

Shoulder Rotator Cuff Tendinosis & Tears

An Interventional Regenerative Medicine Approach

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Introduction:

The shoulder joint is the most mobile joint of the body. With this kind of mobility in a joint, there is more likelihood of developing soft tissue injuries, and balance, instability, and breakdown of the rotator cuff tendons and soft tissues that can lead to persistent pain. It is not uncommon for most individuals to periodically experience shoulder pain on and off through their lives. Some however, experience persistent pain that can alter their quality of life, and function. The rotator cuff of the shoulder is a common source of persistent shoulder pain. Conventional conservative treatment often involves anti-inflammatory medications, physical therapy, various soft tissue manipulation techniques, as well as graded and specific exercises often directed at correcting muscle imbalance and “impingement” which we will described later. Many of us however have developed more advanced disease within the tendons of the rotator cuff that may not be conducive to conservative management. One can waste a significant amount of time and financial resources directed to ongoing physical therapy and treatment where there is little progressive improvement. Many individuals have reached a point where the rotator cuff tendon pathology has become advanced enough that these interventions are going to continue to be ineffective.



Many may seek opinions from orthopedic surgeons and some may be given surgical options. Many would also like to know what the “non surgical options” that are available. Many may have more extensive degenerative pathology, but yet still not have a condition that would warrant a surgical procedure or respond to a surgical procedure. These patients are seeking answers to questions and options for management. They are seeking advanced treatment options and turn to physician specializing in regenerative orthopedics a new and growing field in medicine. This article will review some of the more salient aspects or details of rotator cuff pathology and why patients may not be improving with conservative treatment. We will also discuss the pathophysiology of rotator cuff tendinosis and rotator cuff tears

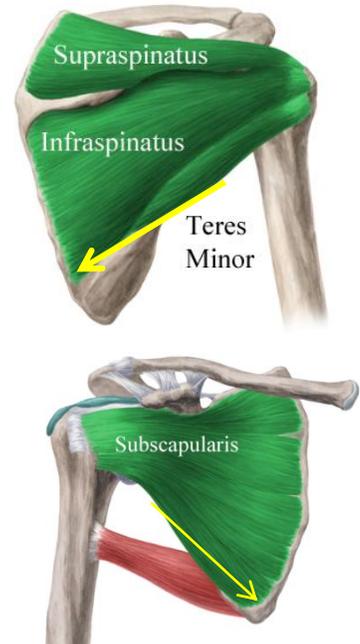


and discuss a host of nonoperative treatment options that are currently available at our 6 centers nationwide.

The rotator cuff:

There are 4 muscles in the shoulder depicted in the picture to the right that as a group we refer to as "rotator cuff". These muscles include the subscapularis muscle in the front of the shoulder, the supraspinatus on the top of the shoulder and the infraspinatus and teres minor in the back of the shoulder. The biomechanics and function of these muscles are very complex. All of these muscles originate off the scapula and attach to various locations on a bony prominence of the humerus. Because as a group a significant portion of the function of these muscles is rotational movement together these muscles have been called "rotator cuff". There are many more functions of the rotator cuff which we will briefly discuss in this article. Once one begins to understand the anatomy and function of the rotator cuff you can begin to appreciate how easily degenerative disease and injury can affect these muscles.

The picture to the right is a view of the scapula (shoulder blade) from both the front and back view. You will see 3 important muscles of the rotator cuff from this view. In addition to fine tune control of motion of the shoulder these muscles also play an important role in providing stability of the shoulder joint. You will notice that many of the fibers of these muscles exert a downward pull as depicted with the yellow arrows noted to the right. It is this downward pull that lowers the head of the humerus so that the tendon and bursa on top of the shoulder can clear a shelf which we will describe later. This is also why we attempt to strengthen these muscles for many conditions of the shoulder also described later.

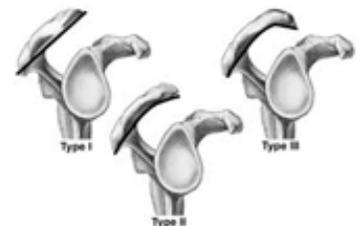


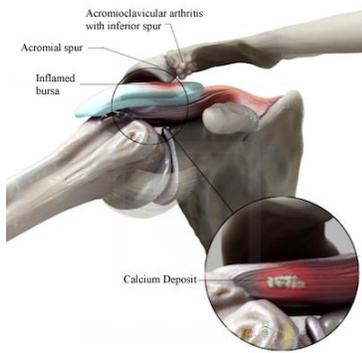
If you look at the shoulder from the side view you will notice an arch that forms the roof of the shoulder joint. This is noted by the orange colored line in the picture to the left. Notice part of the arch is bone (the acromion process) and part of it is ligament (coracoacromial ligament). A critical element in shoulder biomechanics has to do with this arch. Several of the rotator



cuff tendons can be found under this arch depending on the motion and position of the shoulder. There is also an important bursa underneath the shelf also noted in the picture to the left. When you elevate your arm the tendons of the rotator cuff and the bursa underneath the shelf must "clear" the shelf in order to slide under the arch. There are many conditions that can affect the ability of the soft tissues that are under the arch to clear as you

