

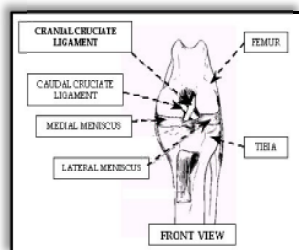


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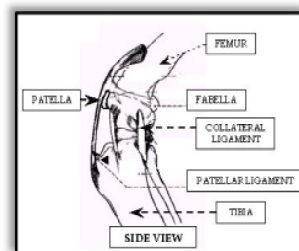
CRANIAL CRUCIATE LIGAMENT (CCL) INJURY

GENERAL INFORMATION, ANATOMY AND FUNCTION OF THE CCL AND MENISCI:

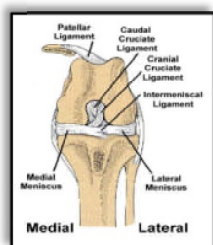


The Cranial Cruciate Ligament (CCL) is also commonly referred to as the Anterior Cruciate Ligament (ACL), although the term ACL is most commonly used to describe human anatomy. CCL injury is one of the most common stifle (knee) injuries in dogs, and less commonly cats. The CCL plays a key role in stabilizing the two major bones of the stifle, the femur on top of the stifle and the tibia on the bottom of the stifle. Although the animal stifle is similar to the human stifle, there are marked differences in the orientation of stifle structures and the forces applied to those structures during weight bearing. The human leg is oriented perpendicular to the weight bearing surface of the foot which places minimal stress to the ACL in humans. However animals, dogs and cats in specific, stand on their toes with the hock (ankle) raised and the stifle (knee) in a forward position. The top of the tibia (tibial plateau) is sloped and weight placement on the femur causes the femur to slide down the tibial slope. This is termed tibial thrust.

The function of the CCL is to prevent tibial thrust. Injury to the CCL causes the stifle to become unstable with the femur sliding in relation to the tibia when weight bearing force is applied to the leg. The flat portion of the tibia is capped with a cup-like cartilaginous structure called the menisci to provide a slippery surface between the femur and tibia so that both bones can rotate without grinding and bony wear. There is a medial meniscus on the inner side of the stifle and a lateral meniscus on the outside of the stifle. The menisci serve to distribute approximately 65% of the compressive load delivered to the stifle. CCL injury was first documented in 1926, however it was not until about 1950 that a surgical correction was documented. Since then numerous surgical techniques of CCL stabilization have been described in the veterinary literature.



CCL AND MENISCAL INJURY:



The CCL can completely rupture with a traumatic injury or it may partially tear and slowly rupture over time resulting in chronic, intermittent lameness. With the initial onset of CCL injury the animal may limp for a period of time but regain normal use of the limb until the CCL completely ruptures and the leg is no longer stable. The CCL can also slowly rupture over a long period time secondary to excessive stress, chronic inflammation and degenerative conditions. This is the most common form of CCL rupture in dogs. Rupture of the CCL results in destabilization between the femur and tibia of the stifle producing a crushing force to the meniscus and possibly a meniscal tear. 98% of CCL cases involving a meniscal tear had a medial meniscal tear versus a lateral meniscal tear. With a meniscal tear the animal will generally demonstrate significant lameness. Animals that suffer a CCL injury have a 60% chance of a CCL injury on the contralateral or opposite limb within 2 years. Meniscal tears occur in approximately 40% - 50% of CCL cases. Movement of the stifle through range

of motion causes a torn meniscus to "pop" back and forth between the femur and the tibia producing a clicking noise called a "meniscal click".

CLINICAL SIGNS OF CCL INJURY:

- Limping when walking.
- Abnormal sitting posture with the affected limb in an extended position.
- Difficulty or favoring of a limb when rising and/or sitting.
- Stiff gait with slow movement, holding up of the limb or severe limping with faster movement.
- Exercise intolerance due to pain with the rear legs.
- Muscle atrophy of the affected limb which can be very subtle with an early CCL injury.
- Stifle swelling and pain, which is more prominent with an early CCL injury and can be very reduced with a chronic CCL injury.

