

Cranial Cruciate Ligament Injury in Agility Dogs

Part 1

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Keili, an 8-year-old female spayed Brittany Spaniel was presented to me at a regional agility dog sports medicine seminar in March 2006. Keili had previously ruptured her cranial cruciate ligament (CCL) in a performance-related injury in December 2005, and had a traditional surgical repair (intra-articular stabilization) performed in January 2006, 7 weeks before the seminar. The owner stated that since surgery Keili had not made any progress toward recovery and was still unable to use the limb naturally. Due to Keili's lack of recovery she had not returned to her normal life as a companion dog and performance athlete. The owner wished that one day Keili would be able to run and play again and return to agility. The owner offered to have Keili evaluated in front of the audience at the seminar.

During the evaluation it was noted that Keili was toe-touching lame in her left hind limb. At a walk and trot Keili had a shortened stride in the left hind limb and would off-load weight on the limb during the stance phase. During the sit, Keili would hold her

left hind limb out to the side. On physical examination, Keili had significant muscle atrophy in the left hind limb. The left stifle (knee) had a decreased range of motion. Pain was noted on extension of the stifle and significant effusion (fluid within the joint due to inflammation) and medial buttress (scar tissue formation) was noted. Despite the previous repair, instability within the stifle was still noted (cranial drawer and positive cranial tibial thrust). Based on the results of the orthopedic examination it was determined that the previous repair had failed. I recommended surgical intervention, stifle arthroscopy, and tibial plateau leveling osteotomy (TPLO), followed by an intense rehabilitation therapy program.

Keili had in-house rehabilitation therapy sessions at VOSM and daily at-home therapy while awaiting surgery. I performed the TPLO procedure on Keili in April 2006, and she was placed in a rehabilitation therapy program. The rehabilitation therapy program included sessions by therapists at VOSM as well as a strict home exercise and retraining program. Keili made an excellent

recovery and returned to agility five months after TPLO surgery in September 2006. Six months following Keili's TPLO she earned her Master Agility Champion title to become Ch. MACH Brookewood's Shooting Star, CDX, RN, JH.

The most common orthopedic injury that we see in our canine patients is a rupture of the CCL. A rupture of this ligament can cause pain and lameness, injury to other structures of the knee, such as the meniscus, and lead to long-term osteoarthritis of the knee. Two of the most common surgical options for this injury are the TPLO and an extracapsular stabilization. We recommend the TPLO to treat this injury. Contrary to popular belief, TPLO surgery is not reserved for large-breed dogs; patients weighing as little as 10 lbs and as much as 240 lbs can benefit from TPLO surgery. TPLO surgery provides a more rapid recovery, improved range of motion, reduction in the progression of arthritis, and can return the patient to complete pre-injury performance when compared to other surgical options.

Anatomy

Four ligaments passively stabilize the canine stifle joint: the cranial cruciate, caudal cruciate, medial collateral, and lateral collateral ligaments as shown in **Figure 1**. The cranial cruciate ligament is functionally composed of a craniomedial band and a caudolateral band. While the craniomedial band remains taut throughout a full range of motion (flexion and extension of the knee) the caudolateral band becomes lax during flexion.

The medial and lateral menisci are semilunar fibrocartilage structures positioned between the articular surfaces of the femur and tibia. The menisci have several important functions, including energy absorption and stress transfer across the stifle joint, joint stabilization, prevention of synovial membrane (joint capsule) impingement between the femur and tibia, and joint proprioception.

What is a cranial cruciate ligament and what does it do?

Although the knee joint in dogs is similar to ours, the forces applied to the joint during weight bearing are vastly different. Our hip, knee, and ankle joints are perpendicular to our weight-bearing surface: our feet. When we stand, there is minimal stress to the ligaments in our knee. Dogs, however, stand on their toes with the ankle elevated and the knee forward. The top of the dog's tibia (tibial plateau) is sloped. Weight bearing creates a force that pushes the femur down the slope of the tibia. This force is called "tibial thrust" and the job of the CCL is to prevent this motion. Each time the dog bears weight, the CCL is called into work. If you think of the tibial plateau as a hill and the femur as a car parked on the hill, the CCL is the brake. If the ligament ruptures, it allows the femur to slide down the slope or in our car example, the brake releases and the car rolls down the hill. When the ligament is ruptured, each time the dog bears weight this sliding motion occurs and causes discomfort. Within the joint, there will be inflammation and swelling, referred to as synovitis and effusion.

How does a CCL rupture occur?

