Cranial Cruciate Ligament Rupture (CCLR)

The stifle (knee) joint is complex — it contains multiple bones, tendons and ligaments as well as other soft tissue structures. The main articulation in the stifle is between the end of the femur and the top of the tibia. The patella (kneecap) resides in the trochlear region of the distal femur, embedded in the tendon of the quadriceps muscle and attached to the tibia via the patellar ligament. Inside the stifle, there are two ligaments that cross each other—the cranial cruciate ligament (CCL), which runs from the back of the femur to the front of the tibia, and the caudal cruciate ligament, which runs from the front of the femur to the back of the tibia. These ligaments cross each other in the joint and provide translational (front to back) and rotational stability and prevent hyperextension. There are two collateral ligaments on each side of the stifle joint: the lateral collateral ligament, which connects from the femur to the top of the fibula and tibia on the outside of the stifle; and the medial collateral ligament on the inside of the knee, which runs from the femur to the tibia and has a strong attachment to the medial meniscus. The menisci are fibrocartilage pads attached to the tibial surface inside the joint via 2 ligaments apiece and attached to each other via an intermeniscal ligament; additionally, the lateral meniscus is attached to the femur and the medial meniscus is attached to the joint capsule. The menisci help with load bearing, load distribution, shock absorption, and joint stability. They protect the articular surface and act as a sort of “spacer” between the femur and the tibia.

Types of CCL problems include: avulsion of the ligament from the femur or the tibial attachments, acute CCLR, and chronic progressive CCLR.

Avulsion fracture of the the CCL. This is exclusively a problem in puppies before they reach skeletal maturity. While the bones are growing and developing, the attachment of the CCL to the bone is actually stronger than the bone itself. If the stifle experiences abnormal forces and is overloaded, it is more likely that the CCL will remain intact but will fracture the bone near where it attaches, taking with it a small piece of either the femur or the tibia.

Acute traumatic CCLR. This is uncommon but can occur in cases of excessive limb loading, severe hyperextension, or severe internal rotation, which can cause an acute tear of the ligament. These dogs are acutely severely lame and painful, have joint swelling and obvious instability.

Chronic progressive CCL degeneration. This is the most common manifestation of CCL disease. The exact cause is currently unclear but is the topic of much research and debate. Progressive mechanical overload has been implicated, which may speak to poor physical conditioning and obesity as possible causes. Breed differences abound, and many breeds have been compared to the Greyhound, which has a very low incidence of CCLR, to determine the difference between their ligaments and ligament attachments and those of other breeds. What we know at this point from retrospective studies is: females are more often affected than males, neutered dogs may have a higher incidence than unneutered dogs, although age at neutering does not have an effect; Rottweilers, Newfoundlands and Staffordshire Terriers have an increased

prevalence of rupture; smaller dogs may have ruptures later in life than large dogs; and Neapolitan Mastiffs, Akitas, St. Bernards, Rottweilers, Mastiffs, Newfoundlands, Chesapeake Bay Retrievers, Labradors, and American Staffordshire Terriers are predisposed to CCLR before 2 years of age.

Owners often report rear limb lameness that gets worse after exercise or long rest. Lameness can range from completely non weight bearing to mild lameness and may wax and wane over months. Lameness severity is often correlated to how much the ligament is damaged. Dogs may sit with the leg sticking out to the side instead of sitting squarely as dogs normally do. Up to 50% of dogs that are affected by CCLR will have the opposite CCL rupture at some point. Because of this, we often see shifting rear limb lameness if both knees are affected simultaneously.

On a physical examination, there are several findings that help us determine if a CCLR has occurred. Sometimes these findings are easily visible on a brief physical exam; other times, the patient may need to be sedated to relax the muscles to adequately evaluate the patient. When the knee is flexed, and especially extended, the patient often becomes painful. There may be obvious joint swelling when the knee is palpated. The muscles of the thigh may be atrophied when compared to the opposite rear limb due to decreased use. There may be excessive joint capsule on the inside of the knee, called medial buttress formation, which is the joint capsule's way of trying to help stabilize the knee.

The telltale sign of a CCLR is to look for cranial drawer. This is when the doctor attempts to move the upper tibia forward while holding the lower femur in place. This is evaluated with the leg in different states of flexion to evaluate both bands (craniomedial and caudolateral) of the CCL. If the caudolateral band is torn but the craniomedial band is intact, there may not be drawer motion present even with a partial CCLR. The tibial compression test for tibial thrust is also performed by holding the stifle flexed and subsequently flexing and extending the hock while checking for abnormal forward motion of the tibia.

Dogs that are more lame and painful may have a meniscal tear, as this affects approximately 33% of dogs with CCLR. Often these dogs are described as having a "pop" when their joint moves through normal range of motion, due to the meniscus moving within the joint.

Although the CCL does not show up on a radiograph, radiographs of the stifle are still performed for several reasons. First, there are a number of signs to look for that help us confirm the diagnosis. Second, we want to see the level of arthritis present in the knee. And lastly, it helps us to prepare for surgical treatment for CCLR, a Tibial Plateau Leveling Osteotomy (TPLO).

Every dog has a unique angle to the top of the tibia inside the stifle joint when the leg is in a weight bearing position. In CCLR, we have found that changing the angle to around 6° will neutralize cranial tibial thrust and will result in a stable stifle while the dog is walking. Radiographs are taken of the leg and the tibial plateau angle is measured. This guides how much the angle needs to change in order to reach around 5-6°.

During surgery, an incision is made on the inside of the stifle. The CCL and the menisci are inspected. A special saw is used to make a semicircular cut in the top part of the tibia to isolate and rotate the segment of bone. It is secured into the correct place with a bone plate. Post operative radiographs are taken to confirm appropriate surgical implant (TPLO Plate) placement, and to evaluate the new tibial plateau angle.

A bandage is placed to help decrease post operative swelling. Once the patient is awake, we start to encourage your pet to walk with sling assistance. Pain medication is administered to keep the patient comfortable during their overnight stay in the hospital.

Provided your pet does well overnight, they will be discharged to you the following day at your scheduled discharge appointment time. After surgery, it will take 8-12 weeks of post operative care at home to help gradually get your pet back to their normal activity. It is crucial during this time to keep your pet confined, avoid furniture, and only limit activity as lined out in your pets' discharges. If your pet is allowed more activity than outlined in your discharges, it may require more time for healing and will likely cause post operative complications. We will go over discharge instructions, physical therapy exercises, medications, and when to return for recheck visits. A referral for physical therapy can be provided upon request.

Complications are not very common with TPLO, but they do occur.
Short term complications usually are related to the incision site: infection, poor skin healing, incisional drainage, incisional swelling and inflammation.
Long term complications include patellar ligament inflammation, tibial tuberosity fracture, bone infection, implant loosening/failure, arthritis formation, continued lameness and meniscal tear. On occasion, a second surgery may be required to address any of these issues.

Information adapted from Veterinary Surgery: Small Animal, Second Edition, Elsevier Inc, 2018.