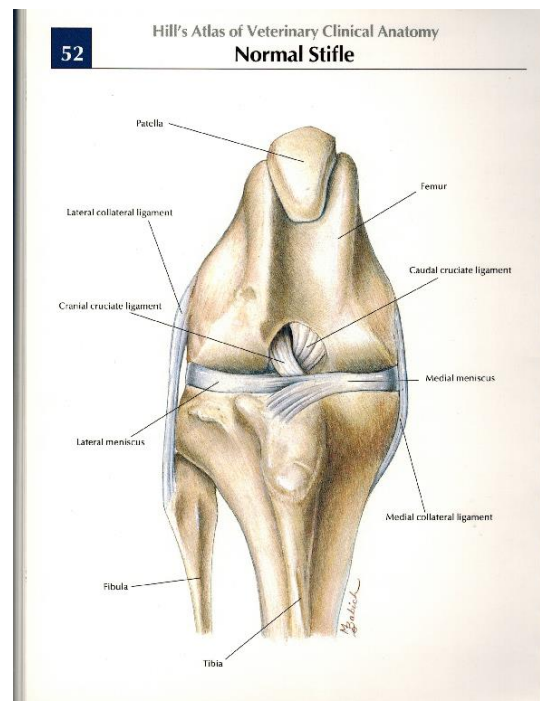
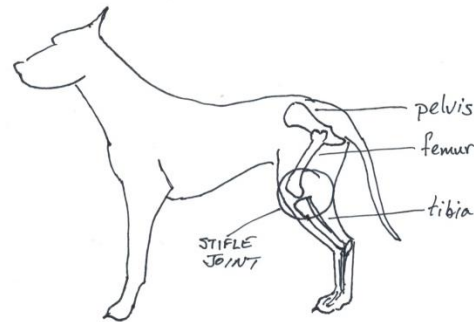


Cruciate Ligament Disease

The Cranial Cruciate Ligament

The cranial cruciate ligament (CrCL, aka anterior cruciate ligament or ACL) is one of several structures in the stifle (equivalent to our knee) that provide joint stability and allow normal function. The stifle is the joint formed by the femur, tibia and patella (“knee-cap”) and is a basic pulley system that allows the lower leg to swing in a backward and forward direction like a pendulum. Four ligaments prevent motion in other planes; two collateral ligaments that prevent side-to-side motion and two cruciate ligaments (because they cross each other) that prevent the tibia moving backward and forward independently of the femur. The cruciate ligaments also help limit internal and external rotation of the joint. The ability of the stifle to sustain motion in any of these directions means that one or more of these ligaments is damaged. Two other structures that help form the contact surface of the joint which are also very important are called the lateral and medial meniscus (plural: menisci).

The cruciate ligaments together provide rotational stability to the joint; ie they limit the internal and external rotation that is possible. They do this by locking against each other when excessive rotational force is applied to the joint. If the cranial cruciate ligament is damaged, this motion is not checked and internal rotation may occur. This finding is variable between dogs; some dogs have significant problems with rotational instability while others seem to have far less issues. This is generally determined during the gait exam.



The purpose of the CrCL is to prevent cranial tibial thrust – motion of the tibia in a forward and upward direction. **Rupture of the CrCL allows this motion to occur, which precipitates most of the problems that happen with cruciate disease.** This is a very important concept as it underpins the repair techniques used to correct this problem.



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How Do I Know If My Dog Has Cruciate Ligament Disease?

Only a veterinarian can diagnose cruciate disease by performing a proper orthopedic examination and obtaining x-rays. A number of signs can occur that suggest cruciate disease and any hind limb lameness that occurs in your dog should be evaluated. The vast majority of medium and large dogs presented for hind limb lameness do in fact have cruciate ligament disease. One retrospective study recently performed at a major university showed that of all large dogs presented for evaluation of hip problems 60% had hip problems, while 98% had cruciate ligament disease.

