



Lone Star Veterinary Surgical Services

Surgical Solutions for Your Loved Pets

Cranial Cruciate Ligament Injury

OVERVIEW

The cranial cruciate ligament (or CCL, see Figure 1.) is one of the most important stabilizers inside the knee (also called ‘stifle’) joint, the middle joint in the back leg. In humans the CCL is called the anterior cruciate ligament (or ACL).

The meniscus (**Figure 1**) is a ‘cartilage-like’ structure that sits in between the thigh and shin bones. It serves many important functions in the joint such as shock absorption, position-sensing, and load-bearing and is frequently damaged when the CCL is injured.

Rupture of the CCL is one of the most common reasons for hind limb lameness, pain and subsequent arthritis. Since the development of this problem in dogs is much more complex than in humans, and dogs suffer from different degrees of rupture (partial or complete), the condition is referred to as ‘cranial cruciate ligament disease’ (or CCLD). **While the degree of lameness with CCLD varies, it invariably causes arthritis in the long-term.**

Traumatic rupture can happen in dogs but it is extremely rare. Most commonly CCLD is caused by a combination of many factors, including aging of the ligament (degeneration), obesity, poor physical condition, conformation and breed. Ligament injury is a result of subtle, slow degeneration that has been taking place over a few months or even years rather than the result of acute (sudden) trauma to an otherwise healthy ligament. This difference between people and dogs explains two important features of canine CCLD:

- 30 – 50% of the dogs that have a cruciate ligament problem in one knee will likely, at some future time, develop a similar problem in the other knee.
- Partial tearing of the CCL is common in dogs and frequently progresses to a full tear over time.

Cruciate disease affects dogs of all sizes and ages and rarely cats. **Certain dog breeds are known to have a higher incidence of CCLD** (such as Rottweiler, Newfoundland, Staffordshire Terrier, Mastiff, Akita, Saint Bernard, Chesapeake Bay Retriever, and Labrador Retriever) while others are less often affected (such as Greyhound, Dachshund, Basset Hound, and Old English Sheepdog).

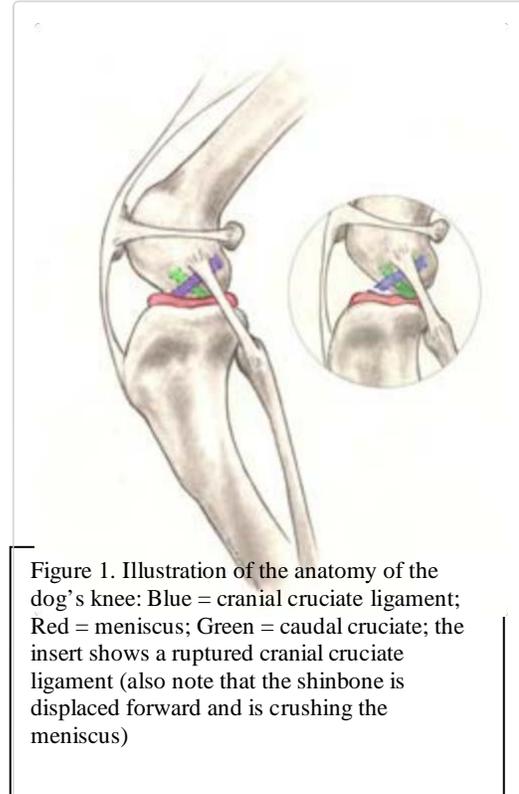


Figure 1. Illustration of the anatomy of the dog's knee: Blue = cranial cruciate ligament; Red = meniscus; Green = caudal cruciate; the insert shows a ruptured cranial cruciate ligament (also note that the shinbone is displaced forward and is crushing the meniscus)



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Female and neutered dogs are at greater risk of developing CCLD. The exact reason for this finding is unknown and the benefits of neutering your pet (such as decreased risk of cancer) certainly outweigh this increased risk. A genetic mode of inheritance has been shown for Newfoundlands.

