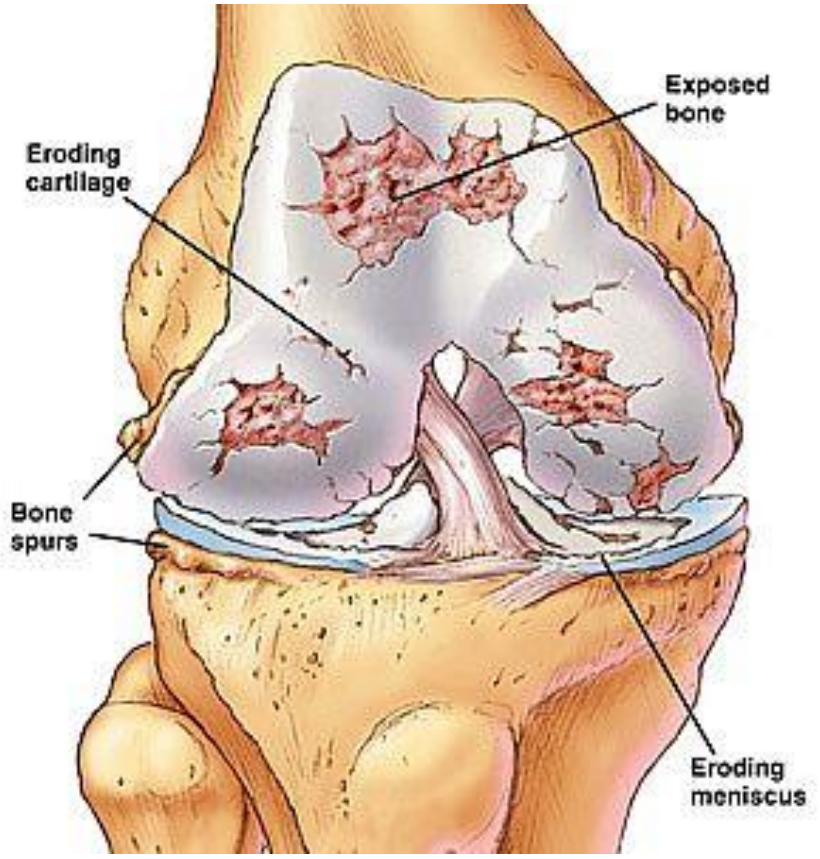


To prevent damage as we move, the shoulder must remain in this minutely-tuned area, what we call the "neutral zone"—the area of alignment between the joint surfaces that nature intended.

In summary, stability is about both muscles and ligaments. Our muscles provide constant input to the shoulder to keep its alignment fine-tuned as we move. When the shoulder moves too much, the ligaments act as the last defense to prevent joint damage from excessive motion. Think for a second about what would happen if the muscles didn't work in microsecond precision to keep your shoulders perfectly aligned or what would happen if the ligaments didn't check excessive motion when the shoulder went a little too far. Both scenarios are recipes for either sudden disaster or a slow damage of the shoulder one movement at a time.

The latter is known as microinstability. What's that all about?

Microinstability: A Constant Drag on Joint Health



It is of note that not all instability can or will be felt. Oftentimes smaller movements occur without your neurons telling you so; these small, extra motions are called microinstability—and while the first or tenth event may not lead to injury, the impact of thousands of them accrue over time.Even an extra millimeter of motion, when repeated 10,000 times, can damage a joint. As a result, the best course of action to inspect these small amounts of extra motion is by having a good physical exam performed by a physician acutely trained on the subject. (The American Association of Orthopaedic Medicine is a good place to find such physicians.) Further, this group provides in-depth educational seminars for doctors interested in treating instability with injection therapy.

Ligaments That Support Your Joints: What You Don't Know May Be Hurting You

Our modern surgically-based orthopedic care system has evolved to generally only treat complete ruptures of ligaments, when the ligament breaks and snaps back into pieces—but what happens when the ligaments are just loose? While this is a big problem that can lead to arthritis, this is almost never detected by physicians because the patients with this type of ligament issue aren't surgical candidates. However, once these ligaments can be tightened or helped via simple injections, the lax ligaments become a big target for therapy and the reason is simple: if a loose ligament is frying a joint, why not try to help the ligament? In many ways, fixing the ligaments is the foundation for any treatment of the joint, just like fixing the shaky foundation of a house is the first step before renovating the building.

Let's take a look at some of the ligaments in the shoulder that become unstable.

Shoulder Ligaments

- **Acromioclavicular/Coracoacromial (AC/CA):** These go between the collarbone and from projections of the shoulder blade and stabilize the top/front of the shoulder. These are the ligaments that get stretched in a "separated" shoulder. When loose, they can lead to arthritis in the AC joint, bone spurs that press on the rotator cuff, and degenerative rotator cuff tears.
- **Inferior Glenohumeral Ligament (IGHL):** This ligament lives at the bottom of the main shoulder joint and keeps the ball from slipping downward, relative to the shallow socket, when you lift your arm above your head. When lax, this ligament can lead to more arthritis in the big shoulder joint as well as bone spurs on the bottom of the joint.
- **Front/Back Shoulder Capsule:** These ligaments are really just thickenings of the covering of the big shoulder joint that are all tightly bound with the rotator cuff muscles that surround the joint. They keep the ball of the big shoulder joint from slipping too far forward or backward in its shallow socket. If your shoulder has ever been dislocated at any time in your life, it was these ligaments that were likely lax. When these ligaments are loose, we see more arthritis in the main shoulder joint as well as labral tears.

Onward, the muscles surrounding joints also act as a secondary, but no less important, stability system. The shoulder is most likely the joint most reliant on muscular stability. The shallow socket of the shoulder means the ball of the humerus has ample opportunity to get out of place. The rotator cuff muscles help to keep the ball in the center of this shallow socket.

An Example of the Kind of Ligament Damage That Can Be Treated with a Needle

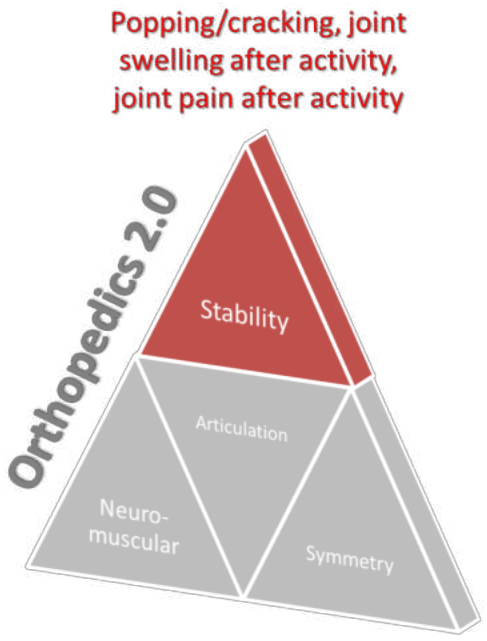
There are three types of damaged ligaments: partial tears, complete non-retracted tears, and complete retracted tears. The best way to conceptualize these tears is by using a big rubber band. Our piece of stretchy rubber can have small tears within it or a tear that doesn't go all the way through: in a ligament, these are examples of partial tears. Next up in severity is a complete tear where the rubber band is badly mangled in one area and there are small tears that go all the way through the structure, but the band still holds itself together: in a ligament, this is called a complete non retracted tear as our band hasn't snapped back into two halves. Finally, there is a complete tear where the two halves snap back: in ligaments, this is called a complete retracted tear.

Now consider the ACL as an example. The ACL is a major stabilizer of the knee, and tears of the ligament are common sports injuries. The ACL can have a partial tear where only some fibers are broken but much of the ligament remains intact. It can also have a complete tear without retraction (an area of light color on the MRI, but the ligament hasn't snapped back like a rubber band). Finally, it can have a complete tear with retraction where the ligament fails completely and does snap back like a rubber band. In our clinical experience, a partial tear, a complete non retracted tear, and even a tear with a small amount of retraction can generally be treated via placing stem cells into the tear under very precise X-ray guidance. Only a complete retracted tear requires surgery yet, despite this knowledge, we still see many patients getting their ACLs surgically ripped out and replaced with inferior ligaments. To learn more about how we treat torn ligaments such as the ACL with stem cells, click the video link below:

Why Can't Strong Muscles Substitute for a Bad Ligament-Stability System?

If your shoulder has one or more loose ligaments, you may be able to strengthen it through physical therapy. After all, the muscles and ligaments work together and can overcome some

weakness for the other. As discussed, there are two types of stability systems, the fine-tuning is provided by the muscles while the ligaments prevent serious abnormal movements that can lead to catastrophic shoulder damage. If the ligaments are stretched out a bit, but still intact, the muscles may be able to substitute and protect the shoulder in most situations. However, if the ligaments are stretched or damaged so that they allow bigger abnormal motions in the joint, no amount of muscular stability will help. In the end, while having stronger stability muscles may help reduce some of the wear-and-tear, the shoulder will still get into abnormal alignments that will lead to accumulated damage. Thus, if ligaments are stretched, it's best to tighten them, and this can often be done without surgery (see the section on regenerative medicine). Only on the rare case they're completely torn and retracted will surgery be the best option.



How Do I Know if I Have a Shoulder-Stability Problem, and What Can I Do to Help It?

Patients often complain of popping or cracking in the shoulder and may at times feel sudden shifts in the shoulder. For example, when lifting or reaching their arms to the front, they may feel there's too much give in shoulder. Yet in other patients, there may be no perceptible sense of instability or popping/cracking in the joint, just shoulder pain or swelling after activity; these patients usually have smaller amounts of microinstability.

Take this short quiz to see if this section applies to you. If you answer any question with a yes, you may have a shoulder stability problem.

1. My shoulder gets very sore or swollen after I exercise. Y N
2. I hear cracking/popping in my shoulder when I do certain activities. Y N
3. My shoulder feels like it's loose or moves too much. Y N

Regenexx Simple Muscular Stability Tests

When you get evaluated using the SANS system, these are the quick and simple physical exam tests that will determine if you have good or poor stability. There are also other aspects that will be evaluated, like the status of your spinal stabilizing muscles on MRI. If you have pain with any of these movements, make sure to pay attention to the culminating chapters.

We expect our patients to be participants in their own recovery, so we want them to take this test on a monthly basis while being treated. If you're a Regenexx patient, before your first evaluation, please take the test, print out the work sheet, and bring it to your first evaluation. If

you were given a physical book, you can find the work sheet in Appendix A. If you're not a patient, you can take the test and use the work sheet to record where you are at any given.

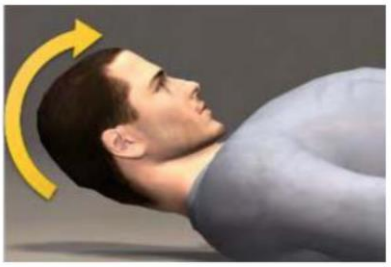
Caution! These tests may cause injury or exacerbate the conditions of patients who have a more fragile stability system or who are at a lower level in their stability. Please do not attempt these if you get injured easily. If you do decide to perform this assessment and experience significant pain during any given test, stop immediately. Perform these tests at your own risk.

Getting Ready: For some of these tests, you'll need an assistant. You'll also need a timer or clock/watch with a second hand (there are good stopwatch programs on most smartphones).

Lift arms above head all the way. Then have someone hold head firmly and retest. Fail if it's easier to lift the arms with head hold.

Neck—Upper Cervical (Scalenes): The first test is simple. Just lift your arms out to your sides and all the way above your head. Can you easily raise your arms up all the way or is it difficult to do so? Now have someone stand behind you and hold your head very firmly. Your head shouldn't move at all as you perform the same hands-over-head maneuver. Was it easier to lift your arms with your head stabilized by someone? If you found it hard to lift your arms over your head without someone stabilizing your head, then you may have upper cervical instability. This means that the muscles or ligaments stabilizing your upper neck may not be strong enough. If you experience significant pain with this maneuver, stop!

Scoring: If you feel no difference with or without the head hold, give yourself a 3 here. If you feel a noticeable difference and can get your arms all the way up, you score a 2. If you feel a difference and get your arms over your shoulders but not all the way up, you score a 1. If you can't get your arms over shoulder height, give yourself a 0.



Tuck chin and lift head about 2-3 inches and time. If any loss of height or chin tuck occurs, then stop timing. Normal is 38 sec for men and 29 sec for women.

Neck—Deep Neck Flexors: The second neck test was developed by an Australian researcher and is a bit more challenging. Lie on a flat and firm surface, like the floor, and have someone time and monitor you. First, tuck your chin fully and then lift your head 2–3 inches. Have your monitor start the timer. The clock stops when you lose any degree of the chin tuck or your head is unable to maintain the same height. Normal for men is 38 seconds and for women is 29 seconds. If you can't do this, your deep neck flexors are weak and you fail this part of the test. These are important muscles that stabilize the front of your neck. When these muscles are

weak, patients often report headaches. If you experience significant pain with this maneuver, stop!

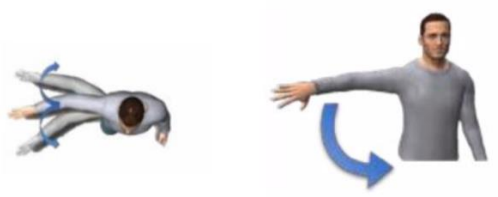
Scoring: Write down your timed score.

Neck—Extensors: The third neck test was developed by a US physical therapist and tests the endurance of the deep and superficial neck muscles that hold your head up. You first lie facedown on a table or firm bed, making sure your chest is stable (you may want to have someone hold you by placing downward pressure on your upper back). You then hold your head perfectly straight with the face parallel to the floor.

You hold this position and time yourself. You should be able to get to 20 seconds without your neck and head bending (as shown in C) or extending (as shown in D). If you went into position C as you fatigued, your superficial neck extensors are weak. These help to hold your head up. If you went into position D, your deep neck extensors are weak, and the superficial extensors are taking over. In both of these instances, patients with weak neck extensor muscles tend to report a heavy head or fatigued neck by the end of the day. If you experience significant pain with this maneuver, stop!

Scoring: Write down your timed score.

Shoulder—Rotator Cuff: The test for the shoulder focuses on rotator cuff muscle endurance. The arm is held out to the side with the thumb facing down and pointing toward the floor. The arm is then moved down toward the side and back up to the shoulder height. You perform this movement in the three planes shown (behind the body, at the body, and in front of the body). Do this slowly. If you experience significant pain with this maneuver, stop! You should be able to do this 10 times in each position (30 reps total). You may be fatigued. If you can't get that far without stopping, you need to strengthen the rotator cuff. These muscles help to stabilize the ball of the shoulder joint in its socket.



With arm out to the side with the thumb down, move the hand completely down and up in the three planes noted. Pass is at least 10 reps slowly (30 up-down movements).

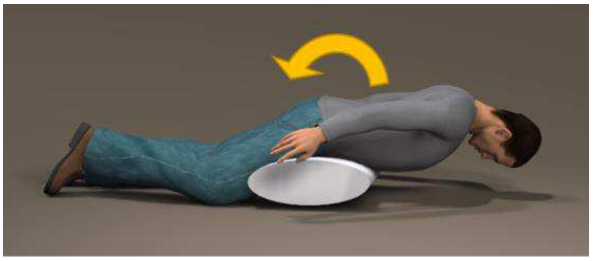
Scoring: If you can get through 30 reps (10 in each plane) without pain (although you may be mildly to moderately fatigued), then give yourself a 3 here. If you can barely do this and experience much fatigue and effort or have pain with this test, then you score a 2. If you can't get through all of this due to fatigue or pain you score a 1. If you can't do this at all give yourself a 0.

Lie on your back with your hips and knees both at 90 degrees and lift your torso off the ground. Time how long you can hold this position.

Core—Abdominals: There are two stability tests for the lower back, both pioneered by a Japanese researcher. The first is a simple sit-up maneuver where you begin by lying faceup and bringing your hips and knees to a 90-degree position as shown. Make sure you keep your neck flexed. Set a timer and hold this position. The normal time for men is 182 seconds (3 minutes), and for women it's 85 seconds (1.5 minutes). If you experience significant pain with this maneuver, stop! If you have a lot of pain with this maneuver, you may have a disc-pain issue as flexion places more pressure on the disc.

Scoring: Write down your timed score.

Core—Low-Back Extensors: The next test starts with lying facedown on the floor and placing a firm pillow under your stomach with your hands at your side. The pillow should be firm enough or doubled up so that you can extend your back and lift your chest off the floor as shown. Your neck should remain flexed. Set a timer and hold this position. For men, the normal hold is 208 seconds (3.5 minutes), and for women it's 124 seconds (2 minutes). If you experience significant pain with this maneuver, stop!



Lie on your stomach on a stiff pillow and extend your back so that your chest is off the floor and hold. Time how long you can hold this position.

If you have pain with extension like this, you may have either a facet or lumbar stenosis problem.

Scoring: Write down your timed score.

What if I failed some of these tests? This means you have poor stability in these areas. This could be due to pain shutting down muscles, weak muscles, or irritated nerves that make them weaker or misfire. If it's pain, then you have to find and fix the source of that problem. If it's weak muscles, they may just need strengthening. Finally, if its irritated nerves, no amount of getting the muscles stronger will help; you need to reduce the nerve irritation. These things will all be covered later in the book.

As you get treated, use this Regenexx Stability Test as your monthly spot-check to gage your progress. You want to increase your scores in each problem area.

Other Tests for the Shoulder

For peripheral joints, such as the shoulder, the most common tests for stability would be X-ray tests and stress radiographs, which would be used to detect too much movement in the shoulder. For smaller amounts of microinstability (very common), we use various tests. There are also other devices that can test many different joints in a similar fashion. We currently use the Telos Stress Device.

While diagnostic tests for instability and hypomobility are just becoming popular, the best way to diagnose these problems is still through history and exam. An experienced physician can compare joint motion from side to side (good side versus bad side) as well as stress the joint to look for signs of instability. As discussed above, the American Association of Orthopaedic Medicine (AAOM) is a good place to look for doctors experienced in diagnosing smaller amounts of instability. Many orthopedic surgeons can also diagnose instability, but realize their focus will be on the larger amounts of instability that we have called surgical instability. Thus, the focus will often be on surgical solutions.

Shoulder Therapies and Exercises

Rotator cuff exercises can be helpful. They are very commonly prescribed and taught by most physical therapists.

- Rotator cuff exercises
- Shoulder stabilization exercises
- Shoulder strengthening exercises

Chapter 9
Articulation

STABILITY
The ability of a joint to tightly move as it was designed without extra motions that might hurt the joint.

Regenexx®

ARTICULATION
The health of the joints. Shock-absorbing tissues like cartilage; spacer tissue such as meniscus; or stabilizing tissues such as labrum can be damaged.

S A
SANS
TREATMENT
APPROACH
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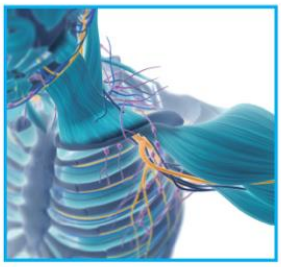


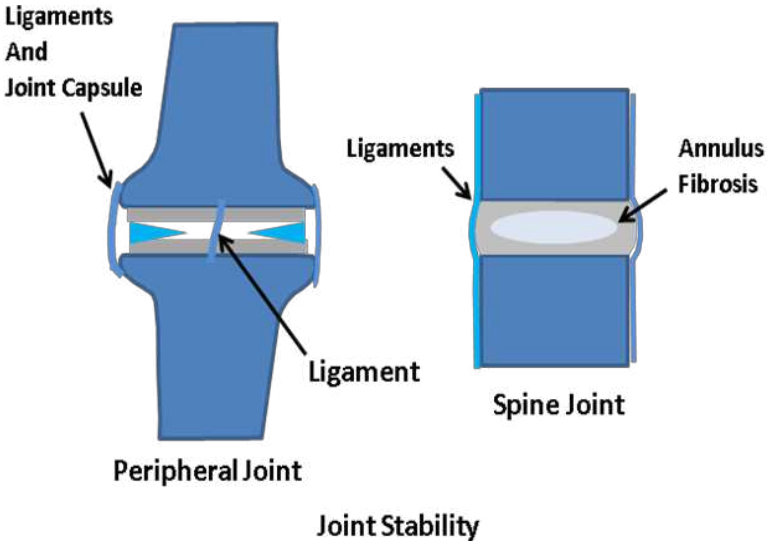
NEUROMUSCULAR
The nerves drive the muscles. Nerves that are irritated or compressed cause pain and may be less able to promote muscles to properly fire.

SYMMETRY
The left/right and front/back balance of the body. When the body is asymmetrical, certain parts get injured or wear out faster.

Articulation means joint, such as the shoulder, which is a peripheral joint allowing motion in a controlled manner. The shoulder, like any other joint, has certain standard components.

Cushioning: The cushion in the shoulder would be the cartilage or labrum. They are not inanimate pieces of rubber, but living tissues with cells and structure. Once these components die off, shoulders lose their ability to provide shock absorption.

Stability: This is provided by the joint capsule (tough outer covering of the joint) or the ligaments that help hold the joint together.



Joint Stability

Notice that while our entire medical-care system in orthopedic shoulder surgery revolves around the joint, in the SANS system, the joint is simply one part of a bigger picture where ligaments, nerves, muscles, and symmetry are equally important. What are the implications of paying too much attention to the joint? Answer: today's modern overreliance on ineffective shoulder surgeries.

Arthritis in the shoulder means that the parts and pieces, like cartilage, labrum, and bone, are degenerating or wearing down. We access the degree of arthritis in the shoulder by using an MRI. However, these images often paint an inaccurate picture of why you hurt.

Imaging Insanity, or the Very Poor Correlations Between Structure and Function

Most every patient I've ever worked with wants an MRI, that fancy picture of the soft tissues created by powerful magnetic fields. While our practice does utilize MRIs to help define pathology, I could give you only 1:1 odds (50/50) that I could ascertain the cause of your pain from solely from it. For instance, several shoulder studies show that patients with severe problems on MRI are often pain free, while patients with severe pain often display limited structural changes on MRI. What gives?

Let's start with the MRI finding of shoulder labrum tears. If your doctor sees a labrum tear on your MRI, it's a sure thing that the tear is causing your shoulder pain, right? Wrong. One study found that 3 in 4 patients still had pain after their shoulder labrum surgery, so what was causing their pain? Since many shoulder labrum tears aren't likely causing the patient's pain, why do we continue to operate?

Once we find problems on a shoulder MRI, traditional orthopedic surgeons like to operate right away. Yet, their "cut to cure" methodology is often not the best course of action for afflicted patients. Let's take a closer look.

"Cleanup" Surgery: Helpful Pain Relief, or a Slippery Slope to More-Rapid Arthritis?

Often with only a cursory exam and an MRI (which you now know is pretty worthless in diagnosing a painful labrum tear), a patient ends up with shoulder surgery. A common procedure used to help "clean up" the shoulder is called arthroscopic debridement, the concept conveying the surgeon to cut out loose pieces of cartilage, labrum, or other tissues. While, at face value this may make some sense, the tissues removed in debridement are made up of live cells, cells often critical for the overall health of the joint.

Say you owned a house where one day one of the walls started to crack and fall apart (like the meniscus seen on MRI), but the house is still structurally sound. You can repair the wall or remove the wall. Since you don't have the technology to repair the wall (which is what happens in many of today's joint surgeries—words like "repair" are actually a misnomer, and they often mean "cut out"), you decide to remove it. You may get some temporary benefit from removing the wall as it was an eyesore, and perhaps removing it makes the house flow better. However, since it's a load-bearing wall (helping to hold up the second story), things obviously deteriorate in the long run. The floor on the second story starts to sag, and other walls begin to crack under loads they weren't designed to handle. Before long, it's clear that removing the wall was a bad idea.

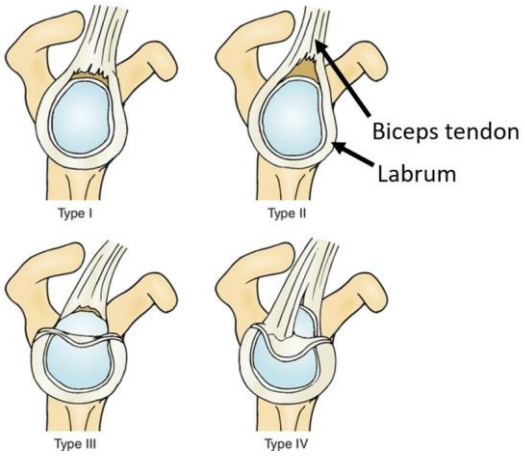
This is analogous to what happens in many of today's modern, unnecessary joint surgeries. In the shoulder, chunks of supporting tissue are removed with each surgery, despite the fact that research has shown that doing so means that arthritis will likely develop much more quickly. We don't want the roof to cave in.

How About Surgery for a Labrum Tear?

Surely this must help as this is a very common surgeries performed in the United States today. Not so much as it seems it can't even beat a placebo in studies. Let me explain.

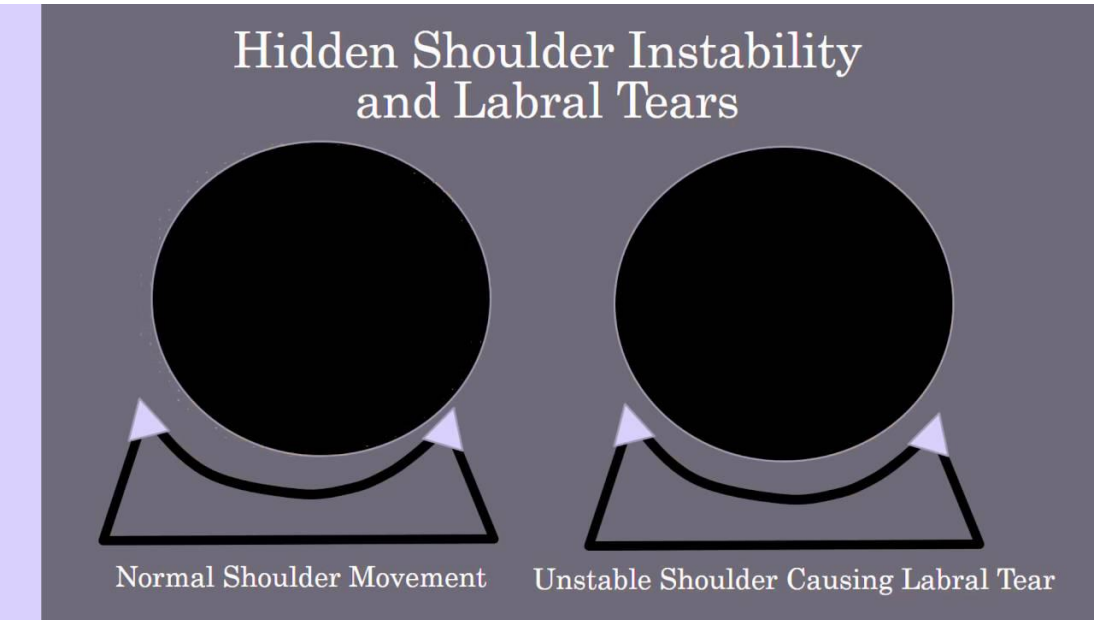
The shoulder labrum, that lip around the socket of the shoulder joint, is a fibrous piece similar to a "shoulder meniscus" or its cousin in the hip—and just like those structures, the shoulder labrum, too, can tear. When a patient reports chronic shoulder pain and an MRI finds a tear, then surgery to "fix" the damage is usually undertaken.

Labrum tears come in four types (I–IV). One study focused on type II, which is where part of the labrum has pulled away from its attachment to the bone portion of the socket. In this case, there's usually a small gap between the two structures. The study also focused on a labral tear known as a SLAP (superior labral tear from anterior to posterior) lesion. This injury is a problem with the labrum where the biceps tendon attaches to the structure. This issue is at the top front part of the shoulder socket.



