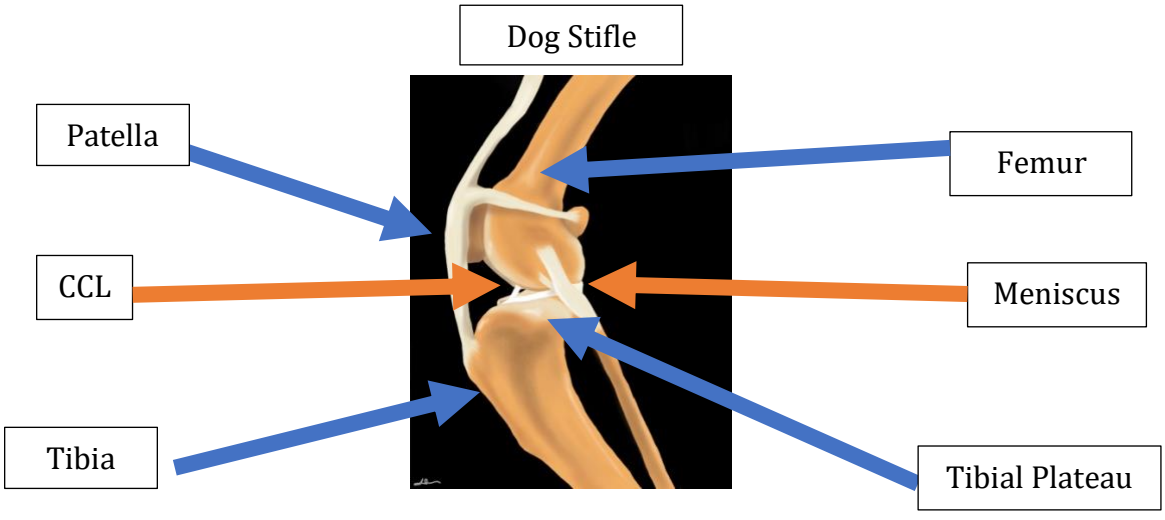
Cranial Cruciate Ligament Sprain

Cranial cruciate ligament (CCL) sprain, also referred to as CCL rupture, is among the most common causes for pelvic limb lameness in dogs.

Anatomy

The stifle (knee) joint is made of the femur (thigh bone), tibia (shin bone), and patella (knee cap). Ligaments are strong fibrous structures that connect two bones together. The cranial cruciate ligament (CCL) is one of several ligaments in the stifle, but is the most common ligament to be injured.

The dog stifle is very similar to the human knee. The two biggest differences are the angulation of the joint when standing (humans stand straight, dogs stand with a bent leg) and the slope of the top of the tibia (tibial plateau; humans have a flat plateau, dogs have a down-hill slope). The CCL is analogous to the ACL in humans. The CCL and ACL have 3 primary stabilizing jobs: preventing over-extension of the knee, limiting internal rotation of the tibia, and blocking forward shifting of the tibia in relation to the femur. This last motion can also be thought of as preventing the femur from rolling down the hill of the tibial plateau.



Why does the CCL become injured?

ACL tears in humans are generally the result of a sporting event or high level activity. The ACL is normal, then an event happens, and it ruptures. This scenario rarely happens in dogs. Instead, some pre-disposing factors make the CCL weak and prone to injury. While the exact cause of this underlying weakness is not fully known, there is evidence to show that there are genetic, conformational, biologic and biomechanical factors that make certain dogs at risk. Some of these factors include:

- Breed (Newfoundland, Labrador, Rottweiler, Pitbull, Akita and more)
- Medial patella luxation
- Overweight
- Spayed or neutered **This is a complicated factor and not a reason to avoid spay/neuter. Talk to your veterinarian more about this.*

There is currently uncertainty whether joint inflammation occurs before or after CCL injury, but no matter what, if the CCL is injured, arthritis will definitely occur. At least 50% of dogs that have an CCL injury in one knee will have it occur in the other knee within 1-2 years.