DIAGNOSIS OF A CCL INJURY:

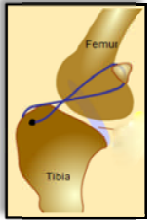
- **DRAWER SIGN:** One of the keys to diagnosing a CCL injury is the demonstration of an abnormal stifle motion called a "drawer sign". The drawer sign is demonstrated by stabilizing the position of the femur with one hand and using the other hand to place forward force on the tibia. If the tibia moves forward in relation to the femur, much like a drawer being opened, this confirms a CCL injury.
- **TIBIAL COMPRESSION:** The femur is stabilized with one hand and the hock (ankle) is flexed with the other hand. The tibia will move forward in relation to the femur if a CCL injury has occurred.
- **MEDIAL BUTTRESS:** A firm swelling at the medial collateral ligament on the medial of the stifle. This suggests a chronic CCL injury.
- **RADIOGRAPHS:** Radiographs (x-rays) are needed to rule out underlying causes that may incite, mimic, complicate or predispose CCL injury. Typically radiographs of the hips, spine and each stifle will be required.

Animals may be tense, scared and/or painful upon examination. Muscle tension can temporarily provide stability to the stifle and hide a drawer sign in a joint that has a CCL injury. Sedation to reduce muscle tension and pain may be required for a thorough evaluation of the stifle. This is especially true if the animal is large or extremely tense.

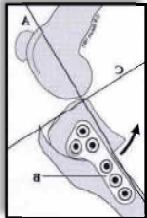
PLEASE TURN OVER

SURGICAL CORRECTION OF CCL INJURY:

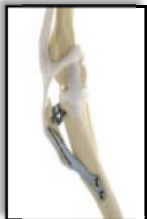
Surgical correction of CCL injury generally starts with an arthrotomy or opening of the joint capsule. The joint is explored and the structures examined to determine the extent of damage to the CCL and menisci. The torn ends of the CCL are debrided (removed). A damaged meniscus requires removal, called a meniscectomy. All attempts are made to preserve the menisci since they prevent bony contact, bone wear and osteoarthritic (OA) disease. If only a small part of the meniscus is damaged, it may be able to be trimmed out. This is called a partial meniscectomy and may result in less OA disease compared to a full meniscectomy. If the meniscus is intact, a prophylactic release of the medial meniscus is performed in order to reduce the potential of a future tear and a second surgery.



EXTRACAPSULAR STABILIZATION: Extracapsular stabilization is the oldest method of CCL stabilization. The most common method is lateral retinacular imbrication first performed in 1970 by DeAngelis and Lau. This procedure involves implanting strong surgical non-absorbable suture, usually monofilament nylon, anchored to a small bone behind the femur called the lateral fabella and to a drilled hole at the front point of the tibia called the tibial tuberosity. The implanted suture material corresponds to the orientation of a normal CCL. The goal of this method of stabilization is to eliminate drawer motion while scar tissue develops around the joint to stabilize it. Numerous modifications have been described in the veterinary literature. This technique is termed extracapsular because the suture implantation is outside the joint capsule. This technique has its best success in animals of body weight less than 30 lbs, has varying success in animals with higher body weight and has poor success in very large animals.



TIBIAL PLATEAU LEVELING OSTEOTOMY (TPLO): The TPLO is a CCL stabilization method that was first performed in 1983 by Dr. Barclay Slocum and was originally a patented procedure. The TPLO attempts to take into account active forces (body weight, muscles and tendons) and passive forces (ligamentous structures) applied to the stifle during movement. With the TPLO the unabated drawer motion is proposed to be the source of stifle pain and meniscal damage and is ultimately the cause of lameness and degenerative joint disease (DJD). The TPLO is a modification of a technique called the tibial closing wedge osteotomy (TCWO) and seeks to neutralize the forces that produce the drawer motion. In doing so the force of weight from the femur is transferred from the CCL to the tibia thereby negating the need for the CCL. The TPLO involves a circular osteotomy (bone cut) at the back of the tibia and rotation of the cut to a certain number of degrees to change the angle of the tibial slope. The degree of rotation is predetermined by measurement prior to the surgery. The osteotomy is stabilized by a bone plate. The TPLO is favored for large animals and can also be performed in small animals.