Biceps tenodesis is yet another way to deal with a labral tear where the biceps attaches to the labrum (SLAP tear). In this case, instead of trying to repair the labral tear, the surgeon detaches the biceps from the upper lip of the socket and reattaches it to the humerus arm bone. The shoulder labral surgery side effects are even greater in this surgery as it is a bigger procedure than an isolated labral-tear repair because you're permanently changing the biomechanics of the biceps muscle.

One of the common shoulder labrum surgery side effects, re-tearing of the labrum, is completely avoidable. Why? The cause of the torn labrum is rarely determined. Hidden shoulder instability is almost always missed by surgeons as surgical decisions are based almost exclusively on MRI rather than extensive exams. Given that your shoulder has the greatest range of motion than any joint in your body, it requires millisecond tuned timing of a series of tendons and muscles to keep it in the right position in the joint. When one of these has become lax due to a prior, long forgotten fall or other injury, the ball of the humerous is not kept where it needs to be and knocks into the labrum continually, as demonstrated in the short video below. One weight lift, or one reach, or one hang done with both arms can spontaneously result in a torn labrum in the shoulder with hidden shoulder instability.



Other shoulder labrum surgery side effects result from changing the biomechanics of the shoulder because of the shoulder's aforementioned precise timing mechanism—and making surgical structural changes to that system can create permanent issues.

Because of its complexity, the healing and rehab from shoulder surgery is very long and very intense. A "cushion" shoulder brace is required for months, and the atrophy resulting from this prolonged immobilization creates yet another of the most common shoulder labrum surgery side effects. Add to these surgical risk and trauma and avoiding the surgery all together becomes the clearly better option.

The research was double-blinded and sham-controlled, meaning that neither the assessor nor the patient knew in which arm of the trial they were entered. The 118 surgical candidates (with a mean age of 40 years) were diagnosed with an isolated type-II SLAP lesion. The patients were randomly assigned by a study coordinator to either receive labral-repair surgery (40 patients), biceps tenodesis (39 patients), or sham (fake) surgery (39 patients).

The results were surprising; there was no difference in outcome in any of the three groups! This means that the two invasive surgeries to "repair" the labrum at the biceps attachment or to reroute the biceps were no better than the fake surgery where no surgery was performed. Wow.

So we can now add the most common shoulder labral surgery to the growing list (alongside meniscus surgery, debridement, spinal stenosis surgery, and shoulder rotator cuff repairs) of invasive surgical procedures that have been proven obsolete and unnecessary compared to placebo procedures or physical therapy:

Why are the most commonly performed orthopedic surgeries no better than placebo or sham surgeries? It's simple, these procedures didn't begin with any research showing that they actually worked—they were simply added to a growing list of procedures that were invented because we could accomplish them, not because we should. Though, despite this evidence, it is highly unlikely shoulder labral tear surgery will end any time soon because, in my experience, it takes about a decade and multiple studies to finally put the stake in the heart of an ineffective surgery.

More Severe Loss of Cartilage: Arthritis

Shoulder arthritis occurs when the joint loses cartilage and begins to degrade. The joint eventually becomes sloppy and unstable and, as a result, bone spurs develop. More on that below.

Many of us have an irrational fear of arthritis; however, many of us will get this problem by the time we're old. I hear patients all the time tell me of their "bone on bone" arthritis (meaning they have no cartilage left), however, the fact that you have little cartilage left may not mean much.

Furthermore, the big-time research over the last five years is actually showing that the idea that bone on bone causing pain is an urban myth? How might this change everything?

Bone: The Structure of the Shoulder

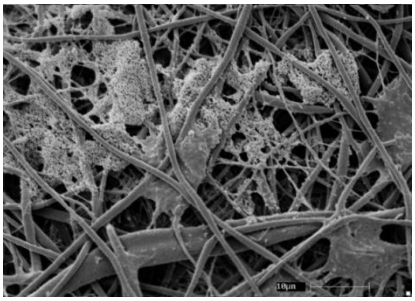
Bone is the structure that gives form to our bodies and the shoulder within, the shoulder being a a place where two bones meet. Ligaments and muscles help keep the bones aligned, and cartilage acts as their cushion. When the shoulder suffers from arthritis, the cartilage breaks down, reducing the cushion. But can the bone develop issues, too?

While we think of bone as cement, it's actually like hard plastic that gives and absorbs shock. However, it relies on the cartilage to help it work properly as a machine to mitigate forces. When that cartilage is damaged, the bone can swell, a an affliction known as bone marrow lesion (BML) readily seen on certain types of MRI images as a bright spot. These areas are places where microfractures have occurred. In addition, research shows that while these areas of bone swelling may be caused by poor cartilage not absorbing the forces of the joint, the swelling of the bone may also cause more cartilage damage. But, can this problem be helped? We have seen good results with what we call percutaneous stem-cell-assisted subchondroplasty (PSCAS). This involves careful mapping of the lesion using MRI and then placing a needle into the bone and injecting stem cells to shore up the area. By helping the bone, in this technique, we believe we can help the cartilage and strengthen the shoulder.

Bone and Joint Tissues Are Alive!

Kind of like The Blob from a bad 1960s horror movie, bone spurs inspire fear in the hearts and minds of most patients; when patients hear that they have them, I often see their eyes widen. However, much like the title of Stanley Kubrick's '60s movie Dr. Strangelove or: How I Learned to Stop Worrying and Love the Bomb, patients shouldn't immediately become frightened when they hear they have bone spurs because most provide stability to the shoulder and other joints—and are an important part of you! Only every once in a while, however, these bone spurs that often aid your body, do sometimes cause problems.

Why do bone spurs develop? When are they good or bad? Bone is made up of mature cells (osteoblasts) and stem cells that react to their environment. It's well known, for instance, that when the cushioning cartilage in the shoulder wears out, the bone underneath makes itself thicker to handle the new forces. We know that people who don't exercise or who pursue non-weight-bearing exercise have more brittle bones and that people who lift heavy weights have more-dense bones. This illustrates how bone is indeed alive, quickly reacting to its environment. What's the timetable?

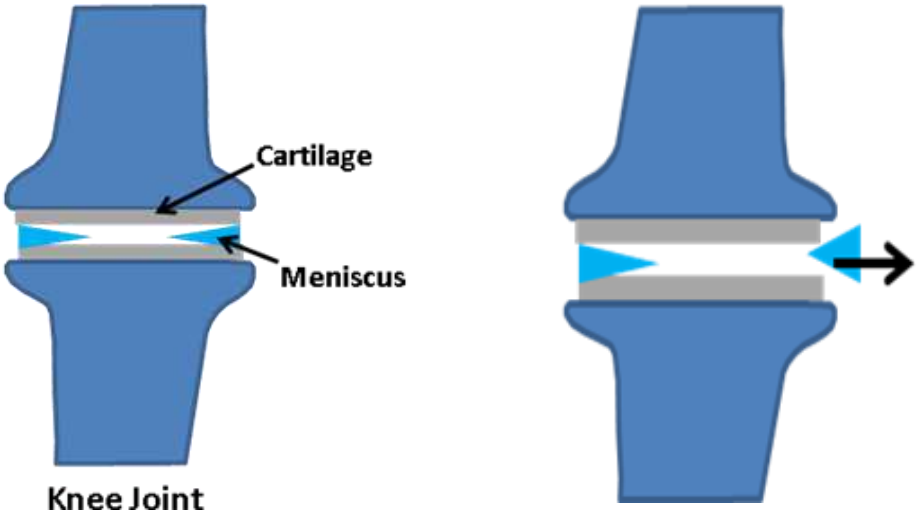


For many years, most physicians were convinced that bone spurs took years to form. This was based on the outdated theory that bone was dumb, inanimate cement. However, more-recent research shows that when instability is created as part of an experiment, bone spurs begin to form in the one-to-two-month time frame.

The same holds true for muscles, tendons, and ligaments. They all react to increased strain forces by making themselves thicker and stronger. This ability to react quickly to increased (or decreased) demands is mediated in part by adult stem cells. The switch from seeing these orthopedic tissues as inanimate filler (bone, cartilage) or pieces of inanimate duct tape (ligament, tendon) to living tissues that react is a key concept in understanding why alignment of the joints is so important in Orthopedics 2.0.

Functional Bone Spurs?

Bone reacts to forces. I've spoken to many patients over the past few years who are planning to have surgery to remove bone spurs and, while I can think of a few situations where this makes a lot of sense—like when a bone spur presses upon a nerve—most times bone spurs are better off left alone. The rare bone spurs that causes mischief, I call nonfunctional bone spurs, but the vast majority are functional. Let's take the example of bone spurs that develop in a shoulder that need to be left intact.



I commonly see patients with chronic shoulder pain who have undergone a shoulder surgery bone spur removal to "open up" the shoulder. Known as distal clavicular resection, it's one of the most commonly performed shoulder surgeries with rotator cuff repair. Research has shown that the surgery doesn't help and leads to more shoulder instability, which frequently causes more pain and arthritis. Why?

The rotator cuff is made up of muscles that help to move and actively stabilize the shoulder, yet frequently becomes torn through old age or trauma—and rotator cuff surgery is the most common shoulder surgery in the United States, with about 80,000 procedures a year. Most patients will also end up with a distal clavicular resection surgery as well, when the end of the collar bone is chopped off. The concept behind distal clavicular resection is that it "opens up" space for the rotator cuff. This is based on the idea that constant compression of the rotator cuff muscles and/or tendons is what may have caused the muscle to tear.

But, is this additional procedure widely added to rotator cuff surgery necessary? A study found that whacking off the end of the clavicle did not help pain or function any more than not cutting out this piece. Likewise, some patients developed instability of the shoulder and about one-third of the participants in the study failed to heal their rotator cuff tears after surgery, which is consistent with other studies showing high rates of failure for rotator cuff repair. I've seen countless patients walk into my office with grossly unstable shoulders after this surgery, still in pain, despite the immense procedure.

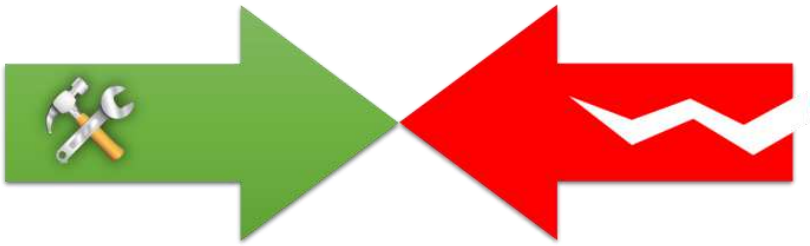
To sum, we've been conditioned to believe that all bone spurs are bad. However, these bone spurs often develop to protect the unstable joint. If we remove these bone spurs, the shoulder loses its ability to absorb shock, and the body will just place more bone spurs in this location. I call these functional bone spurs in that they serve a purpose, and their removal doesn't positively impact the joint. Since all bone spurs are a reaction to instability or joint forces, we have to be careful about removing this reactive tissue, to make sure that the joint will be better off after removal.

Is There a Better Way?

Beginning in 2005, rather than cutting out tissue, our practice was the first in the United States to pioneer a new approach. Rather than surgically removing or repairing the tissues, we began using the patient's own stem cells in an attempt to heal damaged tissues. Click the image below to play a concise little video that helps to explain why we believe this approach to be better.

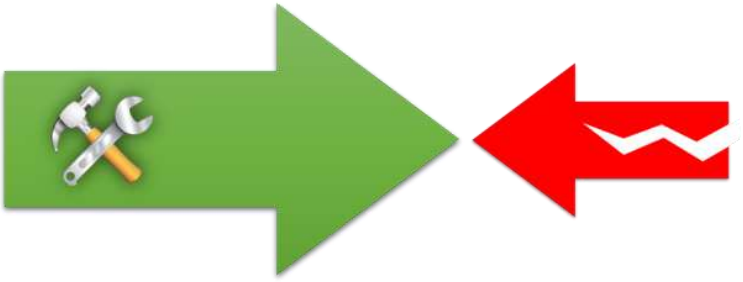
Understanding the Body's Repairmen: Stem Cells

Remember that house in your neighborhood that was inhabited by an older person who couldn't keep up with the maintenance? We'd all accept at face value that a house left unattended for years will weather and begin to slowly degrade and fall apart; our joints and bodies are the same. A quick run around the block, a workout in the gym, or just daily use will cause microdamage in any number of tissues. Just like that unattended house down the street, left unrepaired, these areas will begin to break down over time.

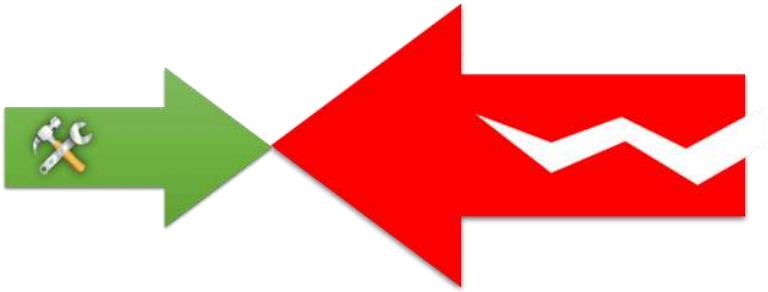


So, what exactly does keep us from falling apart after just a few years? Look no further than the figure to our left, telling the story of the opposing forces of damage versus repair. Everything we do every day adds small (or large) amounts of damage or wear-and-tear on our tissues. On the other side of that coin is repair, the mechanism that fixes the damage. When these two systems are equally matched (our repair system can easily keep up with the damage), you have healthy joints.

As it turns out, we have billions to trillions of tiny little repairmen in the tissues of our body, the repairmen known as adult stem cells. Consider an adult stem cell type called a mesenchymal stem cell (MSC); these cells live in your tissues and are called into action once damage is detected. In a sense, they act as a general contractor in the repair response, giving signals to activate other subcontractor cell types that are needed for the repair job or even deactivating cells that may be causing trouble. They can also "differentiate" (turn into) the final cell type needed for the repair. For example, if the cells are repairing the cartilage of your shoulder, they can differentiate into these cartilage cells. When we're young, while there may be a lot of abuse on the body, in general, the amount of repair capability (adult stem cell numbers and function) generally far exceeds the amount of damage we can inflict. As we age, however, fewer of these stem cells stick around, and even when we're younger an area can become injured so that it doesn't allow the repairmen in the door (less blood flow, or there just aren't enough cells to affect a proper repair). At this point, the amount of damage starts to exceed the body's ability to repair.



Young or Older and Healthy Joint: Repair abilities far exceed wear and tear.



Older or Unhealthy Joint: Wear and tear exceeds repair abilities.

But, what if we could turn that equation around? What if, despite being older, or even younger with an area that has too much damage for the local repair cells to handle, we could amplify repair in the area? As you might have guessed, this is a basic tenant of Orthopedics 2.0.; the doctor's job is to increase the local repair response in nonhealing tissues so that it exceeds the existing damage or wear and tear on the area. This extends to the flip side of the coin—the doctor should avoid prescribing

or injecting medication that will harm or slow this repair process. In addition, the final part of the doctor's job is to reduce the local damage on the area. How do we do this?

Improving the Repair Response

We can increase the repair response by dividing it into approaches with three levels of sophistication.

Level I: Microinjury

Level II: Improving the Healing Environment

Level III: Stem Cells

Level I: Microinjury

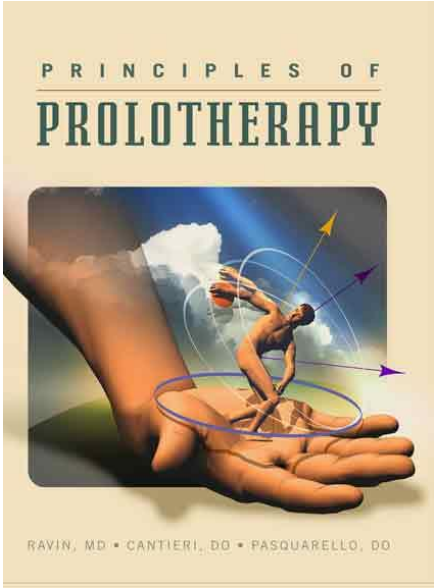
Since ancient times, creating a minor injury to prompt healing has been practiced by healers. (For horses, this was called "pin firing.") The technique was to take a hot poker and place it into a nonhealing ligament to cause small amounts of damage to the area, which caused the body to kick up a repair response. While seemingly barbaric, it generally worked. For centuries doctors continued to create small injuries in a nonhealing wound by "roughing" up the tissues.

Physicians still use this concept today for tendons, ligaments, and joint capsules. For example, in a shoulder capsulorrhaphy, a surgeon usually inserts a small catheter that heats the tissue to prompt healing in a damaged shoulder capsule (the covering of the shoulder joint that helps control motion)—and doctors still score ligaments with scalpels and beat up tendons with a needle (percutaneous tenotomy), all to prompt a healing response. Take microfracture surgery, which is a procedure used to treat a hole in the cartilage in a damaged joint. In this surgery, the doctor pokes holes in the bone to cause the cartilage to heal. The procedure known as prolotherapy falls into this same category; in this procedure, rather than initiating a mechanical injury, the physician injects a chemical irritant to spur a chemical microinjury. These types of treatment rely on the same concept—that we usually get only one bite of the healing "apple," and if something fails to heal completely the first time, we can create more bites at that apple simply by causing a small injury to the area.

The major advantages to microinjury techniques are the simplicity and inexpensive nature of these basic procedures. The downside is that, while they often work well, sometimes they don't have enough "oomph" to produce the correct type, or volume, of healing. In addition, they also tend to do better when fibrous tissue repair is what's needed, meaning they can heal ligaments and tendons with much the same composition as the original tissue—but for things like cartilage, they produce inferior-quality tissue. Consequently, for a microfracture, it's well known that lower-quality fibrocartilage is predominantly produced rather than true hyaline cartilage.

The Original Regenerative Injection Technique—Prolotherapy

Prolotherapy is an injection method where chemicals are injected to cause a small inflammatory healing reaction. In the 1940s, this was a mainstream orthopedic procedure used to treat lax ligaments and spinal pain, and. heck, it even had its own pharmaceutical (Sanusol). However, in the next half of the twentieth century, prolotherapy fell out of favor. Why? Some say it was linked to the bad outcome of a single injection placed where it shouldn't be in the spinal canal. However, others place prolotherapy's demise on the fact that it had no sustainable medical business model. It was simply replaced by big surgical procedures that were far sexier and had better reimbursement through a new concept at the time—employer-sponsored medical insurance.



While we may never know exactly what happened, the procedure was revived in the 1980s, and over the past two decades I've seen this simple and inexpensive technique work for numerous patients who otherwise would not have been helped. I've published on prolotherapy's ability to tighten loose spine ligaments simply through injection, and others have published on the same observation in lax knee ligaments.

If you have a loose shoulder ligament, prolotherapy may be worth considering. However, like any regenerative injection technique, accuracy of placement matters greatly. As a result, prolotherapy should almost always be performed under imaging guidance, especially when deep specific structures are being treated. Check out an article I wrote on this topic a few years back that explains in more detail how this works.

Level II: Improving the Healing Environment

The next level of sophistication beyond just creating a healing microinjury is making the conditions in the area more conducive to healing, or "anabolic." You may have heard this term associated with body builders who use steroids. This is not the same use here, although body builders "build" muscle, so this is why they use "anabolic" steroids (literally "steroids that build"). Here the term means making an area pro-repair, better able to heal.

Creating an anabolic healing environment is not a new concept in medicine and surgery. For centuries, physicians have known that some people have better innate abilities to heal, while others have less healing capabilities. The acronym PPP (piss-poor protoplasm) was used in my medical school training to mean a patient who, due to disease or extreme old age, was unable to heal after surgery. While surgeons have always known that some patients have a compromised ability to heal, little attention has been paid to make routine and otherwise healthy patients heal

better. Doctors have long understood the basics, like good nutrition, young age, high levels of fitness, and good blood supply—and about 20 years ago, that started to change in the dental community. Some dentists began experimenting with a simple concoction called PRP (platelet rich plasma). The dentists used this stuff, made from their patients' own blood, to help dental implants heal. Cool concept.

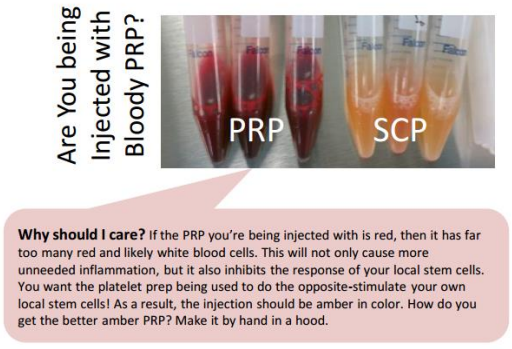
PRP is a simple example of how we can improve the healing environment. Your blood has platelets that contain growth factors that help to ramp up healing. A simple paper cut helps to illustrate the basic points of how these platelets work. When we cut ourselves, we bleed into the cut. The blood coagulates because of cell fragments that live in our blood, called platelets. Yet, the job of the platelets doesn't stop there; they go on to release certain growth factors that stimulate local cells to heal the cut.

Growth factors are like espresso shots for cells. A cell works at a certain pace to do its job, but if we add growth factors (like those in PRP), it's like buying a Starbucks gift card for all the cells trying to make the repair. The cells react to the growth factors like people react to triple espresso shots: they work harder and faster. So, if we use an example of a construction site where we have a few bricklayers building a new wall and we add growth factors (espresso shots), our bricklayers will build our wall faster.

As you might have guessed, Orthopedics 2.0 uses these same concepts to promote healing. The most basic level-II procedure today is PRP, which can be mixed up from a patient blood sample in a bedside centrifuge or more preferably in a simple hospital or clinic-based lab. PRP means that the healing platelets have been concentrated. Injecting the patient's own blood can often accomplish the same thing as it's also rich in platelets.

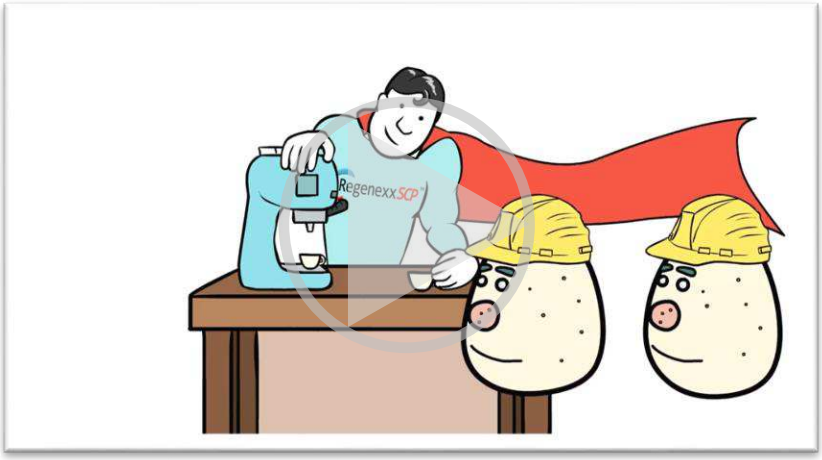
Not All PRP Is Created Equal

One of our focus areas since 2005 has been figuring out how to use various forms of PRP to get stem cells to grow better. This extensive experience has led us to understand that there are different "flavors" of PRP and that some of them seem to work better for kicking stem cells into high gear. Want to know how to tell the difference? Look at the color of the PRP. Based on our lab data, red PRP doesn't work as well to promote stem cell activity as amber PRP. Most automatic bedside centrifuges used by doctors today produce this red, bloody PRP.



Red PRP is problematic because it's rich in red and white blood cells. When it comes to energizing stem cells toward repairing more tissue, our lab experiments show that red PRP doesn't have the same "espresso shot" kick as PRP without red and white cells (amber PRP). Based on these experiments, we have created what we call a "super

concentrated platelet" procedure (SCP) to maximally stimulate stem cells into action. Click here for an infographic that explains the issues and lab data in more detail or click on the video link below to see a two-minute animation that explains these differences.



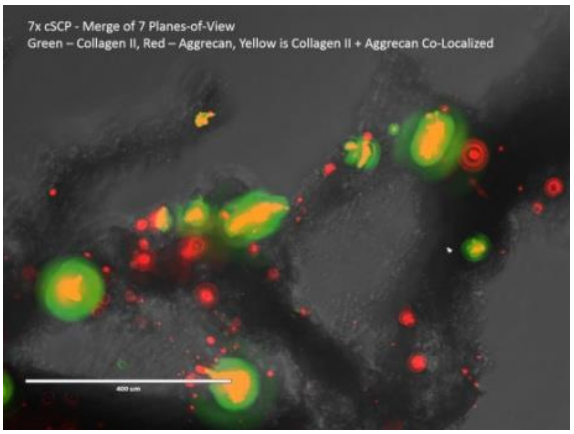
The other advantage to SCP is that since we create it by hand for every patient in a lab rather than mass manufacturing in an automated push-button centrifuge, we have much heightened control over the composition of the final preparation. While most bedside centrifuges can only concentrate to about 5–7 times more platelets than are normally present in the blood, we can concentrate SCP all the way up to 40 times over baseline. Not bad, huh? And getting to higher platelet concentrations is better because with this type of PRP, we see more activity in local stem cells with higher concentrations of platelets. For this lab data, click now.

In our clinic, we also use next-generation level-II tools beyond PRP. These tools include platelet lysate (PL). In the case of PL, our advanced cell biology lab makes PRP from the patient's blood and then breaks open the platelets to allow all of the growth factors to be immediately available. The difference between PRP (or SCP as we call it) and PL is the same as between a time-release pill and an immediate-release pill. PRP has whole platelets that release their growth factors over time. PL has all the growth factors immediately available. Based on our experience, there are specific reasons to use one or the other; for example, in our clinical experience, we find PL excellent to use around nerves.

We now produce an advanced-generation platelet lysate that we call PL-M and cPL-M. In our lab experiments, we noticed that despite blowing up platelet bodies and releasing growth factors, there were still many whole platelets left—this meant that there were still growth factors to be released. As a result, we developed a proprietary type of triple lysate that gets all of the available growth factors out of the platelets.

Can We Create a PRP That's Better at Making Cartilage?

Since PRP is often used in joints, and one of the major regenerative-medicine concerns there is healing cartilage, we must ask if PRP is good at cartilage repair. One of the growth factors in PRP is TGF-beta, which is very good at helping cartilage grow. However, PRP also contains a soup of growth factors, some of which may or may not promote cartilage repair. As a result, we have been researching this issue for some time and have created novel platelet mixes that are better at helping stem cells create cartilage in lab experiments (see illustration above that shows that our chondrogenic PRP produces more cartilage components than a control in the lab—the green is cartilage being made).



What about SCP? We have tested our SCP in the lab for its ability to promote stem cells to produce cartilage and found it to be very capable of this feat (see fluorescent microscopy image to the left).

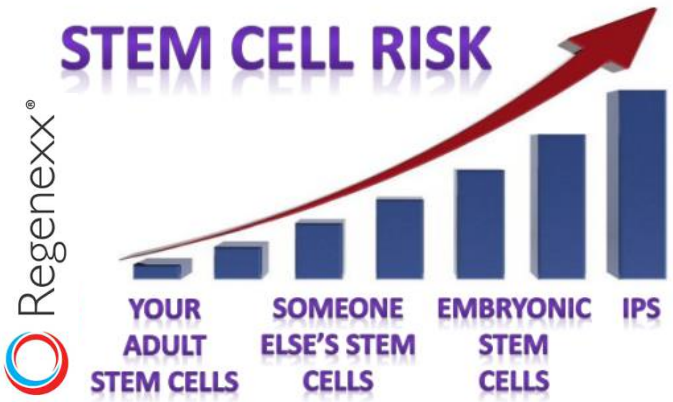
Level III: Stem Cell Therapy, or Adding in the General Contractors of the Body

While level-I therapy consists of causing a little injury to prompt healing and level II getting the local cells to work harder, level III is about adding more workers to the area. Staying with our construction-site metaphor, a general contractor (GC) is the person who pulls a construction project together. He or she hires subcontractors, like plumbers, carpenters, and electricians. Does your body have a GC cell that can help coordinate its daily repair jobs?