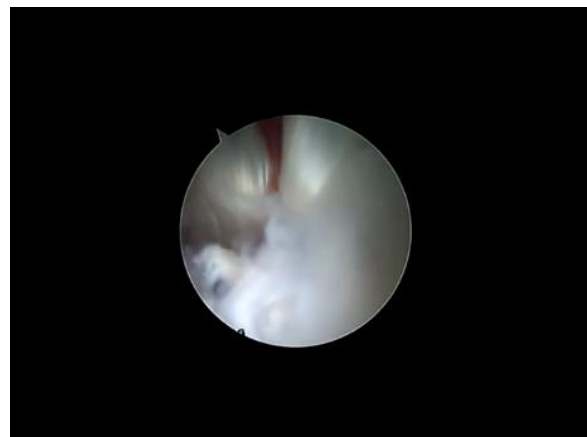
Cruciate ligament disease can occur in a dog of any breed and any age, but tends to occur in larger dogs. Unfortunately, this is often a bilateral disease; approximately 40% of dogs that have cruciate disease eventually have it in both legs. Some breeds of dogs are predisposed to bilateral disease: Labrador retrievers, Mastiffs, Newfoundlands and Bernese Mountain dogs are some examples. Concurrent orthopedic disease such as hip dysplasia and patellar luxation (dislocation of the “knee cap”) can occur and may contribute to the cruciate disease. It is important that these problems also be recognized and addressed.

When you present your dog to your veterinarian for a lameness problem, a complete orthopedic examination is usually appropriate to obtain a proper diagnosis. The lameness exam should include a gait evaluation, a complete physical examination including a detailed examination of all 4 legs with the dog awake, and a proper orthopedic examination. The orthopedic examination itself is a very detailed examination of all 4 limbs and all of the joints of

those limbs. This examination must be performed under sedation and includes a number of manipulations and physical tests to determine the full extent of any existing orthopedic problems. It is important to appreciate that the dog has 4 legs; **all limbs should be examined thoroughly!** Good quality, properly positioned radiographs of any affected limbs and joints are then obtained to assist diagnosis and plan appropriate treatment.

Cruciate Disease, Progression and Arthritis

Rupture of the CrCL can either occur acutely due to traumatic rupture or chronically by tearing slowly over time until complete mechanical failure occurs. We sometimes refer to these chronic cases as a “partial tear”. When chronic disease is present or a torn ligament goes unrepaired, arthritis begins to develop and other structures in the stifle can become damaged.



This dog has a partially torn CrCL. The tear is the disorganized tissue to the lower left. The caudal cruciate is visible in the background.

The meniscus can be torn resulting in significant pain and worsening of the lameness with an escalation in the rate at which the joint

degenerates and arthritis develops. Approximately 50-60% of dogs with cruciate disease have a damaged or torn meniscus at the time of surgery. Meniscal injuries are dealt with at the time of surgery. In dogs that have intact menisci at the time of surgery, approximately 5% will tear it at some later point.

The severity of disease and the rate at which it progresses is directly related to the weight of the dog – the heavier the dog the more severe and rapid the development of disease. **For this reason, rupture of the CrCL in dogs that are over 10 Kg healthy body weight requires surgical repair – period.** All dogs, including those under 10 Kg, will have a better outcome with surgical treatment. There is no way around this reality and failure to address this disease surgically will usually result in severe and rapid progression of disease.

In a large dog that has a ruptured cruciate, the dog is usually presented with a non- or partial weight bearing lameness that fails to resolve with time. If the injury goes undiagnosed or unattended, the dog may initially appear to get better over a period of approximately six weeks and the lameness may appear to nearly resolve. If the dog is receiving medical treatment during this time the lameness may appear to have been “cured”. It is often during this period that owners may conclude that surgical repair is not really necessary and may cancel surgery if it has already been booked.

Over the course of the next several months or years the lameness will usually slowly return and worsen until the dog stops bearing weight on the leg altogether. As cruciate disease is often bilateral (occurs in both limbs), and the unaffected limb is now bearing the weight of both legs, that CrCL may also rupture. At this point it becomes very difficult for the dog to walk and the animal is severely and obviously

lame on both hind limbs. It is advisable to repair a ruptured cruciate as soon as possible after positive diagnosis. The goal of surgery is to restore normal function and mitigate the development of arthritis. With timely management the dog can be expected to have a normal life expectancy with good function and normal quality of life afterwards, especially with some of the newer repair techniques in current use.



This dog has a recently ruptured cruciate. The joint shows no evidence of arthritis.



This dog has a ruptured cruciate that went untreated for 12 months. The joint is severely arthritic. This dog was non-weight-bearing on this leg at presentation.



