Regenerative Medicine for Soft Tissue Injuries in Agility Dogs

By Sherman O. Canapp, DVM, MS, CCRT, DACVS, DACVSMR and Brittany Jean Carr, DVM

Squid Vicious on course at an agility trial (taken by Bruce McClelland of BAM Photo; permission by Monica Bush)

Dr. Canapp examining Squid Vicious (courtesy of VOSM; permission by Monica Bush)

Case Study

Squid Vicious, a three-year-old female Border Collie from Arizona, presented with a nine-month history of a right hind limb lameness, which was initially noted at an agility trial. Squid Vicious's owner observed that Squid Vicious was weight bearing, but "off" in the rear. Squid Vicious was taken to a massage therapist and a primary care veterinarian. Conservative management and additional therapies, including massage therapy, acupuncture, and cold laser therapy, were performed with no response. Squid Vicious then presented to multiple specialists, all of whom could not provide a definitive diagnosis. Conservative management was continued, but no improvement was noted. The owner learned of Veterinary Orthopedic and Sports Medicine Group's (VOSM) specialists lecturing in Las Vegas for a sports medicine course and travelled to Las Vegas for evaluation. During evaluation, an iliopsoas strain was diagnosed on palpation, and confirmed with musculoskeletal ultrasound. Since Squid Vicious failed to respond to conservative management and rehabilitation therapy, regenerative medicine was recommended. Squid Vicious was flown to VOSM for stem cell and platelet rich plasma therapy.

Soft Tissue Injury in the Agility Dog

A recent study reported that one in three agility dogs have sustained a sports-related injury, and over 70% of these injuries involve soft tissue injuries. Common soft tissue injuries in agility dogs include supraspinatus tendinopathy, cranial cruciate ligament injury, medial shoulder syndrome, iliopsoas (groin) tendinopathy, biceps tendinopathy, and Achilles tendinopathy. "Tendinopathy" is a broad term used to describe clinical conditions in and around tendons. Overuse due to chronic repetitive activity is believed to be an important factor in many of these disorders. Activities such as quick turns, landing from jumps, and jump-turn combinations often place soft tissue structures under extreme stress and can result in strain injuries. Strain injuries reduce the tensile strength of tendons, predisposing them to further injury. Repeated strain leads to disruption of the tendon fibers, causing pain and inflammation.

Diagnosis can often be accomplished through physical examination and minimally invasive diagnostic modalities. VOSM's specialists commonly recommend an objective gait analysis (such as GAIT4Dog® System) to identify and quantitate lameness and various gait parameters. Gait analysis is repeated at every recheck to allow for an objective measure of response to treatment. Minimally in-

vasive diagnostic modalities such as diagnostic musculoskeletal ultrasound, arthroscopy, and MRI are used not only to confirm a diagnosis, but also to grade the level of injury. Depending on the grade of injury, conservative management with regenerative medicine and rehabilitation therapy may be an option. In Squid Vicious's case, a diagnostic musculoskeletal ultrasound was used to confirm the iliopsoas tendinopathy and grade the injury. Since Squid Vicious had changes consistent with a moderate strain, and had previously not responded to rehabilitation therapy, regenerative medicine was recommended.

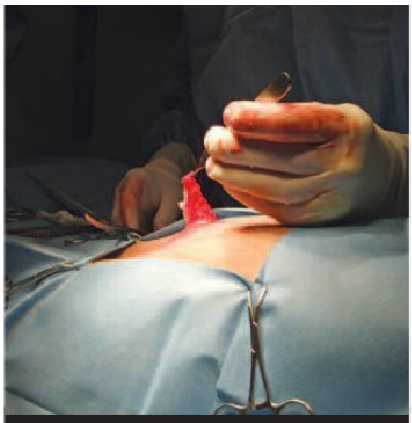
Regenerative Medicine for Soft Tissue Injury