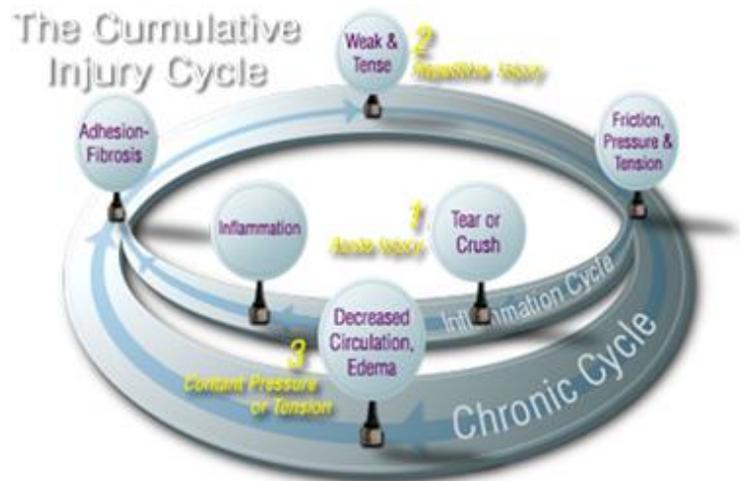
elevate your arm. The bony portion of the arch (acromion) that forms a shelf over the shoulder can be shaped differently from person to person. As you can see in the picture to the right it can be flat, curved or even hooked.





There are also many other congenital anomalies that can affect the shape of the shelf and narrow the space for the tendon and bursa to travel under it. If this shelf is hooked, or down-sloped the bursa and the rotator cuff can get pinched underneath this arch when you elevate your arm. The collar bone (clavicle) joins this bone to form a joint called the acromioclavicular joint named because of the two bones that make up the joint. One can also develop arthritis of this AC joint and bone spurs develop that point downward toward the bursa and rotator cuff tendon (supraspinatus). With normal motion of the arm especially with elevation of the arm one can now cause causing wear, tear and inflammation of the rotator cuff tendons underlying the arch. This is shown in the picture on the left.

With repeated microtrauma day after day eventually this can lead to cellular changes in the tendon. As the tendon is repeatedly compressed through impingement of the tendon under the arch the tendon changes over time. There are special cells in the tendon that undergo a transformation from this constant stress. The cell type actually changes from normal tendon cells to cartilage cells !! Now you may ask what would a cartilage cell be doing inside a tendon? As the tendon is worn and under excess stress there is a lack of oxygen delivered to the tendon. So, the body lays down cartilage cells rather than tendon cells. Cartilage cells do not require much oxygen to survive and thus it is the cartilage cells that are used to replace tendon cells. This causes problems for the tendon.

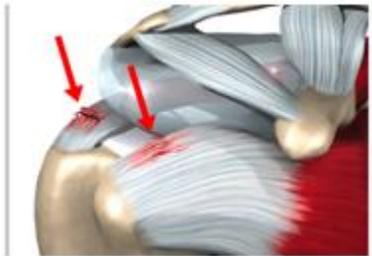


The normal tendon tissues are well designed to tolerate great tensile loads. But that is not the job of a cartilage cell. A cartilage cell normally lays down substances in cartilage like glucosaminoglycan and calcium. The process of laying down these substances within the tendon cause the tendon to thicken. Calcium deposits is a late finding indicating advanced degeneration of the tendon structure. The tendon becomes weak and is no longer able to hold up under the stress of shoulder motion and spontaneous small disruptions within the tendon begin to ensue at the attachment to bone. At the site of these small tears there is inflammation pain and poor healing potential. Healing of the tendon is often incomplete and the tears reform and a chronic inflammatory processes is set up that can cause persistent shoulder pain. This pain can worsen with use of the shoulder. Today there are a number of physiatrists who are becoming experts in using ultrasound to examine the tendons and look for these changes in the tendon. More on that later!

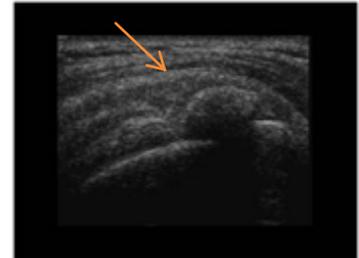
Progression to the rotator cuff tear:

With further stress and degeneration of the rotator cuff tendon small microscopic tears described above can coalesce into larger tears. In addition, where the tendon has become degenerated and it loses its

tensile strength and can spontaneously rupture. This is why so many people do not know what they did to cause such a problem. It is more often than not that the tendon tears occur as a result of cumulative stress on the tendon over years rather than a specific injury. Some of these tears can occur only part way through the tendon which we call "partial thickness tears". At other times the tendon can rupture or tear all the way through the entire tendon which we call "full thickness tears".



