

THE CUTTING EDGE

A RESOURCE FOR REFERRING VETERINARIANS

The Cranial Cruciate Deficient Stifle

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Injuries to the cranial cruciate ligament (CCL) are one of the most commonly encountered abnormalities of the dog's stifle. Because of the constant mechanical stress transmitted through the CCL, it is prone to injury.

ANATOMY AND FUNCTION

The CCL originates from the medial side of the lateral femoral condyle and inserts onto the craniomedial surface of the tibial plateau. The CCL is divided into two major fiber groups according to their insertional position on the tibia plateau; the craniomedial band and the caudolateral band. The craniomedial band is taut during all phases of flexion and extension; the caudolateral band is taut in extension but is lax in flexion. In addition to limiting cranial translation of the tibia relative to the femur, the CCL also limits internal rotation of the tibia and hyperextension of the joint.

MECHANISM OF INJURY

Hyperextension of the stifle with forced internal rotation of the tibia is a position that favors injury to the CCL. Injury can be due to trauma; due to natural aging changes of collagen with loss of strength and stiffness; and due to abnormal conformation. Certain breeds have greater standing angle of the knee joint and narrowed intercondylar notch width that predispose them to CCL injuries. The resultant trauma and instability causes an inflammatory response (release of cytokines) leading to destruction of the proteoglycan and collagen network of articular cartilage. Exposed collagen from the torn ligament also elicits an autoimmune response exacerbating the state of intra-articular inflammation,

CLINICAL PRESENTATION AND DIAGNOSIS

Three clinical presentations are associated with cranial cruciate ligament injury: (1) acute injury, (2) chronic injury, and (3) partial tears. Patients with acute injury have a non-weight bearing or partial weight bearing lameness. The diagnosis of an acute injury is made when

a positive cranial drawer test and or tibial compression test is identified. I find the tibial compression test most useful in the strong, large breeds. In some dogs, it is necessary to use sedation to fully evaluate the knee because of apprehension and muscle contraction. Patients with chronic injury will have a similar history, but the lameness will improve to some degree over time. They usually have frequent setbacks with any activity. A physical exam will show decreased thigh muscle mass and stifle joint thickening especially along the medial surface. A drawer sign may be difficult to elicit due to proliferative response of the fibrous joint capsule. Patients with partial injuries are particularly difficult to diagnose, especially in the initial stages of injury. Usually, a mild weight bearing lameness is present when exercised, and resolves when the dog is rested. Initially, no pain or instability may be detectable. With the patient under anesthesia, some degree of laxity is usually identified with the limb in the flexed position (craniomedial band injury).

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A few millimeters of drawer may be enough for a diagnosis, especially if the opposite limb is completely stable. Lateral projection radiographs are useful in identifying joint effusion causing a cranial displacement of the infrapatellar fat body. This is usually an early indicator of stifle problems especially in those patients with a partial tear. Osteophytes can be detected as early as 3 weeks after CCL injury. Comparative views of the contralateral stifle are helpful. Arthroscopy enables visualization of soft tissue structures and joint cartilage that is not seen on radiographs. ***This practice has utilized arthroscopy to successfully identify partial tears of the CCL and isolated meniscal injuries.*** Unfortunately, corrective procedures cannot yet be performed via this minimally invasive technique.

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TREATMENT

Surgical management is indicated for both complete and partial tears of the CCL. The primary objective of surgery is to re-establish stifle stability. A second primary objective of all surgery for cruciate ligament injury is to thoroughly explore the stifle for concurrent intra-articular damage, particularly meniscal injury. Dogs with partial tears have a low frequency of meniscal damage (5-10%). With chronicity, the frequency increases (50-60%) in dogs with complete tears. The limited mobility of the medial meniscus makes it most susceptible to the unphysiologic motion in the unstable joint. While most veterinary surgeons agree that meniscectomy is indicated for meniscal damage, the relative merits of partial and total meniscectomy are still debated. Both partial and total meniscectomy have been shown to result in degenerative articular cartilage changes. One study has suggested that the degree may be directly proportional to the amount removed. It is clear that meniscectomy is not a benign procedure. Regeneration of the resected portion has been observed in humans and dogs however, it is not uniform and it is not present in every instance. Leaving the grossly normal portion of the meniscus is not without risk either. One of the more common causes of subsequent lameness after having surgery for CCL rupture is a damaged meniscus. In my experience this accounts for about 5-10% of cases. Adequate debridement of the injured CCL, damaged meniscus and periarticular osteophytes is perhaps as important to ultimate joint function as is the stabilization procedure.

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The search to find the ideal method of restoring limb function following CCL rupture began in the mid 1940's. Unfortunately, it has yet to be discovered. Surgical therapy is divided into reconstruction techniques and primary repair with augmentation. Primary repairs are not feasible. There is limited ability of the ligament to heal directly with scar tissue and the remaining stumps undergo collagen degeneration. In addition, the rupture is usually due to degeneration within the ligament itself. Reconstruction of joint stability can be achieved by either an intracapsular or extracapsular technique.

