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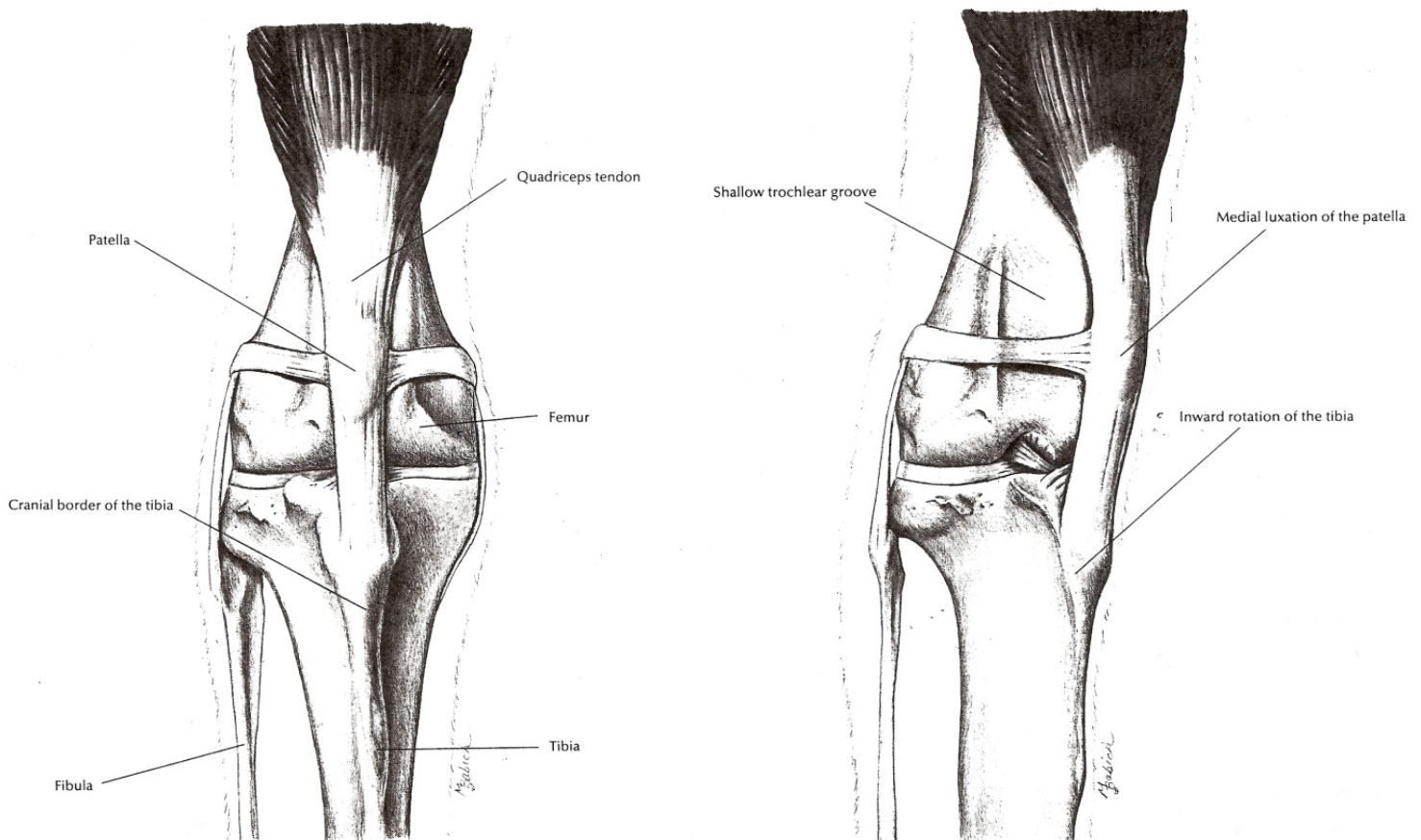
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Patellar Luxation

This information is provided to help you understand the condition that has been diagnosed in your pet. We find that many of the details that come up during the office visit can be overwhelming. By reading this at your leisure, we hope you will better understand the problem and be aware of how it might affect your pet, treatment alternatives, the care you will need to provide during recovery, and the expected prognosis. Please feel free to ask one of our VSRP team members if what is presented here is not clear.