You can see at the red arrows on the left partial thickness tears of 2 of the rotator cuff tendons under the arch. Calcifications can easily be seen under ultrasonography examinations which I perform on all shoulders that I examine in the clinic. The



reason I perform such careful ultrasonography examinations of my patient's shoulders is the details of degenerative pathology that I can see on the ultrasound images. Modern ultrasonography machines now available for physicians provide a very sophisticated method examination for the modern musculoskeletal and orthopedic practitioner to evaluate patients with orthopedic pathology during a routine office examination. When a patient sees an expert musculoskeletal ultrasonographer their experience is very unique. No longer are they seeing a physician or other

health care practitioner that is "poking around" on your shoulder in the process of doing a physical examination and trying to tell you what's wrong with your shoulder. With a combined physical assessment with ultrasound a well skilled physician can see the disruptions in the tendon structure such as partial thickness tears or full-thickness tears within the tendon on ultrasound. The patient can visualize the screen "real time" and the expert ultrasonographer can easily explain the physical findings. For example the ultrasound image on the left demonstrates a rotator cuff tear noted at the yellow arrow on the left. It has been shown that when ultrasonography examination of the shoulder is in the hands of a well train physician it can be just as sensitive as an MRI in picking up rotator cuff and bursa pathology. The drawback to this process is that ULTRASONOGRAPHY is technically difficult and it takes years of experience to be able to do a thorough examination and interpret the imaging findings obtained on ultrasound. It is advisable to find out how much experience a physician, has in examination and interpretation of ultrasound findings.

The rotator cuff can eventually fail completely leading to a full thickness tendon tear as shown in the picture to the right. Once the tear has progress this far then it requires more advanced intervention which we will address at the end of this article. You really need to know if the tear has occurred early. The reason for this is that sometimes when the tendon tears completely the remaining tendon and muscle retracts back away from the bone and if it is not repaired soon the orthopedic surgeon has a very difficult time pulling it back into place because it scars over. So, when full thickness tears occur it is very helpful for me to know if the tendon is retracting or not. A full thickness tear with retraction is often managed by surgery. A tear without retraction can often be managed by techniques described in this article.



Subacromial bursa and the shoulder pain patient:



A bursal sac is an anti-friction device. Imagine placing 2 or 3 drops of oil into a balloon and rather than blowing it up with air you just tie it with the oil inside. Now, place the balloon between the palms of your hands. If you were to rub her hands back and forth the balloon with the oil and side would function as an anti-friction device. This is very similar to how a bursa functions. There are countless bursa in the body which are strategically placed at areas of increased friction between bone and tendon or between bone and muscle and other locations in the body. We have for example 13 named bursa in the knee, 7 in the hip and 9 in the shoulder. The most important bursa of the shoulder is the largest bursa that lies underneath the shelf of the shoulder that we have been already discussing. This bursa

(subacromial bursa) is an important source of potential shoulder pain since this bursa must clear the shelf and slide under it when you elevate your arm seen in the picture on the top left. With repeated elevation of your shoulder repeated microtrauma of the bursa can occur secondary to impingement. Both the tendon and bursa can be effected leading to inflammation, tendon degeneration and pain. The burse becomes chronically inflamed and produces increased fluid (within the balloon) and it will swell.



The bursa can easily be seen on an ultrasound examination. I commonly evaluate the bursa to determine whether or not the bursa has become thickened or possibly swollen secondary to chronic inflammation. In the picture to the left one can see a needle directed under ultrasound (demonstrated by the orange arrows to the left) into the bursa where we can specifically place anti-inflammatory medications within the bursa and thereby avoiding placing these medications into the tendon and other structures which are actually harmful to the shoulder. We will address how injection under ultrasound guidance has transformed orthopedic and musculoskeletal medicine today.



Treatment of shoulder bursitis:

Typically an episode of shoulder bursitis can be treated with ice, a short period of rest, over-the-counter nonsteroidal anti-inflammatory medications as well as physical therapy. One needs to consider gentle mobilization and stretching through the course of care to prevent the inflammation causing adhesions which can cause an individual to be susceptible to a "frozen shoulder". I have addressed the treatment of frozen shoulder in another article that I have written on that subject. When pain persists it is often secondary to chronic wear and impingement of the bursa and tendon under the arch as we have already described. Many times patients develop thickening of the bursa and we find that it can be quite helpful to place a small amount of anti-inflammatory medication within the bursa. When ultrasound is utilized a well-trained physician can slide the tip of the needle directly into the bursa under direct visualization with ultrasound without making contact with the tendons and other important structures of the shoulder. This decision ultrasound provides improved outcome and accuracy of placement of the medication. We have found with precision injection. A low-dose corticosteroid medication is all that is necessary and we do

not use long-acting high-dose corticosteroids which we do not feel is beneficial to the tissues. A well-placed precision injection can be performed in minutes, bringing about rapid resolution of symptoms rather than months of physical therapy modalities. Often a single injection may be all that is necessary to



She is a

quiet his chronic inflammation down and begin the healing process. Once the shoulder pain begins to rapidly improve one can begin to perform specific exercises to improve the "impingement" syndrome or the condition that may be at the heart of the problem. **Oh and one more thing!** People who are afraid of shoulder injections because they are "too painful" have never had an injection with ultrasound guidance. The reason the injections can hurt is you are touch the wrong thing with a needle and more importantly putting the medication in the wrong area! So with ultrasound guidance our experience is even the "needle phobic" patients find this injections very easy to tolerate.