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Medical Management

As mentioned previously, the vast majority of cases of CrCL rupture require surgical repair. However, medical management is necessary pending surgery, in the perioperative period (during recovery) **and for the rest of the dog's life after surgery**. It is important to understand that surgery is a very important event, but management of cruciate disease is life-long. No matter how good a job the surgeon does, it is important to understand that arthritis will develop over time. The goal of all therapy, including surgery, is to minimize the development of arthritis so that the dog can live a normal, healthy and pain-free existence. Simply investing in surgery and failing or refusing to follow instructions regarding long-term management will result in poor results and poor long-term outcome, often within months following surgery.

It is also important to understand that arthritis is not a disease. Hip dysplasia, cruciate ligament disease, elbow dysplasia, etc, are diseases. These diseases cause inflammation; arthritis is simply inflammation with the addition of time. As such, the goal of **all** of our therapies is to prevent or suppress inflammation, thereby preventing the development of arthritis. Attempting to treat arthritis is generally unproductive – at that point it is too late.

Medical management may consist of one or more of the following: NSAIDS, laser therapy, joint diet/dietary management, chondroprotectants, platelet-rich plasma, and stem cell therapy. Which therapies are chosen depends on the particulars of the case, the degree of arthritis present, the size of the dog and the client's preferences. **Ideally, our long-term goal for all**

of our patients after surgical repair is to manage them with chondroprotectants and joint diet alone. Understand that these long-term treatments are not optional – failure to comply with the specific diet and chondroprotectant regimen prescribed is likely to result in long term problems after surgery. Some patients may also require other treatments such as occasional laser therapy or medication to keep them functioning normally. A brief description of these therapies is listed below.



Weight, Diet and Cruciate Disease

In any patient with any orthopedic disease, the most important factor impacting the development of disease, prognosis and treatment is the weight of the patient. This is true with respect to the relative weight of the dog (St. Bernard v. Chihuahua) but especially with respect to obesity. **Regardless of the orthopedic condition, failure to recognize and address issues of diet and obesity will result in treatment failure, no matter how much is invested in treatment and surgery.** Some surgeons have a policy of declining to perform surgery until obesity issues are resolved due to the higher complication rate, increased difficulty in performing procedures and sometimes demonstrated failure of compliance on behalf of



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the client. Your veterinarian should provide specific dietary recommendations including not only a specific diet(s), strict feeding guidelines that include specific measuring instructions and complete diet counselling. Any complicating medical conditions such as hypothyroidism need to be diagnosed and treated.

Joint Diets – A prescription veterinary diet formulated specifically for addressing joint disease and arthritis in our patients. These diets are designed not only to deal with inflammation associated with joint disease but are excellent at addressing weight issues that will have the most impact on patient outcomes. Joint diets have had a major impact on how we manage joint disease over the past decade, and for many dogs on monotherapy have allowed us to replace drugs with food.

Therapuetants

Chondroprotectants - All dogs with any type of joint disease should be on chondroprotectants (glucosamine, with or without chondroitin) and this is usually prescribed and supplied in our hospital. Please note, glucosamine incorporated into dry dog food is not present in sufficient quantities to have a therapeutic effect – most of it is destroyed during processing as it breaks down under the high temperatures and pressures used to make dry kibble. It has to be added to the food after processing, usually as a top-dressing added at feeding time by the client.

NSAID's - All dogs presented for cruciate disease initially start on NSAID's as this is our primary means of immediately addressing pain and inflammation. While our other therapies are just as good at addressing these issues they all take a significant amount of time to start having an effect – drug therapy is immediate. Often we will withdraw the NSAID's if possible when

other therapies have had time to take effect. A number of options are available, including some newer products that have a reduced incidence of adverse effects.

Regenerative Therapies

Laser Therapy – Therapy lasers have become increasingly popular in small animal practice since they became widely available in the past 5 years. Laser therapy allows us to treat both acute injuries and chronic disease with often spectacular results. It is also extremely helpful for managing post-operative pain, inflammation and swelling and is included in our post-operative management for all orthopedic cases. This treatment has had a major impact on dramatically lowering our post-op complication rate for a variety of reasons. A separate hand-out regarding this therapy is available.



