Cranial cruciate ligament rupture (CrCLR) is the most common cause of hindlimb lameness in dogs and, in my experience, the most common misdiagnosed or overlooked cause of canine lameness. Of 369 dogs referred to a teaching hospital for treatment of hip dysplasia, 32% had CrCLR as the primary cause of hindlimb lameness.¹

In most dogs, undiagnosed or untreated CrCLR results in rapid advancement of osteoarthritis (OA). Radiographs taken within 6 weeks of acute cruciate rupture often display signs of OA, including peripatellar and peritrochlear osteophytes, joint effusion, and joint space collapse. Timely, accurate diagnosis and treatment of CrCLRs are likely very important to minimize progression of OA and optimize surgical outcomes.²

Immature dogs are often misdiagnosed with CrCLR because they have greater than expected cranial drawer sign due to normal puppy laxity. Lameness in immature dogs is rarely due to CrCLR because young ligaments are often stronger than bone physes and fracture occurs first. CrCLR can occur in young dogs but the history usually includes severe trauma, such as vehicular trauma.

Even with 25 years of experience as a veterinary orthopedic surgeon, I would estimate that examination with the cranial drawer sign or tibial thrust allows me to diagnose CrCLR in only about 80% of the dogs that subsequently undergo surgery, even though virtually 100% of these dogs have visible cruciate damage at arthrotomy.

How Can Clinical Detection Be Improved?

Hindlimb Lameness. A diagnosis of CrCLR should be considered in any dog with hindlimb lameness until proven otherwise. This is due to the fact that a high percentage of hindlimb lameness in dogs is caused by CrCLR, especially in patients with recent or sudden development or worsening of hindlimb lameness.

Extension & Range of Motion. Dogs with CrCLR often show pain during extension of the hip: it is a common error to inadvertently extend the stifle while extending the hip, resulting in stifle pain misattributed as hip pain. On the other hand, many dogs with CrCLR are not overly painful during non-weight-bearing stifle range of motion or palpation, further complicating lameness localization.

Medial Buttress Sign. All veterinarians should learn and recognize the appearance of the medial buttress sign. Shortly after CrCLR, most, if not all patients, develop a distinct, firm swelling over the proximo-medial tibia in the region of insertion of the medial collateral ligament.
Canine Cranial Cruciate Disease  |  Today’s Veterinary Practice  |  17

(Figure 1). Palpation of a medial buttress over the proximal tibia of the affected leg:
* Is a reliable clinical sign of cruciate rupture  
* Occurs rapidly after ligament rupture in most dogs  
* Provides ample indication for surgical joint exploration even in the absence of a cranial drawer sign.

This swelling can be best detected by simultaneously palpating the medial tibial plateau of both hindlimbs, comparing the swelling of the lame limb to lack of swelling in the normal limb. My preference is to position myself at the caudal aspect of a standing dog, with my hands simultaneously wrapped around from the cranial to the medial aspect of both hindlimbs (Figure 2).

In patients with suspected bilateral CrCLR, remain aware that a bilateral medial buttress will be present and must be considered during diagnosis.

What Role Does Radiography Play in Diagnosis?
On orthogonal stifle radiographs, the following findings are highly suggestive of CrCLR (Figure 3):
* Joint effusion (characterized by compression of infrapatellar fat pad)
* Peripatellar or peritrochlear osteophyte formation.

Either finding alone is sufficient indication for joint arthrocentesis, arthroscopy, or arthrotomy for further diagnosis and treatment.

Increasing severity of radiographic signs of OA is an even stronger indication for further diagnostic attention and treatment. Other less frequent causes of joint pathology, such as septic arthritis, distal femoral osteochondritis dissecans, or chronic fracture, can cause similar radiographic changes; however, their relative rarity and differing clinical histories make inadvertent surgery of these conditions unlikely.

Severity of OA is not of value in treatment determinations because OA scores are not related to kinetic gait parameters and lameness in dogs.

PATHOGENESIS OF CRANIAL CRUCIATE DISEASE
Are Certain Breeds Predisposed to CrCLR?
Our understanding of CrCLR remains a chicken-or-egg-first quandary. Recent information suggests that CrCLR disease is heritable as a recessive trait in certain breeds, such as Newfoundlands, in which there is an identified heritability index of 0.27.