Are there other medications that can be used besides steroids in my shoulder?

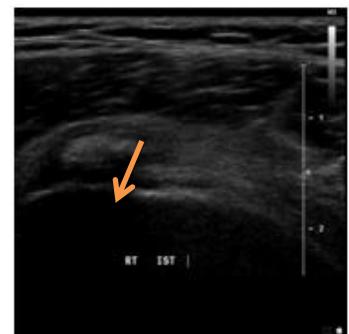
The answer is "yes!" In fact, there are a number of options one can use besides steroids. There is a non-steroid anti-inflammatory medication called Toradol which has been on the market for years. Many physicians have used this for years as an intramuscular medication for acute pain. This has been shown to be actually more effective than steroids in a study presented at the American Orthopaedic Society for Sports Medicine (AOSSM) in 2011. The authors provided an alternative to steroid injection for bursitis.¹

Since I do complementary therapies and integrate them into my orthopedic and pain practice I commonly use alternatives to steroids for bursitis. Vit. B12 can be injected into the bursa for bursitis. There are homeopathic remedies that are made especially for these kinds of injections such as Traumeel®. Now you may recognize Traumeel® this is found over the counter in the form of a cream for inflammation, trauma and pain. The same company makes this in an injectable form as well. I commonly also use a medication called Serapin®. This is a medication derived from the pitcher plant. It has a calming effect on bursitis, arthritis, and nerves as well. It is very common for us to blend vitamin B12, Serapin, Traumeel together with a little local anesthetic and then put just the slightest amount of a corticosteroid in the solution. I do this because I have found it does not take much when you are mixing this sort of "cocktail" for injection. Although I am an injection specialist I really do try to be as steroid sparing as possible in my practice and the complementary medicines are helpful in allowing me to accomplish that. These medications are much more expensive to provide but I still use them without passing on the expense to the patient because I think these are helpful.

Rotator cuff calcific tendonitis:



As we have previously stated many time when the rotator cuff begins to degenerate some of the cells turn into cartilage cells and thereafter deposit calcium within the tendon. The tendon weakens in these regions and makes the tendon susceptible to tears and chronic inflammation. One of the things that we do to treat this in our office is to place a needle under ultrasound guidance and simply inject warm saline into the calcified area then aspirate the calcium out of the



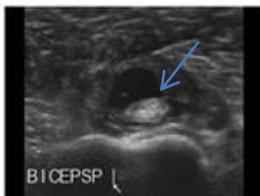
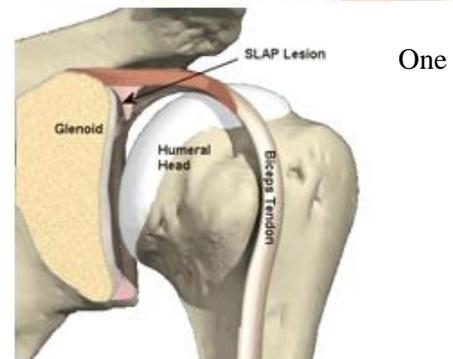
cuff tendon. You may be wondering how that is possible. It turns out the calcified area is not hard like bone but rather soft like toothpaste and therefore easy to dissolve and aspirate with a needle. Once the calcium is broken up in the tendon we do not pull the needle out but rather keep the needle in place and then inject the tendon with PRP (platelet rich plasma) or other regenerative substances such as extracellular matrix proteins and scaffolding or even stem cells from time to time. We have also found over the years that is thorough injections of platelet Rich plasma within calcified regions and tendons can also help the calcified tendons and heal to tendon at the same time. We have been using this technique for many years. We will discuss further the topic of platelet Rich plasma (PRP) in this article. The picture above shows an x-ray of a calcified rotator cuff tendon at the blue arrow. The ultrasound picture to the right shows calcification of the tendon on ultrasound. The calcification can be seen at the orange arrow to the right. One can see how easy it would be to target this area with ultrasound guidance. The outcome of percutaneous ultrasound guided decalcification has been shown to be just as effective as open surgical decalcification.^{2,3} We have empirically had excellent outcome with this technique. We think that adding the PRP injection to this technique has had an added benefit.

The biceps tendon:

Biceps tendonitis is a common source of shoulder pain. It is also common to have biceps tendonitis with in conjunction with other syndromes such as rotator cuff tendonitis, subacromial bursitis, etc. Thus I commonly have to treat the biceps tendon at the same time I treat other sources of pain.



The biceps tendon has 2 tendons which is why they call it the “bi”-ceps muscle. It is named this because of its two tendons. One of the tendons attaches to a bony process called the coracoid process and the long head tendon travels through a groove in the humeral head also shown on the picture to the right. This tendon travels through a tube of connective tissue that secretes fluid that lubricates the tendon so it can glide smoothly through the groove. The biceps tendon curves around the head of the humerus and is under a lot of stress.