Poor physical condition and excessive body weight are risk factors for the development of CCLD. Both of these factors can be influenced by pet owners. **A good fitness level of regular activity is advised** and will also help avoid obesity.

SIGNS AND SYMPTOMS

As mentioned, **progressive degeneration** of the CCL from very mild partial tearing to a complete tear in the later stages of the disease is common in dogs. You may not notice a severe lameness initially, especially if both knees are affected. One common symptom is that dogs will not sit 'square' anymore but rather put their leg(s) out to the side when they sit down.

You may also observe that your dog has:

- Difficulty rising
- Trouble jumping into the car
- Decreased activity level
- Muscle atrophy (decreased muscle mass in the affected leg)
- Decreased range of motion of the knee joint
- A popping noise (which may indicate a meniscal tear)
- Swelling on the inside of the shin bone (fibrosis or scar tissue)

Many dogs will shift their weight away from the damaged leg when they stand but the lameness is less obvious during walking especially with partial tears of the CCL. When a partially damaged ligament ruptures completely or the meniscus becomes damaged your dog may also become non-weight bearing lame and may hop on three legs. This change in lameness may happen suddenly, usually without major trauma (a minor traumatic event may cause the partially torn ligament to rupture completely). Dogs with chronic (late stages) of CCLD usually show symptoms associated with arthritis, such as:

- Decreased activity
- Stiffness
- Unwillingness to play
- Pain



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DIAGNOSIS

Diagnosing complete tears of the CCL is easily accomplished by a combination of observation of your pet's gait, palpation of the knee, and radiographs (x-rays). Specific palpation techniques that veterinarians use to confirm a problem with the CCL are the 'cranial drawer test' and the 'tibial thrust test'. These tests confirm abnormal motion in the knee and hence a rupture of the CCL. Early partial tears can be a bit more complicated and occasionally require surgical exploration to physically examine the ligament.

X-rays are usually taken to: Confirm joint effusion (fluid accumulation in the joint which indicates that there is a problem within the joint) evaluate the degree of arthritis aid in surgical planning rule out concurrent disease conditions such as bone cancer. For certain treatments (TPLO, TTA) specific X-rays are required and hence may require sedation. X-rays do NOT show the status (i.e. intact or damaged) of the CCL or the meniscus since those structures cannot be seen on X-rays. It is crucial that the surgeon evaluate both of these structures (meniscus and the cruciate ligament) when performing the selected surgical repair. This can be accomplished via an arthrotomy (opening of the joint) and is combined with the surgical stabilization procedure itself since both procedures require full anesthesia and clipping of the animal.

TREATMENT

Many treatment options are available for CCLD. The first major decision is between surgical treatment and non-surgical (also termed conservative or medical) treatment/management. The best option for your pet depends on many factors such as your pet's activity level, size, age, and conformation, as well as the degree of knee instability. Pet owners should contact a surgeon as soon as they notice signs and symptoms in order to achieve the best results. Treatment is generally recommended for CCLD since it is the only way to permanently control the instability in the stifle joint and to evaluate the structures within the joint. Surgery addresses the two major problems seen with CCLD

- 1) Stifle instability because of loss of the CCL
- 2) Damage to the medial meniscus commonly seen in conjunction with CCLD.

Again, meniscal injury will be addressed by your surgeon by removing the damaged parts of the meniscus when performing surgery to stabilize the knee.



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SURGICAL TREATMENT

To address stifle instability many surgical treatment options are available. These different techniques can be categorized into two groups based on different concepts:

1. Osteotomy techniques require a bone cut (osteotomy) which changes the way the quadriceps muscles act on the top of the shin bone (tibial plateau). Stability of the stifle joint is achieved without replacing the CCL itself but rather by changing the biomechanics of the knee joint. This can be accomplished by either rotation of the plateau (slope) of the shin bone (Tibial Plateau Leveling Osteotomy - TPLO) or advancing the attachment of the muscle (Tibial Tuberosity Advancement - TTA).

