Forelimb injuries are common in the canine; unfortunately, many of them go undiagnosed or considered a “soft tissue injury” without a true diagnosis. The 3 most common orthopedic soft tissue injuries of the front limb are supraspinatus tendinopathy, biceps tendinopathy, and medial shoulder syndrome (MSS). With many forelimb lameness’s two major questions need to be asked: is this orthopedic or neurologic? If this is orthopedic then is it the elbow, shoulder or both? For many cases there can be an isolated shoulder problem, isolated elbow problem, or a primary problem with both, or a primary problem and then compensation to the other. While it is not the intention to cover every orthopedic condition in the forelimb it is important to learn to differentiate between shoulder and elbow lameness. A good solid orthopedic examination is key. For the elbow is there a reduction in range of motion? Does the dog resist elbow extension that could indicate an un-united anconeal process (UAP), is there a reduction in flexion that could indicate medial compartment disease (MCD) such as a fragmented coronoid process (FCP), is there any muscle spasm or tightness of during ROM in the elbow especially on the biceps? Is there pain on palpation of the medial aspect of the elbow specifically during flexion and supination (Campbell's test) to indicated MCD? For the shoulder am I able to fully extend the shoulder, if not could there be an osteochondritis dessicans (OCD) lesion, can I extend the shoulder and abduct it with no pain or spasm, if not is there evidence of MSS? Can I fully flex the shoulder with no pain or spasm; can I palpate the supraspinatus and/or biceps with no pain or discomfort? Can I complete a biceps stretch test? The biggest thing to remember is we are not trying to make the patient cry out or scream, but rather we are looking for subtle signs of muscle spasm, reduction in range of motion, and possibly discomfort. Even the most stoic dog will show signs of muscle spasm or tightness. Don’t forget about some of the other players that can mimic orthopedic conditions such as a brachial plexus injury/tumor, a cervical lesion causing root signature pain, or even neoplasia.

It has been common practice to diagnose a “soft tissue injury” for forelimb lameness’s that we cant seem to figure out. In many cases these injuries don’t resolve or become chronic. We should make every attempt to identify these injuries and move away from using the term “soft tissue injury” and figure out the problem. Dogs that tend to present with forelimb injuries are the “weekend warrior”, these are the dogs that lie around all week then become very active on the weekends. Given the lack of conditioning these dogs tend to be prone to soft tissue injuries. Performance dogs are those that compete in agility, fly ball, field trail, obedience, hunt test, etc. Many of these dogs are well conditioned but repetitive injury puts them at risk for soft tissue injuries. Working dogs are those that are police, military, search and rescue, etc. dogs that are subject to either acute soft tissue injury or repetitive injuries. Many of these dogs return to being lame after exercise restriction or become lame again after stopping an NSAID.

**Supraspinatus and Biceps Tendinopathy:**

The supraspinatus is a large muscle that originates at the supraspinatus fossa and inserts on the greater tubercle. It is responsible for shoulder extension and is an active stabilizer of the shoulder. It has been shown to be active during about 65-80% of the stance phase. The biceps originates on the supraglenoid tubercle of the scapula then
courses distally to insert on both the radius and ulna. The insertion becomes important when discussing potential medial compartment disease. Its primary function is for elbow flexion; however, it does provide stabilization of the shoulder during the stance phase.

The diagnosis of supraspinatus tendinopathy is not well described and the prevalence seems to be increasing, this is likely due to advanced imaging such as MRI or diagnostic musculoskeletal ultrasound. These dogs will typically have a unilateral forelimb lameness that appears worse after exercise and heavy activity. They tend to be minimally responsive or non-responsive to NSAIDS and exercise restriction. Many will appear to improve during exercise restriction only to become lame after returning to normal activity. In some cases of biceps tendinopathy there may be a partial response to administration of an intra-articular steroid. However, this response is typically on temporary. It has been suggested that Rottweiler's and Labs are predisposed to supraspinatus tendinopathy; however, this was suggested in the late 70’s early 80’s. At our practice we tend to see many Labs, and Border Collies with this condition. Currently the pathogenesis of both conditions is unknown; however, it has been demonstrated that there is a small distinct area of hypovascularity in the tendon of the supraspinatus. This in conjunction with repetitive microtrauma could result in microtears of the tendon and thus lead to the formation of fibrous tissue and in chronic cases calcification in the tendon. Even though the true cause is unknown overuse, which has been described in both human and animal models, is highly suspicious. The repetitive trauma results in a proliferative nodule; the typical inflammatory changes are not seen. During repair there is a poor or dysfunctional response possibly due to the lack of blood flow. The mechanical properties tend to deteriorate resulting in a decreased modulus of elasticity and maximal stress till failure. The origin of the biceps at the supraglenoid tubercle is said to be an area of hypovascularity, which may predispose it to mechanical failure causing either fraying or rupture. Given that the typical inflammatory changes are not seen histopathologically the term tendinopathy is better used then tendinitis or tendinosis. Because of the lack of inflammatory response patients require lengthy management and often respond poorly to treatments.