Individuals that lift weights and over train or use improper techniques in training commonly develop inflammation of the sheath around the tendon. The sheath can secrete excess fluid which surrounds the tendon and can be seen easily on the ultrasound examination.

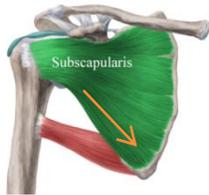
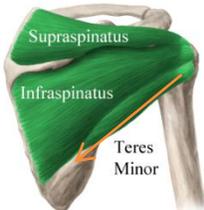
The picture on the left shows an ultrasound examination of the biceps tendon in cross section. Note the black zone around the white dense tendon. This black zone is excess fluid around the tendon. Again this makes the use of ultrasound invaluable when examining a shoulder.

This tendon like the rotator cuff tendon can also degenerate with stress and also can spontaneously tear. If the biceps ruptures completely the muscle will bundle up as shown in the picture to the right. We commonly do injections within the tendon sheath for help quite down inflammation of the sheath. Again we do this under the guidance of ultrasound where we can with great precision place a needle tip into the sheath of the tendon and avoid injecting into the tendon which can damage the tendon. Many doctors inject this tendon



blind and commonly inadvertently inject the tendon which can damage to tendon and make the problem worse.

Shoulder muscle imbalance:



We have already discussed that when we get impingement of the rotator cuff tendon and overlying bursae we can develop pain. When we develop these impingement problems one of the initial strategies to treat impingement is to correct imbalance in muscle strength of the rotator cuff. We also mentioned that most of the cuff muscles exert a “downward pull” on the shoulder and thus pull the head of the humerus down when the arm is elevated. It is this reason that we focus so much on strengthening these muscles when patient present with impingement problems of the cuff tendons and bursa.



We will have you trained properly on how to do these exercises or have a physical therapist train you as part of your treatment program. Correcting any imbalance in strength can have a beneficial effect on your condition. It is also helpful to train these important muscles to maintain stability of the shoulder joint as well. We commonly incorporate plyometric type exercises as well to accomplish this. This will be reviewed in much more detail in another article that we have written about

rotator cuff exercise programs and protocols.

Shoulder instability & rotator cuff disease:

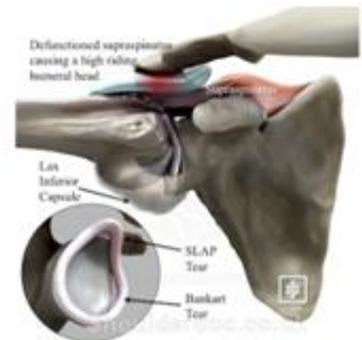


Looseness or instability of the shoulder joint can occur in 3 ways. You can be “born loose, or worn loose”. That means some individuals are born hypermobile and have problems with their joints later in life because of it.



Others have injuries where they damage cartilage, ligaments, and tendons

and other supportive soft tissues of shoulder joint. Some of us wear the joint out for various reasons. Each type of instability has unique features that require different techniques and methods for diagnosis and management. Shoulder instability is a complex subject that we will not discuss in detail and will try and devote another article to that subject. In brief those who are born loose respond to physical therapy and exercise. Those who are torn loose or worn loose often fail physical therapy. When this occurs we have to sort out the cause and get a precise diagnosis. Sometimes surgical intervention is the best recourse depending on your goals and activity level. Sometimes we can prevent having to undergo surgical intervention by strengthening the ligaments of the shoulder. We have a host of different types of injection techniques that can be targeted to ligaments. An example of this would be We prolotherapy and PRP (platelet rich plasma) injections.

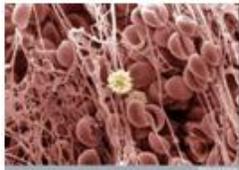


I have devoted an entire article on this topic called regenerative therapy in pain medicine on this web site. I encourage you to read that article. I will discuss PRP briefly below but there are many other methods that can be used to help with ligamentous support some of which will be described in this article and others will not. If you look at the picture on the left you will notice in blue lettering labels for 3 separate ligaments that provide unique support and function to the shoulder. When the middle (MGHL) and



inferior (IGHL) are lax the humeral head migrates too far forward with elevation of the arm. The upward and forward migration of the humeral head places stress on the rotator cuff and this is another reason why you can develop rotator cuff pathology. So, many times I have to address shoulder instability to get to the “heart” of the problem with the rotator cuff.

ROTATOR CUFF REGENERATIVE INJECTION THERAPIES: FROM PRP TO STEM CELLS:



We have already spoken about the cellular transformations that occur inside the rotator cuff attachments secondary to stress, compression and degeneration. For many years my frustration was that despite how much we knew about the pathology there was little that we could do to reverse the changes in the tendon without opening the shoulder and injuring it with a scalpel to try and make it heal.

