



STEM CELL THERAPY IN DOGS

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Stem cell therapy is the act of using cells from the patient's own body to help decrease pain and inflammation and allow injured tissues to heal through regeneration. By introducing new "adult" stem cells through a targeted, minimally invasive approach, the damaged or diseased tissues are treated with minimal risk of rejection or side effects.

Stem cells are the body's "master cells" from which all other cells with specialized functions are generated. Stem cells have three defining properties: they are capable of dividing and renewing themselves for long periods; they are unspecialized; and they can give rise to specialized cell types. Stem cells can be obtained from numerous sources including adult tissues from the patient's own body (autologous adult-derived mesenchymal cells); from the tissues of a genetically different donor within the same species (allogeneic stem cells), or from umbilical cord, yolk sac and placenta (extra embryonic mesenchymal stem cells). In dogs, the use of adult-derived mesenchymal stem cells is the most common for regenerative therapies.

Mesenchymal stem cells can differentiate into the cells that make up bone, cartilage, tendons and ligaments, as well as muscle, nerve and other tissues. The primary functions of stem cells for regenerative therapy include:

- Regenerate and heal injured tissue
- Decrease inflammation (anti-inflammatory)
- Stimulate new blood supply (angiogenesis)
- Activate resident stem cells (chemotactic for progenitor cells)
- Stimulate healing and tissue growth (supply growth factors)
- Create a scaffold for healing tissues (form an extracellular matrix)
- Protect cells from death (anti-apoptosis)
- Break down scar tissue in chronic conditions

STEM CELLS CAN REGENERATE AND HEAL INJURED TISSUE, DECREASE INFLAMMATION, STIMULATE NEW BLOOD SUPPLY, ACTIVATE RESIDENT STEM CELLS, CREATE A SCAFFOLD FOR HEALING TISSUE, PROTECT CELLS FROM DEATH AND BREAK DOWN SCAR TISSUE.

WHERE ARE THE CELLS OBTAINED?

Adult-derived mesenchymal cells intended for regenerative therapy are generally harvested either from the patient's bone marrow or from adipose tissue. Both bone marrow-derived and adipose-derived stem cells have the ability to differentiate into cartilage, bone, tendons and ligaments for repair and regeneration. To date, there have been no studies to support a superiority of bone marrow versus adipose-derived stem cells for regenerative therapy.

Since 2007, Dr. Canapp has used adipose-derived stem cells to successfully treat hundreds of patients. We use adipose tissue as a source of stem cells because it is readily available, yields a high volume of tissue for processing and has a low morbidity for collection.

HOW ARE THE CELLS PROCESSED?

Bone marrow-derived stem cells are typically obtained under a 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 shipped to the local university where it is cultured (stem cells are isolated and grown). Ten to fourteen days later, the cells are shipped back to the Center for injection.

Adipose-derived stem cells are collected under a brief anesthesia. Although there are numerous locations where fat may be collected, a recent study presented at the American College of Veterinary Surgeons Symposium revealed that the falciform ligament (fat on the most superficial surface inside the abdominal cavity) was the recommended location (due to quantity and quality of cells).

The falciform fat is obtained through a small keyhole incision along the cranial abdominal area. Once the fat sample is obtained, the tissues may be immediately processed in-house and injected the same day (fractionated stem cell treatment) or processed and shipped to a university for culturing. The decision between fractionated versus cultured stem cells is based on the condition being treated and will be discussed during the consultation with Dr. Canapp.

HOW ARE THE CELLS DELIVERED?

One of the most important aspects of stem cell therapy is the ability to get the cells to the targeted location. In human medicine, for ex-

ample, the leading cause of failure to respond to a cortisone injection is the clinician missing the targeted site. This is no different in dogs; it is imperative that the injections are performed using advanced modalities in the hands of specialists trained in these types of injections/treatments.

At the Center for Regenerative Medicine, injections are performed under ultrasound guidance or arthroscopy for soft tissue injuries (tendons, ligaments, etc.) or fluoroscopic guidance for joint or spinal injury. [See Figure 1.](#)

These injections are performed by specialists board certified by the American College of Veterinary Sports Medicine and Rehabilitation who have considerable experience with these types of regenerative treatments. The injections are performed under sedation or a brief anesthesia as an outpatient procedure. [See Figures 4 and 5.](#)