Rupture of the CCL can occur in several different ways. There may be a single incident that causes a sudden complete rupture of the ligament; the dog typically show signs of pain and non-weightbearing. A rupture can also occur slowly over time. In addition, dogs can also partially tear the ligament. With a partial rupture, the dog typically experiences an intermittent lameness. The majority of partial ruptures will progress to a

complete rupture within months. Common causes of partial and/or complete ruptures include hyperextension and internal rotation of the knee from sudden turns or stepping into a hole; jumping if the force of cranial tibial thrust exceeds the breaking strength of the CCL; repetitive normal activities; and degeneration associated with aging. Obesity can increase the risk of a rupture, as can the "weekend warrior" routine, when the dog is relatively inactive during the week but very active on weekends. Dogs that have ruptured their CCL in one knee have a 50% to 70% chance of rupturing the CCL in their other knee. Therefore, surgical correction is recommended as soon as possible to decrease the stress placed on the uninjured CCL, thereby decreasing the risk of CCL rupture to that knee.

What are signs of a CCL rupture?

The presenting history of dogs with CCL pathology is varied. The onset varies from peracute after a traumatic or athletic injury to slow and insidious. Dogs with an acute onset of non-weightbearing lameness often improve over several weeks as the inflammation subsides, particularly with rest and nonsteroidal anti-inflammatory drugs (NSAIDs). This initial improvement, however, does not indicate a resolution of the condition. Commonly, dogs with early or minor CCL pathology will initially return to near-normal function with time, rest, and NSAIDs only to present several weeks or months later with a more severe and persistent lameness. In many cases, this history

indicates progression to a complete CCL rupture or the development of a secondary meniscal injury.

If the CCL rupture is complete and acute, often the dog will be non-weightbearing on the affected leg as seen in **Figure 2**. In the case of a partial or gradual rupture, however, the dog will be weight bearing or have an intermittent lameness. Lameness will often worsen with activity. Stiffness upon rising and/or a stiff gait is another common complaint. You may note that your dog sits with the affected leg out to the side as shown in **Figure 3**. The dog may also have difficulty rising and be less active. Physically, you may note a swelling or thickening of the knee and muscle atrophy (wasting) in the affected leg. Dogs that have ruptured the CCL in both knees do not routinely carry or off-load their weight to a particular limb since they do not have a good leg to stand on.

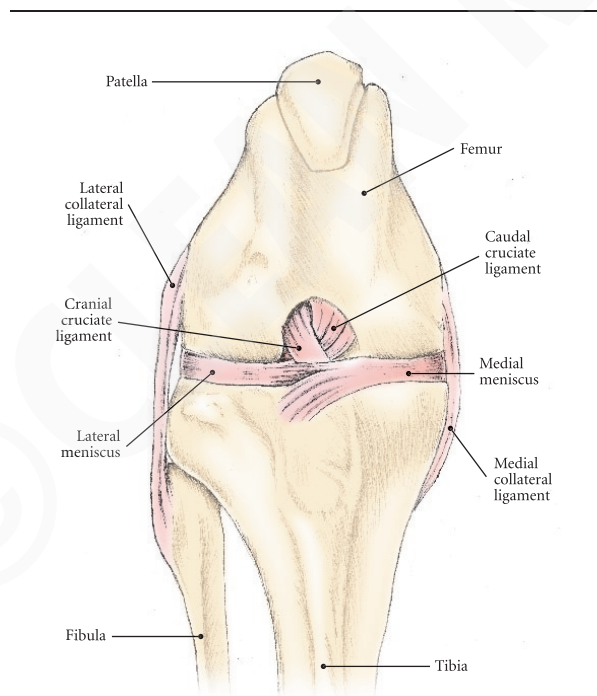


Figure 1: Anatomy of the canine stifle (knee)

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Figure 2: Non-weightbearing lameness

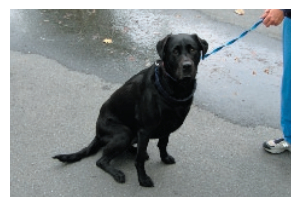


Figure 3: A classic posture, the dog is sitting with the affected limb out to the side

Gait Analysis

Gait evaluation is used to detect lameness and confirm the limbs involved. In some instances, it can strongly direct the orthopedic specialist toward a specific joint as the source of lameness. Closely observing dogs standing still, walking,

trotting, running, sitting, and rising gives a great deal of information regarding CCL function and whether a problem is unilateral or bilateral.