This procedure was called a “tenotomy”. This would work sometime and other times it did not. About 20 years ago myself and a medical pathologist began to experiment with platelets that are found in blood. These cells can be found amongst the red blood cells circulating in your blood. They must be separated from the other cells if you want to use them therapeutically. We began experimenting with goats and looking into the healing potential of this special cell back in 1993. Years ago people thought I was crazy but today the therapeutic use of these cells to heal orthopedic pathology is the hottest topic in musculoskeletal medicine.

The rationale therefore for utilizing platelets is to take advantage of the myriad of growth factors derived from platelets that alter healing response and tissue regeneration. These growth factors include TGF- β , platelet derived growth factor (IGF), vascular endothelial growth factors (VEGF), epidermal growth factor (EGF), fibroblastic growth factor -2 (FGF-2), which have the potential to enhance healing, grafting and connective tissue repair. The specific attributes of these growth factors are not as important as the basic understanding that these growth factors can dramatically influence the way connective tissues heal and proliferate. The use of these growth factors to influence regulatory function for healing has sparked significant interest in orthopedics.⁴ Under ultrasound guidance a needle tip can be guided precisely into a diseased region or tear of the rotator cuff and the cells can be injected in the target region. These cells have significant healing potential as described below.



What are platelets capable of doing?

The growth factors derived from your platelets have been shown to promote the migration of small blood vessels into the tissue and pluripotent (autogenous stem cells) into an area to promote the release of additional growth factors. This has been used for example to accomplish the following:

1. Stimulating articular chondrocyte proliferation and healing cartilage defects in joints.^{5,6} This is currently being used to influence proliferation of cartilage in arthritic joints.

2. Healing of chronic wounds^{7,8}.
3. Enhancing healing and pain reduction in shoulder arthroscopic surgery^{10,11}. Surgeons wanting to take advantage of the healing power of platelets are injecting platelet rich plasma into the shoulder after surgery to enhance healing.
4. Fibroblasts and collagen proliferation. Because I have been working with previous treatment methods utilized to proliferate connective tissue and heal tendons and ligaments, I became extremely interested in the potential of this treatment as another option for my chronic pain patients who suffer from tendon and ligamentous pathology. The use of a patient's platelets has now had become a powerful biologic tool for the orthopedic and musculoskeletal clinician to affect tissue healing^{9,10}.

What exactly is platelet rich plasma?

Platelet rich plasma is typically prepared by obtaining the patient's own blood via an IV. A sample of the blood was placed within a specialized centrifuge tube as shown in the picture to the right. The blood is centrifuge to separate red cells, white cells and platelets.



Feel strongly that is critically important that we use a red blood cell poor, white blood cell poor, pure platelet rich plasma preparation as our particular method of cell prep. Currently we do this manually since we have not found any commercial systems on the market place capable of creating the cell counts that we feel are important to obtain and the period of the preparation that is so necessary for this therapeutic intervention. The plasma (the fluid your blood cells circulating in) and platelets is then further centrifuge to concentrate the platelets within the plasma. Because we use the patient's own blood we eliminate the risk of communicable disease such as HIV, hepatitis C, hepatitis B. In addition since is the patient's own blood there is a perfect match and no issues with rejection.

Over the last 5 years we have began to use more advanced platelet preparation that we now use which includes platelet lysate's and platelet releasates to name just two. We have also more recently taken this preparation of platelets and isolation of specific plasma proteins which we use in unique ways for different rotator cuff cases based on the degree of pathology. We have become much more sophisticated with multiple preparation techniques and the combined use of tissue engineering techniques which we will describe later to provide host of clinical choices based on the pathology presented.

Is platelet rich plasma injection covered by insurance?

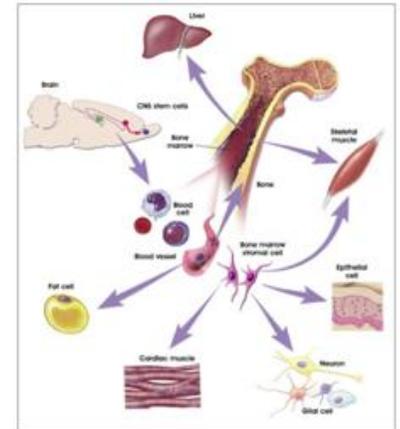
Although there may be insurance companies that have been reimbursing for platelet rich plasma injections we still typically advise our patients that there is no guarantee for reimbursement. Insurance companies continue to be resistant to pay for regenerative injection therapies. Until substantial research is published that forces the insurance companies hands to reimburse for these therapies insurance coverage and reimbursement is going to be a continual struggle.

STEM CELL THERAPIES FOR ROTATOR CUFF DISEASE:



There are numerous stem cell therapy techniques that can be used for rotator cuff disease. In fact, stem cell therapies have revolutionized the treatment of advanced degenerative tendinosis and certain types of rotator cuff tears. What is interesting is that we spent the last 15 years

studying all of the various stem cell types and stem cell preparation techniques for regenerative medicine application. It is only been over the course of the last 2 years that we have realized that there are much more important factors in orthopedic application and simply stem cell therapy. The concepts of tissue engineering has become our primary focus which we will discuss in the conclusion section of this article.