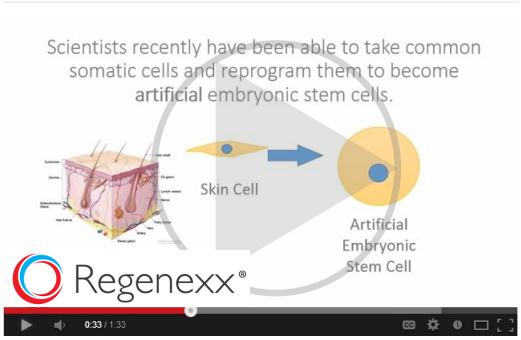
Of course it does, and the GC's of your body are stem cells. So, level-III advanced techniques use concentrated or cultured stem cells to help repair tissues and there are several different types of stem cells. Many of us have heard of embryonic stem cells that are taken from a growing embryo, yet while these cells are highly potent stem cells, they also have the nasty habit of forming tumors.

Cells can also be taken from cord-blood stem cells or adult stem cells, however, while some of these cell types might be appropriate as last-ditch efforts to save someone's life, their risk of transmitting genetic disease makes them too risky for orthopedic applications. As an example, in one study, an older rat bred to have osteoporosis donated stem cells to a young rat without the disease and the young rat acquired osteoporosis in the transmission process. Since we don't yet possess the technology to screen donors for all inheritable diseases, the risk of using someone else's stem cells, in my opinion, is currently too great.

You may have also heard of placental or amniotic stem cells, some newer entrants to the list of stem cells offered to patients. The problem is, as you'll see later in the book, amniotic and placental products being used by physicians, chiropractors, and others are all "dead cell products." That means that they contain no living stem cells and are thus nearly worthless.



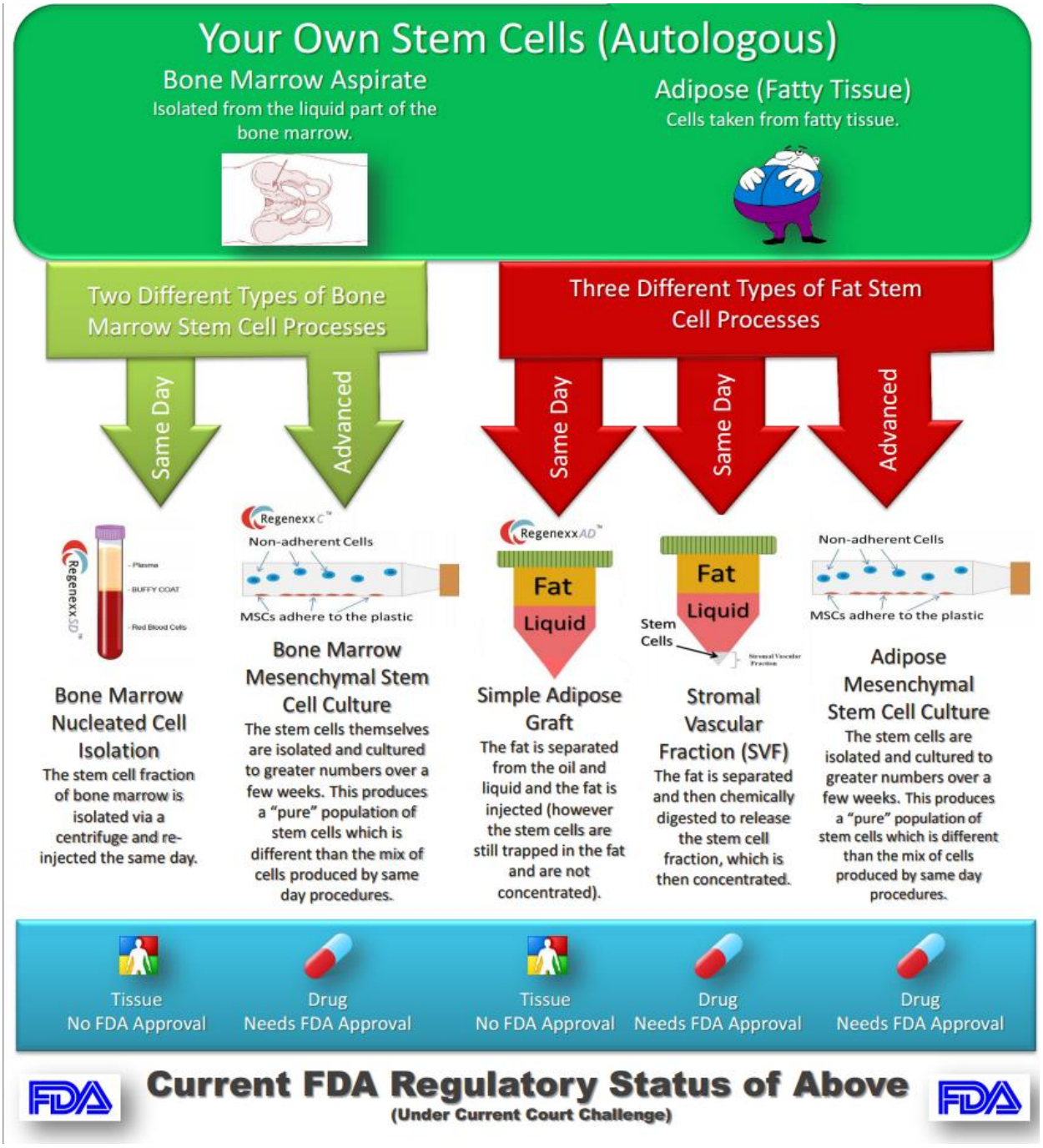
Finally, the newest stem cell types are called induced pluripotent stem cells (iPS or iPSCs). While this may sound daunting, the basic concept is that these are artificial stem cells that don't exist in nature, created from natural cells. These are created by heavy-handed genetic manipulation of the normal cells from the body (like skin cells) or by exposing these same cells to a stimulus (like putting them in an acid) and are likewise very dangerous until proven otherwise. As such, we're much more than a decade away from seeing iPS cells used in real everyday patients. To learn more on iPS, click on the video link to the left. It's a good one.



Mesenchymal Stem Cells

There are many types of adult autologous stem cells, but for the purposes of this orthopedics discussion, one stands out as the best candidate for our general contractor position: the mesenchymal stem cell (MSC). These cells are found in many tissues (for example, as above, they are found in bone marrow aspirate and fat). For orthopedic applications, their ability to help coordinate the repair response as well as turn into cartilage, bone, tendon, muscle, and ligament make them ideal. Other cells, such as very small embryonic-like or embryonic-like stem cells (VSELs or ELSCs), also prove promising for orthopedic use, but insufficient research has been performed with regard to safety to make them practical for everyday use. In the future, there will likely be hundreds of classes and subclasses of adult stem cells that will be used for therapy; it's just a matter of time and proper research. And many of these may even be combined with mixtures of other non-stem cells or tissue-engineered scaffolds to better promote healing.

Fat vs. Bone Marrow Stem Cells

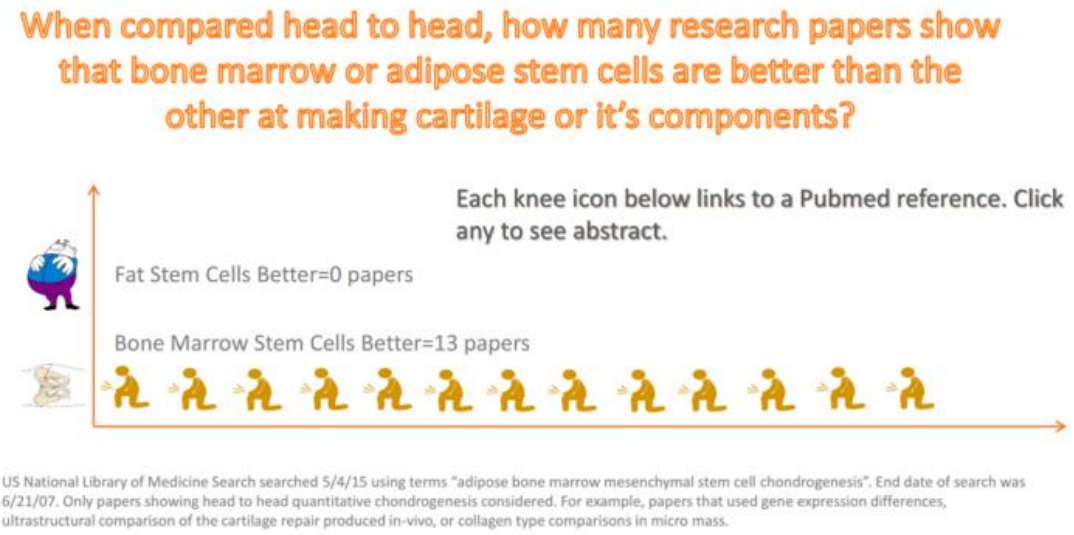


Anyone perusing the Internet can see that there are two stem cell types from the same patient (autologous is the term for this) that seem ubiquitous: fat and bone marrow stem cells. When we began using stem cells in 2005, we thoroughly investigated which of these we should use. At the time, there was mounting evidence that bone marrow stem cells had real utility in orthopedic applications and very little data was published showing that fat stem cells were very helpful. Amazingly, that this data isn't all that different today.

Before delving into the research, let's review the five most common procedures being offered in autologous stem cells for orthopedic injuries (illustration on previous page).

As you can see in the illustration, there are two different bone marrow procedures (same day and advanced) and three different fat procedures (two same day and one advanced). The same-day bone marrow procedure is equivalent to the Regenexx-SD procedure, and the advanced bone marrow procedure is Regenexx-C[1] where cells are cultured for two weeks. On the fat stem cell side, there's a simple adipose fat graft and an isolated stem cells procedure that are equivalent

to the Regenexx-AD procedure. Finally, just like in the bone marrow procedures, you can culture the cells to get more, so there is an adipose advanced procedure.



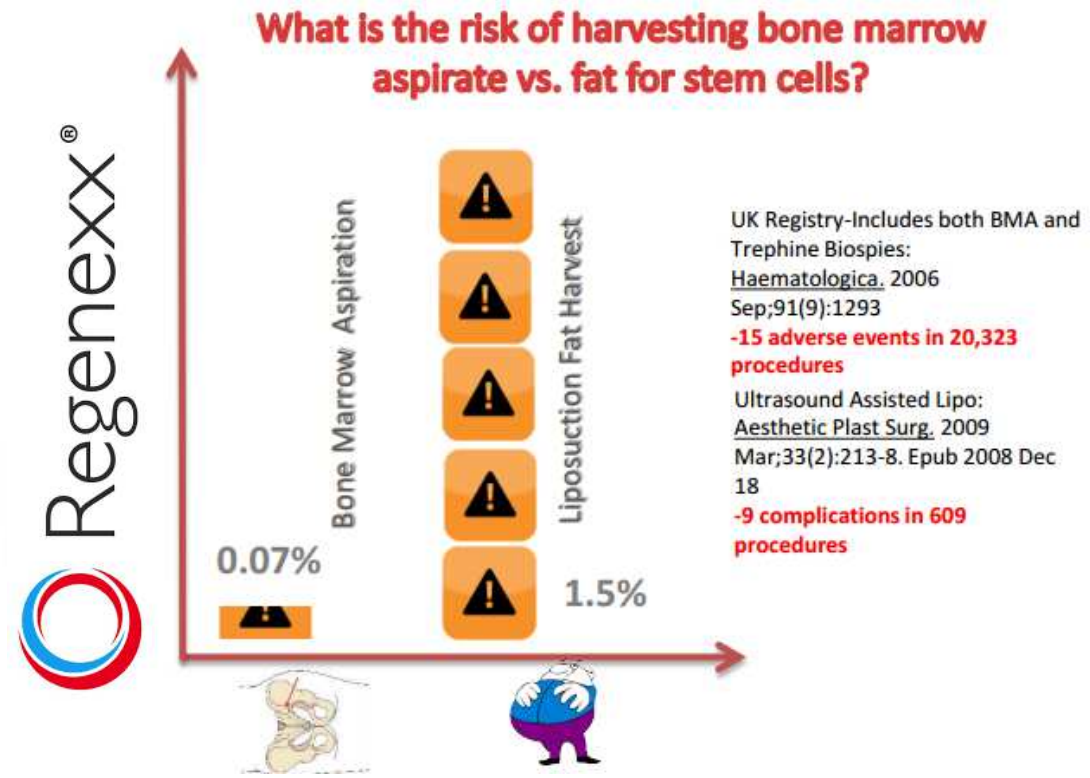
So now that you know what's being offered, let's see if research can guide us as to which is better for orthopedic use—bone marrow or fat?

How about when the two stem cell types are compared head-to-head in the lab for producing new cartilage? Thirteen papers show that bone marrow stem cells are better at producing cartilage than fat stem cells, while none show that fat stem cells are better than bone marrow.

[1] The Regenexx-C cultured stem cell procedure is only offered through independently owned and operated medical services providers operating exclusively outside the United States. These service providers are not part of or affiliated with the Centeno-Schultz Clinic or any US Regenexx Network provider. The Regenexx-C procedure is not approved by the FDA for use in the United States.

How about a comparison of how the cells are harvested? Bone marrow stem cells are taken from the patient using a bone marrow aspiration. This is where a small hole is poked through the bone with a special needle. Fat stem cells are harvested during liposuction where fat is collected through a cannula. As you can see from the graph to the right, the risk of liposuction is about 21 times more than that of a bone marrow aspirate. Again, on the safety of getting the cells from the patient, bone marrow stem cells win again.

In summary, the weak data I found in 2005 on fat stem cells hasn't really gotten much stronger. Bone marrow stem cells are still our first choice for orthopedic tissues. Might that change with time? It may, but for now, we'll go with what the data says is likely to be better for our patients.



A New Type of "Stem Cell" Emerges: Placental, Amniotic, or Umbilical Cord Tissue

Amniotic fluid and placental tissues surround a baby growing in the womb. When the mother's water breaks, this is the fluid that ends up on the floor. The placenta is the part of the baby's sac that attaches it to the mother's uterine wall through the umbilical cord. Cord Blood is located in the umbilical cord as is what's called Wharton's jelly.

Amniotic and placental tissues from the birth sac have been used for a century or more as a filler for the damaged covering of the spinal cord and in eye procedures. Way back when, a surgeon would make a visit to the OB ward and pick up some of this stuff to sew into a defect. In the 1970s

when FDA tissue regulations went into place, companies could make a little money selling these tissues to hospitals and surgeons.

About five years ago, a smart businessman had the bright idea to begin marketing placental tissues as an injectable regenerative medicine product. They took the birth sac and freeze-dried it, chopped it up into very fine pieces, and put the powder in a bottle. I recall one of these companies who had incredibly aggressive sales reps and tactics. The companies then went to medical conferences to convince doctors to inject it for problems like tennis elbow.

Now there wasn't a shred of evidence that this stuff would help tendinitis or any other orthopedic condition, but that didn't matter— it was a "regenerative tissue." The sales were pretty good, but at some point, an intelligent sales rep got the idea that if he told doctors that this was a "stem cell" product, that would sell more vials of the stuff. Sure enough, sales went through the roof! Never mind that freeze drying, processing, and gamma irradiation sterilization of the living membrane made sure it had no living cells of any type, let alone stem cells.

Most doctors, who were new to the concept of stem cells anyway, bought this marketing "little white lie" hook, line, and sinker. Then came amniotic/placental fluid, which was marketed the same way. This was perhaps more believable as a stem cell product, and you can find research that when it surrounds the baby in the womb, this fluid does contain some stem cells. After I was told by a knowledgeable sales rep about the rich stem cell content of amniotic fluid, we decided to test these claims.

We check all manufacturers' and reps' claims before we use products. Unlike other medical groups who frequently take payments from outside companies to perform research or be paid representatives for products, we do this at our expense so there are no potential conflicts (e.g., a manufacturer that funds a study). Also, unlike any other medical group, we also have a research lab outfitted like any university research lab in the country, so we can run these tests and separate fact from fiction.

First, as discussed, the doctors hawking this stuff buy vials of product from sales reps. So, you need to determine which product the doctor is using. Second, if you go to the website of any company selling amniotic powder or fluid, you won't see a word about stem cells. Why? These website claims are heavily regulated, and a single claim that there are stem cells in this stuff would result in the tissue being classified as a drug product and taken off the market to undergo a decade of testing costing hundreds of millions of dollars. This contrasts with the inexpensive FDA tissue registration required if what's being sold has no living cells. However, what the sales reps tell physicians behind closed doors is another thing. In that world, reps meet physicians who would love to "get into stem cells" but don't want the hassle of buying equipment, learning and mastering a harvest procedure, and dedicating the staff to run the machine that isolates the stem cells. They want something to sit on the shelf that contains stem cells they can use when the need arises. The problem, as we found out, is that none of this stuff contains stem cells. Crazy.

Once our lab found no living tissue in any "stem cell product" tested, the Interventional Orthopedics Foundation did an independent assessment of these amniotic products that was presented at the IOF 2015 conference. Their research also found that these products didn't contain any living tissue, let alone stem cells! Regenexx has since tested a cord blood product as well. Same thing—dead cells!

So, the physicians offering this therapy are injecting dead tissue and hawking it as a live stem cell therapy. But, is this deliberate fraud or just a physician who doesn't know what he or she doesn't know? Most of the doctors I've met and educated about this scam had no idea that what an orthopedic sales rep was selling them was dead tissue. Hence, it's likely a doctor who bought what he or she thinks are living stem cells and who doesn't know enough basic cell biology to understand the likelihood that the sales pitch he or she heard was fiction. In addition, the doctor has no way to independently test whether these tissues contain live cells, so the doctor is wholly dependent on the sales pitch.

If you see a clinic offering amniotic, fetal, cord, or placental stem cells, run! The doctor isn't educated enough in this field to know what he or she doesn't know, which is never a good thing for patients. If the doctor does know what he or she is injecting and is still calling it a stem cell therapy, then thatj's consumer fraud, which is also not a good thing for patients.

Does Where You Get Your Bone Marrow Matter?

If bone marrow is the way to go, we must then ask ourselves 'does it matter how it's harvested?' First, when most patients hear about a bone marrow procedure, they think of a different procedure than the one we perform (a bone marrow biopsy is the one you've heard about, while we perform a bone marrow aspiration [BMA]). A BMA is a simple procedure where the area is thoroughly numbed, and then a needle is gently worked through the bone to pull out what looks like thick blood. Sounds painful, right, but in 2007, we polled our patients and found out that about 9 in 10 thought it was no big deal.

Second, where you take the marrow can make a major difference in the number of cells you get. For example, recently some doctors who aren't comfortable using more-advanced guidance techniques have begun taking it from below the knee rather than from the back of the hip—but regrettably, this knee site doesn't produce as many cells as the hip site; hence, we use the back of the hip procedure (at what's called the dimples of Venus or the PSIS) that yields more stem cells.

Different Orthopedic Stem Cell Procedures

As discussed above, there are two different bone marrow stem cell procedures—one is same day and the other is cultured. What's the difference? The same-day procedure is what it sounds like; the stem cells are isolated and used the same day while the cultured procedure grows the stem cells to bigger numbers over a few weeks.

Almost all same-day procedures being used today are performed in automatic bedside machines that remove one fraction of the bone marrow that is rich in stem cells—the buffy coat. The issue with these machines is that they often aren't exact, so they also isolate a lot of junk cells with the stem cells. Thus, we only perform this process of extracting the stem cells by hand so it can be done with heightened precision.

The buffy coat has both the MSCs, discussed above, as well as hematopoietic stem cells (HSCs). While the MSCs are good for helping to repair orthopedic tissues, in our clinical experience, the HSCs excel at bringing in new blood supply and treating muscle. In fact, these cells are responsible for muscle repair in the body. This can be very important for tissues like the meniscus or rotator cuff where poor blood supply may be a cause for delayed healing. Both cell types make up the Regenexx-SD procedure, which we have used to successfully treat injured or arthritic joints; meniscus tears; labral tears; and tendon and ligament tears, like the anterior cruciate ligament (ACL).

Our dedication to lab research has also allowed us to advance this same-day procedure way beyond where it has been. We discovered a second fraction in the bone marrow that's very rich in stem cells and is currently being discarded by everyone else. This layer has many more stem cells per unit volume than the buffy coat, and our lab research shows that they're fast growing and very useful for orthopedic purposes. Thus, we've increased the number of stem cells we can pull out of the bone marrow by a factor of five-to-seven by isolating this new fraction. When we compare how many stem cells we're able to isolate in the lab per unit volume to the number that automatic bedside machines can isolate, it's 15–20 times more! More recently, we have upgraded the isolation process we use a third time, again increasing stem cell yield.

How effective are these same-day stem cell procedures? I can answer that question with the large amount of data we have collected and continue to amass every month. Please follow with me online with our registry-based outcome tool. What's this?

Throughout our website, you'll see references to live outcome data. Depending on where you're coming from, you may or may not get to choose which joint (above). However, by using this web-based app, you can see how patients in aggregate do with our procedures.

This begs the question, why do we have this data when everyone else seems to have very little? We have been investing in data collection through a treatment registry since 2005 and now have the most patients tracked through a registry and treated with stem cells in the world. Also realize that this data only applies to the Regenexx procedure and not to other stem cell procedures that use other cell types or other isolation methods from bone marrow or fat. For example, for knee arthritis, our proprietary SD procedure protocol uses a preinjection (to use a farming metaphor, this is "till the soil"), a stem cell reinject (plant the seeds), and a postinjection (fertilize).

In addition, our biostatistics staff has been able to slice and dice the data to glean information that may be helpful in guiding treatment decisions. For example, our shoulder data shows that

your arthritis severity (meaning if your arthritis is mild or severe) doesn't predict how well or poorly you will do with a same-day Regenexx-SD stem cell treatment. In addition, your age doesn't seem to matter either (i.e., older patients do as well as younger patients). In addition, being heavier doesn't seem to hurt outcome. All of this is important because for many surgical procedures used to treat arthritis, the severity, your age, and your weight do matter.

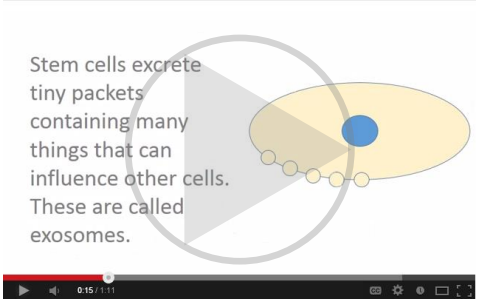
We haven't only been collecting data from our patients with shoulder arthritis. We've also been tracking patients with arthritis in many joints as well as with more specific problems. For example, patients with hip arthritis with good versus poor range of motion and patients who have tears in their shoulder ACL or shoulder rotator cuff, who receive precise injections into these tears either under fluoroscopy or ultrasound guidance. In addition, we track patients who have arthritis in their thumbs or arthritis in the main joint of the ankle (tibiotalar). So, what about the shoulder? How do shoulder patients fare with same-day stem cells? Find out by reviewing our live outcome tool and selecting "Shoulder" to learn more about function, pain, and overall joint improvement.

Finally, we also have a cultured stem cell procedure offered through a licensed site in Grand Cayman (a British Commonwealth country with its own medical-practice laws). In this procedure, we can grow cells to bigger numbers over one-to-two weeks. In addition, for the spine, we can condition and select cells in culture using patent-pending methods to allow cells to survive the rough environment of the low-back disc. As discussed above, this special process, in our clinical experience, makes the cells perfect to treat disc bulges pressing on nerves.

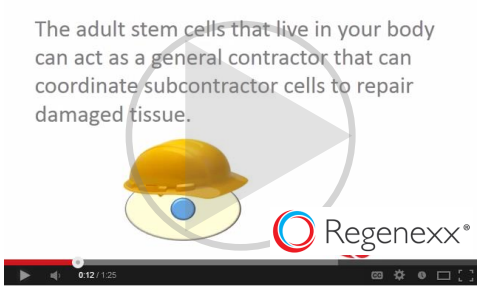
How Do Stem Cells Do Their Thing?

While you've likely heard that stem cells are blank-slate cells that can turn into another cell to replace a damaged cell, there's really a lot more to the stem cell story. Take, for example, the concept of exosomes; these tiny little packets are excreted by stem cells and can contain snippets of mRNA—and stem cells can use these mRNA protein instruction sheets to task another cell to

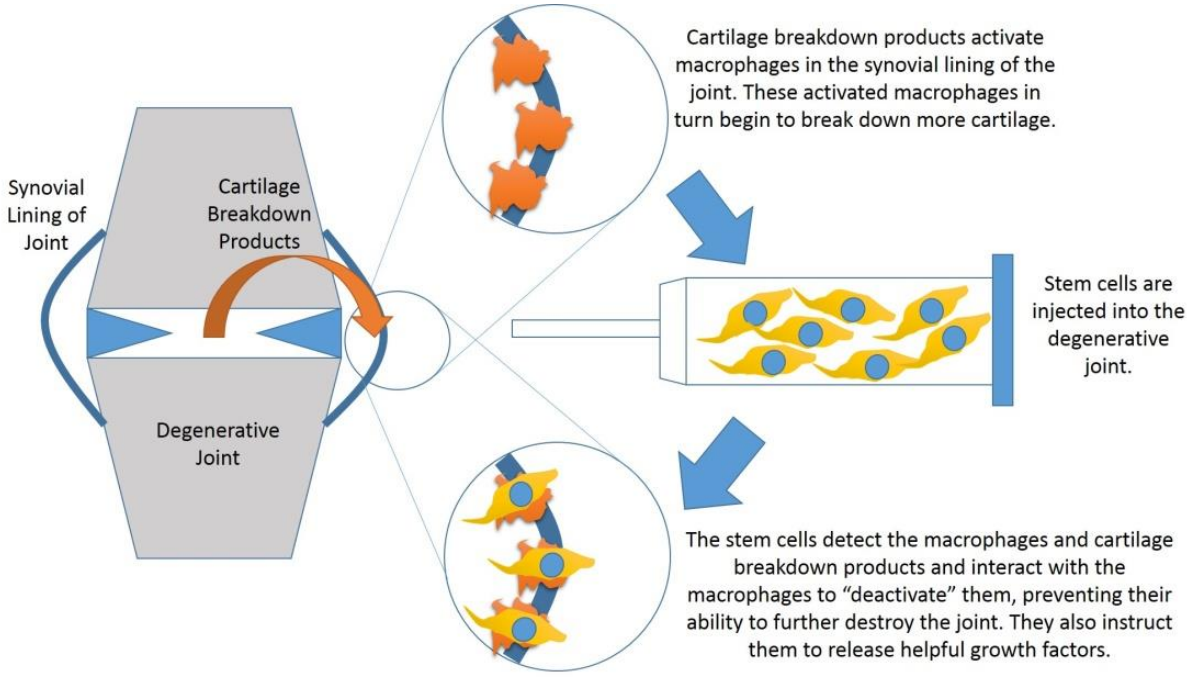
make proteins on its behalf. For a one-minute video explanation of the topic, click on the video link to the right.



Additionally, stem cells can work through what's called paracrine effects. This means that the stem cell excretes chemical messages called cytokines. Think of the stem cell as a general contractor who is involved in coordinating a repair of tissue. It barks out orders to hire subcontractor cells to do some of the work, their language being to release specific chemicals that attract the types of cells it needs and then releasing other chemicals to give basic instructions to the other cells. For a short video that explains this, click on the video link to the left.



[One interesting study also explained another mechanism for how stem cells may help arthritic joints]. In the type of catabolic joints that I describe above, there are cells that act like Pac-Man



by gobbling up normal, healthy cartilage (these cells are called activated macrophages). These cells are deactivated by mesenchymal stem cells and, as such, stop eating the good cartilage.

I've also done a short one-minute video on how this Pac-Man cell inhibition works. For that, click here.

Can We Do More with Specially Cultured Stem Cells?

In 2006, our clinic pioneered a new approach to stem cells, culturing them to grow more. In this advanced procedure, we routinely obtain 20–50 times more stem cells than in our same-day procedure. This Regenexx-C[2] method has been the subject of several safety papers published in the US National Library of Medicine and the cultured stem cell injections were much safer than the more invasive surgical procedures they helped patients avoid.