Intracapsular reconstructions consist of passing autogenous tissue (medial 1/3 of the patella tendon and proximal fascia; central third of the patella tendon and proximal fascia; lateral fibers of the patella tendon and

distal fascia lata) through the joint. The central and lateral patella tendon grafts are stiffer, have greater maximum loads and absorb more energy to maximum load than the medial autograft. Either the “over the top” method or passage of the tissue through a predrilled hole in the femur (modified Paatsama) and tibia are commonly used. Graft material undergoes a time dependent biological and mechanical change. Revascularization, repopulation with cells for eventual collagen synthesis and re-organization does occur. A protracted period of restricted activity is required during this time. Over time, considerable graft strength is lost. Unfortunately, the laxity in the stifle joint usually recurs and the articular cartilage suffers various degrees of fibrillation. Stretching and loss of strength post-operatively may also be a consequence of improper graft placement or inadequate intercondylar notch width rather than the natural consequence of revascularization and remodeling.

Intracapsular reconstruction of the CCL with an expanded polytetrafluoroethylene (ePTFE) prosthesis has recently been published. This material is GORE-TEX[™] and is known as Veterinary Orthopedic Tape VOT[™]. It is implanted in an over the top technique with the use of screws, washers and wire at the anchoring locations. The material has biomechanical properties similar to the natural canine CCL. Two year follow-up data on approximately 100 cases has resulted in a good to excellent result with return to full athletic activity in 80-90% of patients. Several dogs required revision of the stabilization. Failure was associated with persistent synovial effusion, either sterile or septic. The synovial response was characterized by a focal accumulation of chronic inflammatory cells. Wear debris of the ePTFE was also identified within giant cells. Overt failure (rupture) of the prosthesis did occur in several cases and was thought to be the result of continuous fiber abrasion at the intercondylar notch area. To date, I have not had any personal experience with this material for intracapsular stabilization.

Most extracapsular reconstructions are generally easier to perform and quicker than intra-articular procedures. Fibular head transposition is the exception. Concerns about healing of autogenous tissues within a chronic degenerative joint has led to increased interest in extracapsular methods of joint stabilization. They involve placement of imbrication sutures or orthopedic wire outside the joint (modified Flo or DeAngelis techniques); and redirection of the lateral collateral ligament (fibular head transposition).

The use of synthetic, braided sutures may result in infection and draining tracts around the incision site. The

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most common cause of this problem is from the suture entering the synovial space. Lameness, swelling and fistula formation may occur weeks or months after surgery. This problem is resolved by removing the offending suture. Antimicrobial therapy alone is not effective as long as the suture remains within the joint. This complication can be avoided by using a monofilament suture or by carefully positioning a braided suture outside of the synovium. Another complication of extracapsular suture imbrication techniques is peroneal nerve entrapment. This results in placing deficits of the toes. Immediate removal of the suture is necessary.

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The fibular head-lateral collateral ligament transposition (FHT) was originally introduced in 1985. Stabilization of the joint is achieved by separating the fibular head from its proximal tibial attachment along with the lateral collateral ligament from the underlying joint capsule. This bone-ligament complex is moved to a cranial position. The fibers of the lateral collateral ligament are then in an orientation that is near-parallel to that of the CCL. The lateral collateral ligament is recruited to minimize cranial drawer while maintaining its normal lateral collateral responsibilities. The procedure also results in marked reduction of internal rotation of the tibia. Because of this resistance to internal rotation, FHT can also be used as an adjunct procedure in correction of medial patella luxation. In a direct comparison with the fascial strip procedure through a femoral tunnel, FHT demonstrated superior clinical performance. Neither the duration of the CCL disruption nor the degree of osteoarthritis appeared to affect clinical outcome. From this study, it was concluded that the clinical performance after FHT was at least **equal or superior to other surgical methods** for reconstructing the cruciate deficient stifle. Biomechanical analysis of the FHT demonstrates that it has the best time zero strength and stiffness when compared to other popular methods of intra and extracapsular stifle reconstruction. This technique has given our patients the most uniformly successful outcome in medium to large breeds. Complications include hardware migration (10% of cases) and subsequent meniscal damage (5-10 % of cases) which usually requires an additional arthrotomy and debridement.

A recently published investigational report described the use of a transposed popliteal tendon for extracapsular stabilization of the joint. Although significant joint laxity

returned as early as two weeks after surgery, lameness was not detectable at two months following surgery. Further biomechanical studies are indicated before this procedure can be recommended for clinical application.

CONCLUSION

Unfortunately, none of methods evaluated, including the FHT, approach the strength and stiffness of an intact CCL. Currently, the criteria that is used to select a reconstruction method for a cruciate deficient stifle is based on what the veterinarian is familiar with. Overall success rate (defined as good to excellent function) regardless of the surgical technique used is 85-93%. While these numbers are encouraging, a study indicated that dogs with previous CCL surgery reported to be normal had progressive radiographic evidence of degenerative joint disease for 12-18 months after intracapsular stabilization. Radiography gives a more accurate analysis of joint biology than subjective evaluation of lameness or drawer sign. A better method of follow-up is force plate analysis. Studies utilizing this technique demonstrate that the patient is not fully weight bearing on the operated limb for 4-7 months after surgery. As a result, up to 20% of cases may incur a similar CCL injury in the contralateral limb.

Clearly, we do not yet fully understand the entire pathobiology involved and the ultimate resolution. This information should help assist you with those patients that have a difficult to diagnose hind limb lameness, as well as the selection of an appropriate technique that gives the best clinical result for the individual patient.

"With increasing knowledge, doubt arises".