Initially we begin utilizing stem cells from bone marrow and from adipose tissue (fat) which represented a revolutionary new method of treatment of rotator cuff disease and shoulder pain from osteoarthritis. These techniques offered a more potent and effective method of treatment. Then our previous platelet Rich plasma treatments had offered. Over the years, we have explored other types of stem cell therapies and today we have a wide variety of choices of stem cell therapies which are selected based on the type of pathology and condition being treated. We now have a host of choices of therapeutic interventions based on the severity and degree of degenerative disease or the type of rotator cuff tear based on MRI and ultrasonography findings. More importantly, we are now combining these techniques with various orthopedic tissue engineering principles using various scaffolding proteins that allow the stem cells to attach to the collagen and proteins deposited within a defect which provides a much better means of healing specific types of rotator cuff tears. This, in combination with specifically selected growth factors, has taken us to a whole new level in the treatment of rotator cuff disease. This is especially true of the larger rotator cuff disruptions.

Where do you get the stem cells and how to use them?

We will have a comprehensive discussion on the type of stem cells that we will utilize for an individual during the process of our initial consultation visit. However, to use a simple example. Our preference is to use “autologous” stem cell therapies, which means cells that are derived from your own body. One of the older and more established techniques is simply using your own bone marrow blood. This technique isolates a specific type of stem cell called “mesenchymal stem cells” that are derived from your bone marrow. We call this technique BMAC (Bone Marrow Aspirate Concentration). This technique involves extracting stem cells from an aspiration of your bone marrow taken from the pelvic bone. This process requires a local anesthetic injected over your pelvic bone and an aspiration of your bone marrow. Although this can be done under conscious sedation we have recently developed a technique utilizing a specific type of local anesthetic that penetrates bone which keeps discomfort to an absolute minimum. The bone marrow aspirate is then prepared in an attempt to concentrate mesenchymal stem cells. In addition to the BMAC stem cell preparation we also have a number of other autologous cell preps that we isolate as well as the use of important scaffolding proteins and growth factors. We found utilizing bone marrow blood habits disadvantages. One of the biggest disadvantages is that only 0.1% of the cells

isolated are actually the mesenchymal stem cells we are looking for. As a means of getting around this issue we began to explore the use of “fat” or adipose tissue. By using liposuction of fat cells one can extract “mesenchymal stem cells” from fat and one can get younger, more viable and greater numbers of stem cells. We heavily relied on adipose tissue as the source of stem cell for several years and tell we advanced our stem cell technologies even further. Today we have more potent cell isolates with much greater numbers that of enhanced our ability to treat various orthopedic pathologies. Today, as we have advanced are methods and matured clinically we deemphasize the importance of stem cell and focus on tissue engineering principles. Our selection of specific scaffolding proteins and other degenerative techniques and protocols that we combined with stem cell is much more important than the simple use of stem cells alone. While the industry is still focused on stem cell therapies, we would like to think we have outgrown this with years of experience and clinical maturity. It is been our experience that stem cells and the use of stem cells and regenerative orthopedic procedures are only one small component of the procedure that makes a specific therapeutic intervention effective.

Do I have to wear a brace or splint?

If there is a tear in the rotator cuff that is large one may have to wear a shoulder support called an airplane splint similar to what is shown to the right. This allows one to approximate the edges of the tear and allow the cells to proliferate and fill the tear. There are a number of very specialized procedures that we have to do in order to approximate the edges of a rotator cuff tear that we will discuss in more detail in consultation. Some of these techniques are proprietary and therefore will be discussed on an individual basis.



SPECIAL NOTE:

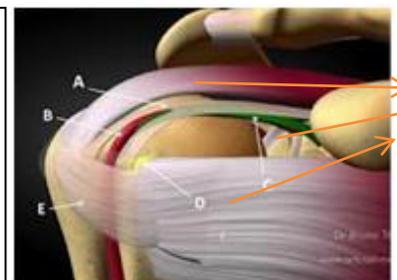
Remember stem-cell therapies are not magic. It requires an understanding of when to use them and when not to. Not everyone can benefit. It is not like you can regenerate a new joint. There are simply biological tools to enhance healing of certain types of orthopedic conditions. Sometimes depending on the degree or severity of the pathology we intervene knowing that we are only going to gain a partial improvement. There are times where I still feel strongly that it is better to do surgery and repair the rotator cuff. We will address briefly for your information the process of surgical rotator cuff surgery and also surgery for rotator cuff impingement pathology.