Dogs with even subtle lameness often lean away from the affected limb while standing. The degree of lameness noted at a walk varies from no lameness to non-weightbearing. Often, lameness that is absent at a walk is evident when the dog is trotting or running. Additionally, circling the dog around may expose a subtle lameness because weight bearing is shifted toward the inside leg. For example, subtle left hind limb lameness may be exposed when circling the dog around counterclockwise. Dogs presented for bilateral hind limb lameness often shift their weight to the forelimbs while sitting and rising.

How is a CCL rupture diagnosed?

The purpose of the standing examination is to begin to localize the source of the lameness by detecting muscle mass asymmetry (thigh circumference), joint swelling, tissue warmth, decreased joint range of motion (goniometry), and joint instability. During the orthopedic examination the stifle will be checked for cranial drawer (abnormal movement at the knee) by holding the femur with one hand and the tibia with the other. The stifle will then be checked for forward motion of the tibia as seen in **Figure 4**. If this occurs, it is an indication that the CCL is ruptured. To further test for a rupture of this ligament, a tibial thrust test will be performed. This involves placing a hand over the knee joint and flexing the hock (ankle) with the other hand. If the tibia has forward motion, it is an indication that the CCL is ruptured. In the case of a partial cruciate rupture, these motions will be noted in flexion of the knee. However, these motions may be difficult to assess. The meniscus

will also be evaluated for injury by performing a McMurray test. In many instances, a click may be noted when placing the stifle through range of motion indicating a possible meniscal injury.

Radiographs (X-rays) of the knee will be taken to evaluate the presence of effusion (excessive fluid within the knee) and arthritis. The CCL cannot be visualized radiographically. Joint effusion, osteophytosis (bone spurs/osteoarthritis), or forward tibial displacement lends support to a diagnosis of CCL rupture. The findings vary depending on the chronicity of the disease. If these tests alone are not completely diagnostic, MRI or arthroscopic evaluation of the joint and structures may be recommended. Unlike radiography, MRI allows visualization of the CCL and meniscus, so it may be used to detect more subtle pathology.

Arthroscopy of the stifle may be used not only as a diagnostic test, but also a therapeutic tool. Through minimally invasive means the CCL and meniscus may be evaluated and treated. Arthroscopic techniques include CCL debridement, treatment of meniscal injury (partial meniscectomy and meniscal release), as well as treating cartilage lesions (abrasion arthroplasty). If arthroscopic evaluation reveals the CCL ligament is injured, a TPLO can then be performed.

What are the surgical options for a ruptured CCL?

Many surgical treatments have been described that aim to restore stifle joint stability and minimize the progression of subsequent osteoarthritis. Most surgical treatments seek to replace the function of the CCL by substituting autologous tissues (derived from the dog's own body) or synthetic materials. More recently, the tibial plateau leveling osteotomy (TPLO) procedure has been described,

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Figure 4:
Cranial (forward) displacement of the tibia due to a CCL rupture

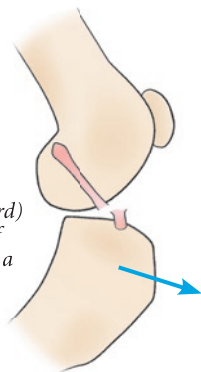


Figure 5:
The osteotomy and the plate that is applied to hold the tibia in this position and allow for the bone to heal

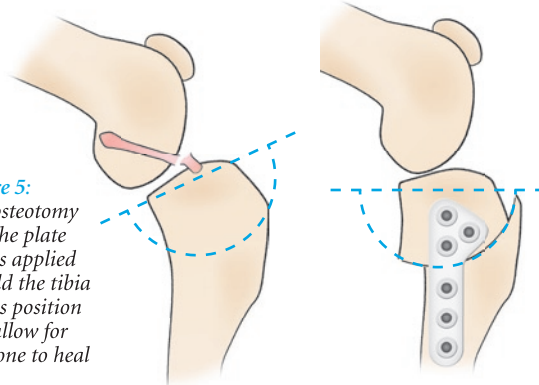
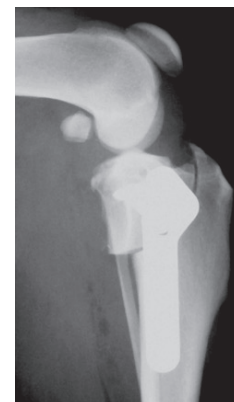


Figure 6:
A post-operative X-ray of the TPLO procedure



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which alters mechanical forces acting on the stifle, rendering the CCL unnecessary.

