

WHEN YOU HAVE A KNEE(D) TO KNOW: UNDERSTANDING

CRANIAL CRUCIATE LIGAMENT DISEASE AND RUPTURE IN BERNESE MOUNTAIN DOGS

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EENDENKOOI KOOIKERS

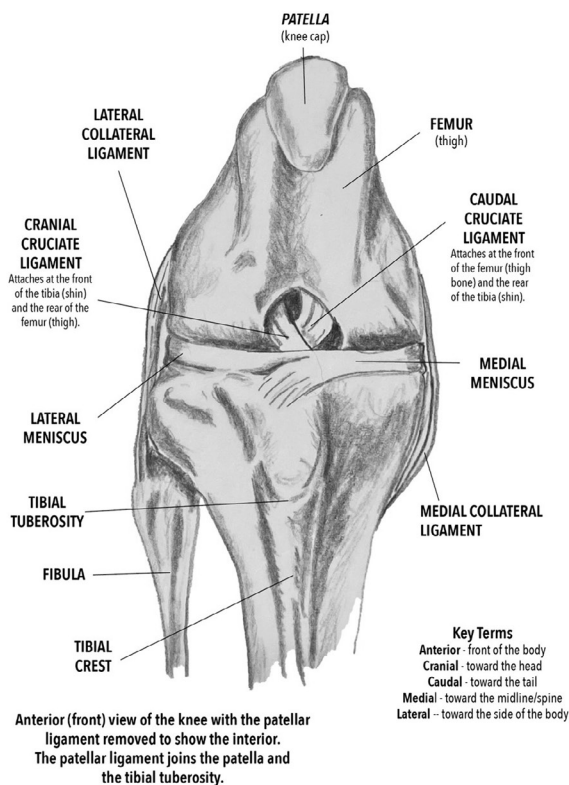
So-called "spontaneous" cranial cruciate ligament (CCL) rupture is the most common orthopedic disease seen in dogs. CCL rupture repair is the most common orthopedic surgery performed by veterinary surgeons. For US dog owners, CCL rupture surgery represents the veterinary procedure of highest economic impact. For example, in 2023, a single-knee TPLO surgery with no complications cost ~\$5,900 at a respected specialty clinic in Western Pennsylvania. Even a well-regarded non-surgical solution, a custom brace from Hero, can cost close to \$1,000.

While not a breed at extremely high risk, Bernese Mountain Dogs suffer from CCL disease and ruptures. A quick search of the Berner-Garde database indicates that nearly 450 dogs have been identified by their owners as suffering from CCL disease (CCLD) or CCL ruptures (CCLR), with a number of those being bilateral (both knees). Similarly, in 2021, the Bernese Mountain Dog Club of Great Britain conducted a survey focused on cruciate ligament disease. The survey attracted returns from 592 BMDs, and of these 80 (13.4%) had some level of cruciate disease. Of these affected dogs, 52 (65%) had surgery. Around two-thirds were females and of these 91% were spayed females. These results are consistent with risk factors reported generally in the literature and elsewhere in this article.

WHAT IS CRANIAL CRUCIATE LIGAMENT DISEASE/ CANINE CRUCIATE LIGAMENT RUPTURE?

There are two cruciate ligaments, the caudal and cranial ligaments, that cross in the canine knee, forming an X (hence the label "cruciate" or cross). The caudal cruciate ligament attaches to the back of the tibia. The cranial cruciate ligament attaches to the front of the tibia. The two CCLs help stabilize the joint, but the cranial cruciate ligament is instrumental in stabilizing the knee in canines and the ligament most often injured. When the cranial cruciate ligament (CCL) tears, the knee joint is destabilized, wobbles, twists and slides. If there is a partial tear, the dog may limp. Once the tear is complete, the dog may refuse to put any weight on the affected leg. When this happens the sliding and movement of

VIEW OF THE CANINE KNEE
SHOWING THE CANINE CRUCIATE LIGAMENT



▲ The canine stifle.. Artist: Nancy Melone.

this misaligned joint causes more damage to the joint, including inflammation, pain and osteoarthritis.

Associated with these stifle injuries is the meniscus, a cartilage-like pad between the dog's femur and tibia. Among other roles, the meniscus functions to absorb shock and bear load. When the CCL is ruptured, the meniscus can be damaged. More often, it is damaged after prolonged instability of the stifle joint. Without the support of the CCL, the femur puts abnormal pressure on the meniscus which can tear or shred it.

The CCL in dogs is often compared to the ACL in humans. While the comparison is useful, the course of the disease in humans and dogs is quite different.



CCL in dogs tends to degenerate over time until the ligament weakens to such an extent that it ruptures.

Specifically, CCL disease in dogs develops in more complex ways than does ACL disease in humans. ACL tears are usually spontaneous, occurring during sports activities where there are sudden stops or abrupt changes of direction such as in basketball, skiing, hockey, or football. In contrast, the CCL in dogs tends to degenerate over time until the ligament weakens to such an extent that it ruptures (i.e., partial tears become complete tears). The degenerative condition in dogs is called cranial cruciate ligament disease (CCLD). The tear itself is referred to as cranial cruciate ligament rupture (CCLR). The degenerative nature of the disease in dogs in which both limbs are often affected also distinguishes the canine disease from that in humans.

WHAT ARE TYPICAL SYMPTOMS OF CCLR?

When a dog exhibits rear lameness, a CCLR is a reasonable diagnostic hypothesis. Symptoms the dog owner may notice include, but are not limited to, the following:

- hind leg lameness
- muscle atrophy on the affected leg
- reluctance to put weight on the limb
- lifting the limb or holding it to the side
- swelling around the knee

- clicking sounds when walking
- decreased range of motion
- reluctance to exercise
- stiffness after exercise

WHICH DOGS ARE AT RISK OF CCLD OR CCLR?

CCLD/CCLR can occur in many breeds of dogs. Large breed dogs are at higher risk than smaller breed dogs. Active, poorly conditioned dogs are at greater risk. Akitas, American Staffordshire Terriers, Chesapeake Bay Retrievers, Labrador Retrievers, Mastiffs, Newfoundlands, Rottweilers and St. Bernards are breeds that seem to have higher than average risk. All large breed dogs, including Bernese, are susceptible to the disease.

Although the exact cause of CCLD is still under investigation, researchers have looked at various risk factors that may predispose dogs to CCLD. Current evidence points to a complex interplay among conformation, genetics, environment and the mechanics of how a dog moves.

Risk Factors

Risk factors for CCL injuries/disease include the dog's breed, neuter status, weight, ligament age and activity. Risk factors are typically correlations that are suggestive of cause, but correlation does not identify the direction of a causal linkage (i.e., depending on the factor, it could be a cause or an effect).

Conformation

Conformational risk factors, depending on the breed, are a steep tibial plateau angle (greater than 30%) and narrow relative width of the tibial tuberosity. An associated risk factor for developing an increased tibial plateau angle is sterilization under 12 months of age.

TYPICAL SYMPTOMS OF CCLR

01 Hind leg lameness

02 Muscle atrophy on the affected leg

03 Reluctance to put weight on the limb

04 Lifting the limb or holding it to the side

05 Swelling around the knee

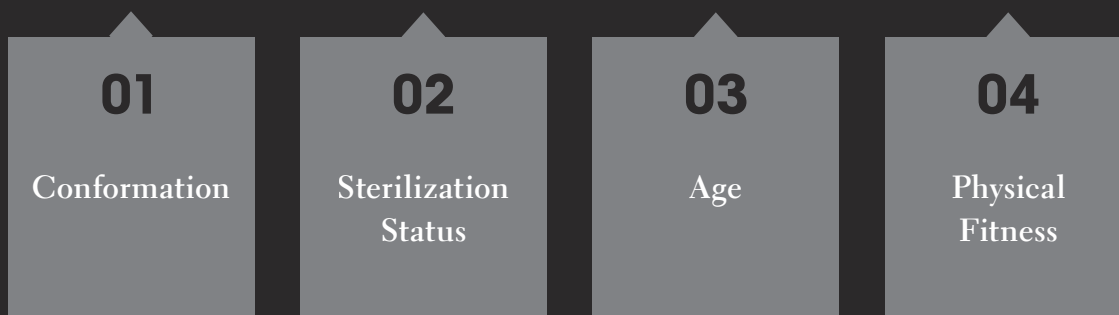
06 Clicking sounds when walking

07 Decreased range of motion

08 Reluctance to exercise

09 Stiffness after exercise

RISK FACTORS FOR CCL INJURIES/DISEASE



Females (an 8% increase) are affected by sterilization more than males (a 5% increase). This tibial plateau angle risk is made much worse by another associated risk factor: overweight.

Sterilization Status

Intact females are twice as likely to develop CCL as intact males; neutering both sexes increases the risk of CCL, but obesity in neutered animals might confound this sterilization risk since sterilized animals are more often obese. Obesity overall increases the risk of CCL by four times. Heavy body weight, whether as a normal feature of the large breed dog or linked to obesity, also increases the risk of ligament failure.

Age

Age is a risk factor in most degenerative joint disease and CCL is no exception. On average, this risk peaks around 8 years old but breeds with a higher prevalence of the disease (e.g., Rottweilers, Boxers) tend to develop ligament degeneration earlier in life.

Physical Fitness

Physical exercise and athletic build are negative risk factors. Dogs that are fit are at less risk. In contrast, dogs that are erratically active but not well conditioned (a canine version of the "weekend warrior") or dogs in poor physical condition are at increased risk of cruciate injuries.

Genetics

Breed is strongly related to a tendency for CCL injury/disease, which suggests a possible genetic link. There have been several genes recently identified in dogs with a high risk for CCL ruptures. These genes are related to collagen strength and stability and are involved in extracellular matrix formation. In contrast, another study found no difference in gene expression in dogs with and without CCL disease/ruptures. A third study found another set of genes that were identified in tibial plateau

slope formation and in developing a compressed infrapatellar fat pad, which is a surrogate for stifle osteoarthritis and CCL rupture.

More recently, researchers at the University of Wisconsin (UW) have suggested a genetic mode of inheritance in Labrador retrievers and Newfoundlands. Funded by a grant from the AKC Canine Health Foundation, UW researchers compared DNA samples from more than 1,000 Labradors, some of whom had CCLR and others who were clear. No single gene was responsible for CCLR, rather CCLR appears to depend on thousands of genetic variants. Taken together these variants account for a 62% risk that the dog will develop CCLR in its lifetime. The other 38% depends on environmental influences such as the dog's weight, physical fitness and other unknown factors. From this work, a genetic test was developed for Labrador retrievers to predict the likelihood that a dog would develop CCLR in its lifetime. While the test is expensive (~\$250), it has the potential to be useful in identifying dogs at risk for whom early interventions might be beneficial and in guiding breeding decisions.

These same researchers are currently developing genetic CCLR risk tests for both Rottweilers and Newfoundlands following the same approach used in Labradors, an approach that could be used for other complex disorders. Currently, we do not know the mode of inheritance for CCLR in Bernese Mountain Dogs.

Reduced Vascular Structure in the CCL in Adult Dogs

Microscopic studies of tissue structures in the cruciate ligament show that a young dog's cruciate ligament contains many blood vessels. Interestingly, at about a year, the blood vessels in the young dog's CCL disappear, with often only a single blood vessel left. In some dogs there are no blood vessels. Researchers hypothesize that the lack of blood supply to the ligament in adults causes the ligament to fail to regenerate and heal when it is injured. Indeed, researchers found that in examined torn ligaments,

there was both degeneration of the ligament and indications that the ligament had repeatedly tried and failed to heal the tear.

Osteoarthritic Changes

It is rare for ligaments on both knees to rupture simultaneously, however it is common for the CCL on the second knee of a dog to rupture after the first knee rupture. One study reported that around 33% of dogs with a CCL rupture on one knee experienced a rupture on the other knee within a year after the first rupture. Other studies have reported up to 50% experienced a rupture on the other knee with a mean time of 2.5 years between the first and second rupture. When both knees (affected and unaffected) are examined for osteoarthritic changes, any changes in the unaffected knee are considered a risk factor for future rupture. This finding would also tend to support the ligament degeneration process as a risk factor in the aging dog.

HOW ARE CCLR AND CCLD DIAGNOSED?

CCLR is typically diagnosed through a physical exam and a cranial drawer test, which reveals instability of the joint if it slides. Any clicks coming from the joint suggest damage to the meniscus. While the CCL is not visible in an x-ray, they are often taken to look for signs consistent with CCL injury (e.g., joint fluid, cranial tibial displacement, osteoarthritis or bone spurs) and to rule out other possible causes of lameness (e.g., neoplasia).

Ross Palmer, DVM, MA, DACVS at Colorado State University, says that dogs with even subtle lameness tend to lean away from the affected leg while standing. Sitting is often uncomfortable which causes them to abduct the limb (move it away from the body) or shift it cranially (upward toward the head). Dogs with bilateral disease may shift their weight to their forelimbs while sitting or getting up.

Partial tears are known to be more difficult to diagnose because they often reveal cranial drawer instability only when the stifle is flexed. Palmer notes that fibrosis (scarring) or early-stage disease may prevent the detection of palpable instability. Thus, the absence of palpable instability does not necessarily prevent the clinical diagnosis of disease or its surgical treatment. Minimally invasive arthroscopic procedures may be used in diagnosing partial tears.

Dog owners must keep in mind that not all rear leg lameness is indicative of a CCL tear. Other possible alternative diagnoses include but are not limited to hip dysplasia, a ruptured disc, soft tissue cancer, tendon rupture, strains and sprains, a displaced kneecap, ruptured tendons, a bone fracture, osteochondrosis or panosteitis. A veterinarian will attempt to exclude these diagnoses while making a final diagnosis.

CONSERVATIVE OR NON-SURGICAL TREATMENTS

While surgery is generally considered the treatment of choice for restoring functionality, dog owners may choose to treat their dog conservatively or non-surgically for various legitimate reasons, including financial constraints, increased surgical and/or anesthesia risks, the advanced age of the dog, the presence of other medical, orthopedic and/or neurologic disease in the dog and/or the inability of the owner to provide extensive at-home care or supervision after certain surgical procedures. These alternative treatments have a role in managing CCL injuries for dogs who cannot undergo surgery.

Alternative treatments are varied and include but are not limited to custom braces, weight loss programs, stem cell and platelet-rich plasma injections, NSAIDs, corticosteroids, anti-inflammatory supplements, nutraceuticals, class IV low level laser therapy, therapeutic ultrasound, hydrotherapy, physical therapy and TENS/NMES.

Pennsylvania veterinarian, Janine Callen, DVM, reports that she has used PulseVet shockwave therapy successfully facilitating the healing of partial tears. She says that most people are not aware of shockwave as a therapy for CCLR, but it has several advantages over laser including higher energy output, deeper penetration, no risk of burns (it uses sound energy, not light energy), takes fewer sessions (2-3 vs. 10-15 for laser) and has documented results lasting up to 12 months. Several studies have been published on the use of shockwave therapies in treating human athlete injuries, including ACL injuries. The therapy has the advantage of few side effects.

Conservative treatments work best for partial CCL tears because it is sometimes possible for there to be enough scar tissue produced to make the joint stable again.

Ideally, we wish there were comparative studies evaluating the efficacy of these modalities, but there are few such studies. Those that do exist tend to be smaller, non-randomly sampled, survey-based retrospective studies. These characteristics make it difficult to generalize results to larger populations. One evaluative study was published in 2013 in the Journal of the American Veterinary Medical Association, "Short term and Long-term Outcomes for Overweight Dogs with CCLR Treated Surgically or Nonsurgically." In that study, 40 overweight dogs with unilateral CCLR were randomly assigned to nonsurgical (physical therapy, weight loss and NSAID administration) or surgical (tibial plateau leveling osteotomy) treatment groups; dogs in both groups received the same nonsurgical treatments. Dogs were evaluated immediately before and at 6, 12, 24 and 52 weeks after initiation of treatments via

owner questionnaires, gait analysis and dual-energy x-ray absorptiometry. Dogs in both groups improved, but dogs in the surgical treatment group seemed to have greater improvement. Dogs in both groups lost weight. Surgically treated dogs had a higher probability of a successful outcome (67.7%, 92.6% and 75.0% for 12-, 24- and 52-week evaluations, respectively) versus nonsurgical treatment group dogs (47.1%, 33.3% and 63.6% for 12-, 24- and 52-week evaluations, respectively). Overweight dogs with CCLR treated via surgical and nonsurgical methods had better outcomes than dogs treated via nonsurgical methods alone. *However, almost two-thirds of the dogs in the nonsurgical treatment group had a successful outcome at the 52-week evaluation time.*

Stem cell and platelet-rich plasma injections were evaluated in, "Partial Cranial Cruciate Ligament Tears Treated with Stem Cell and Platelet-Rich Plasma Combination Therapy in 36 Dogs: A Retrospective Study," published in 2016 in *Frontiers in Veterinary Science*. Thirty-six dogs were studied. For each dog in the study, researchers collected data on symptoms, medical history, physical and orthopedic examination, objective temporospatial gait analyses, radiographs, day 0 and day 90 diagnostic arthroscopy findings, treatment and outcome. A questionnaire, including the validated Helsinki chronic pain index (HCPI), was sent to owners whose dog was known to not have had a tibial plateau leveling osteotomy (TPLO). Stifle arthroscopy findings at 90 days posttreatment were available on 13 of the 36 dogs. In nine dogs, a fully intact CCL with marked neovascularization and a normal fiber pattern was found with all previous regions of disruption healed. One dog revealed significant improvement and received an additional injection. The remaining three dogs had a >50% CCL tear, and a TPLO was performed. Four additional dogs were known to have had a TPLO performed elsewhere. Baseline and day 90

posttreatment objective gait analyses were available on 11 of the 36 dogs. A significant difference was found between the treated limb total pressure index percent (TPI%) at day 0 and day 90 and between the treated limb and (unaffected) limb TPI% at day 0. No significant difference was found between the treated limb and other (unaffected) limb TPI% at day 90.

There is suggestive evidence that these modalities can contribute to healing, pain reduction, inflammation control and mobility. The advantage of these modalities is that they do not remodel the bone as does TPLO or tibial tuberosity advancement (TTA) or center of rotation of angulation (CORA)-based leveling osteotomy (CBLO). Instead, they typically address the ligament and surrounding tissues to improve healing or manage inflammation that leads to osteoarthritis, a risk factor for CCL tears.

SURGICAL TREATMENTS

Currently, surgical stabilization of the stifle joint is considered the gold standard for treatment of CCL ruptures. Surgery does not repair the ligament itself, rather it addresses knee instability and pain. Unlike human ACL surgeries, the dog's CCL is not replaced with a graft because of the mechanical differences between the two species rooted in structural differences between bipeds and quadrupeds. None of these surgeries completely halts the development of arthritis within the joint, but surgical treatment is thought to produce better functional results than conservative (non-surgical) therapies alone. In contrast to suture-based surgeries, TPLO and TTA require specialized equipment and because of that they are usually performed in referral or specialty clinics. Proper post-operative management by the dog owner is critical in TPLO, TTA and CBLO surgeries since the bone must heal. If the meniscus is damaged it is typically

TYPICAL SURGICAL PROCEDURES RECOMMENDED FOR LARGE BREED DOGS WITH CCL

01

Extra-capsular
Stabilizing
Suture/Lateral
Fabelotibial
Surgery

02

Tibial Plateau
Leveling
Osteotomy
(TPLO)

03

Tibial
Tuberosity
Advancement
(TTA)

04

Center of
Rotation of
Angulation
(CORA)-
Based Leveling
Osteotomy

addressed by removing damaged parts or performing meniscal release of an intact meniscus during surgery. Meniscal release is still a controversial procedure.

Bone cutting surgeries, called osteotomy-based surgeries, work by changing the biomechanics of the knee joint. They change the way the quadriceps muscles act on the top of the shin bone. In tibial plateau leveling osteotomy (TPLO), this is done by rotating the slope of the shin bone. In tibial tuberosity advancement (TTA), it is done by advancing the attachment of the muscle. Most of these surgeries require extensive post-operative care including activity restriction and physical rehabilitation to obtain the best outcomes. About 90% of dogs undergoing surgery return to good or excellent function following surgery and correct post-operative care. According to veterinary orthopedic surgeon, Anthony Pardo DVM, MS, DACVS at Blue Pearl Pet Hospital, if there are complications, infection is the most frequent complication. It should be noted that dogs who are on any medication that suppresses their immune systems may not be good candidates for any osteotomy surgeries because they are likely to experience delayed bone healing.

Surgical procedures recommended for large breed dogs are typically one of these four procedures.

- Extra-capsular Stabilizing Suture/Lateral Fabellotibial Surgery
- Tibial Plateau Leveling Osteotomy (TPLO)
- Tibial Tuberosity Advancement (TTA)
- Center of Rotation of Angulation (CORA)-Based Leveling Osteotomy

Extra-capsular Stabilizing Suture/ Lateral Fabellotibial Surgery

This procedure tries to mimic the functions of the CCL by placing a heavy-gauge suture across the stifle joint in an orientation that mimics the normal CCL. The suture is placed on the outside of the joint (“extra-capsular”) around the fabella, behind the knee and through a hole drilled in the front of the tibia. Outcomes are very good in dogs weighing less than 30-40 pounds (and in cats). While it is possible to perform this procedure on larger dogs, the results are not as predictable and the suture is more likely to break. This procedure has the advantage in that it is considered easier for veterinarians to learn, is less invasive, does not require specialized equipment or training and is less expensive. As such, it may be more financially and geographically available to more dog owners. The disadvantage is that the suture can break in larger, active dogs.

TPLO (Tibial Plateau Leveling Osteotomy)

Currently, TPLO is considered by many experienced veterinary surgeons to be the most successful stabilization procedure for dogs regardless of their

size. It is distinguished by its success in large dogs. Unlike the previously described procedure that mimics the ligament, TPLO alters the biomechanics by changing the angle at which the femur bears weight on the flat area (plateau) of the tibia. The tibia has a natural slope. The healthy CCL prevents the femur from “sliding” down the slope when the dog puts weight on its leg. When the CCL is ruptured, the femur can freely slide down the slope. In a TPLO procedure, the tibia is cut and rotated to flatten the tibial plateau (the top surface of the tibia) and prevent the femur from sliding backwards. A plate is attached to the inside surface of the tibia to stabilize the osteotomy. After the bone has healed the plate is not needed but it is rarely removed unless there is irritation or infection.

Advantages over suture methods include superior results for both large and small dogs in terms of limb function and athletic mobility. There is also less arthritis progression. Disadvantages include the need to cut the bone and the rare possibility of revision surgery if the implant fails or the bone does not heal.

TTA (Tibial Tuberosity Advancement)

TTA, like TPLO, changes the biomechanics of the stifle joint to compensate for the abnormal forces placed on the joint when the CCL is injured. Instead of rotating the slope of the tibia as in TPLO, TTA changes the angle of the patellar ligament by cutting and repositioning the tibial crest where the patellar ligament attaches. This part of bone is moved a precise distance and stabilized using a titanium or steel plate and screws (see photo later in this article).

Advantages of this more recently developed procedure compared to the TPLO include a smaller, less invasive cut in the bone at an area that is not directly involved in weight bearing and earlier post-operative weight bearing. The primary disadvantage is the lack of long-term studies comparing this procedure to the TPLO and extra-capsular suture. Like TPLO, TTA requires cutting the bone and carries the rare possibility of revision surgery if the implant fails or the bone does not heal. While dogs tend to bear more weight on the limb earlier in the recovery period, dog owners must follow strict post-operative exercise restrictions with their dogs to achieve those results.

Center of Rotation of Angulation (CORA)-Based Leveling Osteotomy (CBLO)

CBLO is a newer tibial plateau leveling procedure that combines the advantages of both TPLO and TTA. The veterinary surgeon can do a tibial osteotomy without cutting the articular surface (i.e., the place where the femur and tibia condyles come together). Like TPLO and TTA, the cut to the bone is stabilized with a CBLO bone plate, locking screws and a headless compression screw.

FOUR MAJOR CONSIDERATIONS TO PONDER WHEN MAKING CCLR TREATMENT DECISIONS

01

The health status and physical condition of the dog

02

The efficacy of the procedure at restoring functionality and reducing pain

03

The availability and expertise of the veterinarian performing the procedure

04

The cost of both the procedure and follow-up

Advantages of CBLO include the ability to add an extracapsular suture, excellent long-term functional results, normal long-term appearance of articular cartilage, rapid healing (6-7 weeks) and the ability to perform the surgery on very young dogs with open growth plates because the CBLO technique is less likely to disrupt these. CBLO is also beneficial in dogs with very steep angles in their knee joints before any surgery.

The primary disadvantage of CBLO is its cost and a lack of broad geographic availability. Not many veterinarians know the procedure currently, which tends to increase the cost of the procedure and decrease its availability. Like other osteotomy surgeries, CBLO involves a much stricter period of exercise rest, with greater potential for serious complications if this is not followed.

WHICH SURGERY IS BEST?

While suture methods are readily available, they are not as suitable or reliable for larger dogs as the more invasive surgeries. In contrast, CBLO is newer, but not broadly available or widely performed now. The two most popular and available surgical treatments for large-breed dogs now are TPLO and TTA. While several independent studies have been done to assess which is better (TPLO vs TTA), they have produced conflicting results. Moreover, many of these studies have design or sampling limitations that call into question some conclusions.

Faced with this confusing situation, researchers often use a method called "meta-analysis" that helps them understand complex phenomena when independent studies have produced conflicting findings. Meta-analysis is an objective examination of published data from many research studies identified through a databased literature search on the same research topic. Using rigorous statistical methods, meta-analysis often reveals patterns hidden in individual studies and can yield conclusions that have a high degree of reliability.

As such, meta-analytic studies often form the basis of much of evidence-based medicine in human medicine.

While we do not have a clear answer to the question of which surgical procedure is better, we do have a meta-analytic study published in the November 2022 issue of *Frontiers in Veterinary Science*. The article, "Surgical Treatment of Cranial Cruciate Ligament Disease in Dogs Using Tibial Plateau Leveling Osteotomy or Tibial Tuberosity Advancement—A systematic review with a Meta-analytic Approach," written by researchers in the Department of Small Animal Medicine and Surgery, University of Veterinary Medicine Hannover, Hannover, Germany, analyzes 72 research studies on TPLO vs TTA published during the period 2016 to 2021. The techniques were evaluated using several surgical outcome measures: gait analysis (subjective), gait analysis (objective), osteoarthritis, thigh circumference measurements, goniometry (range of motion), joint stability, pain and complications.

The conclusions are that both TPLO and TTA are effective surgical treatments for naturally occurring CCL disease/rupture. Both approaches provide good outcomes and restore functionality and mobility. One caveat for both approaches is that long-term development of arthritis may be a consideration, and unfortunately there is little follow-up data available now to help the dog owner evaluate the arthritis risk. While there is no clear recommendation for one technique over the other, current evidence indicates that TPLO is preferred regarding certain complications such as surgical site infections. In a separate study, researchers felt that the TTA method might be easier than TPLO for veterinary surgeons to learn. Given the near equivalence of both procedures, the geographic availability of the procedure, the skill of the surgeon in the selected procedure and the infection rates at the hospital should guide your choice between the two.



Keep your dog fit with regular exercise.

HOW DO I MAKE A RATIONAL TREATMENT DECISION?

There are four major considerations to ponder when making CCLR treatment decisions:

1. The health status and physical condition of the dog.
2. The efficacy of the procedure at restoring functionality and reducing pain.
3. The availability and expertise of the veterinarian performing the procedure.
4. The cost of both the procedure and follow-up.

While surgery is typically considered the gold standard for treatment of CCLR because of associated progressive osteoarthritis, it is not irrational for dog owners to choose non-surgical treatments for various legitimate reasons, including financial constraints, increased surgical and/or anesthetic risks, the advanced age of the dog, the presence of other medical, orthopedic and/or neurologic disease in the dog and/or the inability of the owner to provide extensive at-home care or supervision after certain surgical procedures.

These treatment decisions are unique to each case, and the various options should be discussed in consultation with the dog's consulting veterinarian. There is no one-size-fits-all solution for every dog. In that spirit, accompanying this article are the commentaries of several Berner owners who were faced with these treatment decisions, their rationales for what they eventually chose and their advice to others based on their experiences.

CAN I DO ANYTHING TO PREVENT CCL RUPTURES?

YES, YOU CAN! The risk factors mentioned previously point to some obvious ways to lower the CCLR risk.

- Manage the dog's weight.
- Keep the dog conditioned and physically fit.
- Consider leaving the dog intact.

First, **obesity** is a manipulable risk associated with rupture. Fat dogs are four times more likely to develop CCL injuries than normal-weight dogs. Feed your dog a quality diet and maintain an appropriate weight based on his or her body condition score (BCS). An appropriate weight on a 5-point BCS scale is 3. Five to 6 is acceptable on a 9-point BCS scale. If you do

not know how to assess your dog's weight using BCS, have your veterinarian teach you. Unlike a regular weight scale, BCS is an individual, dog-specific way to monitor the dog's weight. For a quick overview of BCS, see <https://www.aaha.org/aaha-guidelines/life-stage-canine-2019/nutritional-assessment/body-and-muscle-condition-score/>.

Second, **fitness** matters. Keep your dog fit with regular exercise. This does not require anything extreme. It can involve a combination of regular walks and leash-free exercise in safe, open areas. Avoid any exercise involving sharp turns, abrupt stops or sudden twists because these activities can aggravate a pre-existing partial tear from early ligament degeneration.

Third, decisions on **sterilization** should consider several factors, including the existence of CCLR in the dog's breed or possibly in relatives in the pedigree. Intact dogs have a somewhat lower risk of CCLR than sterilized ones. These trade-offs should be considered and discussed with your veterinarian in making sterilization decisions and the timing of those procedures, if elected.

ACKNOWLEDGMENT:

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About the Author: Nancy Melone's articles, published in several breed magazines here and abroad, have won numerous Dog Writers Association of America (DWAA) Maxwell Medallions, a Morris Animal Foundation Advances in Canine Veterinary Medicine Award and multiple American Kennel Club Publication Excellence Awards. She is Editor Emerita of The Alpenhorn and served on the boards of the Berner-Garde Foundation and Bernese Auction Rescue Coalition. Currently she serves on the board of the Nederlandse Kooikerhondje Club of the USA (NKCUSA) and chairs their Health and Genetics Committee. Her PhD is in Information and Decision Science from the University of Minnesota.

A NON- SURGICAL BRACE EXPERIENCE

Dog's Name: MBISS(Alt) BIS(Alt) TDCH CH(Alt) Orloff Jungfrau Syrrah PCD CD RE DD BDD AGNJ(S) TDX UTD SDN CGN, BMDCC Versatility Dog, BMDCC Working Dog, AKC RN TDX CGC TKP, SDDA SDE, CARO RE VE WCRI WCRII WCREI (Syrrah)

Berner-Garde: #106352

Sex: Female

DOB: July 15, 2016

Treatment: Brace

Owner: Sue Wilkinson, DVM (Canada)

1. At what age was your dog diagnosed with cranial cruciate ligament disease?

My Syrrah tore her left CCL in March 2022 - she was 8 years, 8 months old at the time. A week previous I had come home and found her limping on her left hind leg. I (of course) went looking for cancer—all bloodwork and radiographs were normal, so we rested her and gave Gabapentin. Three days later my younger boy suffered a GDV, thankfully early intervention and emergency surgery saved his life, but I admit that Syrrah's improving lameness got put on the back burner for a week. Then I saw her slip on the kitchen floor and come up non-weight bearing on the left, hind leg. I surmised a partial tear or strain, then the fall totaled it. I was relieved when I got a positive clunk of a drawer sign (it wasn't cancer!!). Syrrah was diagnosed with aseptic meningitis (AM) when she was 9 months old (a littermate was also diagnosed around the same time). Remission was achieved and she was slowly weaned off prednisone. At 19 months old she came into heat (was scheduled for OVH (spay) following the heat). Unfortunately, the hormonal stress relapsed her AM. I took even longer weaning her off the meds. Monitoring bloodwork the following spring found compromised kidney function, which deteriorated within days, leaving her with a stable chronic renal failure, which we attribute to the long-term immune compromised state.

2. What factors did you consider in making your decision about how you would treat the disease?

When she ruptured her cruciate, I knew that surgery was not an option for her. She couldn't have

NSAIDs due to her chronic renal failure (CRF), and if her AM relapsed she would need to go back on steroids—the risk of implant infection and failure was not something I was willing to risk. Because I am a veterinarian, this decision was a hard one for me—I wanted her fixed!

3. What treatment did you choose and how effective was it in restoring mobility?

I had a neoprene brace in the clinic with a hinged metal support rod. We both hated that, and it frankly was useless. I was hopeful it would tide us over until her custom brace was made. Alas, not to be. Thankfully by Easter we picked up her snazzy custom brace.

Syrrah did great with the brace. She tolerated it very well and her mobility, stifle stability, and muscling improved. She wore the brace all day, pretty much every day, for a good six months (I took it off at night). Then we had a sudden episode of anorexia (now 9 years old, for sure I was looking for the cancer again, and thankfully found none). She lost a ton of weight, and when I put her back on steroids she finally started eating again. It was then that I stopped using the brace. My decision to not pursue surgery for her knee was vindicated (we had three more such episodes). Last month I finally solved the puzzle; she had developed atypical Addison's disease! She's not making enough of her own glucocorticoids and needs a daily low dose of prednisone. She's an eating fiend again and has no further clinical signs. She's also now receiving Librela™ monthly for her resultant arthritis and has very good quality of life. She's my first Berner to make it to 10 years; now we're looking forward to 11!

4. Given the treatment that you chose and its efficacy, what advice would you offer to owners of dogs with CCLD?

I would, and do, recommend custom braces for clients who, for whatever reason, are not willing/able to pursue TPLO surgery. Consider the age

and activity level of the dog. For example, I saw a farm dog who had one TPLO and then ruptured the other. The owners were reluctant to spend the money but wanted the dog to be able to go riding with them again. She's just 3 years old and a wild child. Surgery was their best option, and they eventually saw that.

A TTA EXPERIENCE

Dog's Name: Sweetwater Farm's Lucy (Lucy)

Berner-Garde: #125477

Sex: Female

DOB: April 24, 2014

Treatment: TTA

Owner: Kelley Neill (USA)

1. At what age was your dog diagnosed with cranial cruciate ligament disease?

My girl was 4.5 years old when she was diagnosed with a torn CCL.

2. What factors did you consider in making your decision about how you would treat the disease?

My local vet had a vet in the clinic that performed many CCL repairs. He did only TTA surgeries and was not an "orthopedic specialist," but he performed TTA surgeries successfully weekly or at least rather frequently throughout his career. He did not do TPLO so that was not an option. If I wanted TPLO I had to go to Akron, Toledo or Cleveland. I believe my TTA was about \$3,000. The TPLO at the other clinics was more like \$4,000+ and I did not have insurance. So, my local vet was closer, and I was confident in his ability. The price played a big factor in my decision.

3. What treatment did you choose and how effective was it in restoring mobility?

I chose the TTA. It was a nightmare. She got an infection inside the joint. I had to take her back for surgery to have her surgically opened again to correct the infection problem. Of course, before this she had only had infection occur twice in all his previous surgeries. She healed but the meniscus tore. I can't remember if we fixed that or if that got fixed at the time the infection issue was being fixed. At about the halfway point of her recovery, she tore the CCL on her other leg. I did not fix this leg—it healed on its own while she finished recovering from the first

surgery. She then was diagnosed with mammary cancer that spread to the lungs and died at 5.5 years old. It was a nightmare experience for me.

In contrast, my Labrador retriever tore both his CCLs at 6 months. This time we went to MedVet Toledo to a board-certified orthopedic surgeon (I believe that's what she was). She was amazing. I had the TPLO done on his one leg at a year and the other leg healed on its own. He is 4 now and gets along fine. He runs and plays. The recovery from that surgery was so much that I couldn't see putting him through it unless he was severely lame again; he isn't. He might have arthritis when he is older, but the TPLO had no complications. It was great. I don't know if this was just bad luck or the doctor or what, but I would not choose a TTA again unless I was educated on it from recently educated doctors in the various procedures.

4. Given the treatment that you chose and its efficacy, what advice would you offer to owners of dogs with CCLD?

My advice would be if the dog is over a certain age (I honestly don't know that number as each dog is different) but probably 5 years old, I would probably choose a brace over a surgery. It's a hard recovery and the people I have talked to have had their Berners heal okay from the brace. I have seen two heal okay while the other legs were healing from surgery so I can't imagine it would get any worse with a brace for extra stability.

This is my experience. This was also my first Berner.

A TTA EXPERIENCE

Dog's Name: Emma Alonso
Berner-Garde: Not in Berner Garde
Sex: Female
DOB: January 4, 2014
DOD: December 31, 2019
Treatment: TTA
Owner: Ethel Robles (Mexico)

Dog's Name: Loretta de Neboa de Meigas
Berner-Garde: #155240
Sex: Female
DOB: October 2, 2015
Treatment: TTA
Owner: Ethel Robles (Mexico)

1. At what age was your dog diagnosed with cranial cruciate ligament disease?

One bitch was diagnosed at 15 months old. She tore only one knee, living to be 6 years old. My second bitch was diagnosed with both legs at 7 years old.

2. What factors did you consider in making your decision about how you would treat the disease?

TTA was the option I was given by the orthopedic surgeon.

3. What treatment did you choose and how effective was it in restoring mobility?

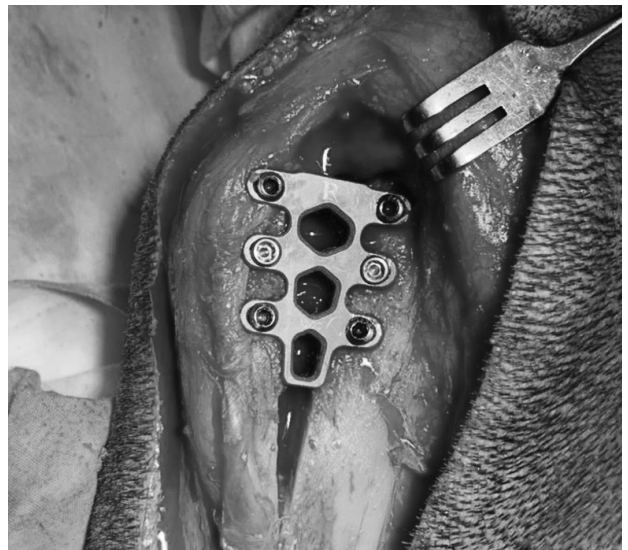
TTA in both cases. It works if we consider that both dogs lived/live a normal life, but the older one experiences some pain if she does a lot of exercise. While the surgery helped somewhat, neither bitch was restored to full mobility after the surgery.

4. Given the treatment that you chose and its efficacy, what advice would you offer to owners of dogs with CCLD?

Treat as soon as possible since the recovery of the surgery is long and requires a lot of care. One leg must be strong enough to support the dog's weight while the other leg is healing. Give supplements such as chondroitin and glucosamine. Be patient since the recovery is hard for everyone. The dog must be crated for long periods of time; make sure the floor has enough traction to stand up and move—this is the same for any area where the dog must walk.



▲ X-ray prior to surgery showing the angle of the femur and tibia. Photo Courtesy of Ethel Robles and used with her permission.



▲ TTA plate post-surgical placement. Photo Courtesy of Ethel Robles and used with her permission.



▲ X-ray post TTA surgery. Photo Courtesy of Ethel Robles and used with her permission.

A TTA EXPERIENCE

Dog's Name: Auseire How It Is.

Call name: Toby

Berner-Garde: #190679

Sex: Male

DOB: November 8, 2020

Treatment: TTA

Owner: Tanya Shields (Ireland)

1. At what age was your dog diagnosed with cranial cruciate ligament disease?

My dog was diagnosed with a tear at 2 years, 8 months old.

My boy was seen and operated on within the week. He came in from outside on Friday night toe tapping the leg. I booked a vet appointment for Monday morning. I was hoping he had just tweaked something and the rest over the weekend might have made a miracle recovery, but I had a good idea it was a cruciate tear. He was operated on that Thursday.

2. What factors did you consider in making your decision about how you would treat the disease?

We followed the orthopedic vet's advice. Our dog had ruptured the cranial cruciate ligament, but his meniscus was still intact.

3. What treatment did you choose and how effective was it in restoring mobility?

We chose TTA and followed the prescribed rehabilitation plan. The surgery was done in July 2023. He was weight bearing on the leg straight away, and 3-4 months after the surgery he is basically moving soundly now.

4. Given the treatment that you chose and its efficacy, what advice would you offer to owners of dogs with CCLD?

For my dog TTA has worked very well. We followed the advice given regarding containing his space, the time and number of walks a day and the exercises to do and when to do them. He also had under-water treadmill therapy with some physio and laser. At the end of the day, every dog is different and in taking this step to operate on him we had to make sure we did the rehabilitation.

A TPLO EXPERIENCE

Dog's Name: Talk About Highlands (Haley)

Berner-Garde: #51338

Sex: Female

DOB: December 24, 2004

Treatment: TPLO

Owner: Lynne Farrell Washburn (USA)

1. At what age was your dog diagnosed with cranial cruciate ligament disease?

Haley was 6.5 years old when diagnosed. I remember her running through the yard at full speed up to the fence with the other five Berners behind. She came to an abrupt stop and was hit by two other Berners from the side. She yelped in pain, almost instantly becoming non-weight bearing on the right hind leg.

2. What factors did you consider in making your decision about how you would treat the disease?

Haley became non-weight bearing. She was the leader of my pack and was used to being active. I had no experience with the issue. My regular vet explained about a TPLO and referred us to VCA Buffalo Grove, IL. I also had a limited budget.

3. What treatment did you choose and how effective was it in restoring mobility?

I chose TPLO of the right cruciate. After surgery it was noted that it was totally ruptured. After following the detailed rehab instructions, including water rehab, Haley's mobility was completely restored.

4. Given the treatment that you chose and its efficacy, what advice would you offer to owners of dogs with CCLD?

I would recommend asking more questions and obtaining alternative opinions. In Haley's case, I feel I made the right decision. We led an active lifestyle, which she enjoyed, and this allowed her to continue to participate.

A TPLO EXPERIENCE

Dog's Name: Swiss Charm Chestnut (Chestnut)
Berner-Garde: #208236
Sex: Female
DOB: July 15, 2016
Treatment: TPLO
Owner: Joyce Walter (USA)

1. At what age was your dog diagnosed with cranial cruciate ligament disease?

First CCL tear, right leg

Chestnut originally started limping in April of 2017. She was treated with gabapentin and watched. In December 2017 she pulled up lame while running and had fully torn her CCL. We did not have surgery until very early January 2018

Second CCL rear left leg

Chestnut tore the left CCL in November 2021. She had it repaired very early January 2022.

2. What factors did you consider in making your decision about how you would treat the disease?

Chestnut has elbow dysplasia in both of her elbows, so we decided to have the repairs done to her knees so that at least the back two legs were functioning fully.

3. What treatment did you choose and how effective was it in restoring mobility?

Both legs were treated with TPLO surgery. The first surgery was done at Chesapeake Orthopedics and

the second one was done at Blue Pearl in Delaware. Both legs are doing great; however, the second leg is much better than the first. She recovered quicker and it appears she has better range of motion. The second surgeon had her up and moving earlier than the first. She had short walks in the yard after just two weeks and was on full walks by nine weeks. The first surgeon did not want even short walks in the yard until four weeks.

4. Given the treatment that you chose and its efficacy, what advice would you offer to owners of dogs with CCLD?

I would recommend this surgery to other owners, especially if they have any other mobility issues to deal with. As with humans, they have learned quite a bit about recovery methods and how important use of the repaired joint as quickly as possible can be. She did require no jumping, no real stairs (we had one to get in and out of the house which the doctor was okay with) and assistance getting up and down for several weeks. She is fully able to move about as she wants. The elbow dysplasia does limit her somewhat, but she is able to walk longer distances and can get up on the couch and bed. Just to let you know, Chestnut has developed some arthritis in her back, likely from the movement issues associated with her elbows and possibly the knees. She is on Galliprant® once a day and moves around better than she has in years.

A PRP EXPERIENCE

Dog's Name: Daisy Mae Daydream, SBN SCN SIN
Berner-Garde: #106344
Sex: Female
DOB: March 13, 2013
DOD: June 30, 2020
Treatment: Stem Cell/Platelet-Rich-Plasma Therapy
Owners: Cindy and Jesse Loflin (USA)

1. At what age was your dog diagnosed with cranial cruciate ligament disease?

Daisy was 4.7 years old when diagnosed. She was a very active girl, normal weight (82 pounds) and 23

inches tall, with excellent hips and normal elbows. She worked in Novice level agility, nose work and normally ran in our large back yard. She never had any previous injuries or lameness. She was intact at the time of injury. When we noticed the problem was

when she and our German Shepherd were running in the backyard. She yelped mid-run and stopped using her right back leg immediately. Initially we suspected a sprain or misstep. We examined her for thorns or another injury. After a few days with no improvement and her failure to use the leg, we took her to our vet. She was diagnosed as having a serious CCL tear that would require intervention.

2. What factors did you consider in making your decision about how you would treat the disease?

Daisy was young, athletic and very active. She was not overweight but had light bone structure. She was in excellent physical condition without a history of lameness. Our veterinarian recommended TPLO if NSAIDs and laser therapy were ineffective. My breeder's sister, a veterinarian in New York, sent us an article about stem cell therapy for active and athletic dogs. These procedures had been successful in cases such as Daisy's (young, athletic and not overweight).

3. What treatment did you choose and how effective was it in restoring mobility?

I was resistant to doing TPLO. Some research suggested that dogs undergoing surgical treatments may develop arthritis after a few years. I was uncertain about the complexity of physical therapy required to ensure the best outcome. The cost of TPLO was prohibitive, especially considering the data showing a high probability that a second knee would likely tear later. The second cruciate ligament did tear two years later. I found MediVet Biologics (now Ardent Animal Health) and scheduled an appointment with their staff. They spent considerable

time discussing their procedures with me and describing the positive results they had experienced. At the time, this was the least invasive surgical option available to me and was half the cost of TPLO. We were referred to a local veterinarian who had the stem cell centrifuge to do the procedure. The veterinarian made a small abdominal incision (a 15-minute sedation), extrapolated the cells and injected the injured ligaments with stem cells and plasma several hours later without additional full anesthesia. Daisy came out of the procedure using her leg for the first time in several weeks! The physical therapy amounted to no running or climbing for 40 days. She experienced no muscle atrophy, required minimal pain management and had no scarring. MediVet (now Ardent) banked the cells they did not use and they were available two years later when we had to repeat the procedure on the other knee. The second knee was equally successful, with full recovery.

4. Given the treatment that you chose and its efficacy, what advice would you offer to owners of dogs with CCLD?

I would highly recommend exploring stem cell therapy (her procedures were in 2017 and 2019) and contact Ardent Animal Health for a consult. My original veterinarian was very resistant to this therapy, so Ardent scheduled a second opinion with the veterinarian we chose, who had done 20+ at the time with great success. I'm very glad we chose this option. Daisy regained her mobility 100%. She continued to do agility and nose work, and never developed arthritis or any lingering weakness or pain with either joint.