Stem Cell Therapy – We have performed stem cell therapy on a great number of our patients concurrent with surgery. This treatment is appropriate for cases where significant joint disease is already present at the time of diagnosis. It is especially important in managing cases that have other concurrent diseases such as hip or elbow dysplasia. Stem cell therapy for these cases has produced excellent results and in

many cases an obvious reduction in radiographic findings associated with osteoarthritis has been noted when follow-up x-rays were taken several months later. A separate hand-out regarding this therapy is available.



Stem cells being processed from fatty tissue.

Surgical Management of Cruciate Ligament Disease

There are a number of surgical techniques currently available for treatment of cruciate disease. The most common are divided into 2 major groups; extracapsular repair and geometry modifying techniques. It is important to understand that when appropriately selected, no one technique has been demonstrated to have an overall advantage over any other in the long term, though there are advantages and disadvantages of each. **There is no “gold standard” repair at this time.** It is imperative to select the most appropriate repair based on the specific details of each individual case. We currently offer Tight-rope®, Tibial Tuberosity Advancement (TTA) and Tibial Plateau Levelling Osteotomy (TPLO) in our hospital.

Extracapsular Repair

Extracapsular techniques rely on using very heavy suture materials to construct a restraint on the external surface of the joint to provide stability. Most of these repairs rely on formation of scar tissue and fibrosis of the joint capsule as the repair is expected to break down over time. The two currently most common are the lateral fabellar suture and Tight-rope®. A number of studies have now demonstrated that extracapsular techniques generally do not perform as well as geometry modifying techniques. We no longer provide extracapsular repairs as a primary stabilization in our hospital, regardless of patient size.

However, the current primary advantage of extracapsular repairs are their ability to provide rotational stability. In patients with identified significant rotational stability, we will implant a Tight-rope® in addition to a TPLO or occasionally a TTA.

Tight-rope® Details

Tight-rope® and several related procedures that involve various bone anchor techniques were developed to improve on the older lateral fabellar suture technique. They are based on isometric points determined through careful experimental studies to be the most stable anchor points for extracapsular joint stabilization. The points are very specific and the most challenging part of performing the procedure is locating these points in the patient. Newer modifications to the procedure have made it easier to locate them with high repeatability. Bone tunnels are drilled through which a heavy braided suture is passed and secured in place with titanium buttons. The suture physically restrains the joint and acts as a

scaffold for the formation of fibrous scar tissue and fibrosis of the surrounding joint capsule.

When performed correctly, these are excellent stabilization techniques. The recovery time is approximately 1-2 weeks to resume weight-bearing and 16 weeks to fully heal and come off exercise restriction. The complication rate is approximately equal to that of other extracapsular techniques. When performed as part of a combined stabilization with another technique, preference is given to the Tight-rope® with respect to post-op care.



Tight-rope® in a small dog

Geometry Modifying Techniques

A number of geometry modifying techniques have been developed over the years but two are currently in common use – TPLO (tibial plateau levelling osteotomy) and TTA (tibial tuberosity advancement). The manner in which these repairs work is quite complex but both involving cutting and repositioning parts of the tibia and plating them in place. They ultimately provide stability by eliminating tibial thrust. These repairs require much greater expertise to perform, have greater potential for serious complications and are generally more expensive. When properly performed these techniques provide excellent results and client satisfaction is very high.



TPLO

TTA

TPLO is an older technique that is probably the most commonly performed repair in North America. It functions by changing the angle of the tibial plateau to eliminate tibial thrust. TTA is the newest cruciate repair technique and eliminates tibial thrust by moving the insertion point of the patellar tendon. A brief comparison of the two procedures is presented below. The data shown are generally accepted published results; the results in our practise are considerably better than these.

TTA and TPLO

	TTA	TPLO
Success Rate	85-95%	85-90%
Client Satisfaction	98%	93%
Complication Rate	17-23%	25-30%
Recovery Time	Immediate/ hours	Immediate/2-3 days
Healing Time	12 weeks	12 weeks

It is important to note that while the published complication rate for both procedures is relatively high, the vast majority of complications were minor and required little if any intervention. Complication rates in our practise for both procedures are in the single digits. Client satisfaction for both procedures is very high.