Even though Dr. Davidson learned the TTA procedure in 2006 and has mastered this technique, Dr. Davidson is not currently recommending the TTA procedure at this time due to the difficulty involved in removing the TTA implants should infection occur. An absorbable TTA cage is in development and Dr. Davidson will be happy to offer the TTA procedure again once that technology is fully developed.

The Tibial Plateau Leveling Osteotomy (TPLO) involves making a circular cut in the tibial plateau and rotating the contact surface of this bone until it attains a relatively level orientation that puts it at approximately 90 degrees to the attachment of the quadriceps muscles (Figure 2). This orientation of the tibial plateau renders the knee relatively stable, independent of the CCL. The cut in the bone needs to be stabilized by the use of a bridging bone plate and screws. Once the bone has healed, the bone plate and screws are not needed, but are seldom removed unless there is an associated problem. The greatest advantage of this technique is the superior outcome (limb function and less progression of arthritis) compared to traditional suture techniques especially in young, large breed, active dogs.

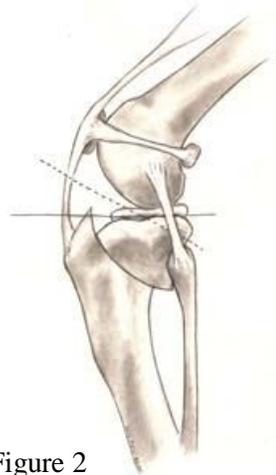


Figure 2

Dr. Davidson is one of the most experienced TPLO surgeons in the DFW area. She learned the TPLO technique in 2000 and since then has performed over 1500 TPLOs.

2. Suture techniques can be divided into intra- articular (within the joint) and extra-articular (outside the joint) procedures. In humans intra- articular replacement of the ACL using some form of ACL replacement is the most common procedure. This approach has been studied extensively in dogs and found not to be successful mainly because of the difference in anatomy and underlying disease process. Many companies and surgeons are revisiting this possibility utilizing novel developments. Because of the disappointment with intra-articular techniques to date, suture techniques are currently performed in an extra-articular fashion in dogs.



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The most commonly performed technique is called extra-capsular suture stabilization and utilizes strong suture material that is placed just on the outside of the knee joint (but under the skin) to mimic the CCL and stabilize the joint. A variation of this technique is called Tightrope® and allows the surgeons to use bone tunnels and toggles.

- a. Extra-capsular suture stabilization (Figure 3), also called “Ex-Cap suture”, “lateral fabellar suture stabilization” and the “fishing line technique”) has been performed for many years. While there are many variations of this technique (different suture materials, ways to tie the suture, how to attach the suture to the bone and so forth), the general concept of this procedure is to replace the function of a defective CCL on the outside of the joint. This is usually accomplished by utilizing a strong suture placed along a similar orientation to the original cruciate ligament. The suture needs to stabilize the knee joint, while allowing normal knee movement, until organized scar tissue can form and assume the stabilizing role.



Figure 3 Extracapsular Repair: Strong monofilament suture is placed around the lateral fabella, thru a pre-drilled hole in the tibia

The most common complications after this procedure involve failure of the suture and progressive development of arthritis. Suture failure tends to be more common in larger, active dogs; hence many surgeons reserve this technique for small breeds, older, and/or inactive dogs. The main advantages of this technique include the lower cost and the lack of a bone cut.

- b. The Tightrope® is a novel technique that has been developed to provide an alternative to osteotomy techniques for large breed dogs providing similar outcome without the complications associated with these techniques (such as failure of the bone to fuse or slow bone healing). It utilizes a specifically developed suture/toggle implant that allows drilling holes through both bones (thigh and shin bones) and using a toggle to attach the suture.



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Advantages of this technique over the traditional suture repair techniques include more accurate placement of the suture and stronger fixation. This technique also allows for minimally invasive placement of the suture.

**Disadvantages include a high incidence of infection post-operatively necessitating implant removal and antibiotics.*

Currently Dr. Davidson does not recommend this technique.