For patients who have multiple joints to treat, culture-expanded cells can come in handy. Since each joint needs a certain number of stem cells from our same-day procedure, not all patients would have enough cells to treat many joints—but this is usually not an issue when the cells are grown to larger numbers. Another advantage to cultured cells is the ability to save them for future use in cryopreservation (deep freeze). In addition, since we have more cells, we can often save many treatments for the same area or other future injuries.

Beware of How Traditional Orthopedic Approaches Can Hurt Tissues

Let's explore some common traditional-treatment approaches that may adversely impact how you respond to the newer biologic therapies, like platelets and stem cells. For example, steroids are commonly injected into joints, and patients are often prescribed nonsteroidal anti-inflammatory drugs (NSAIDs). Is this a good idea? Regrettably, the research of the past decade is increasingly showing that not only are many of these approaches ineffective, but some actually make the problems worse. Let's explore these a bit.

The Opposite of Healing: Apoptosis (Steroid Shots are Bad News!)

What's the opposite of healing? Causing apoptosis, or preprogrammed cell death without any ability to heal. For many years, 69doctors have injected high-dose steroids because they quickly bring down swelling and make the area feel better. However, study after study continues to show that these drugs, when used at the high doses that physicians often inject (milligrams), cause local preprogrammed cell death (apoptosis). In the shoulder, this means that these drugs can kill cartilage cells. While causing a little cell injury is not necessarily a bad thing (as discussed above) and your joint will feel great from the high-dose steroids because the swelling will be less, these medications work by taking away the local repair response (inflammation and swelling). So, when the pain returns it will often be worse because you're left with an injured area, with new dead cells, that can't repair itself. It's, therefore, no wonder why the pain is often worse once the steroids wear off.

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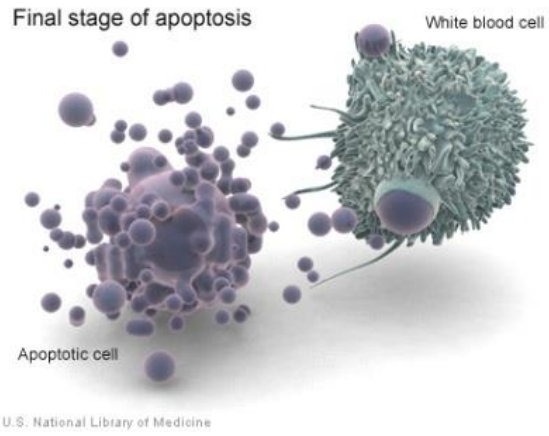
[2] The Regenexx-C cultured stem cell procedure is only offered through independently owned and operated medical services providers operating exclusively outside the United States. These service providers are not part of or affiliated with the Centeno-Schultz Clinic or any US Regenexx Network provider. The Regenexx-C procedure is not approved by the FDA for use in the United States.



Doesn't the body use steroids? Yes, your body can release natural steroids into an area where inflammation is high, only turning down that inflammation dial just a smidge—but how much is too much steroid? While the milligrams of steroid commonly injected by doctors might not seem like much, it's about 100,000 to 1,000,000 times more steroid than your body would expect to see in a given area. If the amount your body uses to control joint swelling is the height of a matchbook (nanogram range), the amount most doctors have been taught to inject is the height of the Empire State Building (milligram range). Or, as I like to tell patients, if we inject the much smaller nanogram dose, we're putting in a thumbtack with a ball peen hammer, but if we inject the much larger milligram dose, it's like putting in the same thumbtack with a sledgehammer. If you use the ball peen hammer, there won't be much collateral damage, but using the sledgehammer is bound to create problems.

Why don't we see more doctors injecting the smaller physiologic doses? For one reason, they just aren't commercially available in those dose ranges. Steroids for injection bought from a medical supply company come only in the much bigger milligram ranges yet despite injecting the much smaller doses, we usually see the same results (decreased swelling). In addition, research has shown that these smaller doses can increase the good growth factors in a joint associated with repair.

Don't I Urgently Need to Get Rid of Inflammation?

The RICE approach in orthopedics has become widespread. The concept is to get rid of inflammation through Rest, Ice, Compression, and Elevation. But is getting rid of the inflammation always the best plan?

Inflammation means "swelling" and you've likely heard the term in a negative way, perhaps that too much inflammation in arteries may be the cause of heart disease. You may have heard of a rare syndrome known as compartment syndrome, where out-of-control swelling within a muscle's fascia can lead to amputation or even death. These scenarios can play out, but for this chapter we will focus on the good side of the inflammation coin—for, without inflammation, we would never heal ourselves.

Maybe you've had a chronically swollen joint or seen other people as such, and the reaction from modern medicine would be to inject high-dose steroids into these joints. As stated above, since high-dose steroids are potent at reducing inflammation, this may seem like a viable response.

However, these ultra-high-dose drugs also destroy the natural repair response, and we thus end up with a joint no longer swollen, but also without the ability to heal itself.

You see, swelling is the result of your body marshaling the troops to heal an area. All of the cell types needed to build new tissue are in the swollen area: cells to clean up the damaged tissue (macrophages), cells to recognize any foreign material and deactivate invaders (white blood cells), and cells to act as general contractors in managing the repair response (mesenchymal stem cells). However, your body will keep throwing inflammation at the area in the form of swelling if the right signal isn't received from the newly formed repair tissue. As discussed above, if there aren't enough stem cells to complete the construction project, the "done" signal may never be received.

An easy way to think about swelling is that it's like the heat in the oven necessary to baking a cake. After all, the term inflammation incorporates the Greek for the word for flame; when an area stays swollen and chronically "inflamed," it's like low-level oven heat. If you place cake batter in a 200-degree oven you simply get dried-out mush, but turn the oven up to 400 degrees, increasing the "inflammation" and you get a cake. The same holds true for a chronically swollen joint; the low heat of chronic inflammation isn't enough to repair the tissue, so the joint stays swollen. However, using the microinjury or platelet techniques detailed earlier, we can "turn up the heat" and use much higher-level healing inflammation to heal the tissue (bake the cake). The same happens when we add stem cells, augmenting the body's natural defenses to complete the repair job.

In summary, while it gets a bad name, inflammation isn't usually is usually a positive for orthopedic applications. Swelling is necessary to healing. Swelling diminishing techniques like (the Rest, Ice, Compression, Elevation [RICE] method) and using anti-inflammatory drugs may have their place in certain rare circumstances, but are no one-size fits all protocol. In Orthopedics 2.0, the use of drugs like high-dose steroids and NSAIDs (Motrin, ibuprofen, aspirin, Aleve, or other nonsteroidal anti-inflammatory drugs) to halt the healing inflammatory response is not part of our ethos.

Should I Take Anti-inflammatory Pills to Help My Shoulder Pain? Medications That Adversely Impact Regenerative Orthopedics

Anti-inflammatory drugs have become a mainstay of orthopedic and musculoskeletal care. While we have discussed steroid medications, we should explore nonsteroidal anti-inflammatory drugs (NSAIDs) as well. These are medications that block the pathways for inflammation—with most of them, the COX pathway (cyclooxygenase). COX drugs help control swelling, but they also cause stomach ulcers by inhibiting the enzyme that helps to protect the stomach wall. Just how dangerous are these drugs?

RA Moore, in 2002, published that the estimated risk of death due to bleeding stomach ulcer when taking NSAIDs for more than 60 days was 1 in 1,200! As a result of these inherent dangers, new drugs were designed to work against COX-2 rather than COX-1 (the latter being more responsible for protection of the stomach wall), but these drugs had their own set of side effects. These drugs (like Vioxx, Bextra, and Celebrex) all come with an enhanced cardiovascular risk, the risk of sudden death by heart attack.

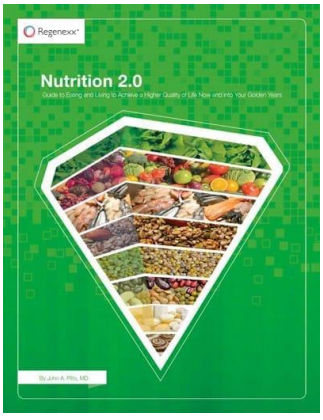
How do NSAIDs impact healing? Well, from a 50,000-foot view, inflammation is needed to heal, so blocking inflammation may inhibit healing—and, sure enough, NSAID drugs, like Motrin and others, have been shown to delay healing. While most of this research has focused on fracture healing, we keep patients undergoing regenerative-medicine treatments off these drugs.

Other drugs are also notable for causing musculoskeletal problems. The antibiotic drug class that includes Cipro (quinalones) has been shown to lead to tendon ruptures. Heartburn drugs, like Nexium, have also been linked to hip-fracture risk. Cholesterol drugs have been known to cause pain and harm muscles. Many commonly used drugs can adversely impact regenerative-medicine healing. Our own cell-culture data implicates cholesterol and certain blood pressure drugs as causing problems with mesenchymal stem cell growth in culture.

If Most Drugs Are Bad News, What Else Can I Do?

Can you change your lifestyle to protect your shoulder and other joints? The answer is likely yes. I would break this down into a few different categories: diet, exercise, supplements, prescription medications, and hormones.

Diet



Could what you're eating impact your joints? We know that patients with metabolic syndrome get more arthritis, independent of their weight. So, what's a metabolic syndrome? It's when you gain weight (usually in middle age, but it can happen earlier), participate in limited exercise, and start to get high blood pressure—this happening because of a combination of genes, low activity levels, and a sugar/starch-based diet. Basically, excessive sugar and carbohydrate consumption leads to spikes in insulin, which eventually makes the pancreas less sensitive to insulin, causing more to be produced. This "hyperinsulinism" leads to a state where insulin is always present, and this hormone is a potent blocker of fat breakdown and facilitator of fat production. All of this not only causes weight gain but also unstable blood sugar, which leads to bad chemicals that can break down cartilage.

Since you can't change your genes, to fix the issue you need to change your diet. If you want an instruction manual on how to eat, I advise a read of Regenexx Doctor, Dr. Pitts's book, Nutrition 2.0.

How would you know if you have better blood sugar control and are consequently better at protecting your cartilage? There are two tests, one that you can do at home and one that requires a doctor's visit. The first is what I call the "Dark-Chocolate Test." Before you start on this diet, you may think that a 70% dark-chocolate bar tastes pretty bad or at least bitter because you've your taste buds' level of sugar detection is too high from eating too much sugar and starch. However, once you've practiced a low-carb diet for a few months, the 70% should taste sweet. Next, try 80%. If you're a real low-carb superstar, it should taste just fine. If it doesn't yet, be a bit stricter with your sugar intake. When you're done with your sugar transformation, an 85% bar will taste delicious and that birthday cake disgustingly sweet.

The doctor's office test is called an HbA1c serum level. This is a measure of changes to red blood cells in the presence of high blood sugar levels. It can take a few months to change, so get it tested a few months into a diet. While your doctor may tell you that anything below a 6.0 is fine, it's really not. You want yours well below 5.6, and for maximum protection, it should be below 5.1. Remember, tracking this number takes patience; despite your blood sugar control improving steadily, it may take a few months low carb eating to reach the nadir.

Exercise

Two questions: first, what are "normal" levels of exercise for cartilage protection? And second, does pounding exercise, like running, destroy joints?

We Americans and others who live in First World countries have become very accustomed to low exercise levels. My favorite candidacy review I've ever performed was when I asked the personal physician of a Middle Eastern woman, who was a member of the royal family, whether the woman got much exercise—and was promptly informed that the royal family took cars and a security detail to go around the block! While this is an extreme example, it gets the point across: we have lowered our expectations for exercise so much that we no longer know what our bodies were designed to do, locomote. I also observe the health club across the street from our office and see people working out like the walking dead, strolling along on the elliptical as if it were a Sunday stroll rather than their half-hour to get after it.

What our ancestors considered everyday activity, many of us may consider impossible. Think about this for a moment; you wake up and haul 100 pounds of water a half mile from the river to your home. You then chop wood with a 30-pound iron axe for an hour. Then you get to walk/run 20 miles while you hunt the big game that will keep your family fed for the next week. You get the picture.

So, what is "normal activity" for our conversation on "Living 2.0"? It's 30 to 60 minutes of exercise so intense that having a normal conversation is very hard, all performed five-to-six days a week combined with weight lifting. Additionally, our definition of weight lifting is absolutely not what we see in the gym across the street, rather 6 to 12 reps of whatever weight causes your muscles to fail by the 6th to 12th repetition. So, if its biceps curls, pick up the weight that will cause your

biceps to stop working by the end of the set. Then do this twice more as a minimum biceps workout.

Why am I pushing the weights so hard? Because elderly weight lifters have muscles that at the cellular level look heaps younger than their sedentary counterparts and exercise increases the stem cells in your muscles.

What if pain prevents you from getting to this level? Well, that's why you're reading this book. Our goal is to use regenerative therapies, diet, exercise, and specialized therapies to keep you this active well into your 70s and beyond.

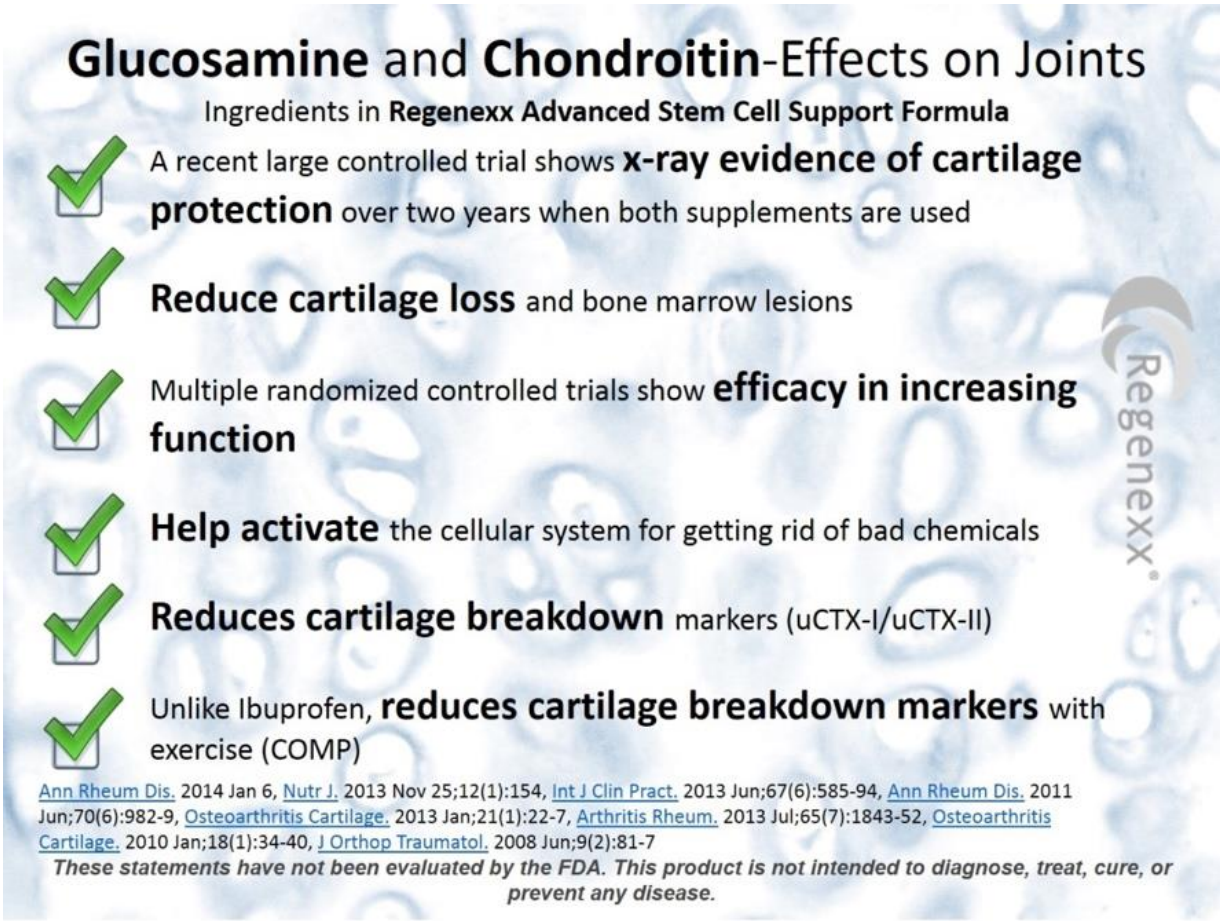
How about pounding exercise, like running? Regrettably, this cartilage research is still all over the map on whether it's good or bad—and so probably lies somewhere in the middle. Some studies have shown that running is protective to knee cartilage while others have shown it's destructive. In the meantime, like anything else, everything in moderation, or get a good doctor!

Supplements

One of the most frequent questions I get asked by prospective stem cell patients is what supplements they should take to help their chances of success. While from looking at the ads on the Internet, this would appear to be a very simple question, it's actually quite complex. The issue is that while some supplements have been tested with cartilage cells, we have very few that have been tested with stem cells.

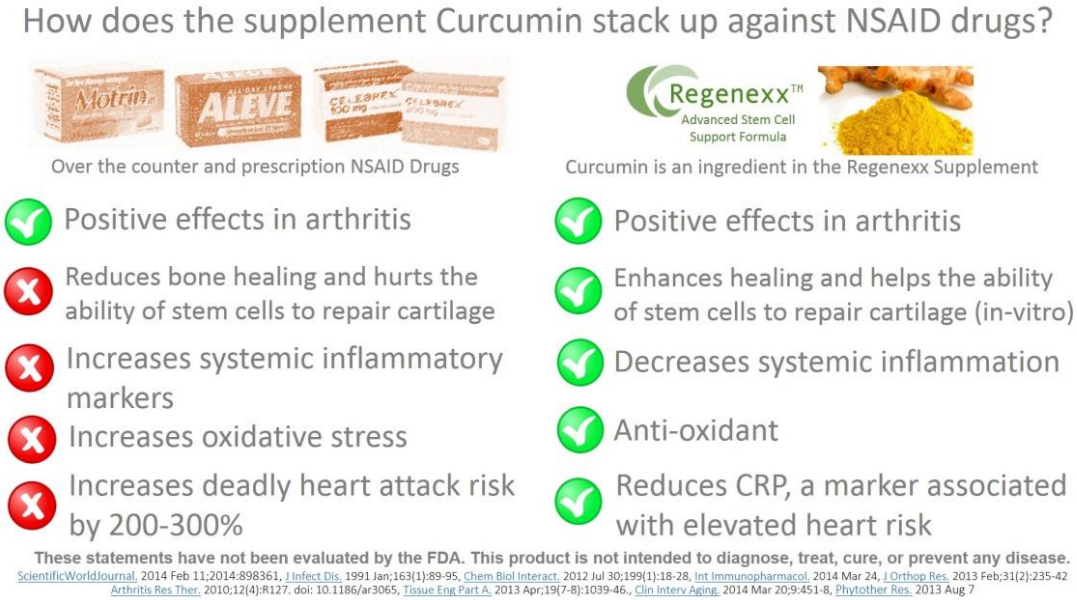
What I can say is mostly from tests with either cartilage cells or early studies in patients where objective measures of cartilage health are used (not stem cells).

- **Glucosamine** is a very common supplement that can be derived from many sources. It's basically a cartilage building block, and there's a bunch of research showing it helps cartilage. See article 1, article 2, and article 3.
- **Chondroitin** is the cousin of glucosamine and another common cartilage-building-block supplement. Many studies also show it helps cartilage. See article 1, article 2, and article 3.



- **Fish Oil** is a supplement that is taken widely, but poorly understood by most who take it. While this is an important source of omega-3 fatty acids that can help reduce swelling, and there's some evidence that it may help preserve cartilage, most people take way too little to see these effects. First, you need to make sure your fish oil isn't oxidized. So, if your fish oil smells fishy, ditch it and get a better brand. Second, if you pop a few pills that you bought in a grocery store with the label "Fish Oil," you're taking way under the dosage associated with big health benefits (the amounts that Greenland Eskimos consume). Using that math, it would take 20 to 30 pills per day of these garden variety capsules to match this amount. An easier way to take more omega-3s is to buy concentrated EPA/EFA brands. This is about 3,000 to 6,000 mg of omega-3 fatty acids per day. More on all of this at this link.

- **Curcumin** is an extract of the Indian spice turmeric. The research looks promising that it's an anti-inflammatory and may help preserve cartilage. In fact, one study shows that it's as good as Motrin for pain and swelling. It also seems to work better when combined with other supplements like resveratrol.



- **Resveratrol** is a powerful antioxidant and activator of the SIRT1 gene which has been associated with longevity. It's found principally in the skin of grapes, and it's thought to be one reason the French suffer fewer cardiac events. Apparently, all of that red wine is loaded with resveratrol! It also seems to help poor blood sugar control, that middle-aged paunch caused by declining insulin control can also eat up cartilage, so resveratrol may protect joints.

There are literally a hundred other supplements touted as good for arthritis. However, our patients also want supplements that will help their stem cells, yet little stem cell research exists with supplements, which is why we had to create our own.

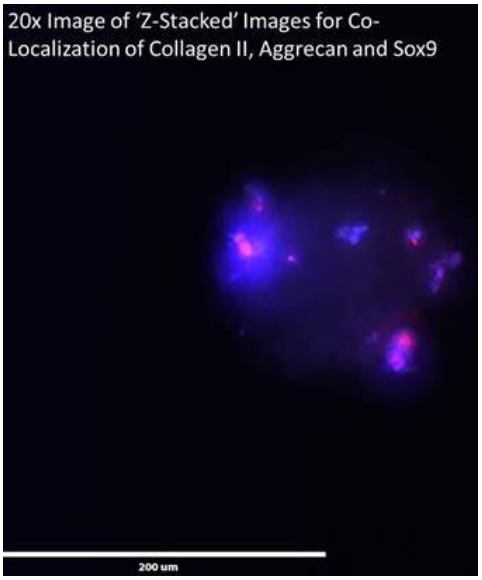
At first, I thought this would be a quick two-to-three-month project of testing stem cells with supplements to see how they grew. Yet, as we got further into this project of determining which supplements were the best at stimulating stem cells to grow more cartilage, the science got more and more complex. We learned we needed to look at the following:

- How the stem cells from the bone marrow of different ages of donors responded to different supplements. Most studies in this area choose young stem cells by default since samples are often bought through a science company or taken from grad students. Yet older stem cells are different and need to be tested alongside younger cells. In addition, the stem cells from arthritis patients are likely different, and few twentysomething grad students have arthritis. As a result, we took all of our cells from real arthritis patients.

- How the stem cells grew when exposed to supplements. This is not so easy, as many supplements are digested into different forms before they reach the bloodstream, so we tested these forms as well.

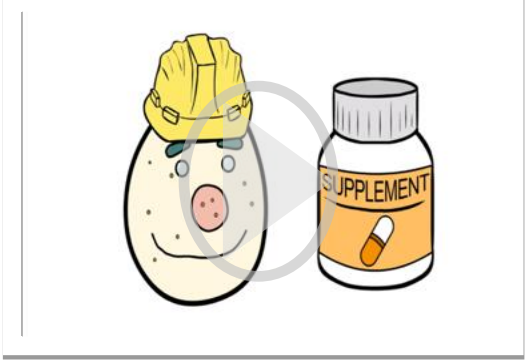
- How well the stem cells produced cartilage components when exposed to various supplements. To do this, we needed to look at the cells as they produced these cartilage-building blocks with quantitative fluorescent microscopy. To the right is an example of what this looks like, with the bright areas representing the amount of cartilage components—collagen 2, aggrecan, and SOX9—being produced by the cells.

- How well these supplements were able to support the overall robustness of the cells. A cell can look great in culture, grow well, and produce cartilage, but how healthy is it when stressed? In medicine, an example is the stress test for the heart. While someone might appear healthy, when they're pushed to the limit on a treadmill, their heart can show signs of trouble. We did the same thing for cells by adding in common bad chemicals found in arthritic joints that beat up cells like IL-6 and then seeing if the supplements helped the cells recover better.



- Determining the sourcing: most supplements come from many different sources. As an example, glucosamine can be extracted from any number of shellfish sources, pig parts, or cow parts. Is one of these better than the other at helping human stem cells?

In the end, after a year of testing, we produced a supplement we could hang our hat on: Regenexx Supplement. One that was based on basic research that we felt represented what we were trying to accomplish in patients. While every other supplement you can buy is merely put together based on snippets of data taken from unrelated lab research done by others, ours was a coordinated and costly plan to find the best ingredients for our patients. Click on the video link below to see a short animation on the Regenexx Supplement.



Prescription Medications

When we first began culturing cells in 2006, we were surprised to find that some patients' stem cells wouldn't grow well. After a few culture failures, we decided to try and isolate the problem, and after much trial and error, we were surprised to learn that the culprit was usually a prescription medication. For example, when we would stop the patient's medication and take new cells and re-culture them, the stem cells would grow fine. We could also get the cells to grow fine when we exposed them to the serum of another person who wasn't on the drug (for research purposes only). This convinced us that many prescription medications are toxic to stem cells.

What should you avoid? Likely the most surprising thing we encountered was that America's wonder drugs, cholesterol medications known as statins, seemed toxic to stem cells. I would take a minute to read about the limited efficacy of these drugs if you're on them, but only make any decisions to stop the drug after consulting your primary care physician. Other drugs that were problems included NSAIDs, like ibuprofen, Motrin, Aleve, and Celebrex. Given that NSAID drugs carry significant cardiac risks, not taking these drugs makes sense. We also found fish oil makes a great alternative anti-inflammatory, and research supports this effect. Other problem drugs include ACE inhibitor blood pressure medications that are usually taken to combat hypertension due to metabolic syndrome. Rather than take these drugs, increase activities and cut the carbs to control your blood pressure. Finally, steroid anti-inflammatories are also a big concern, as they are toxic to many different cell types, including stem cells.

Hormones

We take our hormonal mix for granted, a little like the fact that our heart beats more than 100,000 times a day. Yet if you're trying to control your weight and stem cells, these hormones can play a critical role as you age. For example, serum taken from women after menopause (when many hormones are no longer produced) directs stem cells that should turn to bone to turn into fat instead. For men, testosterone levels decline as we age. Yet testosterone can activate stem cells to produce more muscle and less fat. While the jury is still out on the effects of sex hormones on stem cells, in men it's pretty clear that supplementing these hormones in middle-aged and elderly patients can help overall body composition, reducing fat and increasing lean muscle mass and likely improving heart health. The same has been shown for women. On the other hand, the willy-nilly prescribing of testosterone in men, without strict monitoring, may be linked to an increase in heart attacks.

Supplement your hormones is a personal decision. In my experience, it makes it much easier to keep the pounds off and activity levels high as we age. On the flip side, for men, urologists have been concerned that testosterone may cause prostate cancer. However, newer research suggests this likely isn't the case. In addition, without strict monitoring, the excess production of blood cells may be the cause of blood clots that can cause heart attacks. For women, the Women's Health Initiative study suggested that estrogen pills could cause cancer, yet the study authors

have since stated that the press misinterpreted their results. They now recommend hormone therapy for younger women just after menopause.

My Own Living 2.0 Story

At the age of 37, I was at the low point of my personal health. My wife and I had just gone through the trauma of having premature twins, and my exercise was sparse while my sleep was nonexistent. My weight had ballooned such that my waist had gone from a 32 while in residency to a 42. Just jumping onto our high bed made my heart race. I was an early heart attack waiting to happen. It took over a decade to completely climb out of the hole I dug, and I learned quite a few things. Had I known these at 37, I could have been in perfect shape by 40!

What did I learn along the way?

- Carbs are key. While for my wife's genetics, carbs aren't important, for me they are everything. I spent years on fad diets, trying to prevent my waist from ballooning and avoiding any type of shopping for pants (as that meant admitting that I could no longer fit into a size 40), none of which worked. In the end, it was understanding that limiting my sugars and starchy carbs was the answer. However, that got me only part of the way there.