In looking at the distribution of the diagnosis of supraspinatus tendinopathy it has been shown just a few years ago there were very few cases with a supraspinatus diagnosis. For example in unpublished data from our practice of 327 cases, in 2006 there was less than 6 cases diagnosed with supraspinatus tendinopathy versus in 2013 there were over 90. Around 2010 is when the use of MRI and diagnostic musculoskeletal ultrasound (MSK US) became more commonplace and we began to recognize this disease condition. However, it could also be suspected that with the advent of more advanced imaging the diagnosis of supraspinatus injuries is being over-diagnosed.

From an examination standpoint we want to begin evaluating the dog standing and examine for symmetry of the supraspinatus muscles. Muscle atrophy can be one clue into a chronic problem. From an objective standpoint we want to take muscle mass measurements and compare it to the contralateral side. Furthermore, many of these dogs will have a decrease in shoulder flexion and will resist a biceps stretch test. Goniometry should be measured and compared to the contralateral side; normal shoulder flexion has been reported to be 54-59 degrees. During shoulder flexion palpate the insertion of the tendon for any discomfort, pain, or spasm or for the dog to begin pulling the shoulder away. Subtle changes noted may be a change in breathing (panting then stops), the pupils may dilate or the dog may begin licking its lips. Examination of the biceps tendon may reveal a tendon that is thickened and painful; furthermore, there may
be decreased muscle mass in the affected forelimb. One of the biggest clues is a response to the biceps stretch test. This is completed by having the shoulder flexed and then placing the elbow into full extension. This will put a direct stretch onto the biceps. Many patients with a biceps tendinopathy either will not let you complete the biceps stretch test or they will begin to show signs of discomfort and spasm.

After a thorough physical examination radiographs are typically the next course of action. In acute cases the radiographs are typically normal; however in chronic cases there can be mineralization in the area of the supraspinatus tendon or in the area of the bicipital groove. Granted while this is a nice finding it is very rare. The goal of radiographs is to help rule out other potential issues such as an OCD lesion, osteoarthritis, osteosarcoma, fracture/luxation, etc. MRI is most helpful in acute cases where increased signal intensity can be seen; however, MRI is expensive and requires general anesthesia. Furthermore, it is not very useful to perform recheck MRI’s to gauge healing. MSK US is another option to evaluate the canine shoulder. It will give us the tissue architecture so that we can determine if this is a true tendinopathy or an insertionopathy. MSK US may us to determine the severity (is this a grade I, II, or grade III lesion). Based on the grade of the lesion, it can help us to make treatment recommendations. Furthermore, following treatment we may be able to monitor healing by seeing a reduction in inflammation as well as a more normal appearance of tissue architecture. One big issue is that both advanced imaging modalities are very user dependent especially MSK US. Even the radiologists are still debating the best usage of these technologies as to what information we can get, what information we can’t get, and how to best achieve what we are looking for.

Arthroscopy is not commonly used to diagnosis a supraspinatus tendinopathy; however, it can be useful to evaluate for concurrent conditions. The supraspinatus is extracapsular so it can’t be viewed directly; however, with inflammation and swelling of the supraspinatus a bulge can be seen just adjacent to the biceps. MSS is commonly noted in cases with a supraspinatus strain. Arthroscopy can be utilized as both a diagnostic and therapeutic (biceps release) modality in patients with a biceps tendinopathy.