Regenerative medicine therapy has become increasingly popular in both human and veterinary medicine for multiple disease processes. Recent studies have shown regenerative medicine to be efficacious in managing numerous orthopedic conditions, including osteoarthritis and soft tissue injuries (tendon and ligament injuries). Regenerative medicine therapy at VOSM consists of platelet rich plasma (PRP) and/or stem cell therapy since recent studies suggest that PRP therapy and stem cell therapy have a synergistic effect when combined. Both PRP and stem cells have been shown to regenerate tissues, increase blood supply, and break down scar tissue formation, replacing it with regenerated tissue. VOSM has the capability to offer platelet rich plasma (PRP), bone marrow-derived stem cell concentrate (BMAC), culture expanded bone marrow-derived stem cell (BMSC), adipose-derived stromal vascular fraction stem cells (SVF), and culture-expanded adipose-derived stem cells (ADSC).

Platelet Rich Plasma Therapy

Platelets are cells that circulate in the blood stream and play roles in both hemostasis (clotting of blood) and wound healing. Platelets contain two types of granules. The first type increases permeability of blood vessels to allow for access of inflammatory cells to the site of damage and contributes to blood clot formation. The second type of granule releases growth factors that stimulate other cells of the body to migrate to the area of trauma, thus facilitating tissue healing. It is the growth factors contained within the platelets that are of significance for tissue healing. Platelets have also been shown to recruit and activate stem cells.

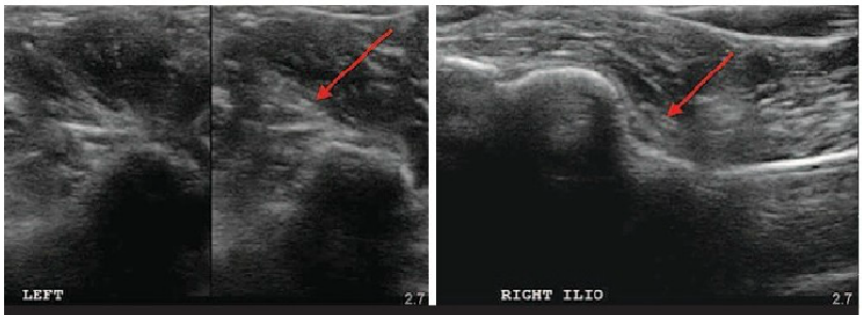
PRP is an autogenous (self-derived) fluid concentrate composed primarily of platelets and growth factors. PRP is made by processing a patient's own blood sample. The goal is to obtain the highest concentration of platelets and growth factors, while removing the other components of the blood such as red and white blood



Stem cell collection from the falciform ligament (fat) in the abdomen (courtesy of VOSM)

Sample of adipose fat harvested from the falciform ligament (courtesy of VOSM)

The Regenerative Medicine Laboratory at VOSM (courtesy of VOSM)



Musculoskeletal diagnostic ultrasound of the iliopsoas of Squid Vicious reveals an area of disruption and fibrous tissue (courtesy of VOSM; permission by Monica Bush)

cells, which can cause pain and inflammation. To make PRP, a sample of blood is obtained from the patient, mixed with an anticoagulant, and processed either manually by spinning it in a centrifuge to separate its components (centrifugation), or through an automated system. This process concentrates the platelets and growth factors, amplifying healing properties.

When considering this technology for your dog, it is important to use a system that has been validated for canine use. It is advisable to look for a system that is able to concentrate the platelets at least five to seven fold, significantly decrease white blood cells, and remove red blood cells. PRP therapy is often performed as a series of one to three injections, with two weeks between each injection.

Stem Cell Therapy Collection

Stem cells are the body's progenitor cells from which all other cells are derived. Recent studies have shown that stems cells can regenerate and heal injured tissue, decrease inflammation, stimulate new blood supply to support healing, activate resident stem cells, create a scaffold for healing tissue, protect cells from death, and break down scar tissue. Stem cells can be obtained from numerous sources from a patient's own body (autologous adult-derived mesenchymal cells). The most common places to harvest adult-derived mesenchymal cells are either from the patient's bone marrow or adipose (fat) tissue. Both bone marrow-derived and adipose-derived stem cells have the ability to differentiate into cartilage, bone, tendons, and ligaments. Recent studies have shown that bone marrow-derived stem cells and adipose-derived stem cells are equally viable and effective.