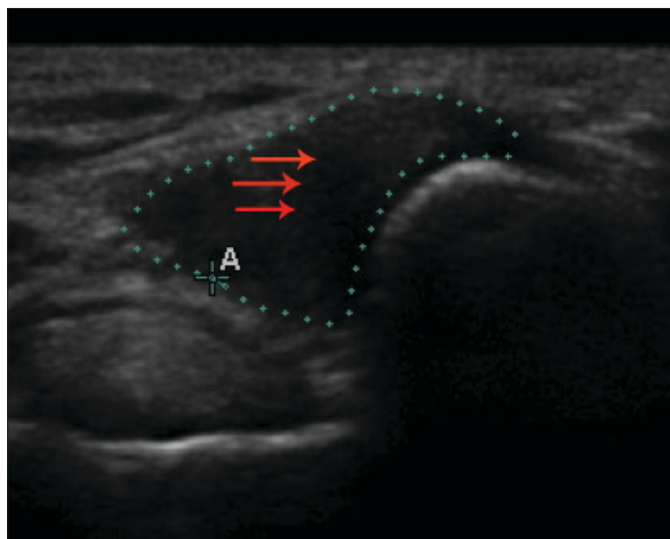


FIGURE 1. ULTRASOUND IMAGE OF A SUPRASPINATUS TENDINOPATHY WITH A CORE LESION (RED ARROWS).

WHAT CONDITIONS CAN BE TREATED?

TENDON INJURIES

Tendon injuries are very common in active dogs and, as in humans, can be extremely challenging to treat. This is especially true for “core lesions” where there is disruption within the tendon. For these lesions, there are no viable surgical options and conservative treatment allows for healing through scar tissue formation. Reinjury or further breakdown is common because scar tissue decreases strength and flexibility. Stem cell therapy allows for healing through regeneration with targeted treatment directly to the lesion. With tendon integrity uncompromised by scar tissue, patients are able to return to full activity and function.

Examples of commonly treated tendons:

- Supraspinatus
- Subscapularis
- Biceps
- Flexor carpi ulnaris
- Iliopsoas
- Achilles

LIGAMENT INJURIES

Ligament injuries can take a long time to heal and are predisposed to reinjury due to poor blood supply. As with tendons, conservative treatment allows for scar tissue formation and predisposes the ligament to reinjury or further breakdown from decreased strength and flexibility. Stem cell therapy allows targeted treatment to the lesion with healing through regeneration.

Examples of commonly treated ligaments:

- Medial glenohumeral ligament
- Carpal, tarsal and stifle collateral
- Cranial cruciate ligament (partial tears)

AUGMENTATION FOLLOWING PRIMARY REPAIR

For severe tendon and ligament injuries (complete tears/ruptures) that require surgical reconstruction, injecting stem cells into the surgical site can strengthen the repair. This augmentation promotes healing through regeneration rather than scar tissue formation, which is preferable as mentioned above.

TREATMENT OF OSTEOARTHRITIS

Osteoarthritis (OA) is a common cause of pain and lameness in dogs. Unfortunately, we still lack a definitive treatment for OA. In many dogs, conservative treatments including non-steroidal anti-inflammatories (NSAIDs), joint supplements, weight management and rehabilitation therapy often fail to provide a long-term response. In addition, many patients are intolerant to medical management. For these patients, stem cell therapy provides another option in the multimodal approach to managing OA.

Examples of commonly treated joints:

- Hip
- Stifle
- Shoulder
- Elbow

NEUROLOGIC CONDITIONS

Spinal conditions, including intervertebral disc disease and lumbosacral disease, can cause chronic pain and dysfunction in dogs. Treatment options typically include medical management, rehabilitation therapy or surgical management, depending on the severity of the condition. The use of stem cell therapy has recently been reported in a scientific peer-reviewed placebo controlled study as a positive treatment option for spinal disease in dogs.

In some cases, additional regenerative medicine therapies such as platelet-rich plasma (PRP) and/or autologous conditioned serum (ACS) may be used in conjunction with stem cell therapy. Use of these additional therapies is based on the specific diagnosis and severity of the injury.

IS REHAB THERAPY RECOMMENDED?

For the body to recover following an injury, the tissues must first heal.

Healing through true tissue regeneration rather than scar tissue formation is preferable. In most cases, orthopedic devices such as braces, orthotics and supports are required to protect the tissues as they heal and regenerate. [See Figures 2 and 3.](#)

Rehabilitation therapy enhances patient recovery by preserving range of motion and addressing proprioceptive and compensatory issues. Once the tissues have healed, rehabilitative therapy focuses on strengthening and reconditioning for long-term protection from reinjury and to return the patient to full function.