TIBIAL TUBEROSITY ADVANCEMENT (TTA): The TTA is the newest procedure of CCL injury stabilization. It was developed by Drs. Slobodan Tepic and Pierre Montavon in 2002 at the University of Zurich in Switzerland. The TTA was released for clinical study in 2004 worldwide with over 30,000 procedures in the initial study. The TTA is biomechanically similar to the TPLO in that it takes into account active and passive forces acting on the stifle, seeks to neutralize the need for the CCL and transfers the body weight force to the tibia. This procedure involves cutting and moving forward the tibial tuberosity (front side of the tibia) to a measured position so that the drawer motion is neutralized under load. A specialized bone spacer called a wedge or cage, a plate and screws are utilized to hold the cut bone pieces together until the bone is fully healed. A bone graft is used in the osteotomy to stimulate bone healing. The TTA is favored for large animals and can also be performed in small animals.

PROGNOSIS WITH CCL STABILIZATION:

EXTRACAPSULAR STABILIZATION: 85% of cases will be significantly improved. 50% of cases will have some degree of lameness, which may be mild or intermittent following heavy activity. 50% of cases regain normal limb function. Working dogs unlikely to return to full working function. Present DJD is not reversible and DJD will progress in 100% cases.

TIBIAL PLATEAU LEVELING OSTEOTOMY (TPLO): 73% normal return to function, 21% significantly improved, 3% fair improvement and 2% failures. Working dogs can return to full working function. Present DJD is not reversible and DJD will progress in approximately 50% of cases.

TIBIAL TUBEROSITY ADVANCEMENT (TTA): 90% normal return to function, 8 % significantly improved and 2% failures. Working dogs can return to full working function. Present DJD is not reversible and DJD will progress in approximately 30% of cases.

COMMON BREEDS AT RISK FOR CCL INJURY:

CCL injury can occur in an animal of any size, even in cats. The most prevalent breeds to suffer from CCL injury include the Neapolitan Mastiff, Newfoundland, Akita, Chesapeake Bay Retriever, American Staffordshire Terrier, Bernese Mountain dog, Bullmastiff, Chow, German Shepherd, Golden Retriever, Rottweiler, Labrador Retriever, American Bulldog, and the Saint Bernard. Large breed dogs are overrepresented most likely due to their heavy body weight and steeper stifle angles in comparison to smaller breed dogs.

PREDISPOSING FACTORS FOR CCL INJURY:

- Overweight/Obese animals – female dogs tend to have a higher incidence of obesity.
- Poorly conditioned animals - sedentary animals that are submitted to sudden intense activity.
- Age – Dogs under 4 years of age are more susceptible to acute, traumatic CCL injury secondary to high activity. Dogs over the age of 8 are more susceptible to chronic, degenerate CCL injury secondary to Osteoarthritis and weaker muscular joint support. 80% of CCL injury cases occur in dogs between the ages of 5 – 8 years.
- Drugs – Chronic steroid use will weaken ligaments and increase body weight and drugs such as Phenobarbital will increase body weight.
- Medical Conditions – certain disease conditions such as Cushing's Disease and Hypothyroidism increase the animal's body weight and increase inflammatory joint conditions.

UNTREATED CCL INJURY:

- **CHRONIC STIFLE PAIN:** With CCL injury the stifle is unstable resulting in bone wear, osteophyte production and eventually severe DJD.
- **MUSCLE ATROPHY/LOSS OF RANGE OF MOTION:** Muscular atrophy and scarring of the joint capsule secondary to DJD will result in loss of joint range of motion,
- **CCL INJURY OF THE OTHER STIFLE:** Excessive stress of the other stifle may result in CCL injury. The animal will have shifting leg lameness or may down in the rear limbs and not be able to rise.
- **CHRONIC PAIN/DJD OF THE HIP/SPINE/ELBOWS:** DJD and pain may develop in other joints and body structures secondary excessive weight due to shifting of body weight off the affected limb.