Anatomy, Function, and Dysfunction



What is the patella and where is it found? The patella is also known as the knee cap. It is a large sesamoid bone that normally can be found within a groove, called the trochlear groove, at the lower end of the thigh bone, or femur, where it makes up a part of the knee, also called the stifle joint. A stout, broad tendon attaches the quadriceps muscle group to the top end of the patella. The straight patellar ligament joins the bottom end of the patella to the tibial tuberosity below the stifle joint. The patella has hyaline cartilage on its deep face where it forms a true joint with the surface of trochlear groove of the femur. The patella has fibrocartilage “wings” on both sides that rest on raised ridges on either side of the trochlear groove; the medial (inner) and lateral (outer) trochlear ridges. Ligaments (femoropatellar ligaments) from either side of the femur run within the joint capsule of the stifle joint and attach to each of these wings to help stabilize the patella within the trochlear groove.

What does the patella do? The patella is very important to the function of the quadriceps muscle group and the stifle joint. The patella can be thought of as a modification within the quadriceps tendon that helps hold the tendon stable in its position over the front of the stifle joint. The patella facilitates gliding of the tendon as the stifle moves and provides for a change of direction so the tendon can attach to the tibial tuberosity below the stifle. By facilitating the function of the quadriceps muscle group, the patella helps with extension of the stifle, flexion of the hip and stabilization of the stifle joint. In short, not only is the patella an important structure, but it is also important that the patella be in its proper place in order for it to do its job effectively.

What is patellar luxation and why does it occur? To understand the abnormal, it is helpful to first know what normal structure and function are. In the normal hind limb, the structural anatomic center of the limb, which we will call “central axis” runs down the center of the femur, through the center of the trochlear groove in the stifle joint, and then down the center of the tibia. Functionally, the sum of all the ground reaction and weight-bearing forces, which we will call “force axis”, is directed principally through the quadriceps muscle group and runs through the center of the patella. In the normal limb, these two axes are concentric or lay on top of one another and, as a result, the patella is in the trochlear groove. There is no force driving these axes apart and the soft tissue structures that hold the patella within the trochlear groove do not have to work very hard to maintain patellar position and stability. In the normal growing puppy or kitten, the “force axis” is applied equally across all growth plates and the limb remains straight as it grows. In addition, the trochlear groove, which depends on the presence of the patella for normal development, goes on to form properly.

The word “luxation” means out of joint. Patella luxation means a knee cap that comes out of its normal position within the trochlear groove. Most commonly, patellar luxation occurs as the result of congenitally abnormal development and growth of the limb. The mechanism of this abnormal development is not well understood, but it is thought to begin as a subtle change in the conformation of the hip region. This leads to a small off-set in alignment between the “central axis” of the limb and the “force axis” of the limb. In the growing puppy or kitten, this small alignment mismatch then sets in motion a misguided cycle of events where the off-center forces apply uneven pressure to the growth plates of the developing long bones causing them to grow abnormally. As a result, undesirable changes in the shape of the limb begin to take place which cause the central axis to move even further from the force axis of the limb. As these axes drift apart, the soft tissues that have been working to hold them together reach a point where they can no longer keep the patella from leaving the trochlear groove. In essence, the trochlear groove has no choice but to stay with the central axis of the limb and the patella has no choice but to follow the force axis and the patella moves (luxates) out of the trochlear groove to where the quadriceps muscles pull it. In addition, if the patella begins to luxate at a young enough age, the trochlear groove may under-develop and be even less able to hold the patella reduced and stable. With the trochlear groove contributing less and less to the stability of the patella, and with the axes drifting further and further apart, even greater growth disturbance occurs and the process seems to perpetuate itself until the puppy or kitten finishes growing. How unstable the patella becomes and how poorly the trochlear groove develops, depend on when in the growth period this process begins and at what rate the changes take place.

Patellar luxation can occur to the inside (medial patellar luxation or MPL) or to the outside (lateral patellar luxation or LPL). Congenital patellar luxation occurs to the medial side more often in smaller and mid-size breeds of dog and laterally more often in large and giant breeds of dogs; however, there certainly are exceptions in either case. Congenital patellar luxation occurs less frequently in cats and can be either medial or lateral in direction. The patella can also luxate, in an otherwise normal limb, as the result of trauma. Forces applied to the stifle that tear the joint capsule and femoropatellar Ligament on one side can leave the patella with unbalanced support and lead to luxation in the direction of the remaining intact support.