- Understanding what the term "workout" means. Like I have said, I see people working out at the gym like they're the walking dead, and I understand that once that was me. It wasn't until I got a personal trainer that I finally understood what working out was all about. My trainer worked me like a dog, and the harder he pushed, the more I wanted. It took a few years with a trainer to understand that to stay in good shape in middle age for most of us requires working very hard. An example is the INSANITY workouts. For most of those 30 to 40 minutes, the exercise is tough enough that holding a conversation is difficult—you're simply pushing too hard. A kinder and gentler approach that starts slow and builds (by the same trainer) is FOCUS T25. The same applies with weights, which should be a cardio workout as well. If you're not huffing and puffing while you quickly move from one weight station to the next, you're not hitting it hard enough. When I finally figured this out, my weight went down again. But there were still two more pieces.

- Hormonal control is a problem for middle-aged men and women. I spent many years being asked to lecture to doctors involved in age-management medicine as many are very interested in stem cells. I would sit through the lectures before and after mine, which were about supplementing hormones in middle-aged and elderly men and women. I have to say that at first, I thought these doctors were a bit nuts. Was this really necessary? After a few years of seeing countless lecturers review the science, I was convinced that I had to be my own guinea pig. In 2010, I worked with a Denver-based age-management specialist to check my testosterone levels. They were dismally low, so I started testosterone therapy. The final piece of the puzzle clicked into place for me. Much of the

extra weight that I had been carrying melted off as I already had the diet and exercise piece under good control. Unlike the recent rush to prescribe testosterone to everyone with “Low T,” this program is carefully monitored. Which brings me to the last part.

- Proactive injury management is important. You can’t help but get injured from time to time if you’re hitting exercise hard enough to stay active as you age. I constantly look at my joint stability, levels of nerve irritation, muscular firing, and body symmetry—just as I describe in this book. All of this is to try and prevent injuries or catch problems when they’re early. Since supplementing testosterone pushes my blood hematocrit up (the number of red blood cells), I put those extra blood cells to good use. Once every two to three months, I have blood taken to reduce my hematocrit and to fuel the Regenexx-SCP and Regenexx-PL procedures. I proactively have small issues treated with these regenerative cocktails. As an example, my right knee, left shoulder AC joint, right elbow, and low back are common problem areas for me. These aren’t disabling problems but are areas of constant irritation—all likely related to wear and tear and declining stem cell activity as I age. So, I have my colleagues give these areas an “espresso shot” of my own healing blood platelets.

The conclusion? For me, controlling my weight, staying off prescription drugs, and staying active requires four key elements: diet, exercise, hormones, and early injury detection and management.

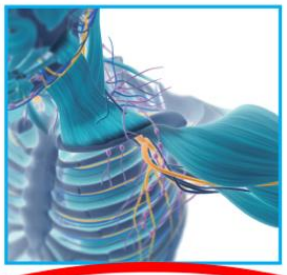
Chapter 10
Neuromuscular

STABILITY
The ability of a joint to tightly move as it was designed without extra motions that might hurt the joint.

Regenexx®

ARTICULATION
The health of the joints. Shock-absorbing tissues like cartilage; spacer tissue such as meniscus; or stabilizing tissues such as labrum can be damaged.

S A
SANS
TREATMENT
APPROACH
N S

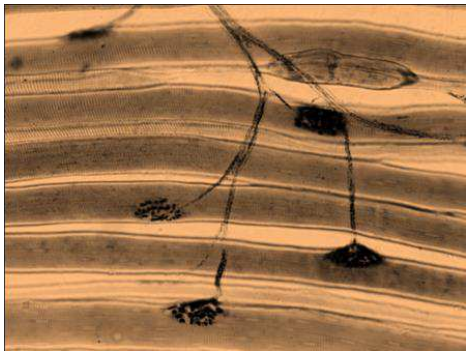


NEUROMUSCULAR
The nerves drive the muscles. Nerves that are irritated or compressed cause pain and may be less able to promote muscles to properly fire.

www.regenexx.com

SYMMETRY
The left/right and front/back balance of the body. When the body is asymmetrical, certain parts get injured or wear out faster.

For many readers, the term “neuromuscular” may be a new term. As used in this text, it means “both nerves and muscles” and often refers to the connection between the two. While the nerves in various parts of the body tell many different organs what to do, the most visible organ they direct is muscle. Your nerve says, jump, and your muscle says, how high?



Think of the nerves as the wires that connect the main computer (the brain) with the muscles. You think of a movement, and the brain generates a nerve impulse that drives muscles. Information also goes the other way, from the skin, muscles, joints, ligaments, and tendons up to the brain. This information is called "proprioceptive" and allows you to finely adjust your movements to what's going on in your environment. For example, if you step on something unstable, you might fall. However, that information is quickly relayed to the spinal cord where reflex patterns stored there instantly adjust your stance.

As discussed above, this type of stability during movement is made possible by proprioception, which is used to provide real-time feedback so that a moving joint stays in finely tuned alignment. For example, if the joint experiences forces that might cause it to translate or shift too much, small joint sensors detect this motion and instantly tighten muscles to counteract that abnormal motion and keep the two joint surfaces aligned (keep the joint in the neutral zone). If this didn't happen thousands of time each day, the joint would wear out much more quickly.

What happens when this system of sensors, nerve impulses, and finely tuned muscle firing goes off-line? As discussed earlier in the "Stability" chapter, all heck breaks loose. In this chapter, "Neuromuscular", you'll learn that when spinal nerve irritation or compression occurs, the muscular stability system for the spine goes off-line, and the spine becomes unstable. The same happens in peripheral joints, like the shoulder. If spinal nerves are irritated in the neck (again: you may not feel any neck pain), the muscles that help stabilize the shoulder in movement can go off-line or have reduced efficiency, and thus, the shoulder joint becomes unstable. So now, when the shoulder experiences abnormal forces like a shift, the wiring loop through the spine between the joint sensors and the muscles that protect the spine is impacted, causing an ever so slight delay. This delay leads to a joint that gets out of alignment more easily during motion and as a result, a joint that is more likely to become arthritic. Since this concept of muscular activation delay has already been very well documented for spinal stability (here the delay causes the vertebrae to become unstable in movement), there is no reason to believe it only applies to the spine.

One of the problems we've had as a medical community is our main and most widely available test for diagnosing nerve pathology (electromyogram [EMG]/nerve conduction study [NCS]) is very specific for certain types of nerve injuries (such as when a nerve is wholly or partially destroyed by trauma) but not very sensitive for other types of nerve problems. In particular, many significant problems with the nerves involve small fibers (small-fiber neuropathy), whereas the EMG/NCS test can't detect this type of pathology. In addition, the test has very poor sensitivity in detecting nerve irritation. While other more sensitive nerve tests (in particular, quantitative somatosensory tests [QST]) are commonly used in research, they are not yet widely

used by physicians. So, in a very real way, physicians often "fly blind" from a diagnostic testing standpoint in deducing when nerves are sick. Not good.

To sum, even small amounts of spinal nerve irritation may not cause any noticeable back or neck pain, but can wreak havoc with the muscular stability system either in the spine itself or in your joints. Since this system protects your joints during activity, when this nerve problem takes muscles off-line or reduces their efficiency, it eventually leads to less protection for the joints and earlier onset of arthritis. In addition, the diagnostic-test toolbox we have available to us today doesn't include tests that are capable of detecting this type of nerve problem, hence the reason this problem often goes undiagnosed. Thus, I believe that treating this problem is a key component of long-term joint preservation.

Take This Simple 10-Item Test for Nerve Problems

1. I have numbness, tingling, burning, or electrical sensations. Yes / No
2. I have chronic tightness that feels like pressure in my arm or leg with certain activities. Yes / No
3. I have a chronically tight muscle that just won't "let go" no matter how hard I stretch. Yes / No
4. I have pain in my wrist area whenever I reach for something. Yes / No
5. I have pain in the back or bottom of my heel that won't go away. Yes / No
6. One arm or leg always seems to be significantly weaker or smaller than the other, no matter how hard I try to strengthen it. Yes/No
7. My arm or leg feels a bit "goofy" or uncoordinated after I do certain things. Yes/No
8. I have an area of chronic pain that just won't go away no matter what I try. Yes/No
9. I have chronic neck or back pain. Yes/No
10. I had a back or neck problem years ago, but it seems to be fine now. Yes/No

If you answered yes to any of the above, you may have a nerve/muscle problem and not know it. Questions 1 about numbness is more obvious. Most people associate these symptoms with nerve problems. Question 2 isn't so obvious. When there's pressure on a nerve in the neck or back, many patients don't necessarily feel neck or back pain, but instead feel pressure in the muscle that is supplied by that nerve. Some patients describe it as feeling like a blood-pressure cuff is pressing on the muscle.

Question 3 is also not obvious. That chronic hamstrings or groin tightness you've been blaming on being out of shape could actually be caused by a pinched or irritated nerve. Question 4 is really interesting, and we commonly see this when there's scarring around the median and/or ulnar nerve. Reaching out to get something places the nerve on stretch, and since it's scarred, it can't move with the arm, which causes pain where the nerve is scarred down. How about question 5, the heel pain? Most patients with plantar fasciitis would think it must be caused by something in the arch of their foot—however, we see patients every day who have S1 nerve problems in their back or a pinched tibial nerve at the ankle who have this problem caused by an irritated nerve.

Question 6 may seem more like something associated with a nerve, but the weakness or atrophy (smaller muscles) I'm talking about is where one arm or leg is notably smaller, not the kind you see in paralysis. Question 7 is an extension of 6, as sometimes patients with nerve problems note that their arm or leg seems uncoordinated. Questions 8 and 9 are connected, in that a bad nerve can cause pain just as readily as it can cause numbness, tingling, or burning. Finally, it's important to note in question 10 that many patients who no longer believe they have any back or neck problems because the pain has gone away still have bad nerves that cause problems in joints, muscles, and other areas.

Arthritis Doesn't Cause Pain; Pain Causes Arthritis

I saw the above title come across a science news feed a few years back. As I had often suspected that this had been happening in my patients, it hit me like an unwelcome pie to the face, the concept is simple, yet it will change the face of orthopedics and rheumatology forever. It states that irritated nerves can cause bad chemicals to dump into joints, which leads to cartilage breakdown.

Since that time, many other articles have been published confirming this link between bad nerves and bad joints (see nerve pain related to knee arthritis, nerve pain in knee arthritis among older adults, and central sensitization and osteoarthritis). This discovery is equivalent to when doctors—many of us learning in medical school that ulcers were caused by stress—learned they were actually caused by bacteria.

How did the authors illustrate how arthritis can be caused by pain? They created an elegant animal model showing that nerve activation in a joint leads to bad chemicals being dumped into the joint, which leads to pain and faster onset of joint arthritis. This is a reverse of what has traditionally been considered (i.e., that a joint is injured and begins to degrade and then causes pain.) Let's stop for a moment to consider how these scientists turned orthopedics on its head. Again, our entire orthopedic care model is based on the concept that injury in a joint (or accumulated injuries over a long period of time) leads to arthritis, which leads to more joint breakdown and pain. This new model reverses the old paradigm. Sound familiar? It's an extension of what we've been discussing here: problems with spinal nerve irritation lead to bad chemicals being dumped into a joint and a "sloppy" joint with poor stability, which ultimately leads to arthritis.

I've had my own knee problems, caused by my back. Using this new model, I now know my knee problems were caused by spinal nerve irritation (which I never perceived as low-back pain) causing not only a sloppy knee joint (due to parts of the big stabilizer muscles being shut down by trigger points) but also bad catabolic (breakdown) chemicals dumping into the joint. This issue was quickly fixed—not by operating on my knee or even injecting magic stem cells into the knee—but by bringing the spinal and joint stability systems back online using IMS to get rid of the trigger points.

Low-Level Arthritis Pain vs. Nerve Pain

Based upon my clinical experience and this new model of nerve-related joint pain and arthritis, I would place patients into two distinct categories: what I'll call "neuropathic arthritis" versus "classic arthritis." Early on in the degenerative process, and for some patients who have more of a spinal component to their joint pain, patients are firmly in the "neuropathic arthritis" (NA) camp. These patients have severe joint pain that is often disabling or can become disabling with certain types of activity. I see these patients in the clinic, often very desperate because their joint pain is very intrusive. They are either completely disabled by their pain or they are unable to exercise at high levels.

In this new model of joint pain, these patients have an active spinal nerve problem manifesting as joint pain. They are often unaware that this joint pain is linked to their spine, but if you dig enough they will usually admit to a history of spinal problems that have either (in their mind) been successfully treated (perhaps with a surgery many years in the past) or are ongoing, but the pain is low level and (in their mind) under good control. They have usually had several unsuccessful joint surgeries, which didn't work because they also have active issues in the spine that were unaddressed by their joint surgeries. Treating the spine in these patients can often make a huge difference.

The second camp is the traditional "classic arthritis" (CA). The CA group no longer has an active spinal component, or if they do, their arthritic joint has long since degenerated. Their pain pattern is different and matches what we know of arthritis pain. You may remember your grandparents being stiff in the morning with low-level pain that became better with activity as the joint "warmed up." Just like gramps and granny, once these patients start moving, they generally feel better—yet treating the spine in this group is often too little too late, as the joint damage is done.

It's of note that there are other factors at play in many of these patients. For example, patients with shoulders that are unstable from a ligament standpoint may also have more pain when they are active, and patients with bad shoulders due to severe trauma may have less pain as their joint warms up. The human body is a beautiful and complex machine, and that is why we at Regenexx so closely adhere to our SANS approach—never treating anything in a vacuum and studying all components of the musculoskeletal system as the interconnected system it is.

So, What Can Be Done to Fix the Spinal Nerve-Joint Connection?

Despite research showing that irritated spinal nerves may be associated with joint problems, most physicians have a difficulty associating joint pain with a spinal nerve problem. The first step in identifying a spinal nerve component as a cause of shoulder pain is simply a thorough neurologic exam. When I say a complete exam, I don't mean the "Can you feel this?" type of neurologic exam, instead I mean a careful exam that's focused on comparing sensation from side-to-side and on the same side, testing multiple different sensations—including light touch (the can you feel this exam), pain sensation (pinprick) and perhaps even hot/cold sensation. The exam

also recognizes that there are multiple types of pain and nerve referral patterns, including those from spinal joints, nerve trauma, and muscle trigger points.

If the exam shows possible spinal nerve irritation, the next step is a spine MRI, and correlations between the exam findings and the MRI are important. This correlation acknowledges that while spinal nerves can be compressed by bone spurs and herniated/bulged spinal discs, they can also be irritated by sloppy stability in the spine. An MRI marker of this type of sloppy stability can be seen on MRI as multifidus muscle atrophy, so even though there may be no bulging disc on the spinal nerve, significant atrophy of the deep stabilizers at this level (multifidus) combined with sensation problems at the leg nerve shows the spinal segment is likely instable.

Treatment for Irritated Spinal Nerves

The discs in your spine act as shock absorbers, and the diagram to the left illustrates how the discs can herniate their inner contents (nucleus pulposis), placing pressure on spinal nerves. This is called radiculopathy (if more severe) or radiculitis (if less severe) and also known as "sciatica," though not an accurate term. The traditional solution to this affliction is to surgically remove the herniated portion of the disc sitting on the spinal nerve. In the 1940s, this was a great advance; patients with numb and weak legs due to a bad back now had a treatment. On the other hand, it began our current move toward invasive spine treatment, a path that many have criticized.

If I have shoulder pain, why should I care if there's a problem in my neck? Again, the two issues may be very much linked together. If your doctor believes that there is a connection, he or she needs to treat your neck along with your shoulder.

Can We Use Platelet Lysate Injections to Help Damaged Nerves?

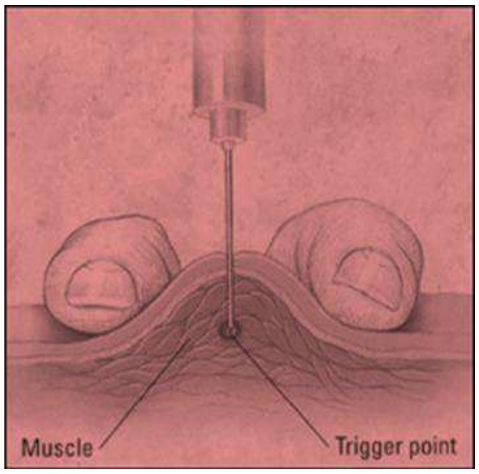
In medical school, I was taught that while a damaged nerve might be able to regenerate slightly over time, most nerve injures were permanent. Recently, however, we investigated whether nerves might be helped by injecting around the structure—utilizing the simplest form of this procedure, called nerve hydrodissection. Basically, fluid is injected around the nerve with very strict ultrasound-imaging injection protocols, freeing up the nerve from any scarring that may cause pain. Next, platelet lysate (a cocktail of growth factors isolated from your blood platelets) is injected to help the nerve heal. We've seen some very interesting results in select patients with everything from severe chronic nerve pain (complex regional pain syndrome [CRPS]) to more specific nerve damage. We remain cautiously optimistic and will continue to move forward trying to help these patients who have few other viable options.

Making the Transition from the Nerve to the Muscle

You've learned about the nerves. Now you should learn about where the nerves go—the muscle. We like to think of these as separate structures, yet the sight of Christopher Reeve shows us that they are not, even for Superman, as a spinal cord injury in his neck shut off all nerve input to the muscles. What happened? He went from being one generation's Superman to being shriveled

up. Why? The nerve and the muscle are one continuous structure, and what happens to your nerves directly and immediately impacts the muscles.

The Nerve-Muscle Hotspot: Trigger Points



Trigger point injections (TPIs) were first popularized by Janet Travell, MD, one of John F. Kennedy's physicians. Janet's techniques made it into popular medical culture because JFK had a bad back that often responded well to her trigger point injections with numbing medicine.

Sometime later, Canadian neurologist Chan Gunn, MD added a significant piece to the trigger point puzzle. Travell had noted that just using a needle without injecting anesthetic (dry needling) seemed to work just as well. To the medical establishment of the day, this seemed like voodoo. At the time, Chinese acupuncture was largely unknown in the West, so Travell largely placed her emphasis on injecting anesthetic and anti-inflammatory medications. Gunn grew up in Korea, where a more aggressive form of Korean muscle acupuncture was common, so he moved forward with Travell's dry needling technique, substituting the much finer and less traumatic acupuncture needles for the more traumatic cutting-edge injection needles used by Travell. Gunn also theorized that the muscle trigger points that Travell thought were due to overuse were more likely caused by nerve irritation.

The science of the last 20 years supports Gunn's theory that nerve problems (autonomic and likely spinal nerve) and trigger points are closely related. By the early 1990s, when physicians expert at trigger point injections were rare, TPIs were used by a multitude of doctors to treat musculoskeletal pain. Then something happened that often drives the course of medical care much more than efficacy or science—the reimbursement changed.

Prior to the mid-1990s, a physician could receive adequate compensation per site injected, yet a few years later the average compensation for this procedure was reduced by 70–90%! In addition, getting compensated by insurers became more difficult. This was all it took to relegate the art of trigger point injections to the history books. Today, because of this reimbursement collapse, finding a physician experienced in managing this type of muscle pain is like finding that needle in the haystack.

My own personal story is important to insert here. In the late-1990s I attended a medical conference that involved days of sitting, and my left knee began to ache and swell. Yet, there was no previous trauma to the knee but after I returned home I was literally hobbling around the office, and all of my aerobic exercise came to a halt. I underwent an MRI, convinced that I had

somehow torn a meniscus or some cartilage. While the MRI showed the swelling and perhaps some microtears in the meniscus, it didn't show a "smoking gun" cause for my severe pain.

I went to see an orthopedic surgeon who wanted to perform a diagnostic arthroscopy, likely chop out some meniscus and remove a "plica." I was desperate and convinced the MRI was missing the true cause, so I reluctantly signed on for surgery. A few days before the planned surgery, a visiting doctor from Canada was in our clinic and asked if I had tried trigger point therapy in my quadriceps muscle and low back? I said no, looking at him like he was some alien speaking in tongues. At this point, I had seen the best physical therapists in town and failed all of their exercises, so I was desperate. I told my Canadian colleague that I would try anything.

Turns out, this visiting physician was one of those "needles in a haystack" as he was experienced in the Gunn trigger point technique (called IMS, short for intramuscular stimulation). He examined my thigh muscle (quadriceps) and my low back, pulled out an acupuncture needle, and proceeded to stick this in my low back and thigh muscles. The muscles cramped suddenly as the needles hit the trigger points (more strange than painful). After a two-minute treatment, I got off the table and walked normally. That night, without a twinge or hitch, I went running for the first time in months. I canceled my surgery and have never looked back. I was so impressed with this technique that I learned the it, perfected it, and began using it in my own patients.

IMS has revolutionized our practice, providing relief to patients who would only otherwise be treated by much more invasive treatments. Only because of reimbursement issues (insurers don't generally cover IMS, and the other form of trigger point therapy [TPI] is poorly reimbursed) has the technique remained obscure. And, to be honest, the technique takes significant dedication to get consistent results—which may hinder some from undertaking it.

At a medical conference where both traditional Chinese acupuncture and IMS were being taught, I had insight into how my medical colleagues view this complexity. After Dr. Gunn lectured about IMS, I turned to the physician sitting to the left of me and asked, "Wow, isn't this IMS stuff great?" Her response was, "It's too complex. You have to learn where all the muscles are, what they do, where to put the needle for each one, what to avoid…With traditional Chinese acupuncture, I just look at a chart on the wall and put the needle at X marks the spot."

So while traditional Chinese acupuncture (placing a needle into the skin at specific Chinese chi points) has become popular, IMS has remained in obscurity. These past few years, IMS has finally taken a leap forward by being adopted by various Colorado physical therapists (PT). One of our

former PTs who we had trained in IMS went through the red tape to allow physical therapists to widely practice the technique after very intense coursework. As a result, IMS is now gaining more acceptance, and more patients are getting more access to the technique through physical therapists.

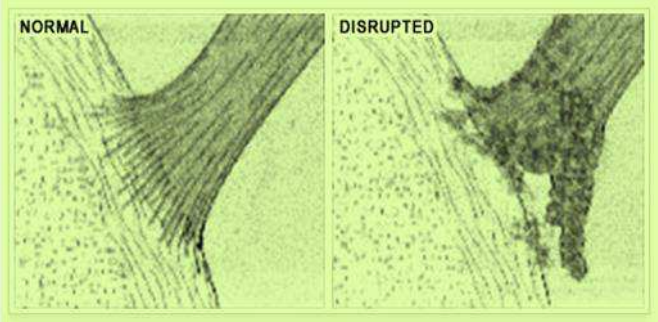
How Can My Back Cause My Knee Problem if I Have No Back Pain?

Let me again use my own example. I'm using my knee here, but the same concept would apply in the shoulder. While I no longer had back pain when my knee went out, how did my low back cause a knee problem? How does that work?

On that fateful day at the end of the medical conference, muscle trigger points in my spine and thigh caused severe knee pain and swelling. Did I have a back issue? Turns out, I had fractured a few little bones in my back about 10 years before the day I had my knee pain. Other than a few bouts of mild stiffness, I had never had any ongoing back pain after the fractures, just a sudden and unexplained onset of knee pain. So what's the connection?

The low-back spinal nerves were irritated, which caused big trigger points to develop in my quadriceps thigh muscle. As this happened, large sections of that big muscle began to shut down, turning off the major stability system of the knee, which began to swell because of the extra wear and tear due to abnormal motion. Why didn't my back hurt? Pressing on spinal nerves generally doesn't give you back pain; it causes symptoms where the nerve innervates (the area the nerve supplies). So if I took magic fingers and pressed on the right-L5 spinal nerve in your back, you would feel it in your right leg and big toe, not your back.

Enthesopathy



We take for granted that our muscles not only contract but also have a function as shock absorbers, letting go in a controlled fashion. As an example, when you jump from a fence at a height of just four feet, your femur bone should break. Why doesn't it? The big quadriceps muscle absorbs the shock by acting an eccentric contraction (controlled release). When a muscle has trigger points, the biomechanical properties of that muscle change. Large sections of the muscle can lose their ability to act as active shock absorbers. We believe this leads to extra pull on the areas where the muscles attach to the bone. This causes swelling and breakdown of these areas known as enthesopathy.

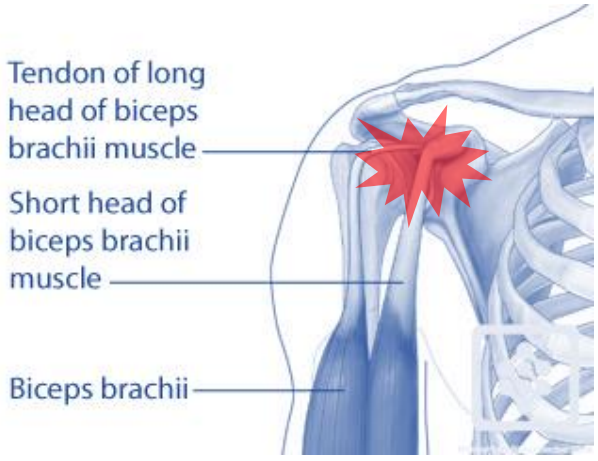
Enthesopathy means that where a tendon attaches to bone, the tendon is aggravated and swollen. If this goes on a long time, you may see small tears in the ligament. If it gets really severe, you may see bigger tears. All of this can cause pain.

While many physicians will recognize problems in joints, and fewer will recognize trigger points in muscles, in our experience, even fewer will recognize enthesopathy. This is a problem, as many patients suffer from this problem. The good news is, a new generation of physicians armed with PRP to treat tendons and ultrasound imaging to detect problems in those tendons is finally beginning to address this important problem.

What Happens When Tendons Have Bigger Problems?

We've discussed what happens when tendons attached to bone are overloaded and aggravated. What happens when they fail? For partial tears, in our experience, platelet rich plasma (Regenexx-SCP) works well. For complete tears, where the pieces haven't retracted back like rubber bands, same-day stem cells tend to work well. For full-thickness retracted tears, where the ends have snapped back, surgery is likely needed (although we're working on nonsurgical options).

In the shoulder, the biceps muscles is the big one you see in front of the arm. It attaches through its tendon to the top of the main shoulder joint and becomes one with the lip around the shoulder socket (labrum). It can be irritated and cause pain in the front of the shoulder or get torn (usually where it originates at the shoulder labrum), which is called a SLAP tear. The tendon can also have partial or degenerative tears inside it, often caused by rubbing on the other shoulder structures due to poor biomechanics. Sometimes, surgeons will try to cut the ligaments on top of this area (called a shoulder decompression), but this can leave the shoulder more unstable.



Peripheral Nerve Entrapment

A "peripheral nerve" is simply one that instead of living in your spine, lives in your torso, hips, arms, legs, hand, feet, and so on. So the nerves that live in and around the shoulder are peripheral nerves. The nerves that course through your body sometimes have to make it through some tight spots. The more common tight spots have lent their names to common medical maladies like "carpal tunnel syndrome" (the tight spot for the median nerve in your wrist). These common tight nerve areas are in all parts of your body.

One area where nerves might get entrapped in the shoulder and cause symptoms in the thoracic outlet. Impingement of a nerve is this part of the shoulder/rib complex causes numbness and tingling down the arm, often into the little finger.

There are many more places where nerves can become entrapped throughout the body.

Superficial Nerve Syndromes

There are many places where nerves pass through small tunnels in the fascia that covers your muscles. These small tunnels are all over your body, and, recently, a physician from New Zealand (Dr. John Lyftogt) developed a technique to treat this type of pain. Basically, the area is localized on exam or with ultrasound (the small nerve appears swollen at one of these common tunnels) and injected with a solution to reduce nerve pain (usually 5% dextrose in anesthetic). This procedure seems to work well in chronic-pain syndromes where the patient can localize certain areas on the skin or just below the skin that when pressed, re-create the pain pattern. For example, a patient with pain on the outside of the knee where the skin nerve exits the kneecap fascia (the covering tissue of the outside of the kneecap). This area can be pressed on, and this reproduces the pain. Another use of this technique can be in widespread pain where many injections are used at many nerve exit locations.