Previous treatment recommendations consisted of surgical excision of the calcification; however, this was met with variable success rates and the mineralization returns in almost all cases. Furthermore, when surgical removing the calcification one is also removing a portion of an active shoulder stabilizer. Extracorporeal shockwave therapy was an effective treatment in 2 dogs with chronic cases. At the author’s facility our current treatment recommendations are based on the exam, MRI, and MSK US findings. If I have a companion that is a first time offender with mild exam findings I will many times place them on an NSAID and/or muscle relaxer for 2 weeks with 4-6 weeks of exercise restriction AND formal rehabilitation therapy. Exercise restriction will prevent the issue from getting worse and help quiet down the inflammatory response. The formal rehabilitation will allow us to stretch out the tissue and facilitate healing. For the athlete, or companions that have failed the first go around of conservative management or patients with more moderate exam findings I will recommend either an MRI or MSK US. From the MSK US if it is a grade I (or they have not undergone rehab) we will recommend exercise restriction and formal rehabilitation therapy. For grade II lesions we will recommend regenerative medicine (PRP or stem cell/PRP) with an exercise restriction period of 8-12 weeks. Also, if the MSK US suggests any intra-articular pathology then we may recommend scoping the shoulder to address any other underlying conditions.
Rehabilitation for the supraspinatus and biceps tendinopathy is initially geared at releasing of trigger points, stretching and massage. Therapeutic US therapy can be used to heat the tissues to allow maximal stretching while laser therapy can be used to improve blood flow and stimulate healing while reducing inflammation. In the later stages of the supraspinatus and/or biceps strain we will incorporate UWT therapy; however, open water swimming should be monitored very closely as to not exacerbate the condition. Therapeutic exercises are initially isometric and geared towards improving fatigue of the muscles, after progressing from this stage eccentric exercises can be used. Regenerative medicine is a current promising treatment modality for supraspinatus and/or biceps tendinopathy. We tend to use combination therapy of stromal cell and PRP. The stromal cells are harvested from either fat or bone marrow. They help to diminish tissue injury, promote neovascularization, recruit and induce proliferation of resident stem cells, inhibit fibrosis, act as a source of growth factors, and they are anti-inflammatory. PRP provides a great source of growth factors responsible for promoting angiogenesis, enhancing cellular proliferation, promoting extracellular matrix formation.

From a prognosis standpoint there is limited reported data in the literature. A study published recently from VOSM revealed that in dogs with grade I lesions or first time offenders we see about 42% respond to exercise restriction and rehabilitation therapy. Typically I tell owners we have about a 50% chance of improving their dog with exercise restriction and rehabilitation. Grade II or repeat offenders treated with regenerative medicine have well over an 82% response rate with the addition of exercise restriction, rehabilitation, and regenerative medicine. The biggest issue is many supraspinatus injuries may be secondary to another disease condition. So if a patient fails to return to normal activity then additional diagnostics to evaluate the joint are warranted.

**Medial Shoulder Syndrome (MSS):**

I tend to refer to the medial aspect of the shoulder as the “dogs rotator cuff” which is probably way off, but owners tend to understand it better. The shoulder joint itself is stabilized by both active and passive stabilizers. The active stabilizers include the supraspinatus, infraspinatus, and others (which is why many patients with MSS have concurrent supraspinatus tendinopathy). The passive stabilizers are the medial glenohumeral ligament (MGL), joint capsule, and subscapularis tendon along with others.

Much like supraspinatus and biceps tendinopathies, dogs suffering from MSS typically have an open diagnosis of unilateral forelimb lameness that is worse after exercise, and tends to be non-responsive to NSAIDS and exercise restriction. What makes this even more challenging is that some of them will have no lameness at all except during specific activities, which is commonly noted in agility dogs. You may note a shorten stride length or step length and owners may complain about them knocking bars, pulling up or refusing weave poles or taking wide sweeping turns. On big question is if MSS is a common occurrence or if it something rare? I think it is a common problem not only in the agility world but also in the weekend warrior that is not conditioned and goes out and over does himself or herself, but I believe also that it is rarely diagnosed and usually missed for some type of “soft tissue injury.” The MGL plays a role in shoulder stability and Dr. Bardet found that 69% of dogs with chronic forelimb lameness had pathology of the MGL; furthermore, MGL pathology is the most common form of shoulder instability. Unfortunately, there is no real information out there as to the clinical significance of damage to just the MGL. For example, one study looked at the stability of the MGL and
found that by transecting the cranial arm there was no increased instability in the shoulder. It did result in marked inflammation and the authors speculated that with continued repetitive motion that overtime this could result in shoulder instability. So, this brings to light what structures really need to be damaged before it causes a clinical issue. Could a complete tear of the MGL result in instability, a complete tear of the subscapularis, or do both have to be torn? What if they are frayed or stretched, at what point does this result in a clinical issue? These are issues that have yet to be determined.