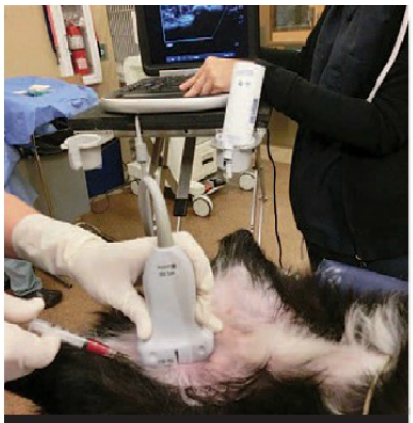
Bone marrow-derived stem cells are obtained under brief anesthesia or heavy sedation. A needle is inserted into the medullary cavity (center of the bone) and the cells are aspirated with a syringe. The sample is then processed and prepared for injection. Similarly, adipose-derived stem cells are collected under a brief anesthesia. While there are numerous locations where fat may be collected, recent studies suggest that the falciform ligament (fat located inside the abdominal cavity) yields the highest quantity and quality of adipose-derived stem cells. A small incision is made along the cranial abdominal area to obtain the fat.

Once the sample is obtained, it is then processed and prepared for injection. Both bone-marrow derived stem cells and adipose-derived stem cells can be processed either on-site or shipped to a university for processing, culturing, and banking for future use. Recent studies have shown that PRP both activates and recruits stem cells. Thus, PRP is often combined with stem cells prior to injection to both activate and act as a scaffold for the stem cells.

Regenerative Medicine Therapy Administration

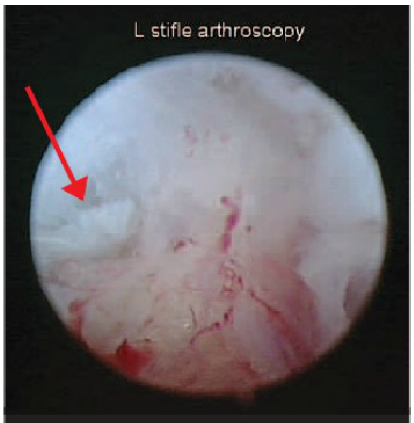
Regenerative medicine therapy is a minimally invasive procedure that typically can be performed on an outpatient basis. Sedation or general anesthesia may or may not be required, depending on the location of the injection. Joint injections are usually performed without sedation; however, some joints, such as the hip, require sedation and may also require advanced imaging (fluoroscopy) for guidance. For soft tissue injuries, ultrasound guidance is used to ensure accuracy of the injection since both PRP and stem cells are most effective when administered directly into the site of injury. Sedation is often required for ultrasound-guided injections. The most common side effect is mild discomfort associated with the injection, which typically resolves within 12 to 24 hours of the injection.

For Squid Vicious, bone marrow derived stem cells were harvested from the proximal left femur for on-site preparation of regenerative progenitor cells, and blood



Squid Vicious receiving an ultrasound guided iliopsoas injection of bone marrow-derived stem cells and PRP into the site of injury (courtesy of VOSM; permission by Monica Bush)

Harvesting of bone marrow under fluoroscopic guidance for bone marrow derived stem cells (Cool Ross; courtesy of VOSM; permission by Lisa Ross)



A partial tear of the cranial cruciate ligament diagnosed via stifle arthroscopy (Cool Ross; courtesy of VOSM; permission by Lisa Ross)

was collected for on-site preparation of platelet-rich plasma (PRP). Bilateral iliopsoas ultrasound guided injections of bone marrow-derived progenitor cell and platelet rich plasma (PRP) were performed under general anesthesia.

Rehabilitation Therapy Following Regenerative Medicine Therapy

Tissue healing following regenerative medicine therapy takes about three months. A dedicated rehabilitation therapy program is often recommended for 12 weeks following regenerative medicine therapy, depending on the diagnosed condition. Rehabilitation therapy helps to speed healing by decreasing inflammation and swelling, building muscle mass, increasing range of motion, and improving overall comfort. Therapy sessions often include manual rehabilitation therapy, standard isometric exercises, gentle passive range of motion (PROM), and class III-b laser therapy. Underwater treadmill therapy can usually be started eight weeks after starting rehabilitation therapy. Rehabilitation therapy should be performed weekly in conjunction with an at-home exercise program.