Central Sensitization

Let's say you're in your car and suddenly all of the warning lights start to go off. You take the car to the mechanic, and he or she says that there may be a few things wrong here and there with the car, but the real problem is that the wiring is bad. This is central sensitization (CS) also known as complex regional pain syndrome type II, fibromyalgia, neural sensitization, and so on. In all of these conditions, it's an injury to the pain-reporting wiring of the body (the nerves and microprocessors that control them) that causes the problem. The nerves become hypersensitive to pain. This phenomenon has been extensively published—most references are for whiplash or fibromyalgia. This problem is also now being discussed as related to joint pain (as discussed earlier).

Patients with CS simply have a nervous system that's on fire. At its early stages, it may cause arthritis (see above), but as this gets worse, large areas of the body can be impacted. In addition, these areas don't follow normal nerve pathways like dermatomes (skin areas associated with certain spinal nerves), so oftentimes many physicians without training in this area label these patients as having "nonanatomic" sensation problems. These patients, as they progress, can't tolerate physical therapy, massage, injections, acupuncture, IMS, and so forth. Our research group demonstrated that at an early stage, trigger points may make the sensitization problem worse. At later stages or when more severe nerve injury has occurred, cold sensitivity is common. For example, for patients with traumatic CS, a cold summer's night (about 60 degrees Fahrenheit) is actually painful, as that's all it takes to activate pain nerves.

Think about this for a second: How cold would it have to be for a normal person, you, to perceive cold as pain? Below freezing? Twenty below? These patients feel this at less than 60 degrees.

CS patients are generally the most difficult patients to treat. First, the pain sensitivity levels have to be brought down to a more normal level. One way to do this is medication. We have seen many medications for this type of nerve-related pain come and go—Neurontin, Tegretol, Elavil

(amitriptyline), Doxepin, just to name a new. They all had the problem in that they didn't work for most patients. However, newer nerve-pain drugs are just coming to market, with many new ones in the pipeline. The most effective drug we have seen is the newer drug Lyrica. This works well in about 6 in 10 of these patients to reduce nerve pain and "put some water on the fire."

Once this is accomplished, the next step is usually to identify the problems that caused the fire. In many patients, there were specific musculoskeletal problems that led to others, which ultimately led to the fire getting out of control. Finding these specific problems and treating them can then start to provide relief. As an example, a patient labeled with "fibromyalgia" may note that his right neck and shoulder began hurting first, then his right low back, then his arm and leg. Tracing the issues back to the neck would be the way to approach this patient.

In addition, we are also encouraged with the results in using the nerve-hydrodissection technique with platelet lysate, as discussed earlier. This approach is to try and help the nerve function better by placing helpful platelet-derived growth factors near the nerve.

Neuromuscular Resources

Calming down nerves through injection often requires an expert trained in X-ray–guided procedures. Here are some resources:

- ISIS (International Spinal Injection Society)
- ASIPP (American Society for Interventional Pain Practitioners)

Realize that almost all of these physicians still use steroid epidurals as their primary injection type. If you're interested in platelet lysate epidurals, see the Regenexx Network physicians at this link.

The most effective way we've seen to address chronic trigger points is either through IMS or trigger point injections. Here are some lists of where to find these "needle in the haystack" doctors and physical therapists:

- A list of Gunn IMS practitioners
- Trigger point educational group
- Physical therapists trained in IMS

Trigger points in muscles can be difficult to treat on your own, but we've seen some success with these approaches:

- Electro Therapeutic Point Stimulation (ETPS)

- Thera Cane

Enthesopathy: See level 1 prolotherapy and level 2 PRP resources discussed in the “Articulation” chapter.

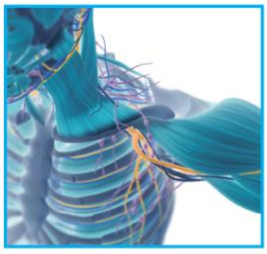
Chapter 11
Symmetry

STABILITY
The ability of a joint to tightly move as it was designed without extra motions that might hurt the joint.

Regenexx®

ARTICULATION
The health of the joints. Shock-absorbing tissues like cartilage; spacer tissue such as meniscus; or stabilizing tissues such as labrum can be damaged.

S A
SANS
TREATMENT
APPROACH
N S



NEUROMUSCULAR
The nerves drive the muscles. Nerves that are irritated or compressed cause pain and may be less able to promote muscles to properly fire.

www.regenexx.com

SYMMETRY
The left/right and front/back balance of the body. When the body is asymmetrical, certain parts get injured or wear out faster.

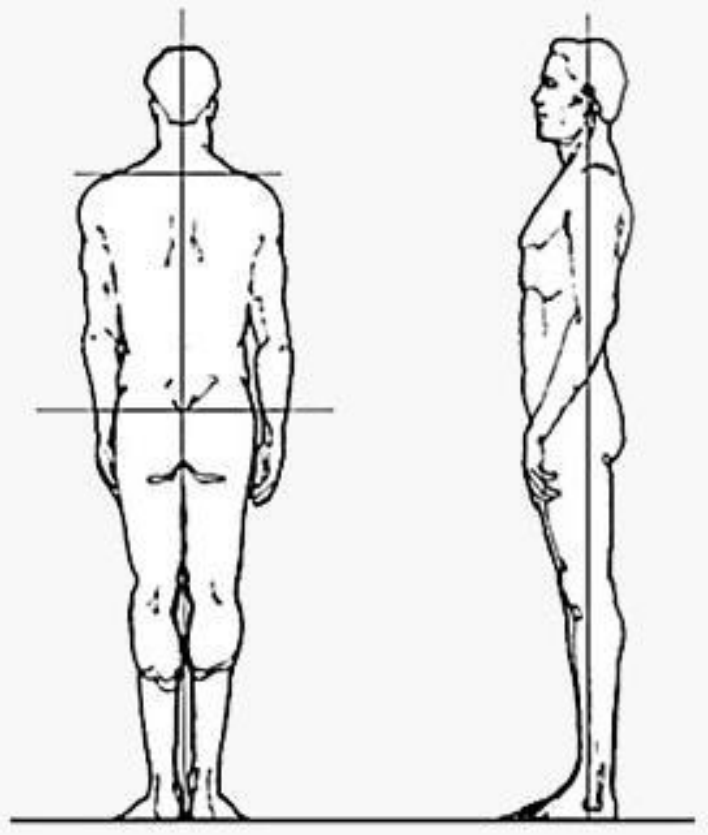
In most patients, there's usually more joint damage on one side than the other. Why? If someone has a genetic predisposition to arthritis and this is the only factor causing the joints to degenerate, shouldn't all joints be affected equally? In addition, osteoarthritis is more commonly seen first in the knees and hips and less often in the ankles and elbows. Why? Again, shouldn't we see all joints being impacted the same? The reason is clear: the wear and tear on our joints occurs unevenly, with some being impacted more than others or one side undergoing more wear than the other.

Why Should I Care About My Symmetry?

If you don't want to stay active and pain free as you age, then ignore this chapter. If you do want to stay active, then pay attention! Your body is designed to be symmetrical, and even slight amounts of extra force or motion, in any area, caused by an unbalanced body will cause problems. These may start small, but like a snowball rolling downhill, they become bigger and bigger with time.

Reducing the Wear and Tear

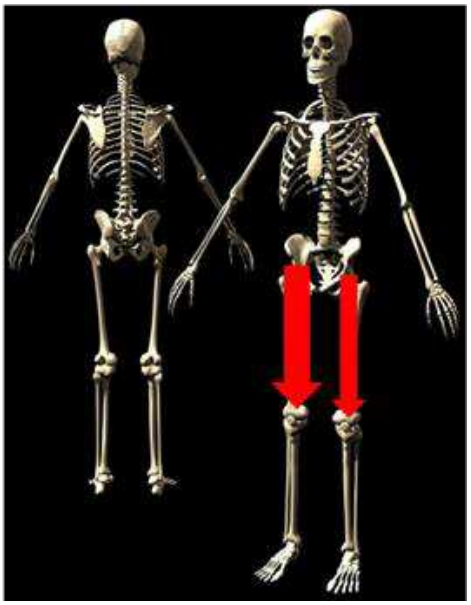
As already discussed, increasing healing ability is only one part of the Orthopedics 2.0 equation. The other half of this coin is reducing the wear and tear forces that destroyed the joint in the first place. As an example, placing new tires on a car with bad alignment, without fixing the alignment, is guaranteed to quickly wear out the tires again. This issue is often ignored in our current quick-fix treatment methodology. I've seen hundreds of patients with a specific wear pattern, like on the right medial meniscus, where the most salient questions have never been asked: how did this knee get like this, and what are we going to do to ensure that it doesn't get this way again?



The reason the issue of specific wear-and-tear patterns is mostly ignored is that it's complex. Most physicians aren't trained to understand the biomechanics of the body. The few physical therapists or other providers who have spent years of extra study learning biomechanics are often too heavily incentivized by insurance companies to take the time needed to figure out why a part keeps failing.

Let's use a simple example to illustrate this concept. The skeleton on the right has been drawn with red force arrows going down from the hips. Let's say that because the spine is slightly bent to the side that slightly more force is applied to the right side (the thicker arrow) than the left side (the thinner arrow). We take thousands of steps a day. What happens to the extra forces on the right, and how does the body handle them?

The right knee, hip, and ankle will all react. They will initially just shore up the bones, tendons, ligaments, cartilages, and muscles on that side. When this person is young, with many adult stem cells in these areas, he or she may not notice much. However, as the number of adult stem cells begins to decrease with aging, the damage due to wear and tear at some point will begin to overtake the repair ability of these tissues and react to the extra forces. These areas (the ones that are the most vulnerable) will begin to break down.



If our only goal is to replace the right-sided knee, shoulder, or any other right-sided joint, with an artificial joint, that prosthesis may wear out a bit faster on that side, but this is likely not a huge issue. However, if we want to preserve that right-sided knee or shoulder with Orthopedic 2.0-type procedures, we had better figure out why that knee or shoulder is getting so much more wear-and-tear and correct that problem.

Take Five Minutes to Understand Your Symmetry

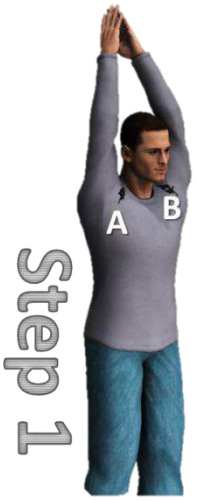
Patients are often surprised to find out that their body is no longer symmetrical. Others have noticed that a certain area has been getting tight for years. Either way, going through an intensive five-minute test of all major body joints, checking for symmetry is well worth your time. Why? As discussed above, joints that are not equal in their side-to-side or front-to-back motion don't wear evenly. If you have any areas that are tight and not symmetrical and you don't figure out what's going on and fix these, you can bet arthritis is in your future if it's not already knocking at the door. In fact, symmetry is often the single biggest thing you can fix so you have an active older age rather than one plagued by problems and inactivity.

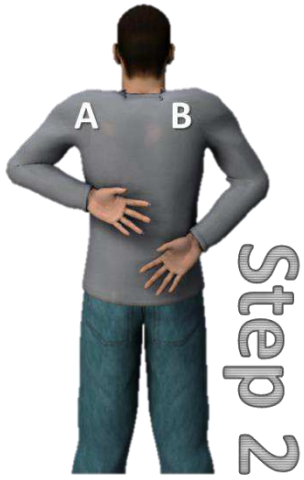
This is an 11-step test. You need to focus on whether you can attain the movement to the degree asked, whether the right and left are identical or different, whether the front and back is the same or different, and whether the tightness in the lettered areas is different on one side or the other. Realize the differences may be subtle but important. In addition, pay attention to which movements cause pain and where. If you're a patient of our clinic or a patient of a Regenexx Network physician, fill out the form in appendix A and bring it to your visit.

If any movement causes significant pain, stop immediately and see a doctor. If you think any of these motions may injure you, or you are prone to injuries with common or unusual movement, don't do this test, and, instead, see a physician.

Step 1: Protracted Shoulder Check

Stand normally and place your hands together. Raise them over your head as shown. Move the hands as far back as they will go. Pay attention to whether the shoulders go back equally (you may want to have someone check, or do this in a mirror). Also pay attention to whether the front of the shoulders at points A and B are equally tight or if one of them is painful. You can also do this same maneuver lying flat on your back on a firm surface. In that case, your hands should touch the floor. If they don't, then both sides of your chest are too tight, or you may have problems with the range of motion of the large shoulder joint. This step checks your ability to abduct the shoulder and also checks the tightness in the pectoralis major and minor muscles along with the front and bottom of the shoulder capsule. If this causes shoulder pain, you may have a shoulder impingement, a problem where the structures of the shoulder are getting pinched by poor movement patterns.





Step 2: Posterior Shoulder Check

Stand normally and place one hand behind your back. Raise it up as high as it will go. Both hands should be able to go at least to the middle of your upper back with the thumb just below the shoulder blades. Notice whether both sides can go equally as high and whether you have tightness in the back of the shoulder at points A and B. Is one side tighter than the other? This movement measures the tightness in the infraspinatus muscle as well as the back of the shoulder capsule. Patients who can't do this tend to develop overload on the back of the shoulder joint where they can develop labral tears. While many surgeons would just focus on the labral tear, the real focus should be on why this shoulder can't internally rotate!

Step 3: The Neck Check

Very slowly and carefully roll your neck 360 degrees (only 180 is shown). Does this cause any pain at any point? Does it roll equally well to the front, side, and back? Is one side tighter than the other? Patients who don't do well with going straight back or back and to the sides may have an arthritic or injured facet

joint in the neck or a problem with lordosis (discussed later in this chapter). If bending to the side or forward is tough, you may have tightness in the postural muscles of the neck that hold the head up, like the levator scapula, upper trapezius, or cervical extensors. Finally, if one of the front muscles is tight, it could be the stenocleidomastoid, an important muscle that helps to turn the head. You may also notice that you can't hold your head back like this or that if feels out of control if you do. This is often caused by weakness in the deep neck flexors, like longus colli or longus capitis. Weakness in these deep neck flexor muscles can lead to chronic headaches. In the "Neuromuscular" chapter (next chapter), there's a strength-and-endurance test that also covers this issue.

Step 4: Cervical and Thoracic Rotation Check

While standing, place your hands on your chest, and turn your head all the way over your shoulder as far as it will go. Then follow through with a rotation of your upper back as far as it will go with your feet firmly planted (they shouldn't move). Do this on both sides. Can you turn as far with your neck and your upper back on the left as on the right? Is there more tightness on one side of the neck, upper back, or lower back than on the other? Patients who can't turn their neck may have a problem with the facet joints, whereas patients who can't turn their upper back may have that issue or a problem with the normal motion of the rib cage, the rib attachments at the spine (called rib facets), or the thoracic spinal facet joints. In addition, chronic chest wall tightness on one or both sides may also limit the rotation of the upper back.

Step 5: Hip Rotation Check

Stand normally and place the toes of your feet together as shown. Make sure your feet are aligned and symmetrical—it's easy to cheat by placing one foot forward or back. Note whether both feet move inward equally (the motion is mostly coming from your hips). Also note the A and B points listed in the front and back of the hips. Are these areas equally tight? Is one tighter than the other? Also note the C and D points—does any of this stress or hurt your knees or one knee? Now take your toes and rotate them out all the way. Again, be careful to make sure your feet are symmetrical (heels are together) as otherwise it's cheating. If one hip has a very different range of motion (toes don't move as far in or out, and this seems to be due to tightness in the hip), this is very concerning. The hips tend to lose range of motion quickly and almost always

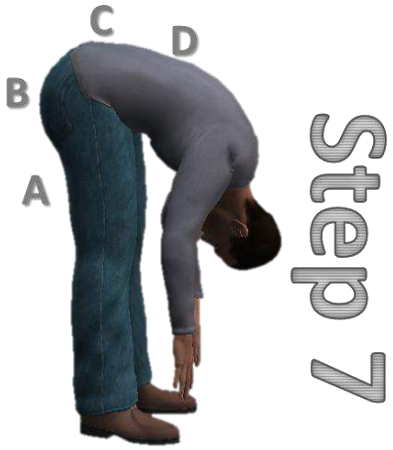
after the onset of moderate or severe arthritis. I would advise you to get your hip checked immediately by your physician. If you already know you have a hip problem, this means that you have serious work to do. Unlike other joints, the hip has a very limited weight-bearing area (the part of the joint where it gets the most force). When the hip loses range of motion, and when arthritis is already present, the joint will put much more pressure on already worn areas, hastening cartilage loss. Getting hip range of motion back can be a challenge. In addition, patients with poor hip range of motion tend to have a less robust response to stem cell injections. As a result, there are procedures we can use to try and improve the hip range of motion through an injection that stretches the joint capsule.

Step 6: Lateral Hip and Back Check

Stand normally and reach to the side as shown. Go as far as you can, and note points A and B. Can you go as far on the right as you can on the left? Does one side of the lower back and/or outside hip feel tighter (point A or B)? Does that tightness extend down the side of the leg to the knee (points C and D)? This step measures the tightness in the opposite lateral lower and upper back muscles, like the quadratus lumborum and iliocostalis lumborum. It also measures the tightness of the opposite lateral hip muscles, like the tensor fascia latae and iliotibial band. If you can't bend as much to one side, there may be tightness in these muscles or the spine. If you have pain that goes down the side of the hip and leg, you may have an SI joint problem with tightness in the iliotibial band or an S1 nerve problem in your back.

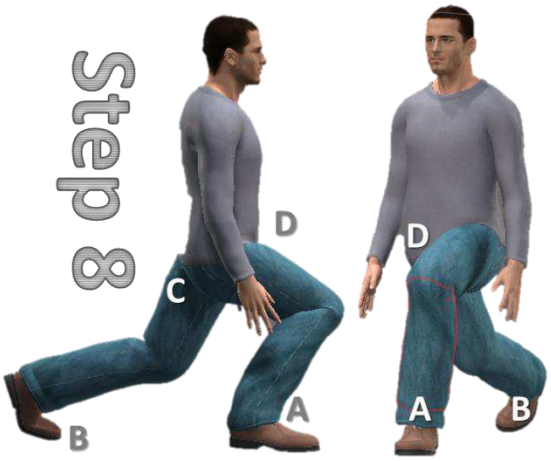
Step 7: Gluteal, Lumbar, and Thoracic Extensor Check

Bend forward all the way, and try and touch your toes. Do you get pain or severe tightness in one or both hamstrings (point A)? Is one side of your buttocks tighter than the other (point B)? Is your lower or upper back tight (points C and D)? Can you get within six inches of the floor? Does this cause pain or perhaps tightness, numbness, or tingling in one or both legs? Is your belly in the way? Patients who have difficulty getting close to the floor have significant tightness in hip flexion (which could be arthritis) or lower/upper back flexion (which could be disc disease or extensor muscle tightness). If one hamstring is always tight despite your best efforts to stretch it, it could actually be an irritated S1 nerve in your back despite the fact that your back doesn't hurt that much. Irritated nerves in your

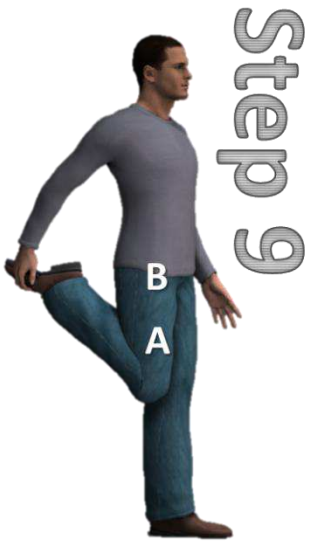


back can also cause one or both legs to get tingly in this position.

Step 8: Hip Flexor, Ankle Dorsiflexion, and Forefoot Check Perform a lunge as shown, getting as far down as you can, making sure you feel a good stretch in the front of the hip on the back leg. On that leg, bend your toes so that they meet the floor flat. On the other leg, flex the ankle as much as possible. For some people, getting a good stretch may involve placing the hands all the way down to the floor. Notice the front of the ankle of the forward leg, and compare that to the other side when you perform the opposite stretch (point A). Does the buttock on the front leg have the same side to side tightness? On the back leg, can you flex your toes (point B), or is this restricted on one side or painful? On the same leg, is the front of the hip (point D) equally tight on both sides, or is one side tighter? Can you get as low on each side?



Patients who have difficulty at point A (front of the ankle) may have ankle arthritis or a bone spur in the front of the tibiotalar joint, restricting dorsiflexion of the ankle. Patients with problems at B (toes) may have arthritis at the metatarsophalangeal (MTP) joints in the foot. For the big and 2nd toe, this can sometimes be related to long-standing low-back problems (even though you think your back is fine).



Patients with problems at C (buttocks) may have problems with hip flexion, indicating tight gluteal muscles or arthritis in the hip. Pain with this maneuver could also mean a labral tear in the front of the hip. Finally, if you have an issue at D (front of the hip), this could indicate a tight psoas muscle. This muscle goes from the front of the lumbar spine to the hip, so tightness here can be due to chronic low-back issues or trigger points in this muscle. Sometimes patients with psoas issues have trouble getting in and out of a low car.

Step 9: Knee-Extensor Mechanism Check

Stand normally and grab one foot with the same hand while bending the knee as shown. You may need to hold onto something. That's actually your first observation. If you can't easily balance like this (after a practice run), then you have significant low-back and hip-stability problems on the opposite side of the knee bend (see the "Stability" chapter). For the symmetry check, do the right and left knees bend equally? To really check this, make sure you stand straight while checking both sides. Does point A (quadriceps) feel the same on each side? How about the front of the hip (point B). Does either knee hurt in this position? If you have less

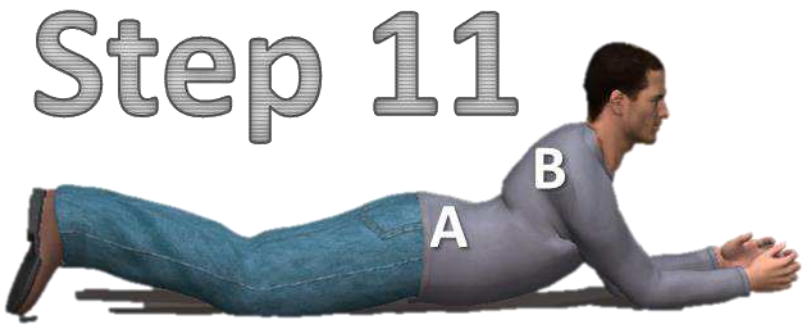
knee bending on either side, the simplest explanation is that you have trigger points in the quadriceps muscle (see next chapter). If the front of the hip is tight, you may have issues with the rectus femoris muscle. If the knee hurts, you may have a patellofemoral problem (an issue with the kneecap in its groove). Another common cause of asymmetry here is swelling in the knee joint due to chronic arthritis, which reduces the ability of the knee to flex.

Step 10: Adductor, Sartorius, and Gracilis Check

Lie on the floor and place one ankle over the opposite knee as shown. Next, try to get the bent knee as low to the floor as possible. Check both sides and see if they are equal in your ability to get the ankle high up on the opposite knee. See if point A (inside of the thigh) feels the same degree of tightness side to side? Can you get one bent knee farther toward the floor than the other? Tightness in these muscles of the inside of the thigh are common in patients with chronic low-back conditions and sometimes can cause hip or inside-of-knee pain. In addition, patients with hip arthritis may notice a difference in flexibility from side to side.

Step 11: Lumbar and Thoracic Extension Check

Lie face down and prop up on your elbows, arching your back by lifting your head as high as possible and pushing your hips into the floor. Can you do this without pain? Does your lower back (point A) or upper back (point B) feel tight or hurt? Do you have pain or tightness at the back of the shoulder blades? Patients who have tightness in the front of the hip and low back may have tight psoas muscles. Patients who have pain in their low back with this maneuver may have injured or arthritic low-back facet joints. If you have pain in one shoulder blade, there could be a problem in the joint between the shoulder blade and ribs or in the rib cage itself.



Now, what do you do with this information? If you have an area where your movement isn't normal, or there's a noticeable side-to-side difference in motion or tightness, there may be a few different causes. First, this needs to be looked at by a physician,

physical therapist, or other musculoskeletal provider. Why? In our experience, asymmetrical motion is a leading cause of excessive wear-and-tear arthritis, so getting symmetrical and balanced motion back is critical. Second, the lack of motion may indicate problems in that joint that have yet to be addressed.

What are some common ways to treat these tight areas?

1. Do simple stretches. The longest-running stretching book on the market is Bob Anderson's. See this link for Amazon or this one for the basic stretches.
2. Clear trigger points. When I discuss specific muscles above, these are your areas to target. Many times, there are knots in the muscles that when cleared will allow normal movement. The next chapter will focus more on ways to get rid of these trigger points.
3. Repair irritated nerves. Sometimes an irritated nerve won't allow normal motion in an area, as a protective response for the nerve. This topic is dealt with in the next chapter.
4. Treat joint arthritis. Sometimes an arthritic joint won't allow motion because bone spurs within the joint are blocking motion or the covering of the joint (the capsule) is too tight. For information on these issues, see the "Articulation" chapter.

Now That You Know You Have Problems, Let's Learn More About Symmetry

Everything starts with the spine—as your arms, legs, and head would be useless without an anchor point. This anchor is your spinal column. You might be saying, But I have a shoulder problem. Why should I care about the spine? Because regardless of where you feel the pain, it's almost impossible for your spine not to be involved in some way.

A documentary on the tragedy of 9/11 provides a vivid example that may help bring this concept home. On one of the upper floors, many workers were trapped by a door to the stairs that wouldn't open. No matter how many strong guys tried to ram it open, it wouldn't budge. It turns out that the violence of the airplane strike had twisted the spine of the building ever so slightly, and this compressed the doorframe against the door. These workers were eventually saved by a heroic building superintendent who guessed accurately that kicking a hole in the drywall next to the doorframe might release the pressure on the door. Your spine is the same. Small issues here can cause large problems in your shoulders, arms, hands, hips, legs, ankles, or feet.

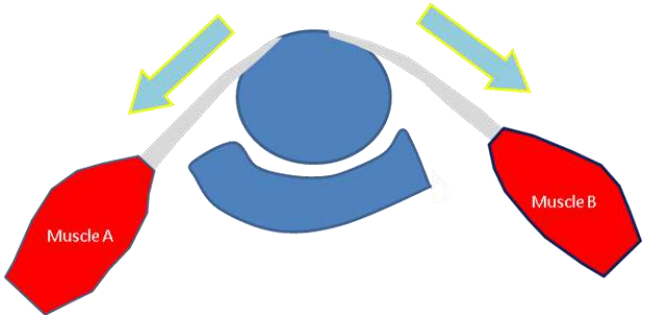
What Did I Self-Diagnose in the Symmetry Screen?

Poor stability caused by too much movement is hypermobility and equally important is hypomobility, where a joint or spinal segment doesn't move enough in all directions or certain directions. This is what you self-diagnosed in the five-minute symmetry screen.

Chiropractors and osteopaths have been focusing on hypomobility for more than a century. The reason we medical doctors have given them a hard time is that hypomobility has been

traditionally hard to measure. However, there is good evidence now that this does occur. In fact, studies that specifically apply this concept (hypermobility versus hypomobility) show that patients with spinal hypermobility treated with exercise do better than patients with hypomobility. This makes sense because if you have too much mobility you need to get the muscular stability system back online with exercise or other treatments to restore muscle function. However, patients with hypomobility did poorly with stability exercise. Why? They need more mobility, not more stability. This group did better with manipulation to force these segments to move.

