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Rai Somil
PhD Scholar, Department of Veterinary Surgery and Radiology, NDVSU, Jabalpur Madhya Pradesh, India

Chandrapuria
Professor & Director Clinics, Department of Veterinary Surgery and Radiology, NDVSU, Jabalpur Madhya Pradesh, India

Kumar Dinesh
Assistant Prof, Department of Veterinary Anatomy, College of Veterinary Science & A. H., NDVSU, Jabalpur Madhya Pradesh, India

Correspondence
Kumar Dinesh
Assistant Prof, Department of Veterinary Anatomy, College of Veterinary Science & A. H., NDVSU, Jabalpur Madhya Pradesh, India

Management of cranial cruciate ligament rupture in canine

Rai Somil, Chandrapuria VP and Kumar Dinesh

Abstract
The cranial cruciate ligament or anterior cruciate ligament is the ligament that usually tears in dogs and more frequently seen in overweight, neutered, middle-aged dogs. There are two ligaments within the knee joint that form a cross or x-shape, thus the name cruciate ligaments. The ligaments do not have a good blood supply and no mechanism for repairing themselves. For diagnosis of cranial cruciate ligament tears or ruptures, acute lameness with the characteristic "toe-touching" gait or as a chronic lameness may be an important sign but for confirmatory diagnosis Cranial Drawer Test is mostly done with radiographic examination. There are a number of non-surgical and surgical treatment options are available.

Keywords: Cruciate, ligament, gait, rupture

1. Introduction
The stability of a joint is because, nature has provided some very strong ligaments and one such is cranial cruciate ligament (CCL) which connects the thigh bone to stabilize the stifle joint. Two of these are attached in a crosswise fashion; hence, named as anterior (ACCL) and posterior cruciates or "cross" ligaments. These ligaments act together with two outer bands of fibrous ligament, the lateral collateral ligament and the kneecap to maintain knee stability through a wide range of motion. The two most common problems are torn or stretched cruciate ligament and dislocating kneecap. The rupture of ACCL is the most common injury in the stifle joint. Its rupture is usually sudden (acute) or progressive failure, which results in partial to complete instability of the stifle joint [1, 13]. It is the common cause of rear-leg lameness in dogs and a major cause of degenerative joint disease i.e. progressive and permanent deterioration of joint cartilage in the stifle joint. The rupture may be partial or complete. Small breeds of dogs suffer from torn cruciates as they test the physical limits of their bodies through over-exertion, quickness trials, rough housing, dock jumping, and Frisbee catching. Cruciate ligament rupture is much more frequently seen in overweight, neutered i.e. gender which is neither masculine nor feminine and middle-aged dogs [3]. The possibility of a genetic link is unknown, however, all breeds are susceptible. Specifically, the incidence of CCL rupture is more for Rottweilers and Labrador Retrievers at one to two years of age [16].
CCL rupture is most frequently caused by repetitive micro-injury to the cranial cruciate ligament i.e. putting pressure on the ligament in the same way repeatedly. This action causes slight stretching of the ligament each time, altering the structure and eventually causing the ligament to tear [4, 16]. The strength of dog's CCL deteriorates with aging, correlating with loss of fiber bundle organization and metaplastic change of cellular element. These changes are more pronounced and occur at an earlier age in large dog, perhaps leading to occurrence of rupture earlier in life than in small breeds [5]. Ligament deterioration is more marked in a central core of the ligament and is because of scarcity of blood supply.

2. Diagnosis
Sudden (acute) front ligament (cranial cruciate) rupture results in non-weight bearing lameness, and fluid build-up in the joint (known as joint *effusion*). The dog will hold the affected leg in a partial bent position (flexion) while standing [6, 16]. A slight to marked intermittent lameness is seen, which may last from weeks to months, is consistent with partial tears in the cruciate. Muscle atrophy is also seen in the rear leg. If the condition is left untreated this may lead to progressive and permanent deterioration of joint cartilage. Rupture of the CCL can present either as an acute lameness with the characteristic "toe-touching" gait

or as a chronic lameness that was pronounced initially, improved with rest, but never completely resolved. The dog observed at rest, trot the dog to observe its conformation and gait. The comparative girth of the quadriceps femoris musculature and the stifle should be noted. In chronic cases the circumference of the quadriceps muscle may be decreased appreciably. The cranial drawer test assessment is best done on the laterally recumbent animal. The examiner stands behind the dog and places a thumb on the caudal aspect of the femoral condylar region with the index finger on the patella. The other thumb is placed on the head of the fibula with the index finger on the tibial crest. The ability to move the tibia forward (cranially) with respect to a fixed femur is a positive cranial drawer sign indicative of a CCL rupture [7].