CCL Injuries

When a ligament is injured, this is called a "sprain." There are 3 types of CCL sprains:

- **Grade 1:** The ligament is stretched but not torn. Pain fibers in the ligament tell the brain to protect the damaged ligament, so the dog places less weight on the leg and may not fully extend or bend the stifle joint. Inflammation and swelling are present, but the joint is not unstable. With rest, the signs of injury tend to improve, but they return whenever activity resumes.
- **Grade 2:** The ligament is partially torn, but some fibers remain intact. Symptoms become more consistent and do not fully resolve with rest. There is some instability in the joint that a veterinarian can often feel on examination.
- **Grade 3:** The ligament is completely torn. This leads to greater inflammation and swelling and instability in the joint. Lameness may be severe (non-weight bearing).

The meniscus also commonly becomes injured, especially with Grade 3/ complete tears.

Treatment of CCL sprain can be surgical or non-surgical. Unfortunately, the CCL will not heal on its own. Overtime, the injury typically progresses to a complete tear. The body's natural reaction to the joint being unstable is to lay down scar tissue to stabilize the knee. This takes many months to years. Meanwhile, arthritis is progressing rapidly. **While surgery is not an option for all dogs, it is the most effective and reliable means of returning dogs to a high level of function and minimizing the progression of arthritis.**

Surgery

The first part of surgery is exploration of the stifle joint in order to evaluate the CCL and the medial and lateral menisci. Joint exploration may be performed by arthrotomy or arthroscopy. In cases of meniscal tear, the torn portion of the meniscus will be removed. If the medial meniscus cannot be fully evaluated, a meniscal release procedure may be performed. This involves cutting the attachment of the meniscus on the tibia to allow it to fall away from the compressive force of the femur, thereby reducing the chance of future tears and future surgery.

After evaluating the CCL and meniscus, a technique will be performed to help stabilize the stifle joint. Surgical stabilization is divided into two categories: osteotomy and extra-capsular techniques.

Osteotomies (TPLO, TTA, CBLO, CWO)

Osteotomy means "to cut the bone." Osteotomy techniques include tibial plateau leveling osteotomy (TPLO), tibial tuberosity advancement (TTA), CORA based leveling osteotomy (CBLO), and closing wedge osteotomy (CWO). These techniques all aim to change the biomechanical forces acting on the stifle joint in order to eliminate the "rolling off the hill" motion, (called cranial tibial translation or cranial tibial thrust), that occurs with partial or complete CCL rupture.

In cases of Grade 1 sprain or very partial CCL rupture, these surgeries may decrease the stress on the CCL and decrease the pain that occurs when the injured ligament is stretched.

Of the osteotomy procedures, TPLO is the most well studied and has the most research to support its efficacy. While all surgeries carry a risk of complication, the TPLO has a very high success rate when performed by experienced surgeons. Other osteotomy techniques may also provide excellent outcomes, but results will be closely linked to the experience of the surgeon. **Ultimately, the best surgery will be the one the surgeon feels most comfortable with and recommends for your dog**.

This is a great website to learn more about the TPLO: www.TPLOinfo.com.

Technique

The theory for the technique is based on the fact that the slope of the tibial plateau causes cranial tibial thrust (instability) in the CCL deficient stifle (either the CCL isn't working fully or is completely ruptured). The technique produces functional stability of the knee by leveling or flattening of the tibial plateau slope. This is accomplished by cutting the top portion of the tibia (osteotomy) and leveling the tibial plateau to prevent cranial tibial thrust during weight bearing. The tibia is then stabilized with a bone plate and screws.

Prognosis

The TPLO has gained nationwide acceptance by providing dogs with a faster recovery, better functional outcome, and decreased development of osteoarthritis as compared to dogs treated with other procedures. Over the last 15+ years the TPLO has been the most commonly performed surgery for CCL rupture in medium to large-breed dogs, and is now often performed in smaller dogs. The typical dog will achieve about 95% of normal limb function following TPLO surgery. However, the level of pre-existing arthritis can also affect the prognosis. Dogs with severe arthritis may have a persistent lameness.

Complications

The following complications have been reported: infection, inflammation of the patellar tendon, fracture of the tibial tubercle, breakage or loosening of the bone plate or screws, delayed healing of the osteotomy site, rupture of the caudal cruciate ligament, post-operative meniscal injury, and bone cancer (very rare). Many of these complications can be the result of too much post-

operative activity. When performed by experienced, board certified surgeons, the risk of complications with TPLO is typically less than 5%.