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TTA Details

TTA offers many specific advantages that make it a highly valuable repair option for many patients. The most attractive advantage to most of our clients is the rapid recovery time – most patients are fully weight bearing on the leg immediately after surgery (as soon as the epidural wears off –about 6 to 8 hours post-op). This can be especially important for large dogs, where it may be more physically difficult to assist the dog post-operatively. It is also extremely helpful for dogs that have multiple joint problems or bilateral cruciate disease and need to have a functional limb immediately post-op. TTA will help provide a small degree of rotational stability.

A TTA is performed by making a cut through the tibial tuberosity to reposition it in an outward and upward direction. A special implant called a cage helps maintain it in the correct position and a tension band plate secures it in place. This is an extremely precise and meticulous technique where correct placement to the millimeter is necessary. For technical reasons, all of the implants and screws are made of titanium. The resulting triangular gap is filled with bone graft to accelerate healing. The incisions are closed and the leg is bandaged.

TPLO Details

TPLO is a well-proven and valuable repair method commonly performed in many referral centres. When properly performed it results in elimination of tibial thrust by rotating (“levelling”) the tibial plateau. For some dogs that have very high tibial plateau angles, TPLO is the only appropriate repair method. The cut-off for TTA and tight-rope is a tibial plateau

angle greater than 30 degrees. We suspect that dogs with slopes greater than 27 degrees probably experience more benefit in the long-term from TPLO than other techniques. Newer implant designs in recent years such as locking screws and pre-stressed/precontoured plates have eliminated a lot of potential complications. One disadvantage of TPLO is that it does not account for rotational instability and can actually make it worse (a complication called pivot shift).

A TPLO is performed by making a circular cut through the back of the tibia and rotating the resulting segment by a predetermined amount to result in a tibial plateau angle of about 5.5 degrees. The bone segment is held in that position by a special plate where it heals permanently. In our hospital the site is treated with PRP to accelerate healing and mitigate post-op pain. The incisions are closed and the leg is bandaged.

Which Repair is Best For My Dog?

The choice of repair is tailored to fit the specific needs of each individual patient. All of the available treatments have different advantages and disadvantages. The patient’s tibial plateau is a major factor but many other criteria also play a role in selecting a repair. These criteria include the presence of caudal femoral subluxation, the individual anatomy of the tibia, size/weight, concurrent orthopaedic disease, and many other individual patient factors. The surgeon will take all of these various factors and offer a repair that is most likely to result in the best outcome for that patient.

For patients with significant rotational instability (about 15-20%), a recommendation to perform a combined approach may be necessary.

This will involve a Tight-rope® being implanted after first performing a stabilization with either TPLO or TTA. There is slightly more cost involved when this technique is necessary and the post-operative care is different than with TTA or TPLO alone. This is discussed in more detail with clients on a case-by-case basis.

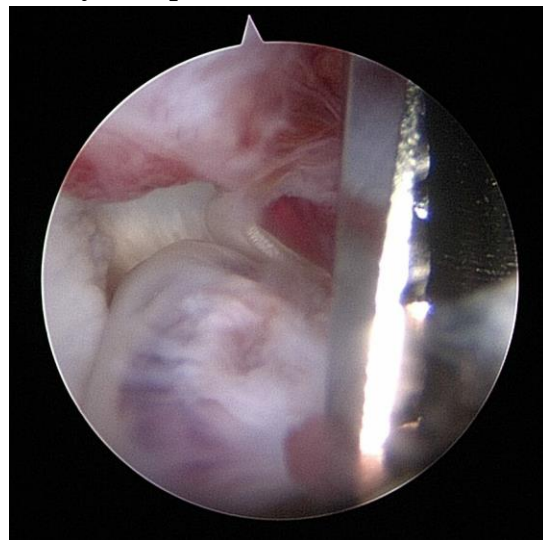
Small dogs and cats get TPLO's regardless of plateau angle (which is usually excessive in any case) due to the technical difficulties of performing TTA accurately in very small patients. They are otherwise treated in the same manner as a larger patient would be. This includes arthroscopic joint treatment in all cases. These patients generally do extremely well; our standard of care does not have a size limit!