The most reliable radiographic method of diagnosing cruciate disease is through the use of tibial compression in lateral radiographs of the stifle, cranial displacement of the tibia with respect to the femur was demonstrated in 97% of subsequently confirmed ruptures of the CCL [12, 16]. Joint fluid analysis is generally of little use because the majority of dogs with CCL rupture have synovial fluid WBC count cell less than 5,000/mm^3, consistent with chronic degenerative joint disease. The cell is generally mononuclear, large number of polymorphonuclear cells suggest immune mediated joint disease. Dog with partial tear may have elevated total white WBC in synovial fluid. Therefore, arthocentesis and joint fluid analysis may be valuable in diagnosis [9, 10].

3. Management

The nature of therapy in dogs with rupture of the CCL are influenced by the animal's age, body size and weight. Small dog i.e. less than 15 kg often do well without surgical intervention. Treatment is basically restriction of activity to short leash walks, weight reduction, and the use of analgesic as needed. Physical therapy include range of motion exercises and swimming has been useful in the few cases in which it has been practical; unfortunately it is impossible for many dog owners. Large dog of 15 to 20 kg clearly benefits to numerous surgical procedures designed to restore the stability and minimize secondary degenerative joint disease. There are following surgical techniques commonly used in CCL [11].

4. Intra-articular reconstruction

The use of autogenous material has long been advocated for the anatomical replacement of the cranial cruciate ligament. Fascia lata, skin, and patellar ligament have all been used as replacement material. The basic technique involves there-creation of an intra-articular structure in the approximate spatial orientation of the normal cranial cruciate ligament [16].

5. Paatsama procedure

Paatsama developed the classic intra-articular operation for use in dogs, using autogenous fascia lata routed through drill holes in the femur and tibia. The procedure is a modification of one for use in humans. The procedure has subsequently been modified by Paatsama and by Rudy [8]. Disadvantages of the Paatsama procedure include the tensile strength weakness of the graft; inconsistent location of bony tunnels which cause non-isometric graft placement; and possible abrasion at the graft-tunnel interface [10].

6. Dekinson and Nunamaker Procedure

A modification of the Paatsama technique uses a fascial graft passed through the joint from the lateral aspect of the proximal tibia and through a femoral drill hole [13].

7. MRIT (Modified Retinacular Imbrication Technique) or Lateral Suture

It involves the use of single imbrication sutures on the medial as well as the lateral aspect of the stifle joint. In this technique the heavy, non-absorbable sutures are placed around the fabellae and through a drill hole in the tibial crest. Once these sutures are preplaced, the limb is put in a functional position and the lateral suture is tightened first to externally rotate the tibia and thereby limit internal rotation. The medial suture is then tightened and together with the lateral suture acts as a "sling" to prevent cranial drawer motion. Following routine closure, the limb is placed in a modified Robert Jones bandage for 2 weeks [10].

8. Osteotomy techniques

Osteotomy techniques, unlike the previous intra-articular and extracapsular techniques depends on changing the biomechanics of the stifle joint to effectively remove the need for the CCL thus repairing the problem of CCL deficiency [11]. Following are the osteotomy techniques-

9. Tibial plateau leveling osteotomy (TPLO)

Without an intact CCL, tibial slope allows the thigh-bone ("femur") to slide backwards off the tibial plateau. The tibia in turn is pushed forward in a motion called "cranial tibial thrust." In this technique the tibia is cut, and the top portion is rotated to reduce its slope. A metal bone plate is applied to maintain this new position while the bone heals and the surgical site closed routinely. By two weeks, moderate weight-bearing is expected. After a TPLO, dogs return to full activity much more rapidly than with extracapsular stabilization or other traditional procedures [11].

10. Tibial tuberosity advancement (TTA)

Tibial Tuberosity Advancement surgery involves cutting the tibial tuberosity (tibial tuberosity osteotomy) and advancing it to achieve a perpendicular (90 degrees) angle between the tibial plateau slope and the patellar tendon. This relationship results in a stable joint and eliminates the abnormal sliding movement within the knee joint. The advanced tibial tuberosity is secured to the tibia using titanium implants. Bone graft is collected from the top of the tibia and packed in the open area of the osteotomy. Healing takes about 8 weeks and Implants do not need to be removed [12].

11. Conclusion

The two most common problems associated with the CCL are torn or stretched cruciate ligaments and dislocating kneecap and results in partial to complete instability of the stifle joint. It is the common cause of rear-leg lameness in dogs and a major cause of degenerative joint disease i.e. progressive and permanent deterioration of joint cartilage in the stifle joint. CCL rupture much more frequently seen in overweight, neutered, middle-aged dogs. Rupture of the CCL can present either as an acute lameness with the characteristic "toe-touching" gait or as a chronic lameness. For diagnosis Cranial Drawer Test is mostly done with radiographic examination. In general, dogs that are less than 15 kg do not require surgery, instead medical management is appropriately recommended. Large dog i.e. more than 15 to 20 kg clearly benefit to surgical therapy i.e. Modified Retinacular Imbrication technique and osteotomy techniques specially TPLO and TTA.

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