Recovery

One of the true benefits of this procedure is that it relies on bone healing, which is very predictable. The osteotomy should heal in 8-12 weeks, and once healed, the bone will be as strong as it was before surgery. However, during the healing process it is critical that excessive force is not placed on the bone. No running, jumping, off-leash activity, or play is allowed until the bone has healed. Dogs must begin using their limb within the first 1-2 weeks after surgery in order to stimulate healing and build muscle, and then they should have progressively longer leash walks over the recovery time. Additional rehabilitation therapy is recommended in order to speed muscle strengthening and guide return to activity. Most dogs with a TPLO are using the leg with near normal function by 10-12 weeks post-op.

Extra-capsular Suture/ Lateral Suture/ Tight-Rope

This technique uses strong nylon sutures placed just on the outside of the joint capsule to mimic the path of the CCL. Eventually, scar tissue aligns itself around the sutures and ultimately it is this scar tissue that provides stability to the stifle. This technique is typically performed in small breed dogs (less than 30 pounds). Another type of extracapsular procedure called TightRope uses a very strong, braided synthetic suture material (TightRope brand by Arthrex) and the technique uses bone tunnels in the femur and tibia for suture placement. This technique offers increased stability as compared to prior extracapsular repairs, and offers increased stability for larger-breed dogs. However, there may be an increased risk of infection with TightRope compared to other stifle surgeries due to the nature of the braided suture material.

Prognosis

Extracapsular repairs rely on scar tissue to ultimately stabilize the stifle. Scar tissue is somewhat unpredictable in the time it will take to form and the ultimate strength it can provide. The prognosis following extracapsular surgery is generally good for smaller dogs; however, larger dogs will often stretch out the extracapsular sutures and have continued instability within the

joint. This will result in decreased range-of-motion (stiffness) and progression of arthritis (although likely much slower than without surgery). Smaller dogs would be expected to return to about 90-95% of normal limb function, while larger dogs may only obtain 75-85% normal limb function. Post-operative rehabilitation has been shown to improve outcomes following extracapsular repair. The level of pre-existing arthritis can also affect the prognosis. Dogs with severe arthritis may have a persistent lameness.

Complications

As with any surgery, complications are a possibility. Although not very common, the following have been documented: infection, reaction or irritation to the sutures, breakage of the stabilization sutures before the development of sufficient scar tissue, and post-operative damage to the meniscus. Some type of complication occurs in about 5-10% of dogs, but the complication rate can be much higher in larger-breed dogs.

CCL Non-Surgical Management

While surgery is generally recommended as the first line option for treating CCL sprains and ruptures, there will be cases in which surgery is not possible. The expected course without any surgical intervention is that the dog will develop progressive thickening/scarring/fibrosis around the stifle; this is the body's attempt to provide stability. This process takes months to years, and progression of arthritis, including muscle atrophy will occur.

Non-surgical management should include comprehensive pain management and possibly physical rehabilitation. The goals of rehabilitation include: reducing inflammation and pain, supporting joint health, increasing muscle strength, weight loss (if indicated) and supporting the body while fibrosis develops around the stifle.

Non-surgical management of CCL sprains with rehabilitation is less predictable in the time course of returning to activity, and full/ normal function is not expected. Rather, some degree of lameness should be expected. The degree and frequency of lameness will depend on the

degree of CCL rupture (partial vs. complete), concurrent meniscal pathology and degree of arthritis. One study suggests that 60% of dogs with conservative management for CCL disease

can have an acceptable outcome. Dogs in this study were placed on a weight loss plan, received NSAIDs, and participated in at least 6 sessions of formal rehabilitation.

One thing to note with non-surgical management is that at this time, the CCL is not expected to heal. Improvements seen over months and years are generally due to the natural development of per-articular fibrosis.

In the best case scenario, Grade 1-2 ligament sprains take 2-6 months to heal. This can be expected with extra-articular ligaments such as the medial collateral ligament. Partial CCL tears fall in the category of Grade 1-2 sprains, but the location of the CCL inside the joint makes the ligament unlikely to heal. An experimental canine study showed promise for healing of partial CCL tears after multiple injections of platelet-rich plasma (PRP). However, at this time, there is insufficient long term (years) evidence to suggest that naturally occurring partial CCL tears will fully heal in dogs with intra-articular therapy (PRP or stem cells) or rehabilitation techniques. There is also insufficient evidence to show that the use of orthotics (braces) improves the outcome of patients managed surgically or non-surgically.

Visit https://caninearthritis.org/dog-owner/references/ *for list of references.*