Dogs with MSS may show no evidence of lameness at presentation or may have a severe unilateral forelimb lameness. On examination one can appreciate pain on shoulder extension with abduction; along with pain there may be spasm on the medial aspect of the humeral head when palpated. With goniometry an increased abduction angle is noted. The typical normal angle is usually 30-32 degrees whereas dogs with MSS may have 50 or greater degrees of shoulder abduction. However, it is very important to compare to the contralateral side and in many cases this is a unilateral disease. Recently the use of abduction angles in determining MSS has been called into question. Jones, et al. presented a study where they looked at the accuracy and precision between and among observers as well as between fluoroscopic measured abduction angles. They found there was poor accuracy between the observer measured abduction angles and the fluoroscopic measured abduction angles. In addition the mean abduction angle with the intact medial structures was 28.34° where as the mean abduction angle after complete transection of the MGL and subscapularis tendon was only 35.63°. This means there was only about 8° of difference in abduction angles between cadavers with completely intact medial structures versus the same cadavers with completed transected medial structures.

Radiographs are typically normal in dogs with MSS; in really chronic conditions there may be some mineralization in the area of the supraspinatus and/or biceps if there is a secondary tendinopathy. MRI and MSK US are more beneficial for showing secondary supraspinatus or biceps tendinopathy; however dynamic instability can’t be seen with MRI. MRI can be used to pick up on tears of the MGL and subscapularis tendon. MSK US may reveal joint effusion, and a thickened or irregular joint capsule that is suggestive of intra-articular pathology; however, MSS can’t be fully differentiated from other types of intra-articular issues. Shoulder arthroscopy is beneficial for not only the diagnosis of MSS but also treatment in select cases. Arthroscopy allows for direct intra-articular observation as well as dynamic evaluation of tissues during ROM. During arthroscopy we are able to palpate the intra-articular structures to evaluate for any laxity. The treatment of dogs with MSS is very controversial. Some consider this to be a surgical disease while others consider it to be a conservative/rehabilitative disease. From a surgical standpoint there is the option of thermal capsulorrhaphy (radiofrequency), prosthetic reconstruction, biceps transposition, or subscapularis imbrication. With thermal capsulorrhaphy a heat source is applied to the tissues to cause reorganization of the collagen. In other words it “shrinks” or “tightens” the tissue. This is accomplished by using a monopolar radiofrequency probe at 25W and 70°C in a striping technique. It creates scarring and the recovery of the tissues as well as immobilization is very long (5-6 months). One has to be extremely careful when performing this as permanent damage can be created to the tissues. Initially, Dr. Cook found a 93% improvement in patients treated with radiofrequency. A more recent study by Dr. Franklin found an 80% improvement with radiofrequency; however, the improvement was not significantly better than the patients that were treated non-surgically. In addition, thermal
Capsulorrhaphy is under intense review in human medicine due to the number of complications and the number of lawsuits. The American Association of Orthopaedic Surgeons recognizes the higher complication rate and lack of long-term efficacy. In addition most insurance companies consider it to be not medically necessary and will not provide coverage for it.

Prosthetic reconstruction is probably a better and safer alternative to thermal capsulorrhaphy. This can be done as an open procedure or as an arthroscopic assisted procedure. A recent study with at least 6 month follow up data reported a success rate of 93% and a complication rate of 15%. In addition, another paper showed that patients treated with surgical reconstruction have a higher likelihood of a successful outcome compared to non-surgical management. One problem area is trying to determine what patients benefit from surgery and which patients benefit from conservative management. In personal discussions with Dr. Peter Lotsikas, he seems to think that patients with complete subscapularis tears or multidirectional instability benefit the most from surgical reconstruction.

Conservative management is my initial approach (unless the condition is severe) where I place these patients in hobbles and place them in a formal rehabilitation therapy program for 8-12 weeks. Other conservative treatments such as extracorporeal shock wave therapy or regenerative medicine (stem cell/PRP) can be considered in addition to hobbles and rehabilitation therapy. From a regenerative medicine standpoint I may tend to inject PRP (my preferred starting point) or stem cell/PRP. Following this they are placed in hobbles for 4-6 weeks followed by continued strengthening via rehabilitation for an additional 4-6 weeks. Another modality that can be used for the conservative management in conjunction with hobbles and rehabilitation therapy is using extracorporeal shock wave therapy at the insertion point of the proximal humerus on the medial side as well as the glenoid cavity. This is completed initially, then 2 weeks later. At the 4 week mark they come out of their hobbles and begin strengthening exercises. In discussing this with Dr. Darryl Millis he sees about a 75% success rate.

Above all else, formal rehabilitation therapy seems to be the most critical factor in success. The basic modalities can be used such as laser therapy, therapeutic ultrasound, etc. However, most of the improvement is going to come from the incorporation of exercises that strengthen the shoulder. Things such as the balance board, lifting the opposite forelimb or hindlimb, weight shifting, standing on a balance ball, walking in figure 8s or circles, and scapular stabilization exercises. Initially, this is done with the hobbles on then over 4-6 weeks the exercises are transitioned to having the hobbles off.

References: