

## **The Knee: Problems and Solutions**

Animals, like people, may suffer a variety of disorders of the knee that weaken the joint and cause significant pain if left untreated. Two common knee problems in companion animals involve either tears in the cranial cruciate ligament and/or displacement of the knee cap (patella luxation). Both of these conditions can be surgically treated today, returning your pet to a more comfortable and active routine.

### **The Treatment of Cranial Cruciate Ligament Deficient Stifles**

One of the most common causes of hindleg lameness in the dog is damage to the cranial cruciate ligament in the stifle (knee joint). A ligament is similar to a cord or small rope that is attached to two bones and spans a joint. A ligament (and a cord) is made up of thousands of smaller fibers that together comprise the larger structure. A rope (or ligament) can fail in one of two ways: either catastrophically (by tearing in half all at once) or by sustaining damage to some fibers, thereby becoming weakened. With repetitive use, more and more fibers tear, until finally the rest of the rope breaks completely. Similar scenarios occur in the cranial cruciate ligament of the dog's knee. Some dogs sustain a chronic progressive tearing of their ligament over several months time, until the ligament finally becomes weakened to the point that it fails completely (chronic progressive tear). Others tear abruptly and completely when the dog is running or jumping or otherwise exerting great pressures on the knee (acute tears).

Dogs with chronic progressive tears tend to have a history of morning stiffness and stiffness following exercise. They have lameness (a limp) with exercise and get better with rest. On physical examination, arthritis can be felt in and around the knee joint and there are arthritic changes present on x-rays. Eventually looseness develops in the knee once the cruciate ligament tears completely, and the pet suddenly becomes lame and stays lame.

Dogs experiencing rapid complete tears are easier to diagnose, as their histories are more clear cut, the knees less arthritic and the looseness in the knee easier to feel on physical examination. A definitive diagnosis for a cruciate ligament tear is made by feeling looseness and fluid buildup in the knee on physical examination. Additional clues to diagnosis include: history, radiographic evidence of arthritis in the knee joint, and findings using other imaging techniques such as CT scan, MRI, or nuclear scintigraphy (bone scanning).

### **Anatomy**

Although the knee joints of dogs and people are similar, in a standing position tremendously different forces are placed on the cranial cruciate ligament in a dog as compared to man. In a standing position, a person places very little force on the cranial cruciate ligament, because the plane of the knee joint is perpendicular to the ground and parallel to the foot. Because the dog stands on his toes, his knee is at a much different angle to the ground in a standing position. (Figure 1).

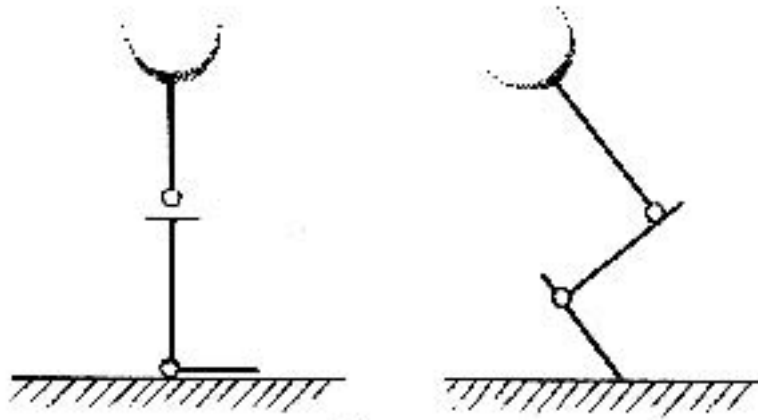


Figure 1

Because of the shape of the dog's knee in a standing position, a tremendous amount of force is applied to the cranial cruciate ligament just to hold the bones in alignment (Figure 2). The mechanics at play in the dog's stifle (knee) are similar to that depicted in Figure 2. Just as the cart would roll down hill if the rope holding it were cut, the femur bone tends to fall off the back of the tibia bone when the cranial cruciate ligament is torn, resulting in looseness of the knee joint.

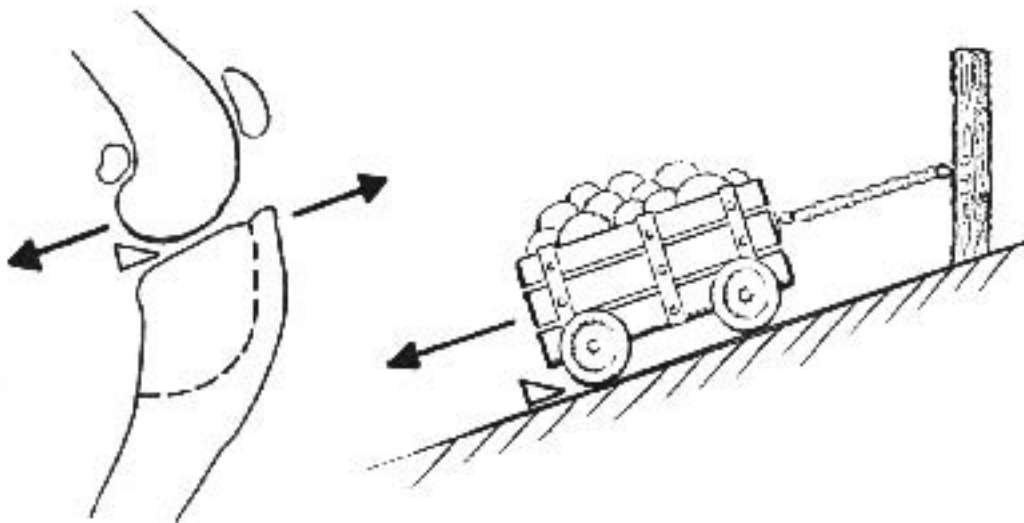


Figure 2

Muscles also are very important in their influence on the stifle's stability/instability. One very important muscle group is on the front of the thigh and is called the quadriceps. The quadriceps attach to the knee cap (patella) which in turn connects to the patellar tendon that inserts on the lower bone of the knee, the tibia, as depicted in Figure 2b. This muscle group's main purpose is to provide support for the pet when standing and to extend (straighten) the stifle. Because of the

angel of the dog's knee in relationship to the patellar tendon, there is a tendency for the tibia to be pulled forward (cranial displacement). This tendency for displacement is resisted by a healthy cranial cruciate ligament. However, when the cranial cruciate ligament is damaged, pull by this muscle group will result in an unstable stifle and discomfort.

When the tibia slides forward (or the femur slides back), other joint structures can be injured. Just as the wedge behind the wheel may be crushed as the rope fails and the cart rolls over it, the meniscus (cartilage) in the knee may be damaged as the cranial cruciate ligament fails and it becomes squeezed by the femur sliding on the tibial plateau. If the meniscus is damaged, it is a source of constant pain and discomfort in the knee causing the pet to limp quite badly forever. Also, a click or pop may be felt or heard when the dog walks on the leg or the knee is placed through a range of motion. Some knees with an isolated cruciate ligament tear can get better on their own without surgery, although they tend to rapidly become arthritic. Pets with a torn cranial cruciate ligament and a damaged meniscus tend to always be quite lame and rarely, if ever, get better without surgery. These knees also tend to experience very rapid and severe arthritis formation.

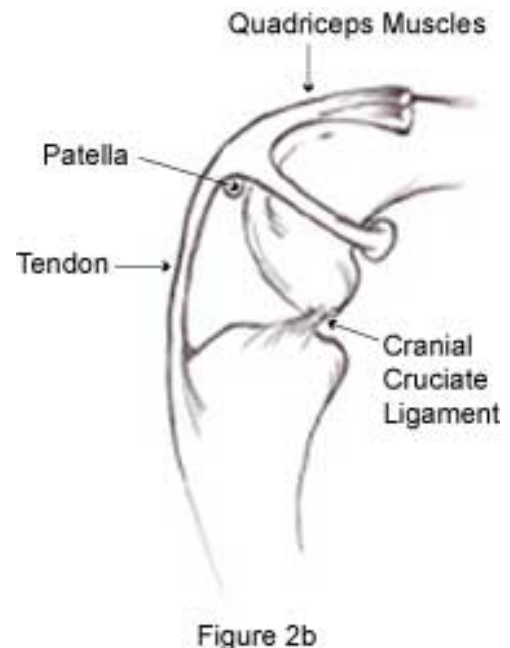


Figure 2b

### **Cranial Cruciate Ligament Rupture - Ligament Replacement**

During this surgery, a new ligament (graft) is created out of surrounding tissues. In some cases, a sterile ligament from a cadaver is used to replace the torn one. With ligament replacement techniques, healing/strengthening of the graft is slow and it takes several months for the graft's attachment sites to adequately heal. During this time, the operated limb must be protected with support measures such as bandages and/or casts and the patient is only allowed very controlled activity. Although the replacement ligament helps stabilize the knee, long term studies are disappointing and indicate that arthritis will continue to progress. This fact, as well as the prolonged and harder recovery, lead us to recommend other procedures such as TPLO and TTA (which will be discussed next) as better alternatives.

### **Tibial Plateau Leveling Osteotomy (TPLO)**

Historically, the surgical repair of a cranial cruciate ligament deficient stifle has centered on attempts to minimize the knee joint laxity created by the torn ligament. This has been achieved either by rearranging muscles, tendons or ligaments around the knee to stabilize the tibia bone, or by replacing the torn ligament with either a synthetic material or new tissue graft of ligament or tendon (either from the same dog or a cadaver). Because when the dog stands on the leg there is immediate force placed on the ligament substitute, these new ligaments invariably stretch, resulting in some knee joint laxity. This is why perhaps the success of cranial cruciate ligament

reconstruction in the dog does not equal that in man to date.

Tibial plateau leveling osteotomy attempts to solve the problem of instability in a totally different way. Rather than replace the ligament, the angle of the knee joint is changed in relation to the ground. By cutting the tibia bone and freeing up the tibial plateau (weight bearing surface of the tibia) one can rotate it into a new position so that the dog has a joint surface more parallel to the ground, (similar to man). By doing so, the knee instability is resolved, function is returned and there is no more need for the ligament. (Figure 3). The tibial plateau is held in its new position with a stainless steel plate and screws while the bone heals. Typically it takes 8 weeks for the bone to heal before the pet can resume normal activity, although no heavy activity is allowed for 4 months following surgery.

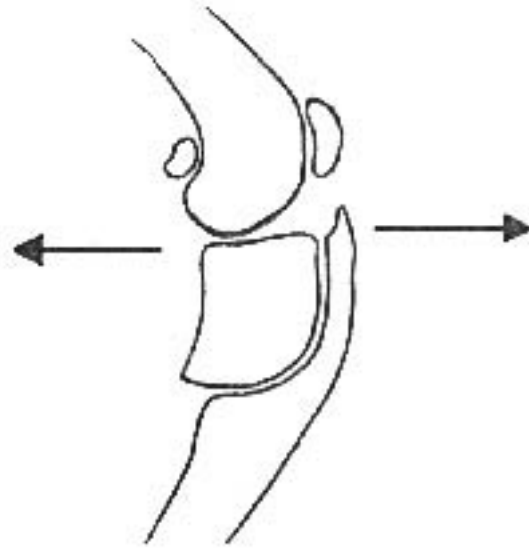


Figure 3

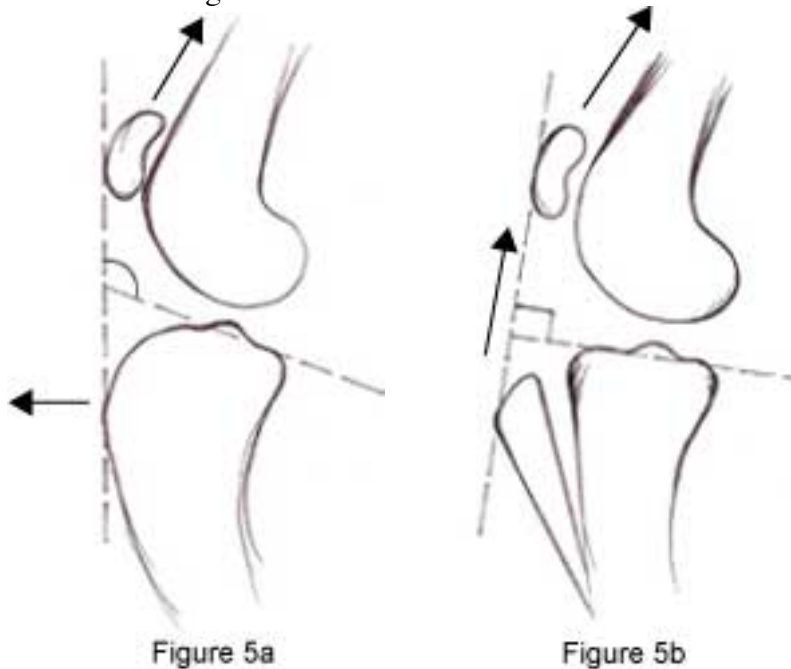
Advantages of the TPLO procedure over other ligament reconstruction techniques include: faster recovery, better range of motion in the knee joint, and less arthritis formation in the knee as time progresses. Disadvantages of a TPLO procedure include: slightly increased cost, more extensive surgery, and possible complications related to the bone not healing or the plate and screws failing. Also, in rare instances the plate and screws may need to be removed at some future date.

In our practice, ideal candidates for the TPLO procedure include dogs that are young, large (greater than 70 lbs), or athletic. These are the animals that will place the most stress on their knees over the longest period of time, and hence are in need of the best available surgical techniques. The TPLO procedure can be performed in dogs greater than 30 lbs., though historically smaller pets have tended to do well with the standard (and less expensive) procedures for cranial cruciate ligament reconstruction.

### **Tibial Tuberosity Advancement (TTA)**

Similar to the TPLO procedure, Tibial Tuberosity Advancement (TTA) is a technique that attempts to stabilize stifles in which the cranial ligament has been damaged by influencing the forces acting about the stifle. As discussed in the TPLO section, the shape of a dog's stifle is a very important factor in understanding why the stifle becomes so unstable when the cranial cruciate ligament is damaged. Another important factor is the direction and pull of the quadriceps muscles with respect to the stifle. As previously stated in the anatomy section, the pull of this muscle group not only supports and extends (straightens) the stifle, but also results in a tendency to pull the tibia forward as indicated in Figure 5a. Studies have shown that if the pull of this muscle is redirected to be at right angles to the tibial surface, that the tendency to pull the

tibia forward is eliminated. The TPLO procedure accomplishes this by rotating the tibial surface. Instead of changing the architecture of the tibial joint surface, Tibial Tuberosity Advancement changes the direction of pull of the quadriceps by moving the attachment site of the quadriceps tendon forward as indicated in Figure 5b.



Indication for TTA is the same as with TPLO. Early results indicate that success rates are as good as and maybe slightly better than TPLO with a lower rate of complications. TTA is less invasive than TPLO, results in less deformation of the stifle and recovery seems quicker. TPLO is still superior, however, if your pet has concurrent angular issues with the limb, as the TTA procedure cannot simultaneously correct these concurrent problems. Until more definitive studies are available to determine whether TPLO or TTA has superior results, we offer both the TPLO and TTA and will recommend whichever procedure we feel best suits you and your pet's unique needs.

### **Conclusions**

History has shown that surgery on cranial cruciate deficient stifles of dogs has resulted in better performance and less arthritis formation than has conservative (medical) management. Recent evaluations seem to indicate that the results of TPLO and TTA surgeries are superior to other older techniques. The decision for or against surgery, and the type of surgery chosen, should be made after a full evaluation of your pet's overall health status, orthopedic status, and the degree of athletic function desired by you. A consultation with your family veterinarian in concert with a specialist can help you come to this decision.