It is imperative that a board certified specialist from the American College of Veterinary Sports Medicine & Rehabilitation oversees your dog's rehabilitation program.

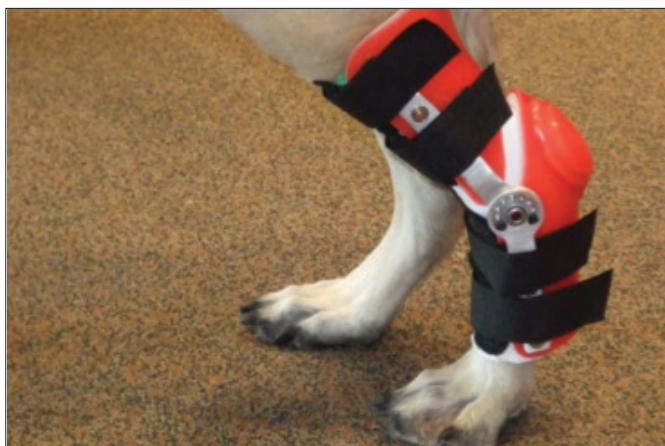
It is also important that they have experience treating regenerative medicine patients, as some modalities (i.e. Class 4 laser therapy, shock wave therapy, therapeutic ultrasound, use of NSAIDs, etc.) are contraindicated and can actually harm the regenerative cells and/or decrease response to treatment.

CAN STEM CELLS BE STORED?

Yes, regardless of the type of stem cell therapy performed, stem cells can be banked in the event future treatments are needed.

In less than 10 percent of cases, a second injection may be necessary to achieve complete healing. Should your dog require another treatment, collection will not be required since the stem cells will have been properly stored by the laboratory.

For the treatment of osteoarthritis, it is not uncommon for a patient to require a booster stem cell injection 9 to 12 months following the first injection.



FIGURES 2 AND 3. TWO EXAMPLES OF ORTHOPEDIC DEVICES COMMONLY USED TO PROTECT THE TENDONS FOLLOWING STEM CELL THERAPY.

Once again, re-collection is not required and banked stem cells can be recultured for the second injection. Some cases may require an additional blood collection in order to process banked stem cells. The laboratory will provide information on what is needed upon the request for booster injections.

IS MY DOG A STEM CELL CANDIDATE?

Stem cell therapy is an option for any age or breed of dog. The conditions listed above are just a few examples of the most common treatments performed. Many other conditions can benefit from stem cell therapy and will be discussed during the consultation. There are a few critical steps that must be considered before treatments can be performed:

First and foremost, is there a definitive diagnosis? For example, it is not sufficient to determine simply whether the lameness or pain is coming from the shoulder. For this type of treatment, we must determine, specifically, which tissues are affected to effectively target the exact and appropriate location. Otherwise, your dog's chance of improvement following regenerative medicine therapy will be greatly decreased.

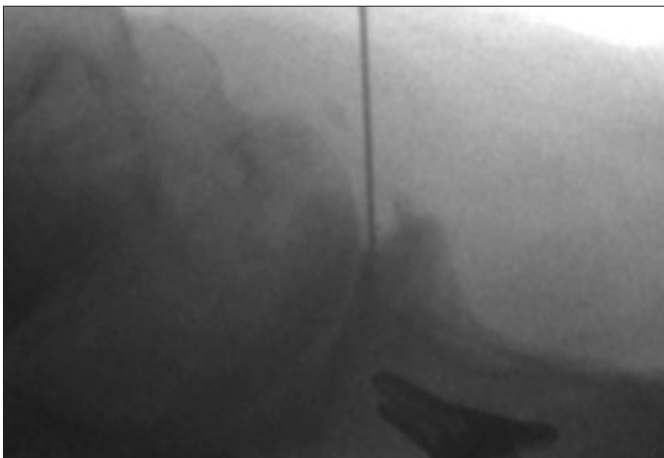
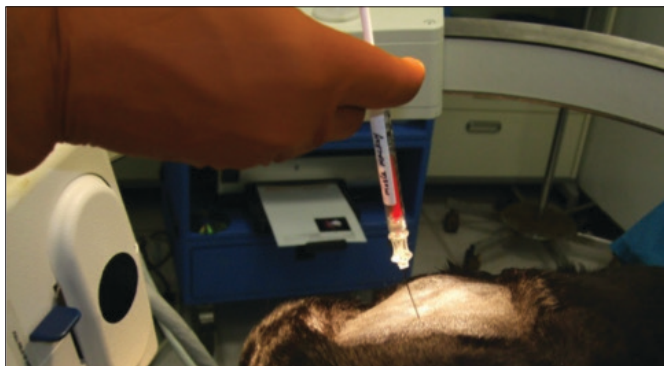
Second, how will the injections be performed (ultrasound guided, fluoroscopic guided or arthroscopic guided) and does the specialist have extensive experience with these types of targeted treatments? If not, the stem cells may not be placed in the correct location and you may not see improvement.