Bilateral CrCLR is present at initial diagnosis in up to 30% of large breed dogs presented for CrCLR. Bilateral disease in small breeds is much less frequent than in large breed dogs.
How Does a Rupture Develop?
In small breed dogs, CrCLR is often associated with long-standing patella luxation or acute trauma. In large breed dogs, CrCLR occurs as 2 distinct disease types:
1. A small percentage of large breed dogs acutely develop CrCLR, with no preexisting evidence of OA and often during strenuous activity in which the cruciate rupture occurs as a result of hyperextension and/or excessive strain on the cranial cruciate ligament.
2. The majority of large breed dogs, however, have preexisting radiographic OA at the time of complete CrCLR, suggesting that an unknown etiology causes slow degeneration of the ligament before functional failure occurs.

What Are the Risk Factors for CrCLR?
Risk factors for increased prevalence of cranial cruciate ligament (CCL) injury include:
- Obesity
- Neutering

Degeneration of the CCL is associated with:
- Aging
- Excessively straight hindlimb conformation
- Immune-mediated arthropathies.

In some studies but not others, degeneration of the CCL has also been associated with:
- Increased tibial plateau angle (TPA)
- Excessive patellar ligament-plateau angle.

How Likely Is Rupture of the Contralateral CCL?
In 1 study, 48% of Labrador retrievers ruptured the contralateral CCL within a median time of 5.5 months. Therefore, it is prudent to warn owners of large breed dogs with unilateral CrCLR that these dogs have a high probability of contralateral CrCLR.

TPA is not a useful predictor of contralateral CrCLR in dogs with existing unilateral CrCLR. Consequently, any measures that decrease stress on the remaining intact ligaments are important therapy additions, including careful weight management of the patient and exercise restriction.

What Is the Focus of Current Research Efforts?
After CrCLR, there are:
- Increased matrix metalloproteinases and changes in proteinase location within the ligament and synovial membrane
- Histologic changes, including decreased typical fibroblasts and increased chondroid cells in the ruptured ligament core.

A great degree of research effort has been directed at understanding and comparing changes in the extracellular matrix of ruptured ligaments and cytokines in stifles affected by CrCLR versus intact ligaments, but few findings have been relevant to prevention or treatment of ligament rupture.

Findings of recent in-depth summaries on the pathogenesis of CCL disease and those of future studies may ultimately lead to better anti-inflammatory joint therapies and shed some light on disease progression and prevention. Surgical intervention after CrCLR will still be a necessary part of therapy for the foreseeable future.

State-of-the-art treatment considerations for CrCLR will be discussed in the second article in this series, *Canine Cranial Cruciate Disease: Updating Our Knowledge about Therapy & Prognosis.*

CCL = cranial cruciate ligament; CrCLR = cranial cruciate ligament rupture; OA = osteoarthritis; TPA = tibial plateau angle; TPLO = tibial plateau leveling osteotomy; TTA = tibial tuberosity advancement

References

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<td>Indications: COMFORTIS® fipronil is indicated for the prevention and treatment of flea infestations (Ctenocephalides felis), for flea control, on cats and kittens 12 weeks of age or older and two pounds of body weight or greater.</td>
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**Adverse Reactions:**

- In a 12-week clinical study, which included a total of 211 cats treated with COMFORTIS® 7.75 mg/kg treated with an active control arm once a month for three months, two adverse reactions were attributed to the administration of COMFORTIS®. The most frequently reported adverse reaction in cats was vomiting. Percentage of Cats (%) with Adverse Reactions

<table>
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<th>Month</th>
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<th>Month 3</th>
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<tr>
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<tr>
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<tr>
<td>Intensity</td>
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<tr>
<td>Severity</td>
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<tr>
<td>Duration</td>
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<td>2.4</td>
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- In a 3-month (33-week) study, vomiting occurred on the day of or after the first dose in 28.3% (277/981) of the cats treated with COMFORTIS® and in 2% (20/981) of the cats treated with an active control. Three of the 11 cats treated with COMFORTIS® vomited on the day of or after the first three doses, and two cats had vomiting in 7 days of COMFORTIS. The most frequent reported adverse reaction in cats was vomiting. Percentage of Cats (%) with Adverse Reactions

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<tr>
<td>Vomiting</td>
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