Surgery for impingement syndrome:



Remember when we first began this discussion we spoke about the shape of the subacromial arch and the shape of the acromion. Remember it can be downsloped, hooked or develop thickening the narrows the outlet where the supraspinatus (rotator cuff) tendon

- Acromion
- Subacromial space
- Supraspinatus

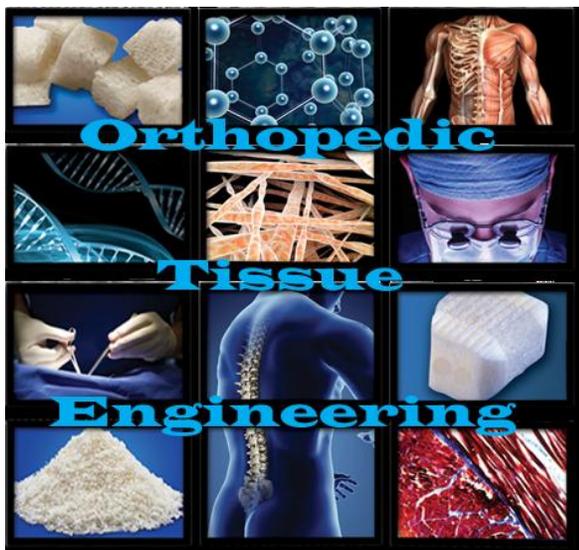


comes out. This can cause wearing on the tendon which can degenerate under this pressure and cause tendinosis, tears, bursitis and pain. There are times when I have to tell a patient that despite my ability to treat the inflamed bursa, and even repair some of the damage to the tendon with cell transplants, stem cell injections, PRP

injections, etc. the problem will reoccur because the arch is abnormal. If we do not decompress the tendon and the space through arthroscopic shaving of the acromion seen in the picture to the left we are not going to be able to resolve the problem in the long run. We believe that in the future orthopedic surgeons will work with regenerative orthopedic specialist intraoperatively (during the surgery) to create unique methods of treatment, which will include decompression procedures, and augmented rotator cuff repairs utilizing regenerative techniques and conventional orthopedic surgical procedures.

Some patients have already had the decompression surgery but they continue to have pain from the bursa and rotator cuff tendon. There are times when we do have to do some soft tissue regenerative injection therapy after surgical decompression. Depending on the state of the tendon orthopedic surgery techniques may not be able to address the degenerative tendinosis changes and therefore additional care may need to be performed to augment tissue healing after decompression procedures.

Advances in regenerative orthopedic medicine:



As I have stated previously on most of the physicians around the world. Let do regenerative medicine services are still focused on stem cell injection we have moved on. This came with years of experience. Our approach now. His a biologic interventional approach, utilizing principles of orthopedic tissue engineering. This topic is so vast that there is no way to address the complex of these of this discussion in the contents of this document. For brevity, tissue engineering involves the use of a combination of cells, engineering and materials methods, and suitable biochemical and physiologic chemical factors to improve for replaced biologic function. Most tissue engineering research today is working on biological substitutes that restore, maintain or improve tissue function of the whole organ.

They are even working on regrowing organs and body parts. Tissue engineering is a process of using a person cells to create a new artificially fully alive tissue or organ that can replace or improve the old one. Although we are clearly not at the level of trying to grow or replaced new organs. We work on a more simplistic premise of trying to repair tissue defects. We utilize a combination of cells and biological substances, which include growth factors as well as biodegradable connective tissue scaffolding for this process. In the process of attempting to heal certain rotator cuff tears and advanced degenerative change we have to use a number of tissue engineering principles to repair the damage. If we don't your rotator cuff continues to degenerate. We find a significant number of physicians who have decided with little understanding of stem cell technology and most importantly, tissue engineering to "jump into" this field. I would suggest that patients seeking regenerative orthopedic medicine services to carefully evaluate the physicians background, training, experience and understanding before choosing where they see can receive care.

Rotator cuff tear surgery:

Occasionally a rotator cuff tear is bad enough that it needs to undergo surgical repair. The surgical techniques have advanced over the years and it is more common place to do this repairs with arthroscopic surgery that to do open repairs like we did for years in the past. One of the advancements in arthroscopic surgery was the development of the anchors that are used to repair the cuff. These tiny devices can be passed through a working channel under visualization of the fiberoptic scope. They can be anchored into bone and the rotator cuff can be sewn back onto the anchor.

This sounds great but you need to understand that sometime recovery can be somewhat “ruff” and you need to be prepared to put up with some pain and recovery time for such a surgery. It will require extensive physical therapy.



There are times when the rotator cuff is too far damaged and retracted to have any other choices but to consider an anchor repair as described. There are times when it

is worth the long postoperative recovery. The alternative is to let you fear of such a procedure lead you into a life of progressive pain and disability with her shoulder. We believe strongly that in the future. We will be working with orthopedic surgeons during the operation to augment and enhance tendon repair healing and shorten the recovery. I find most surgeons unwilling to collaborate in such a manner. The reason for this is that there is still not a lot of evidence to suggest these methods and efforts are any better than what they are already doing. This is why it is important for us to continue this work and continue efforts and publishing clinical outcomes of the techniques that we develop.

We hope this article has been helpful in gaining a more comprehensive understanding of why having a shoulder pain from rotator cuff disease is much more complicated and he may have originally recognized. It is also important to see a physician who is capable of doing a comprehensive assessment and is skilled in orthopedic ultrasonography to be able to evaluate your condition is not responding to conservative efforts.

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