Third, has a qualified therapist established an appropriate rehabilitation therapy program for your

dog following treatment? A certified rehabilitation therapist (CCRT/CCRP/PT) and/or board certified specialist from the American College of Veterinary Sports Medicine & Rehabilitation should oversee your dog's rehabilitation program. If you have not found a local, qualified therapist, we can help you locate one.

Lastly, how will response to treatment be objectively assessed? In other words, how will you, your rehabilitation therapist and your specialist objectively determine if your dog is progressing as expected following therapy?

At the Center for Regenerative Medicine, objective gait analysis (GaitRite/GaitFour) is performed at the initial evaluation and at each subsequent



FIGURES 4 AND 5. THE FLUOROSCOPICALLY-GUIDED STEM CELL INJECTION IS DIRECTED INTO A PATIENT WITH HIP DYSPLASIA.

recheck evaluation to objectively measure progress and ensure your dog is improving.

In addition, the Center can perform follow-up diagnostic ultrasounds to assess tissue healing. The diagnostic ultrasound provides an objective assessment of healing, assessing for new and healthy fiber pattern formation and filling of the defect. This allows for progression of the rehabilitation program and, ultimately, a return to full activity and function.

Recovery following stem cell therapy for soft tissue injuries typically takes 3 months (90% of cases) followed by 1 to 2 months of strengthening and conditioning. For the treatment of osteoarthritis, improvement is typically noted within 2 to 4 weeks following injection.

WHAT'S THE NEXT STEP?

If you believe your dog is a candidate for stem cell therapy or wish to obtain more information the following steps are recommended:

Schedule a consultation with Dr. Canapp to review your dog's history and perform a complete orthopedic evaluation and objective gait analysis.

A definitive diagnosis will be determined based on results of the orthopedic evaluation and advanced diagnostics. For out-of-state and international patients, it is recommended that the consultation and potential diagnostics and/or treatments be booked the same day or following day for convenience. Our Surgical Coordinators can assist with scheduling.

Should fractionated cells be recommended, collection and injection will be performed the

same day. For cultured cells, a return visit about 14 days from the time of collection will be required for injection. If necessary, this can be slightly delayed for convenience of travel. The recommended treatment options will be discussed during the consultation.

If you are interested in learning more or scheduling a consultation, please contact our Surgical Coordinators. Sending x-rays, blood work, MRI reports, etc. in advance will help us prepare for your consultation. This can be either emailed to the Surgical Coordinators or faxed to 240-295-4401.

The Center for Regenerative Medicine at VOSM is conveniently located between Baltimore and Washington, DC. It is only 20 minutes from Baltimore-Washington International airport and within an hour of Dulles International and Reagan National airports. There are several dog-friendly hotels in the area with shuttle services to and from VOSM, if needed.

DOES STEM CELL THERAPY WORK?

Dr. Sherman Canapp, Director of the Center, is actively engaged in clinical trials to objectively assess treatment response to various regenerative medicine processing techniques, combination therapies and treatment protocols. His data has been presented at national and international conferences. His clinical findings have been published in a peer-reviewed human regenerative medicine journal and additional papers are in progress for publication in peer-reviewed veterinary journals.

In addition, we have the privilege of collaborating with leaders in the fields of human regenera-

tive medicine and equine medicine: Dr. Victor Ibrahim and Dr. Jennifer Barrett, respectively. This partnership ensures that we stay abreast of leading-edge regenerative treatment options, enriching our therapies for the canine community.

As you research the use of regenerative medicine therapies for your dog you may come across sources that state there is no evidence of efficacy, or that the treatments do not work. Unfortunately, not everyone is well informed about the most recent publications and evidence regarding these types of therapies.

Even within the field of veterinary medicine, exposure is limited to a few basic journals, which do not cover cutting-edge regenerative medicine research or positive clinical findings from other species (including humans), or those published in other countries.

Referenced below are just a few examples from recent peer-reviewed scientific publications in regenerative medicine in veterinary and human medicine. Additional publications can be found at <http://www.ncbi.nlm.nih.gov/pubmed>. ■

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