An arthroscopically guided injection of bone marrow derived stem cells and PRP into the cranial cruciate ligament (Cool Ross; courtesy of VOSM; permission by Lisa Ross)

Ninety-day second look arthroscopy revealing complete healing/regeneration of the partial CCL tear following stem cell and PRP therapy (Cool Ross; courtesy of VOSM; permission by Lisa Ross)

Dr. Carr processing bone marrow stem cells (courtesy of VOSM)

Current applications of regenerative medicine therapy for agility related conditions include medial shoulder syndrome, shoulder tendinopathies (for example, supraspinatus tendinopathy or biceps tendinopathy), iliopsoas strain, Achilles tendon injury, early partial cranial cruciate ligament (CCL) tear, carpal and tarsal ligament injuries, and osteoarthritis.

Once the tissue has regenerated, as confirmed via diagnostic ultrasound or arthroscopy, the rehabilitation program focuses on strengthening and conditioning. Once appropriate muscle mass has been attained, dogs are then cleared for retraining and return to sport. On average, patients treated with regenerative medicine therapy typically return to competition within four to six months of treatment.

Case Study Follow Up

At Squid Vicious's 90-day re-evaluation, she exhibited normal range of motion bilaterally in her coxofemoral (hip) joints and no spasm was noted on direct palpation or stretch of either iliopsoas insertions. She showed good muscle mass bilaterally in her hind limbs. A recheck diagnostic ultrasound of bilateral iliopsoas confirmed the bilateral iliopsoas insertionopathies had resolved and showed a more normal fiber pattern. Squid Vicious was cleared to start gradual off-leash work and retraining. Free running was gradually brought back over a two-week period of time. In reference to agility, it was recommended to slowly return Squid Vicious to training over the course of eight weeks. Squid Vicious has regained full function and is currently training to return to competition at the national level.

Summary

Current applications of regenerative medicine therapy for agility related conditions include medial shoulder syndrome, shoulder tendinopathies (for example, supraspinatus tendinopathy or biceps tendinopathy), iliopsoas strain, Achilles tendon injury, early partial cranial cruciate ligament (CCL) tear, carpal and tarsal ligament injuries, and osteoarthritis.

References

Are available online in the Articles section of the *Clean Run* Magazine Forum page: http://www.cleanrun.com/index.cfm?fuseaction=category.display&category_id=739.

Dr. Sherman Canapp, owner and Chief of Staff at Veterinary Orthopedic & Sports Medicine Group (VOSM), specializes in orthopedics, sports medicine, minimally invasive surgery, and rehabilitative and regenerative medicine therapies. Dr. Canapp is recognized as a leading authority and lectures worldwide in his areas of specialty. His special interests include the study of conditions common to sporting dogs and the use and development of cutting-edge technologies for diagnosis and treatment of these conditions. He has been serving the agility community since 2007, offering advanced diagnostic and treatments, and in 2010 began an annual free gait analysis clinic for agility competitors. Visit www.vosm.com to learn more about Dr. Canapp and VOSM.

Dr. Brittany Jean Carr is currently a rehabilitation therapist and American College of Veterinary Sports Medicine and Rehabilitation resident at Veterinary Orthopedic and Sports Medicine Group (VOSM) in Annapolis Junction, Maryland. She earned her B.S. in biology from Furman University in Greenville, South Carolina. She then attended the Virginia-Maryland Regional College of Veterinary Medicine at Virginia Tech in Blacksburg, Virginia. During her time in veterinary school, she served as president of the student chapter of the American Veterinary Medical Association and was honored with the College of Veterinary Medicine Outstanding Senior Award. After earning her DVM, Dr. Carr completed a small animal rotating internship at the Animal Specialty Group in Los Angeles, California and surgical internship at VOSM. Dr. Carr's research studies include objective gait analysis, regenerative medicine, and return to sport following cranial cruciate ligament injuries.