POSTOPERATIVE CARE

Postoperative care at home is critical. Premature, uncontrolled or excessive activity, risks complete or partial failure of the surgical repair. When choosing a suture repair, this failure may simply mean that the surgery has to be performed again but when choosing an osteotomy technique this failure may mean that a much more invasive approach is now needed. Proper postoperative care limits activity to leash walking for a minimum of 8 weeks and no running, jumping, rough-housing, or off-leash activity. While it is important to control activity it is also important to maintain muscle mass and joint function (range of motion).

Studies show that physical therapy can speed the recovery and improve final outcome regardless of the chosen surgical technique. This rehabilitation should start two weeks after surgery and usually includes a regime of passive range of motion, balance exercises, and underwater treadmill. Several options for physical therapy will be available to you after your pets surgery.

The long term prognosis for animals undergoing surgical repair of CCLD is good, with clinical reports of improvement in 94-98% of the cases. Unfortunately, arthritis progresses regardless of treatment, however much slower when surgery is performed. Therefore, medical arthritis management/prevention is recommended for any dog with CCLD regardless of the chosen surgical. It is important to realize that arthritis is a progressive disease and develops fairly quickly in an injured (or damaged) stifle joint.

The most common complication caused by CCLD is long-term impairment due to arthritis. Other complications associated with arthritis and CCLD include loss of range of motion in the joint, muscle atrophy, and loss of full function of the limb, as well as decreased activity. Unfortunately, neither human nor veterinary surgeons are able to completely



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restore normal joint anatomy and function. Even with surgery some progression of arthritis is expected. It is important to understand that arthritis is an irreversible disease and hence everything should be done to prevent its development or progression. Therefore, two steps are crucial when treating CCLD:

1. Surgical repair and
2. Medical management of arthritis

The second most common complication caused by CCLD is tearing of the meniscus. Due to the instability in the knee joint, the inside (medial) meniscus frequently gets damaged. This can happen during the initial injury or even later after surgical repair of the CCL. Meniscal damage in dogs is addressed by removing the damaged parts of the meniscus since it is too small to repair. A meniscal tear is very painful and if a damaged meniscus is left in place the animal will not regain full function. Removal of the damaged parts of the meniscus (if present) will be performed by Dr. Davidson during the chosen procedure to address the knee instability. If Dr. Davidson finds that the meniscus is not torn she will perform a meniscal release which is a small transverse cut in the back portion of the medial meniscus that will usually prevent meniscal tearing and damage after surgery. Performing the meniscal release also should prevent surgery of that knee since if the meniscus were to become damaged after the surgery another surgery would be needed to remove the torn portion.

NON-SURGICAL TREATMENT

Non-surgical treatment usually involves a combination of medications, exercise modification, joint supplements, and possibly braces/orthotics:

1. Activity restriction and anti-inflammatories – The lameness associated with CCLD usually waxes and wanes and generally improves significantly with administration of pain medications (please note that dogs should not be given Aspirin) and rest. Especially in small dogs and with partial tears, the lameness may completely disappear with this treatment but usually some degree of lameness remains in larger dogs. Attempts to return to normal activity levels will often be limited by the progression of arthritis. The combination of pain medications and rest is not a treatment per se because it does not stabilize the knee. Therefore, this treatment is generally not advised, but it may be appropriate for individual dogs due to some combination of their very small size, inactive lifestyle, or other concurrent injuries or diseases.



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2. Rehabilitation therapy - There is ample evidence that rehabilitation therapy by a trained rehabilitation practitioner can advance and hasten the recovery from surgery. However, there is little evidence to suggest that this is a consistent and predictable alternative to surgical management for most dogs. Occasionally the combination of concurrent injuries or diseases, advanced age, patient size, and financial limitations may make this an attractive alternative option.
3. Custom knee bracing/orthotics – Custom knee bracing is relatively new to canine orthopedics and hence there is little scientific evidence available. This treatment is valuable for the selected patient. However, it is a temporary solution and therefore not ideal for young, active animals.

Please feel free to contact Dr. Davidson or your family veterinarian if you have any questions or concerns about your pet's knee injury.