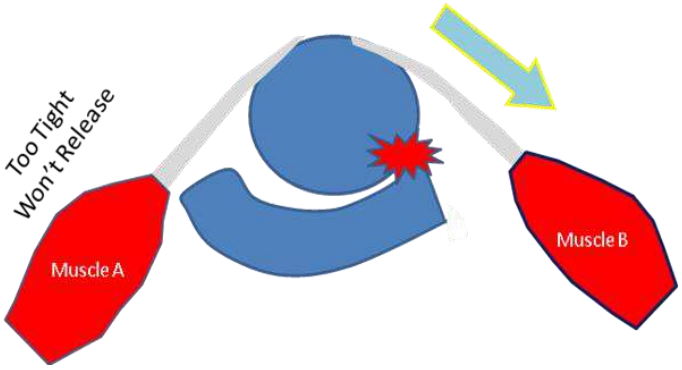
Hypomobility can be as damaging as hypermobility. The take-home message is that if your joints don't move normally in all directions, you have to get them to move normally or this will place more wear-and-tear on the certain parts of the joint. What are some examples? If your knee won't straighten all the way, the front of the joint cartilage will wear more than the back. How about a hip that won't turn out all the way? The inner part of the hip will wear more than the outer.



Take, for example, this simple model of a joint and the muscles that help control that joint's movement. We have a ball-and-socket-type joint with a ball sitting in a shallow socket (like the shoulder.) Here we'll call them muscle A and muscle B. Both muscle A and B pull equally on the joint, and when one pulls harder, the opposite muscle lengthens equally to allow the joint to move.

So, as this joint moves, the ball stays in the middle of the socket. In fact, keeping the joint aligned with millimeter precision as it moves is critical.

But what happens if one muscle can't release as the other pulls? The joint moves too much to one side, banging into the side of the socket. This is an example of muscular hypomobility, where trigger points in one muscle make it tight and weak (more on this topic at this link). How do you fix this problem? You need to loosen up the tight muscle. This is discussed further in the neuromuscular section. The same thing can happen if one part of the joint capsule (the thick fibrous covering of the joint that helps to limit motion) is too tight or the ligaments that hold the joint together are too tight.



Adhesive Capsulitis: What Happens When the Joint Locks Down?

While it's clear, above, that a joint not moving freely may have issues with overloading certain parts, what happens when the joint loses almost all of its motion? This is what happens in adhesive capsulitis. Nobody is 100% sure why this happens. Some think it's due to chronic inflammation in the joint due to poor blood sugar control, as it's seen more commonly in diabetic patients.

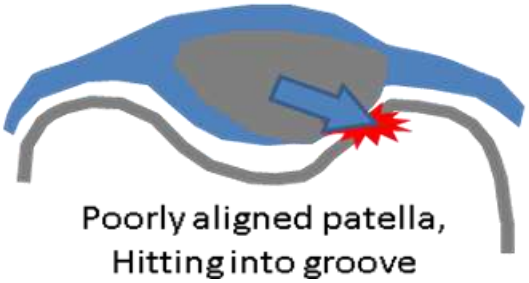
This problem is most common in the shoulder and lesser recognized in the hip. In the shoulder, it tends to get noticed quickly, as the patient has to get any motion there from the shoulder blade against the chest wall rather than the shoulder joint. In the hip, it just tends to go hand in hand with arthritis, but often goes unnoticed. In the shoulder and hip, the loss of range of motion severely overloads small sections of the joint, which only tends to make arthritis happen faster.

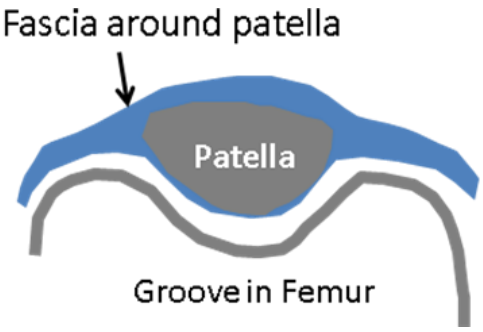
We've had great success in both joints treating this range of motion problem using what we call pecutaneous capsuloplasty. This involves injecting platelet growth factors into the joint (the same ones we use in an epidural) and over-distending the capsule to break up the scarring and adhesions. This tends to free the joint and allow motion while hopefully leaving healing growth factors around to help things repair. In the hip, this is critical, as our treatment registry data there shows that outcomes with hip stem cell procedures are poorer with less range of motion of the joint.

Realignment Surgery: If I'm Asymmetrical, Won't Surgery Help?

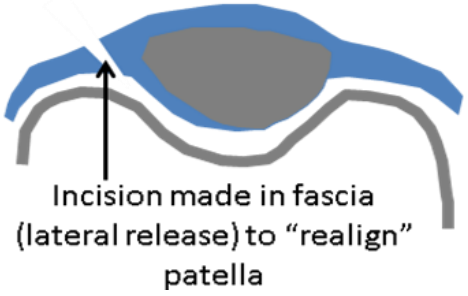
When I was in residency, my rotations through pediatric rehabilitation was both one of my most and least favorite. While it was always fun to be around the kids, these particular kids all had severe physical deformities. The surgeons on this rotation were great heroes, often allowing these kids to walk or function better by adding an inch here, taking away an inch there, or cutting this or that tendon. These kids were so severely disabled that it simply didn't matter that the accuracy of the surgical healing could be off by a few millimeters either way.

Fast forward 20 years, and I no longer see disabled kids for a living but patients with chronic joint and spine pain. I have seen hundreds of patients through the years who have undergone the same type of realignment surgeries, although they didn't do so well. What's the difference? The normal musculoskeletal system is tuned to submillimeter to millimeter precision. Human accuracy and surgical healing can be off, a few millimeters either way. So, while it's possible that a surgically realigned tendon, muscle, ligament, or bone might be in the perfect anatomical position, it's more likely that it will heal "a little off."



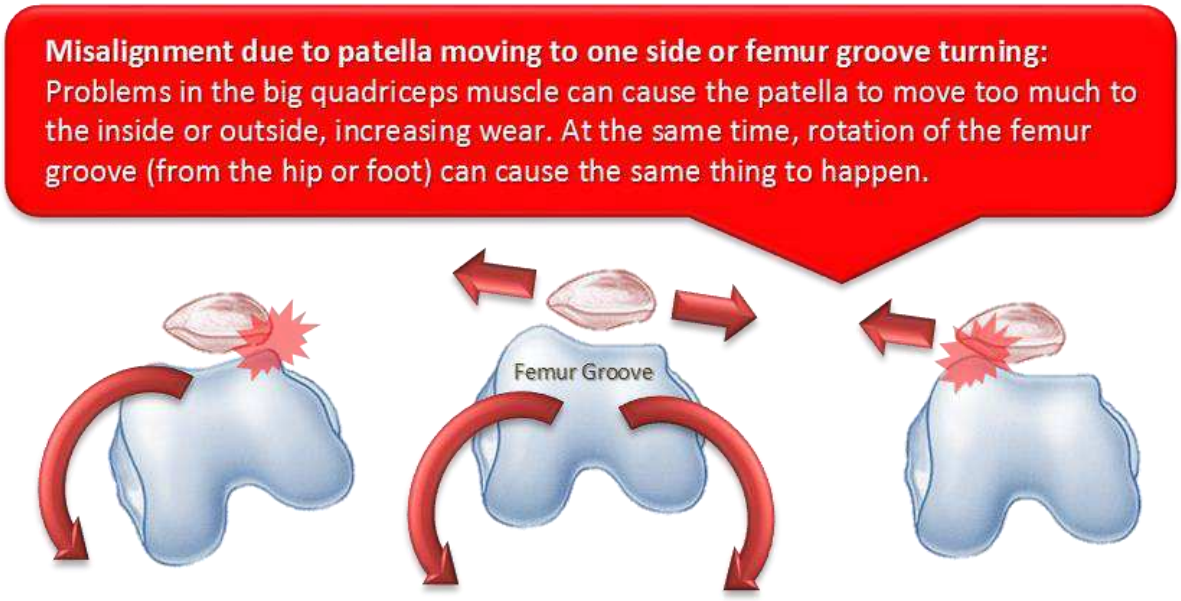


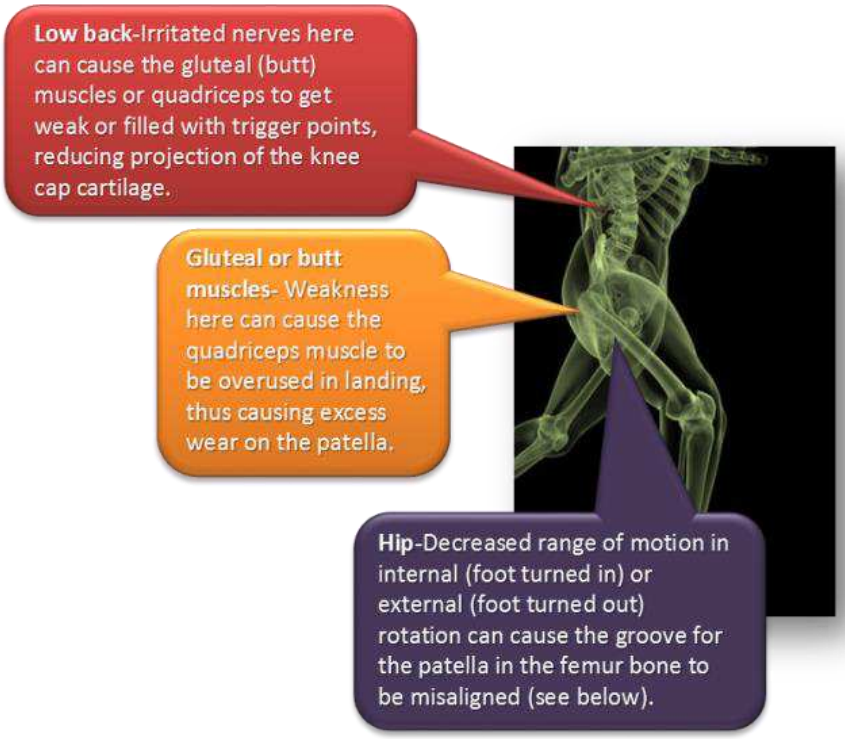
Also, many times these surgeries ignore the cause of the problem. Take the example of a knee lateral release: the concept is that the patella isn't tracking properly and is being pulled too far to the outside of its groove (or doesn't have enough pull toward the inside). Rather than asking what biomechanical forces have caused this to occur (issues in the hip, low back, etc.), we often try to take a quick-fix approach by cutting some of the quadriceps attachment and fascia on the outside. Since the patella is aligned to submillimeter precision, and the surgery can only have accurate healing to a few millimeters, I often see that the patella is misaligned after the surgery. For example, if the lateral side scars and heals too tight, the patella will be too far lateral, or if too much of the lateral side is cut, too far medial. Add in to that calculus that the same forces that were pulling the patella too far laterally are likely still there (say too little hip external rotation), and the surgery hasn't solved the cause. Since these are permanent realignments of the musculoskeletal system, I tell patients to think long and hard before getting the procedure—once done, it cannot be undone.



Learning More About How the Knee Is One Part of the Whole: Nonsurgical Solutions

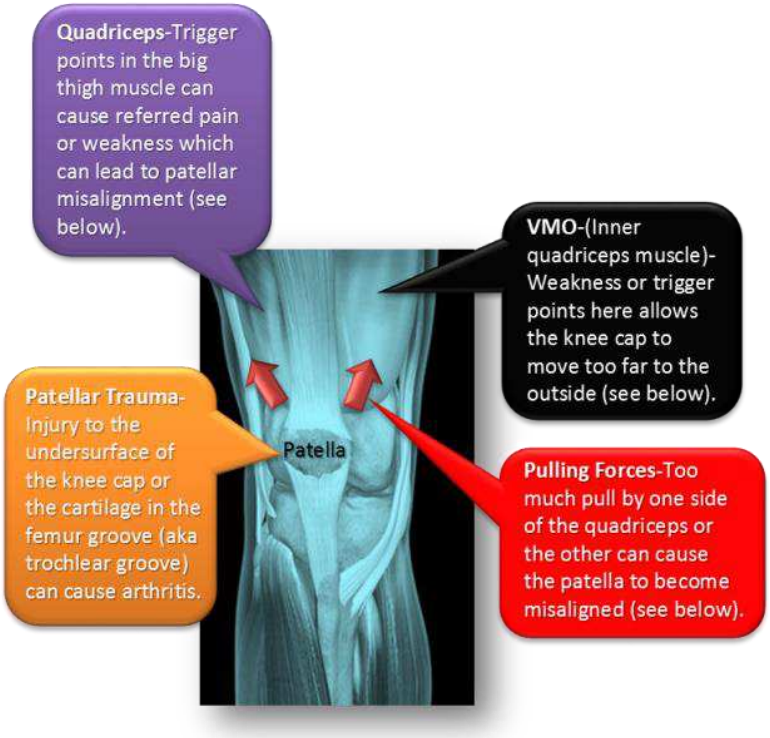
So, we just learned that trying to fix small alignment errors that can lead to big problems over time with surgery isn't such a good idea. Is there a better way to approach this problem? Yes, but it requires more thought. You know the song: "The hip bone's connected to the leg bone…" The same applies here.





We'll start by breaking down the patellofemoral problem on the previous page. The kneecap sits in a groove and is controlled by the surrounding structures (see below). There are two ways the kneecap can rub against the side of the groove. The first is that the kneecap moves out of position and bangs against the side walls of the groove (straight arrows). The second is if the groove itself moves (curved arrows). The groove sits in the femur bone and that bone's motion isn't controlled at the knee but at the hip. Thus, to fully understand kneecap problems, we must first start with the hip and work down.

The femur bone, where the kneecap groove lives (trochlear groove), can move out of place if the hip doesn't have normal motion. The hip range of motion can be controlled by many things, not the least of which is arthritis at the hip. Irritated nerves in the low back can also lead to muscle firing issues in the hip or thigh muscles, which can also impact both the way the hip and kneecap move. Finally, weak muscles due to trigger points can also cause abnormal hip motion. In summary, what happens at your hip impacts your kneecap.

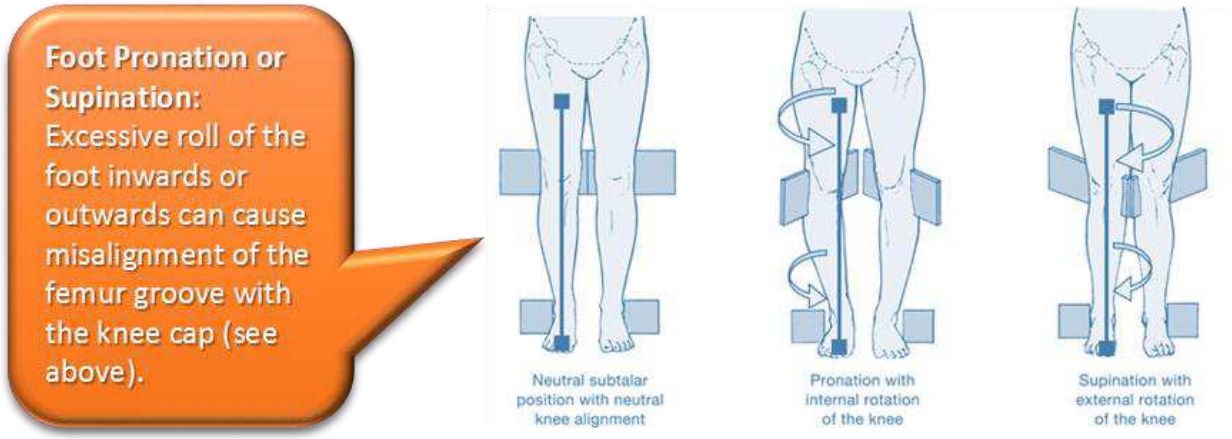


Now let's look at the knee area. The kneecap is a just a small bone that lives at the end of one of the most

powerful muscles in the human body: the quadriceps (aka “the quad”). What happens to these four muscles that make up the quadriceps determines what happens to the kneecap. I’m always dumbfounded when patients show up and are more concerned about the cartilage loss under their kneecap than the status of the main muscle that controls it. The problem is that outside of a short stint in physical therapy, nobody has ever told them that they should be concerned about the muscle. What can happen to the quad? Trigger points in the muscle can lead to parts of it being shut down, so this means that one part of the muscle pulls more than the other on the kneecap. Obviously, trauma to the kneecap can knock off cartilage, leading to arthritis. Ultimately, weakness in one of the muscles that make up the quadriceps (the VMO, or vastus medialis oblique) can also cause more outside pulling on the kneecap than inside pulling, leading to alignment problems.

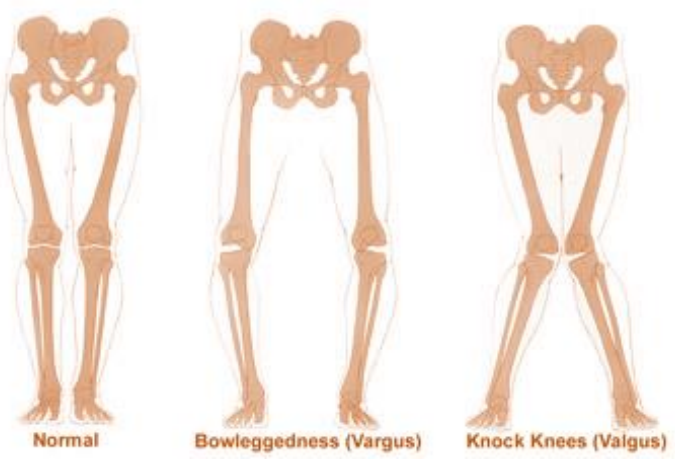
Finally, we have to look below the kneecap to see if anything in the foot and ankle can also lead to problems. The angle of how the foot strikes the ground can impact how the femur groove is rotated at the hip. This will impact the knee as well.

In summary, looking at a kneecap problem as being caused solely by this bone is a bad idea. It’s also related to what happens in the low back, hip, and foot and ankle. So, if you see a physician for a kneecap problem, and he or she only focuses on the knee, know that other possible causes of your problem are being ignored. Why would physicians look at a problem this way? Many times its lack of training, but sometimes it’s because our medical care system rewards more for procedures on a joint than it does for diagnosing how the joint got that way.



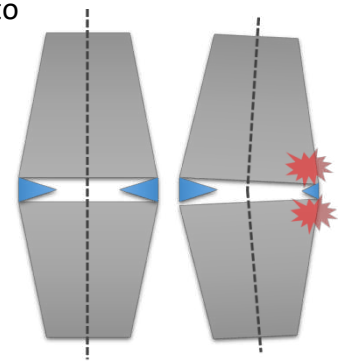
More Specific Joint-Alignment Issues That Affect the Knees

Now that we’ve learned about the complex alignment of something as simple as a kneecap, let’s look at some more obvious ones. First, the knee can be side bent just like the spine can. You’ve

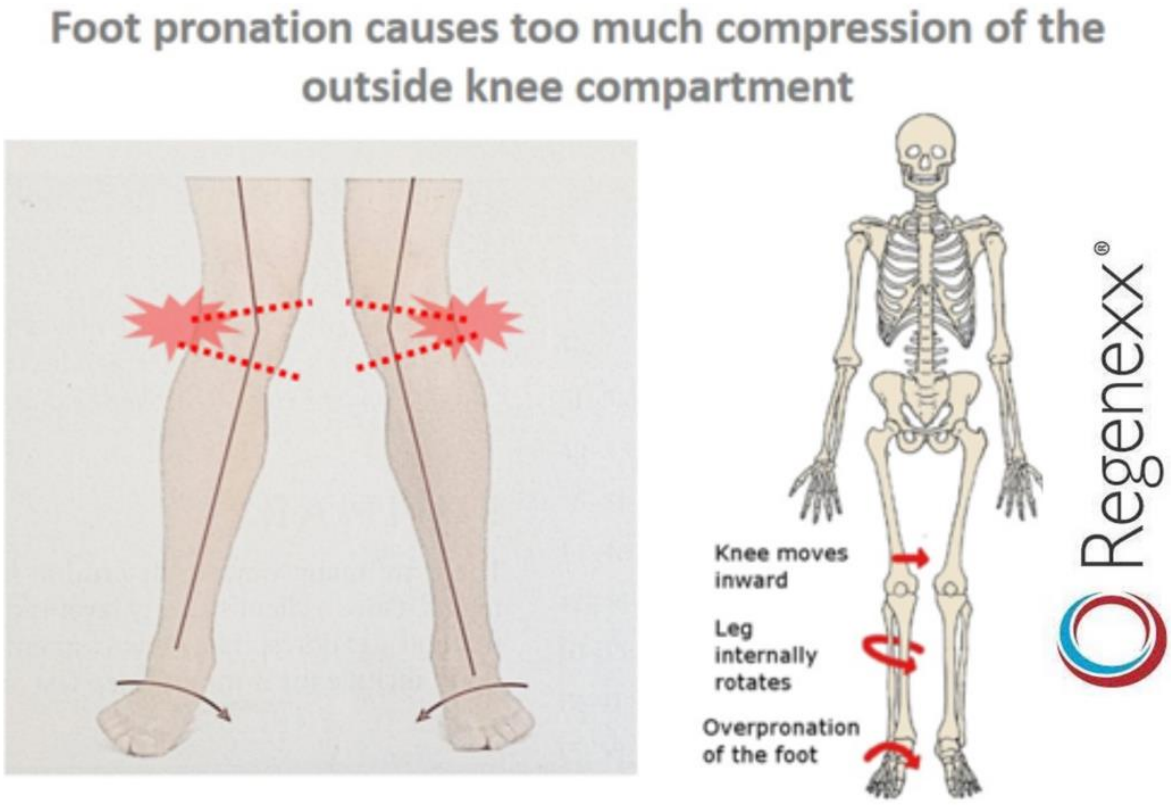


likely heard the term knock-kneed or bowlegged; these are conditions where the knees can be bent so that they touch (knock-kneed, or what doctors call valgus) or are too far apart (bowlegged, or what doctors call varus).

While people can be born this way, the leading cause of one knee going side bent is the removal of all or part of one meniscus surgically, which causes that one side to lose its spacer. The knee then collapses toward that side, putting much more pressure on the cartilage, which can lead to more arthritis. One solution often proposed is a high tibial osteotomy (HTO), a surgery where a wedge of bone is removed from the lower bone of the knee on the high side to even out the forces. The good news is that it does seem to help but the bad news is that it's a big surgery, and one way to prevent ever having to do this is to not remove pieces of the meniscus in the first place.



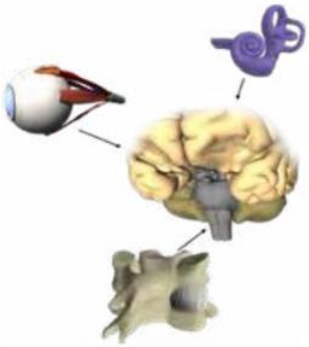
Foot Pronation

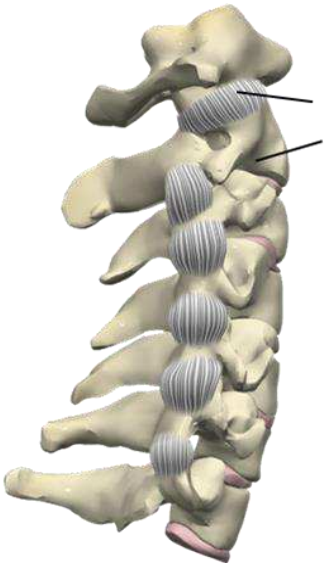


When your foot rolls inward, this is called pronation, often causing knee and hip alignment issues, such as knock-knees. This can also cause the hip to internally rotate, overloading different parts of both of those joints. So sometimes, correcting a knee issue means correcting what's going on at the foot. Pronation can also be caused by irritated nerves in the back making the supporting leg muscles weaker.

The Master Control System for Body Symmetry

The upper neck is a special area with respect to alignment and posture. Most of us have heard about the balance system that involves the inner ear. However, our balance system is very complex. A bit like a NASA spaceship, it has triple redundant systems, so that if one fails to provide enough information about balance, another system will automatically take over. This makes sense, since the loss of balance perception is not compatible with leading an active life and fending for yourself. Our balance system, therefore, has three inputs (as shown on the right): the inner ear, the eyes, and the upper neck joints. For many years, the focus has only been on the inner ear, but these other two systems are equally important and play into symmetry.

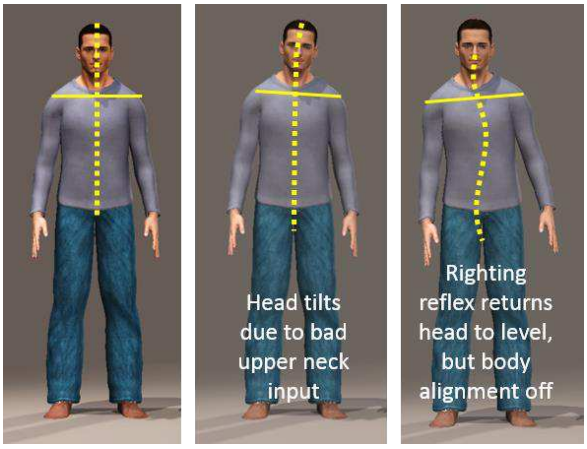




What part of the upper neck seems to be the most important for body symmetry? A number of years ago, a team of researchers started killing the little nerves that took information from the C2-C3 joints. The goal was to help alleviate the pain associated with these joints yet, while the pain got better, these patients all became very dizzy. The researchers were confused. While they knew about the inner ear being involved in balance, they didn't know about the upper neck. This misconception still exists in medicine today, with the vast majority of doctors not knowing about "cervicogenic dizziness," or dizziness coming from the neck, despite published research on the phenomenon. Based on the research, the C2-C3 area and upper neck muscles, as well as the sternocleidomastoid muscles, all seem to be implicated.

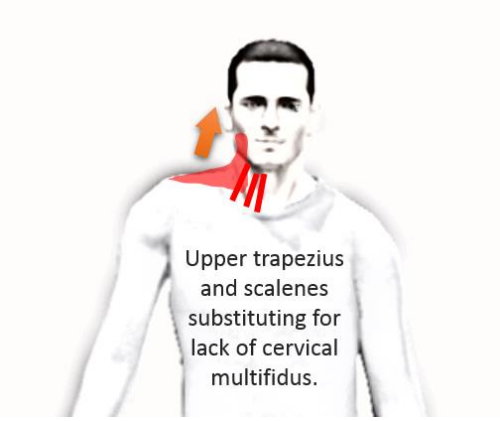
So, what does this have to do with alignment? Recently, some Australian researchers have determined that patients with whiplash injuries have difficulty in determining which end is up. Literally, their necks don't have the same proprioceptive ability as normal subjects. We believe this is due to injury of the upper neck joints, which is common in this type of injury. We also see this same type of problem in patients who have injured the upper neck in the past or, for some reason, have chronic arthritis at C2- C3 or the high upper neck.

These patients often have a head tilt. When I correct the head tilt on exam so their heads are straight, they feel crooked. Why? The upper neck joints are giving bad information about normal posture. This bad data causes the patient to tilt the head, but this strange position feels normal to the patient. The "righting reflex" then kicks in to keep the eyes and head level while standing. This causes the patient to tilt the body to one side to compensate, as the neck stays bent. This then causes all sorts of problems with arms frequently getting numb (usually on the little-finger side of the hand) from thoracic outlet syndrome (the nerves in the shoulder getting pinched). In addition, notice above how this causes the spine to bend sideways and can impact areas all the way down to the pelvis. It can even alter how one side of the leg and foot strikes the ground. As a result, in looking at alignment, one must always consider how it interfaces with this master balance-control system.



Can Alignment Be Impacted When the Spinal Stability System Goes Off-Line?

One of our physical therapists was tasked with seeing if the multifidus muscle in the neck showed signs of atrophy, like in the lower back, and he was able to prove (later as part of his PhD thesis) that this does occur. When these small segmental stabilizers go off-line, something else has to kick in to stabilize the neck. In the neck and shoulder, the muscles that kick in are the trapezius, levator scapula, and scalenes (and sometimes jaw muscles). These muscles were never designed to be stability muscles, so they quickly get overloaded. As they get tighter to stabilize the neck, they can bring one shoulder higher. This causes the attachments of the muscles to get angry, as they were never designed to handle this type of excessive loading.