Arthroscopy – Addressing the Joint

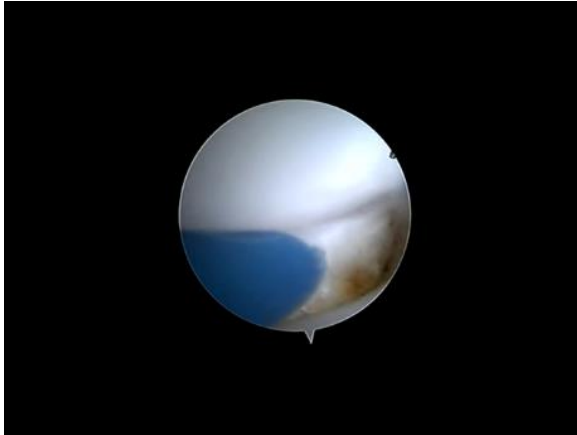
Stabilization of the joint with Tight-rope®, TTA or TPLO is important but is only half the procedure – the joint itself must be addressed and tissues inspected for damage and removed or debrided if necessary. Addressing the joint is a major part of proper surgical management and should be performed in every single case. This is most commonly done by open arthrotomy; the joint is incised and opened up so that the surgeon can physically inspect and operate on the joint with standard surgical instruments. While this approach will adequately address the joint if performed properly, it is highly invasive and traumatic. It also will not result in as complete or precise a debridement of damaged tissues. The best approach for performing this procedure is arthroscopically.

An arthroscope is both a camera and a magnifying glass – up to 20X magnification.

Arthroscopy is performed through 3 or 4 very small holes through which both the scope and miniaturized surgical instruments are passed into the joint. The entire joint is visually inspected and the damaged cruciate ligament is very carefully debrided or removed. Both menisci are also inspected for tears and other damage and treated if necessary. We are also able to perform these procedures far more accurately and precisely than by open arthrotomy. Many lesions not visible to the naked eye are very easily visualized and treated with this minimally invasive approach. Unfortunately, routine arthroscopic treatment of the joint during cruciate repair procedures is rarely performed in the majority of referral centres. **As part of our commitment to provide the highest possible standard of care to our patients, we have invested the necessary resources so that every patient undergoing cruciate surgery in our facility is scoped.**



Ruptured cruciate being arthroscopically debrided with a 3.0mm motorized shaver.



Torn meniscus being arthroscopically debrided with a radiofrequency ablation probe.

Post-Operative Care

Client compliance with post-operative care is extremely important – **failure to meticulously follow instructions can, and usually does result in severe complications and treatment failure.** It is our preference whenever possible to provide complete and comprehensive case management for the entire post-op period. In our practise, we perform laser therapy during the first two weeks post-op to aid with recovery and pain management. Other pain management such as NSAIDs, opioids (codeine), bandaging, etc, are provided as is a short course of antibiotics. Physiotherapy is a crucial component of post-op management and is initiated immediately. Physiotherapy instructions are given at discharge and include passive range-of-motion exercises and controlled leash walks. Other than prescribed physiotherapy, absolute exercise restriction is necessary and off-leash activity is strictly forbidden. Unrestricted access to flights of stairs in the house is to be avoided, however going up and down exterior stairs to get in or out of the house is permissible (on-leash only!).

Sutures are removed after 14 days and post-op x-rays are taken at 6 weeks. If post-op x-rays are within expectations, owners are instructed to continue with prescribed treatment and physiotherapy until 12 weeks post-op, at which point normal activity may be resumed. For dogs with bilateral cruciate disease, the second surgery can be booked at 6 weeks post-op if the x-rays show sufficient healing. Our long-term goal for our patients is maintenance with glucosamine, joint diet and if necessary annual laser treatments. Patients with more advanced disease at surgery may require more aggressive treatment for arthritis in the long term.



Failure to follow instructions! The photo on the left is immediately post-op. The photo on the right is 6 weeks later – note the severely fractured tibial tuberosity. The owner did not follow instructions with regard to exercise restriction.



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Cost

The cost of these procedures is as follows:

Orthopedic exam: \$450 + HST

(includes consult, sedation and whatever xrays are necessary)

Cruciate Surgeries:

(includes laser therapy sessions, all routine post-op medications, suture removal, rechecks, etc)

TTA or TPLO \$3000 + HST

Tight-rope® with TPLO or TTA \$3500 + HST

Note that 6-week post-op xrays are **not** included in the cost of surgery: \$50 + HST (sedation not included if necessary, usually xrays can be obtained without).

****A non-refundable deposit of \$250.00 is due at the time of booking any orthopedic work-up and/or surgery.****