Two of the most common surgical options for correction of the CCL injury include the TPLO or an extracapsular stabilization. The extracapsular stabilization stabilizes the joint with a prosthetic ligament. This technique relies on scar tissue to ultimately stabilize the joint. The reported recovery time for the extracapsular stabilization is approximately 3 to 5 months. The reported recovery time for the TPLO procedure is approximately 2 to 3 months. Following surgery, patients use the limb much sooner with the TPLO than with an extracapsular stabilization. Additionally, studies show that there is far less arthritic development long term following a TPLO versus the extracapsular stabilization (*Lazar T, Vet Surg, 2005*). For these reasons, at VOSM the TPLO is considered to be the “gold standard” for correcting this injury, especially in the canine athlete.

What is a TPLO?

The TPLO procedure stabilizes the knee by leveling the tibial plateau. In the earlier example of a car parked on a hill, the TPLO levels the hill, eliminating the need for the brake. Radiographs of the knee are taken before surgery. Using specific landmarks, your dog’s tibial plateau angle (slope) is observed to precisely determine the amount of rotation that is needed to reduce the angle. During the TPLO procedure, a circular cut (osteotomy) will be made in the top of the tibia and rotation of the segment will occur so that the load-bearing surface of the tibia is between 5° to 8°. **Figure 5** shows the osteotomy and the plate that is applied to hold the tibia in this position and allow for the bone to heal. A post-operative X-ray of the TPLO procedure is seen in **Figure 6**. Restricted activity is required while the bone heals.

The menisci are the “shock absorbers” of the knee and are located between the bottom of the femur and top of the tibia. There is a meniscus located on the inside (medial) and outside (lateral) aspects of the knee. When the knee is unstable due to a CCL rupture, either complete or partial, these structures are at risk for injury. Before the TPLO procedure, I perform a stifle arthroscopy or a mini arthrotomy to evaluate these structures, and if either menisci has sustained an injury, the damaged portion will be treated.

What can I expect after TPLO surgery?

After surgery, dogs are typically non-weightbearing to toe-touching lame for the first few days. Shortly thereafter, dogs begin to bear weight with an obvious lameness. When walking, they will use the limb but they will often hold the leg up when standing. Within two to three weeks, however, they are using the limb consistently, although a lameness will still be obvious. Patients are typically quite comfortable within two or three days following surgery. Most owners report that the greatest challenge they face while caring for their recovering dog is preventing him from being too active! By the four-week recheck and radiographs, the dog is typically fully weight bearing. By the eight-week recheck and radiographs, most pets are healed and may begin a gradual return to normal activity. A few pets require an additional month to complete healing.

At-home care and rehabilitation therapy are the most important aspects of a successful recovery. A soft padded bandage is applied to the leg post-operatively to help reduce swelling. This bandage will be removed one to two days after surgery. An Elizabethan collar or Bite Not collar is needed following surgery until the incision has healed and the staples are removed (10 to 14 days). The dog will need to be confined to either a crate or a small area of the house where he does not have access to stairs or furniture. A crate is only recommended for dogs that are normally confined in that manner. The dog should not run, jump, or play for at least two months following surgery. Stairs should be limited to only those necessary. A sling and leash should be used when performing stairs, crossing slippery surfaces, and on uneven ground. You will be given rehabilitation exercises to perform at home. Your dog is limited to short leash walks for elimination only for the first two weeks. Thereafter, your dog is allowed gradually increasing leash walks as part of rehabilitation. Radiographs will be needed at 4 and 8 weeks, and possibly, 12 weeks post-operatively. At those appointments, based on the amount of healing noted and orthopedic evaluation, changes to the at-home therapy program are provided. All at-home care and rehabilitation exercises will be reviewed with you in detail. Like in humans, rehabilitation therapy will help to speed your dog’s recovery and return to full function.

In the next part of the article, we will discuss the structure of rehabilitation, rehabilitation at home, and the dog’s progression during the process. 🐾

Dr. Canapp, a Diplomate of the American College of Veterinary Surgeons, completed a combined D.V.M./M.S. at Kansas State University, an internship in small animal medicine and surgery at the University of Missouri, a three-year residency in small animal surgery at the University of Florida, and training in canine rehabilitation by the Canine Rehabilitation Institute. Dr. Canapp currently practices orthopedic surgery and sports medicine at the Veterinary Orthopedic & Sports Medicine Group (VOSM) in Ellicott City, Maryland, and acts as a consultant to local zoos, police K-9 units, agility, flyball, and disc competition dogs. See additional information about Dr. Canapp at www.vetsportsmedicine.com.