This is called enthesopathy and is discussed elsewhere. In addition, the upper trapezius and scalenes both have nerves nearby or traveling through them, so when they get too chronically tight, these nerves get in on the act. For the upper trapezius, the occipital nerve can get irritated, causing headaches. For the scalenes, the brachial plexus can get pinched, again leading to thoracic outlet symptoms with numbness in the little finger of the hand (ulnar or lower trunk of the brachial plexus distribution).

The Great Adaptation Machine

Our bodies were designed to keep moving at all costs and are great at adapting to problems that may develop in the human machinery. In a preindustrial society, the amount of physical prowess it took to collect, hunt, process, and consume food was vast. In such a society, the potential for injury from a runaway animal or even a rockslide was also high. The only way for us to sustain injury and keep going was to design the musculoskeletal system to be an adaptation machine. What does this mean?

Let's take a left-shoulder injury and begin simply. With an injured left shoulder, you instinctively transfer more arm and shoulder motion to the right. This takes pressure off the left so it can heal. This strategy works because we were meant to heal on the go. For example, in weight-bearing joints, studies where patients are asked to bear more weight on an injured or operated area (different from the current non weight-bearing orthopedic healing paradigm) show that healing with weight bearing is better than extended periods without weight on the joint.

Yet, the great adaptation machine gets far more complex. I have noticed that in chronically injured patients, the system is constantly rearranging forces to be able to off-load certain areas. An example is my own minor chronic neck, upper back, low-back, and leg symptoms. At times, my left scapula will hurt; at other times, my biceps tendon; and at others, my low back. I can feel my body rerouting forces through adaptation, from one site to the next. When the neck stabilizers go off-line, or when they are too taxed from my heavy-weight-lifting routine, the big neck muscles take over, and the upper trapezius, levator scapula, scalenes, and SCM fire up. And, what happens when these muscles complain too much? My body reroutes the forces to the front of the shoulder by moving the scapula forward, but this aggravates the biceps tendon. If and when this causes the biceps too much pain, my body reroutes those forces by turning the rib cage, which causes the low back to get torqued, and so on. This complex neuromuscular response has allowed us for millennia to continue to function with injury. So we can survive.

For patients and medical practitioners, this adaptation process often feels like peeling back layers of an onion. Again, at its simplest (the injured left-shoulder analogy), since the left shoulder is putting extra work on the right, it may come as no surprise to the patient that the right shoulder begins to hurt as a result of excessive use. However, most patients fail to recognize the more complex adaptations. This means that they are completely unaware that the problems in all of these areas are related. In addition, physicians will often only go for the "low hanging fruit" of where it hurts, today. But again, this approach avoids the salient question, How did all of this get this way? Merely treating the part that hurts is only be a temporary fix, as this part will soon be overloaded again.

How Do I Know if I Have an Alignment Problem That Could Be Affecting My Shoulder?

First off, I've only scratched the surface here concerning common problems with alignment. My aim was to introduce the concept, not list all things that an experienced musculoskeletal expert would see in daily practice.

At its simplest, patients with alignment problems have one-sided pain or arthritis in the absence of specific trauma. For example, while they may have both shoulders that hurt, the right hurts much worse than the left—and an MRI or X-ray of both shoulders shows one has much more severe arthritis than the other. Examples of alignment issues can often be seen when looking in a mirror or asking your friends to look at you. You may notice that one shoulder is higher than the other, or the head is slightly tilted to the right or left, or that one hip is higher. Looking at wear-patterns on clothing and shoes can give more clues. Does one shoe wear more than the other? Does one part of the sole of one shoe wear more than the other parts? Does one part of your pants wear out faster than another? Is it easier to hold a handbag or backpack on one shoulder or the other? When you're active, are you dramatically stronger on one side versus the other (more than you would expect based on being right or left handed)?

If I Have an Alignment Problem, What Else Can I Do About It?

The good news is that there are many therapists and practitioners who specialize in alignment. These concepts truly began shortly after the turn of the century, when traditional allopathic medicine was in its infancy and unable to address what seemed like obvious problems to nonphysicians. The pioneers were Moshe Feldenkrais, Ida Rolf, and Matthias Alexander. I was introduced to these geniuses when I realized that in the early 1990s (just out of residency) these issues were still not being addressed by physicians—and the concepts I've discussed were not part of my training in physical medicine and rehabilitation. To remedy this deficiency, I took to reading the old works of these masters to glean what I had never been taught as a modern physician.

Newer systems such as Pilates, Muscle Activation Technique, Myofascial Release Approach, and Egoscue have added to the diversity of treatment methodologies that address various aspects of posture and alignment. In addition, curve restoration has now become a scientifically vetted medical art.

A caution: while some physical therapists have spent years learning advanced biomechanics, they are few and far between. The standard course of physical therapy education contains very little about how to identify and address common alignment problems—despite one of the early geniuses of muscle function actually being a physical therapist (Florence Kendall). So, if you've tried and failed physical therapy, it's unlikely that you actually saw a physical therapist with proper training in the art of biomechanical and alignment analysis and treatment.

Brief descriptions of the alignment concepts follow. Click on the links to learn more.

- Rolfing: Sounds a bit like the vernacular for vomiting, but it's actually named after the founder of the method, Ida Rolf. The focus is on very rigorous deep-massage techniques to free up areas of muscle and fascial tightness with the goal being to restore normal posture and alignment. This is generally accomplished in 10 sessions.
- Alexander: Matthias Alexander was a turn of the century orator in a time before the electric amplification of voice. He figured out that certain head and neck positions allowed the speaker to project his or her voice better in an auditorium. This was later applied to "sick" performers to improve their performances. This is now a system of treatment focused on head and neck alignment popular with stage and theater performers.
- Muscle Activation Technique: Developed by athletic trainer Greg Roskoph and based on the concept that certain muscles can become less active based on injury and certain patterns of movement, the focus is on balancing the moving biomechanics of the body by "turning on" these inhibited muscles.
- Myofascial Release: Pioneered by Arizona massage therapist John Barnes, the focus is on trigger point massage to release or free up tight muscles leading to poor body alignment. There is less focus on overall body posture than in Rolfing.
- Egoscue: Begun by Pete Egoscue, this system focuses on activating and strengthening specific muscles with specific exercises to restore normal body alignment and posture. This system has become popular with physical therapists wanting to increase their knowledge about biomechanics.
- Feldenkrais: Developed by Israeli physicist Moshe Feldenkrais, the focus is on alignment in simple movements.
- Curve Restoration: The gurus of this now scientifically-vetted field are the Harrisons, chiropractors who have published their results in peer-reviewed medical journals for years. They use very specifically designed forms of specialized traction to restore the normal curvature. They have also designed home units so that patients can try to deal with this problem in a do-it-yourself program.

Chapter 12
Getting Out of the Hole

The goal of this book is to provide additional information for those patients who want to take the understanding of their problems further—to go from an educated participant in their own recovery to a leader of that recovery. And, while I've only had a few patients make it this far in their understanding, one gentleman who comes to mind. He was an engineer from Canada who moved to Colorado to get care from our clinic. Over time, our office visits became less about doctor leading patient and more about me providing advice about his next steps and what could be wrong. At first it was a bit disorienting, but later became fun.

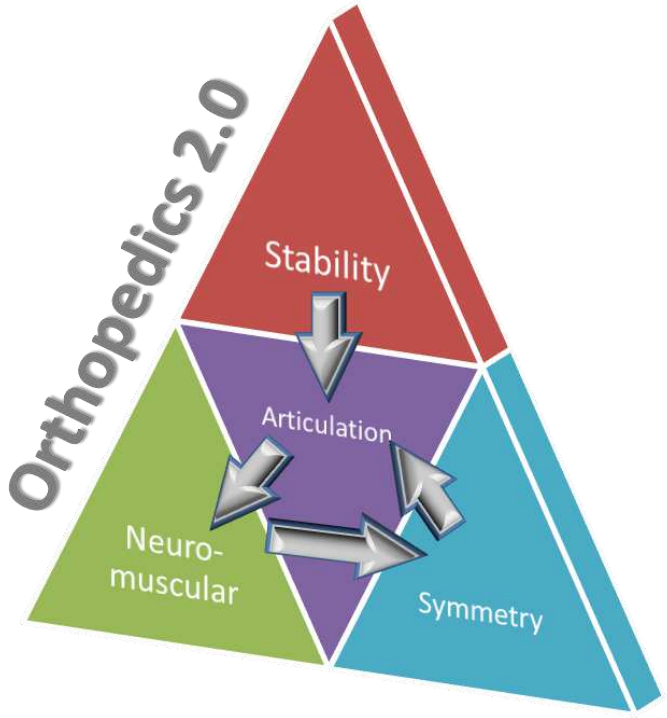
If you're a patient who can't do much without symptoms badly flaring up, this section is for you. First, you need to read this whole book to understand what's wrong. Next, you'll likely need to make some hard choices and follow the process diligently. I call this "digging out of the hole."

What is "the hole"? Your body has all or most of these systems we've talked about seriously involved. Your stability is fried, your joints are beginning to or have already given out, your nerves and muscles are shut down and on fire, and your symmetry is all catawampus. It may take you one to two years to get all of this addressed and to "climb out of the hole."

Where Do You Start?

1. You must get "off the sauce." We've seen an explosion in the prescription of narcotics by doctors after pharmaceutical companies claimed that newer long-acting and very addictive narcotics weren't addictive. Narcotics also take away your natural ability to control pain. So, while they may take away the pain in the short run, they make the pain signals magnified in the long run. As a result, you have to decrease and eventually eliminate your use of narcotics.
2. Reduce the pain coming from various joints, tendons, muscles, and nerves. These problem areas must be first carefully identified. Often this will take an hour or more of hands-on exam, combining many different types of imaging, including ultrasound, MRI, and movement-based studies. Once the areas are identified, then the focus should be on precise biologic injections to ramp up the healing response in these areas.
3. Get rid of muscle trigger points caused by irritated nerves using once or twice a week IMS. This will allow your muscles to begin to participate in providing stability.
4. Slowly work on getting more stable and stronger. This may at first be at very low levels. For example, some patients may have to begin in the pool and then take a few months to graduate to simple and gentle land strengthening. It may take one to two years to work back up to anything resembling a big workout.

5. Fix the bad symmetry that likely got you here in the first place.



Appendix A —Regenexx in Healthcare

The *Regenexx Orthopedic Cost-Reduction Strategy* is a program for self-funded employers to address the rising costs of musculoskeletal care. Currently available to over seven million people across the United States, this program can be easily added to your insurance plan—and offers employees a nonsurgical approach to address their orthopedic pain without the need for invasive surgery.

Orthopedic issues such as osteoarthritis, torn or damaged ligaments and tendons, and various spinal injuries are the most prevalent reasons for doctor visits each year, the cost of these orthopedic injuries exceeding every other healthcare spend category (1)(2). Musculoskeletal (MSK) costs account for 15-30% of overall annual benefit expenses for self-funded employers, with the five-year average across all employers at 20% (3). The cost to treat major musculoskeletal issues—which often includes long-term pain management *and* disability—outpaces treatment costs for cancer, heart disease, and even diabetes (3).

Sadly, these costs are passed on to the consumer, increasing personal debt and causing many to delay the care they need today only to make their injury more difficult to manage tomorrow.

As described in this book, *Interventional Orthopedics* serves as a new step in the continuum of orthopedic care that can treat as many as 70% of structural problems without the need for invasive and costly surgeries*, and at significantly reduced cost.

And again, the *Regenexx Orthopedic Cost-Reduction Strategy* for self-funded employers can be easily added to health benefit plans, providing employees access to these procedures with coverage from the plan.

The Regenexx approach reduces the need for many elective orthopedic surgeries, providing significant cost-savings compared to the current orthopedic care continuum.

If you work for a company with roughly 200 or more employees, chances are they are self-funded. Please discuss the cost-saving strategy with your Human Resources or Benefits Department and have them contact Regenexx directly to see if our strategy can work for your company.

www.regenexxcorporate.com

References

1. https://www.mayoclinicproceedings.org/article/S0025-6196%2812%2901036-1/abstract

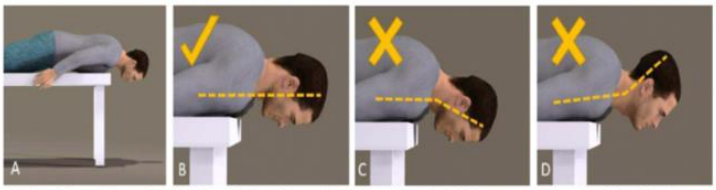
2. https://www.ribgh.org/documents/resources/Leading_Drivers_of_Employer_Healthcare_Spending_Growth.pdf

3. https://www.cnbc.com/2019/08/13/employee-health-benefits-costs-expected-to-rise-5percent-in-2020-new-survey-says.html

* This applies only to elective orthopedic surgery without fracture-related care or acute trauma

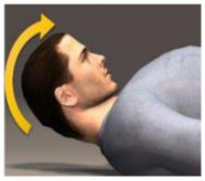
Appendix B—Worksheets

These begin on the next page.



Write down your time: __/20 seconds

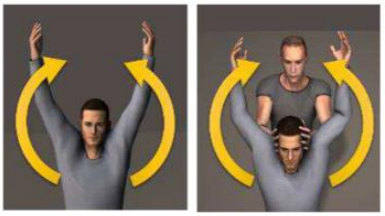
Lie face down with your head off the end of a table or a firm bed as shown in A. Make sure your chest is stable and hold your head straight as shown in B. Time your endurance. When your head begins to fall downward or extend due to fatigue (as shown in C and D), the clock stops.



Write down your time:
Men:___sec/38
Women:__sec/29

Tuck chin and lift head about 2-3 inches and time. If any loss of height or chin tuck occurs, then stop timing. Normal is 38 sec for men and 29 sec for women.

__3-No difference between with and without the head hold
__2-Noticeable difference with arms all the way up
__1-Noticeable difference with arms above shoulder but not all the way up
__0-Can't get your arms over shoulder height



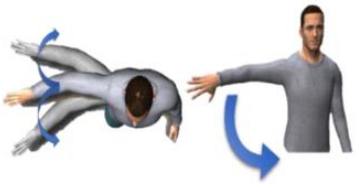
Lift arms above head all the way. Then have someone hold head firmly and retest. Fail if it's easier to lift the arms with head hold.

Lie on your stomach on a stiff pillow and extend your back so that your chest is off the floor and hold. Time how long you can hold this position.

Write down your time:
Men:___sec/208
Women:__sec/124

Make sure your head/neck are flexed!

__3-Able to do 30 reps easily w/o pain
__2-Much effort to get to 30 reps or pain with same
__1-Unable to finish 30 reps due to fatigue or pain
__0-Can't perform at all



With arm out to the side with the **thumb down**, move the hand completely down and up in the three planes noted. Pass is at least 10 reps slowly (30 up-down movements.

Stand and balance on one leg and then perform a single leg deep knee bend. Hold for 10 seconds.

Write down your time:
Right:___sec/10
Left:__sec/10

The clock stops when you lose any stability or look like the picture on the right!

Stand on one leg as shown and try to balance while holding the ankle steady. Record the number of stable seconds for each side. The clock stops when your feel the wobble.

Write down your time:
Right:___sec/10
Left:__sec/10

Lie on your back with your hips and knees both at 90 degrees and lift your torso off the ground. Time how long you can hold this position.

Write down your time:
Men:___sec/182
Women:__sec/85

Make sure your head/neck are flexed!

STABILITY

Self Assessment Sheet

Regenexx®

www.regenexx.com

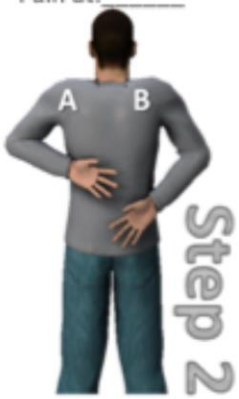
Regenexx Symmetry Test

Please fill out where you have tightness or pain by recording the letters on the figure that correspond to your problem areas. For example, in Step 1, if you have pain in the right shoulder with this stretch, you would place "A" in the blank for "Pain at___".

Tightness at:_____
Pain at:_____

Tightness at:_____ Pain at:_____

Tightness at:_____
Pain at:_____



Tightness at:_____
Pain at:_____

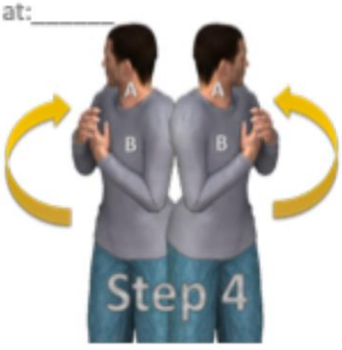
Tightness at:_____ Pain at:_____

Tightness at:_____ Pain at:_____

Tightness at:_____ Pain at:_____

Tightness at:_____ Pain at:_____

Tightness at:_____ Pain at:_____



Tightness at:_____ Pain at:_____

Tightness at:_____ Pain at:_____

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About the Author

Christopher J. Centeno, MD, is a specialist in regenerative medicine and the new field of interventional orthopedics. He is board certified in physical medicine/rehabilitation and in pain management through the American Board of Anesthesia.

Dr. Centeno is one of the few physicians in the world with extensive experience in the culture expansion of and clinical use of adult stem cells to treat orthopedic injuries. He is a founding member of the International Cellular Medicine Society. His clinic incorporates a variety of pain management techniques, and he treats patients from all over the United States and the world who travel to Colorado to undergo innovative, nonsurgical treatments. Dr. Centeno's clinical practice in Colorado (The Centeno-Schultz Clinic) has a state-of-the-art cell biology research lab, a bioengineering department, and a clinical research arm.

Dr. Centeno has chaired multiple international research-based conferences. He also maintains an active research-based practice, with multiple publications listed in the U.S. National Library of Medicine. Dr. Centeno has also served as editor in chief of a medical research journal dedicated to traumatic injury. He has lectured all over the world on regenerative therapies, including at the Vatican in Rome.

Dr. Centeno trained at the Baylor College of Medicine, Texas Medical Center, and the Institute for Rehabilitation Research. He hails from both Florida and New York and currently resides in Boulder, Colorado, with his wife and three children.

Resources

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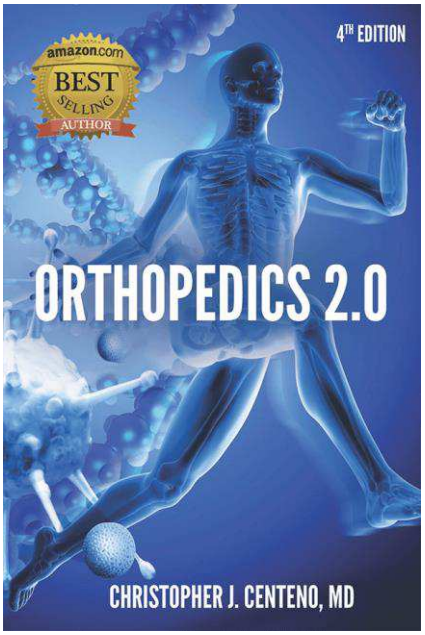


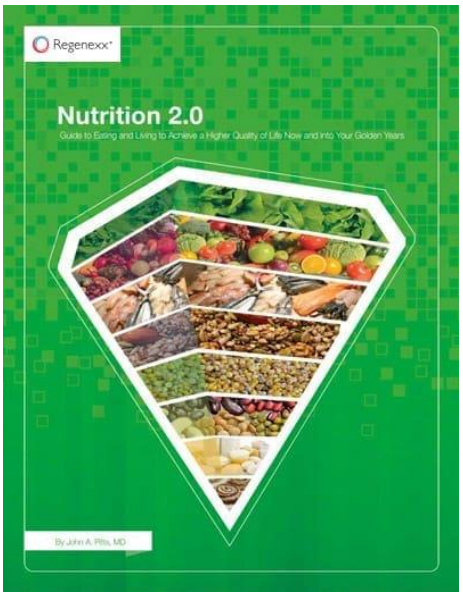
Orthopedics 2.0: How Regenerative Medicine and Interventional Orthopedics will Change Everything

By: Chistopher J. Centeno, MD

Written by Dr. Chris Centeno, this e-book delves into the human musculoskeletal system and explains how everything works together in concert to maintain our physical wellbeing. When a single component in this chain is damaged, it can lead to a cascade of joint, spine and connective tissue problems, resulting in chronic pain.

Using the Regenexx SANS approach, Orthopedics 2.0 walks you through a series of tests and exercises that you can do on your own to better understand where your own body is struggling to maintain proper stability and alignment, explaining the possible reasons and long term implications along the way. Orthopedics 2.0 also explores how Regenexx is pioneering the new field of Interventional Orthopedics, where the use of regenerative biologic treatments, such as adult stem cell therapy and platelet rich plasma, are being used to help repair and strengthen damaged tissues, as opposed to invasive surgeries that often remove important tissues when a joint or the spine becomes damaged.

With hyperlinks to more detailed information, related studies and commentary, this book condenses a vast amount of data and resources into an enjoyable and entertaining read. This is the fourth edition of Orthopedics 2.0 with even more content and graphics.

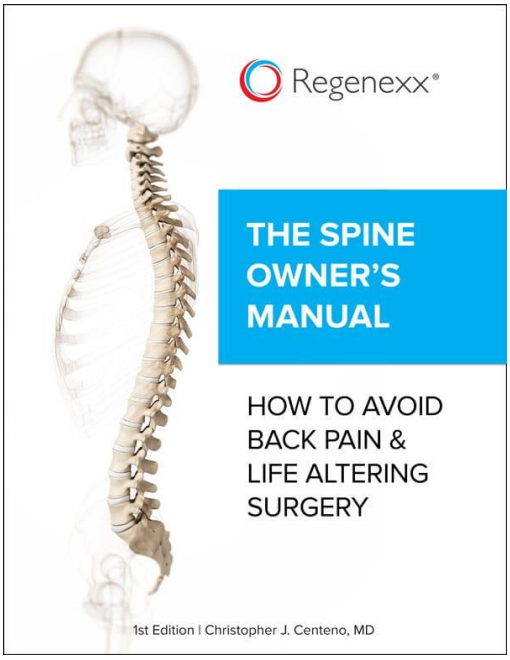


Nutrition 2.0: Guide to Eating and Living to Achieve a Higher Quality of Life Now and into Your Golden Years

By: John Pitts, MD

Nutrition 2.0 is a concise guide to eating and living healthy, written by Regenexx regenerative medicine doctor, John Pitts. The book gives a basic foundation of information on mostly diet, but also supplements, physical activity, and

stress-relief to improve your life. It explains complex topics in simple terms. The book reveals the negative effects of sugar and high glycemic index carbohydrates and differentiates between "good" and "bad" sources of protein and fats. Dr. Pitts' food pyramid is a much needed update to the outdated food pyramid the FDA recommends. This book also dispels common nutrition myths, discusses some common supplements, and gives practical advice on how to obtain an appropriate amount of physical activity. Following the suggestions given in the guide can help you feel and look younger, prevent and supplement treatment of chronic diseases, maintain an active lifestyle, plus help you lose weight in a healthy way and keep it off. This guide is not a magic formula or quick fix program that will suddenly cure all your ailments. Nutrition 2.0 teaches you simple measures that you can implement into your daily life that require some adjustment, commitment, and dedication, but will provide a lifetime of results.

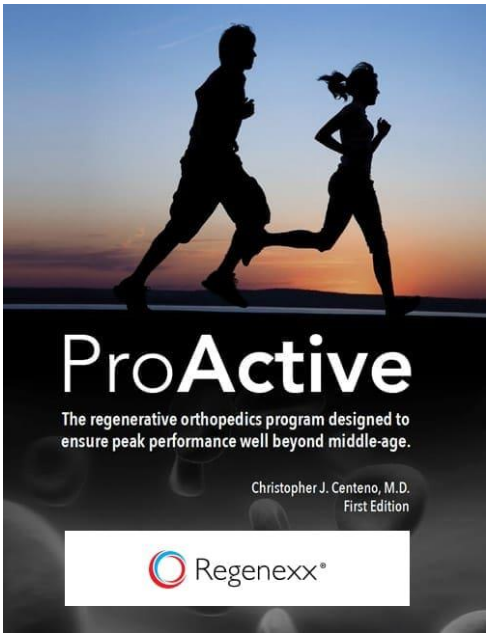


The Spine Owner's Manual: How to Avoid Back Pain and Life Altering Surgery

By: Christopher J. Centeno, MD

Written by Dr. Chris Centeno, this e-book delves into the spine and how it functions within the human musculoskeletal system and the body as a whole. Everything within the body works together, like a precisely tuned symphony, to support our well-being, and a healthy spine and all of its component parts (e.g., spinal nerves, ligaments, muscles, etc.) are critical to full-body health. When a single component in the spinal chain is damaged, it can lead to a cascade of problems not only in the musculoskeletal system but throughout the body and even further spinal damage when it goes untreated. The result is chronic pain anywhere in the body that with the proper diagnostic approach can be traced back to the damage in the spine. Using the Regenexx SANS approach, The Spine Owner's Manual provides a series of tests and clearly defined exercises that you can do on your own to measure and monitor your own spinal health. It will allow you to investigate where your own body might be struggling to maintain proper stability, articulation, symmetry, and neuromuscular function and will help you make the connections between these deficiencies in other parts of the body and the spine. The Spine Owner's Manual also explores how Regenexx is pioneering the new field of interventional orthopedics, where the use of regenerative biologic treatments, such as adult stem cell therapy and platelet rich plasma, are being used to help repair and strengthen damaged tissues not only in the spine but in the entire musculoskeletal system. This is contrasted with invasive spinal surgeries, which often remove important tissues or permanently fuse, or immobilize, segments of the spine when it becomes damaged. With hyperlinks to more detailed information, related studies, and commentary, this book condenses a vast amount of data, images, and resources into

an enjoyable and informative read. This is the first edition of The Spine Owner's Manual, a companion book to Orthopedics 2.0.



Regenexx ProActive: The Regenerative Orthopedic Program Designed to Ensure Peak Performance Well Beyond Middle Age

By: Christopher J. Centeno, MD

As we grow older, our body begins to send us warning messages. When these messages are ignored, small musculoskeletal problems can compound until they leave us sidelined from the activities we love. When such issues are left untreated, they can ultimately lead to more chronic conditions and may permanently reset what we consider to be our normal level of fitness, performance, and activity. This is why some people in their seventies can run a marathon while others in their fifties can barely walk a mile. The Regenexx ProActive program provides practical advice on understanding these warning signs and taking action to maintain peak performance through middle-age and beyond. ProActive explains how the use of biologic treatments such as stem-cell and blood-platelet procedures can help return joints and the spine to a healthy state before things go awry ensuring that small problems don't go from bad to worse.

The Knee Owner's Manual: How to Avoid Game Changing Invasive Knee Surgeries and Stay Active as You Age

By: Christopher J. Centeno, MD

This e-book by Dr. Chris Centeno examines the knee and its role within the human musculoskeletal system and the body as a whole. Using the Regenexx SANS approach, The Knee Owner's Manual provides a series of tests and clearly defined exercises that you can do on your own to measure and monitor your own knee health. It will allow you to investigate where your own body might be struggling to maintain proper stability, articulation, symmetry, and neuromuscular function and will help you make the connections between these deficiencies in other parts of the body and the knee. The Knee Owner's Manual also explores how Regenexx is pioneering the new field of interventional orthopedics, where the use of

regenerative biologic treatments, such as adult stem cell therapy and platelet rich plasma, are being used to help repair and strengthen damaged tissues not only in the knee but in the entire musculoskeletal system. This is contrasted with invasive knee surgeries, which often remove important tissues or replace the entire knee itself when it becomes damaged. With hyperlinks to more detailed information, related studies, and commentary, this book condenses a vast amount of data, images, and resources into an enjoyable and informative read. This is the first edition of The Knee Owner's Manual, a companion book to Orthopedics 2.0.

Index

This section is both for patients to find various subjects that might interest them and for physicians to highlight certain “homework” reading assignments for patients.

S

T

V

W