### **Caveat**

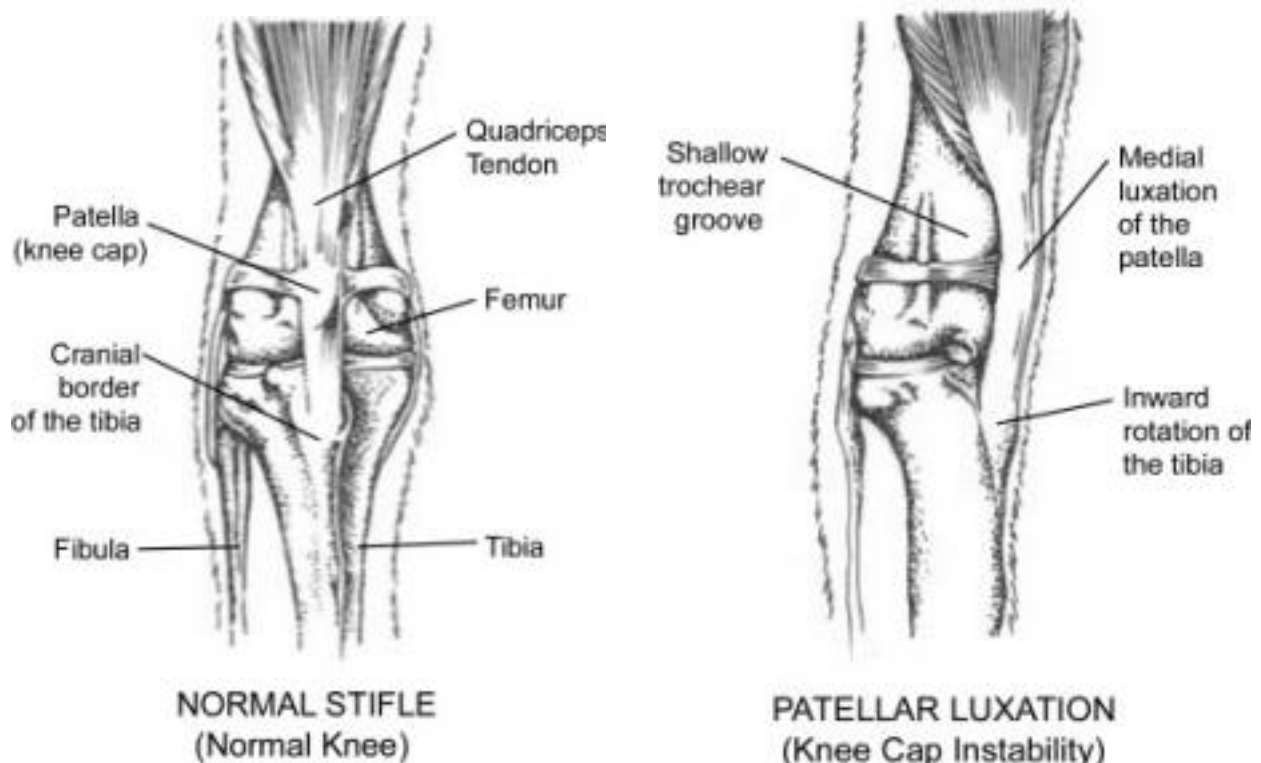
Thirty percent of dogs that have torn the cranial cruciate ligament in one stifle are in jeopardy of tearing the ligament in the opposite knee. Certain breeds have a much higher risk for bilateral

failure; these tend to be the more straight legged breeds (Rottweiler, Chow Chow, Akita, Shar Pei) as well as those breeds that seem genetically predisposed to the problem (Rottweilers, Bull Mastiffs). In these breeds up to 70% of the animals that tear the ligament in one stifle will experience a torn cranial cruciate ligament in the opposite stifle at some point during their lifetimes.

### **Knee Cap Instability (Patella Luxation)**

The knee cap should normally be situated on the front of the knee. Usually it will move up and down in the groove of the femur bone allowing the large quadriceps muscle group on the front of the thigh to properly extend the knee.

If the ligaments holding the knee cap in position on the front of the knee are too loose, the knee cap will slip in and out of the groove. This causes an abnormal wear and tear of the cartilage, and results in "water on the knee", inflammation, pain and leg weakness. If this continues uncorrected, arthritis will build up causing irreversible damage to the knee cap, surrounding bone, and tissue. *Surgical* options depend on the extent of the problem.



Generally, a deeper groove is created in the femur bone in which the knee cap can ride up and down. Ligaments on the sides of the knee cap are cut, adjusted in length, and sutured back together to tighten the knee cap and prevent further abnormal movement out of the groove.



## VCA Animal Specialty Group

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Sometimes, the main tendon holding the knee cap to the tibia bone is repositioned, being held in its new location by a pin or pins and wire.

The goal of surgery is to prevent knee cap instability, create a more stable functional knee, and minimize further arthritic deterioration.

### **Conclusion**

Knee disorders and the resulting inflammation and pain can be a serious problem for affected animals. Early diagnosis and treatment can lessen further arthritic deterioration and restore your pet to a more active, comfortable lifestyle.

Treatment options vary with each situation. A careful veterinary evaluation of your pet's problem will allow you to choose the most appropriate course of treatment.

### **Evaluation**

For an evaluation of your dog or further information about the diagnosis and treatment of either Cranial Cruciate Ligament Rupture or Knee Cap Instability, please call VCA Animal Specialty Group.