What happens once the patella begins to luxate? With congenital luxation, once the patella becomes unstable, it remains so, moving out of and back into the trochlear groove repeatedly. With advancing degree of instability, the patella spends less and less time within the trochlear groove. With movement in and out of place, soft tissue supports become strained and cartilage damage begins to develop on the under surface of the patella and across the medial or

lateral trochlear ridge, depending on direction of luxation. These events lead to chronic inflammation, cartilage loss, sclerosis (hardening) and remodeling of subchondral bone, and the development of osteoarthritis. The affected stifle joint often becomes uncomfortable due to chronic inflammation and developing osteoarthritis. In addition, unlike cartilage, bone is supplied with sensory nerve endings. Once the cartilage is missing, continued movement of the patella over the trochlear ridge can cause discomfort in its own right. If the patella luxates laterally, it can disrupt the origin of the long digital extensor muscle tendon. When the patella luxates medially, strain on the cruciate ligament complex increases. Luxation in either direction leaves the stifle joint with less support and strain on all of the remaining supporting structures increases.

Patellar luxation is described not only by direction, but also by grade of severity using a scale of 0 to 4.

<u>Grade</u>	<u>Instability</u>
0	normal stifle with no patellar instability
I	usually or always in place but it can be luxated with pressure once the patella is out, it usually quickly reduces on its own
II	patella is out one minute and back in place the next spontaneously moving in and out of place
III	patella is out of place most of the time can be manually reduced, but once the limb returns to use it reluxates
IV	patella is always out of place and cannot be manually reduced

Traumatic patellar luxations are most often grade I or II. If the grade is higher, there may be an underlying congenital predisposition for luxation which was then initiated by the trauma. The purpose of this grading scale is to allow owners and veterinarians a means of describing the condition and talking about the treatment and prognosis. It is good to keep in mind that the grade of patellar luxation does not necessarily correlate with the degree of discomfort or disability the condition may be causing your pet.

Treatment and Prognosis

What can be/should be done to treat patellar luxation? Any discussion concerning treatment for this condition needs to start with a few realizations about congenital patellar luxation. Once the condition begins, it usually does not resolve on its own. However, some patients do not seem particularly bothered by the condition and it may even be discovered by your veterinarian as an incidental finding on a routine wellness physical examination. On the other hand, some patients are nearly incapacitated by the condition. Sometimes the clinical problem is very infrequent and subtle at first, causing only a very occasional and brief lameness, but then progresses with time. Conversely, some patients, initially bothered significantly by this condition, seem to regain comfortable use of their affected limb. This usually occurs as the result of becoming more “tolerant” of the abnormal patellar movement rather than the underlying instability actually resolving. Because of the wide variety of possible presentations and the biomechanical/anatomic complexity of the condition, whether to treat, and how, are decisions made on a case-by-case basis.

There are two general objectives of treatment; one is to address a current clinical concern and the other is to “invest” in the future health of the stifle joint. It is always more comfortable to elect surgery when your pet is lame and so most owners and veterinarians will consider surgery to treat a current clinical concern. The decision becomes more difficult when your pet does not seem particularly bothered by the condition at the time of diagnosis. In this situation, if surgery were considered, the reason would be entirely prophylactic and this then opens a philosophical debate. Some veterinary surgeons would argue that any joint surgery is not benign and the risk versus return would only be favorable if your pet were lame. Others, in their experience, might feel the chance of avoiding more serious problems in the future would warrant surgery at present. There is no simple “right or wrong” here and this is best left to a discussion with your family veterinarian and your surgeon.

If the decision is to pursue surgery, the objective, if not the process, is simple; to relocate and stabilize the patella within the trochlear groove. For congenital luxation, there are two general approaches that could be taken to do this; one is to re-direct the “force axis” (remember this from earlier?) and, in so doing, bring the patella to the trochlear groove; and the other is to re-orient the structural axis to bring the trochlear groove to the patella. The former approach is the more common; especially in smaller breeds of dogs and cats. By comparison, it is a less complicated approach and is usually less invasive and less costly. With this approach, we accept the abnormal shape of the leg and move the quadriceps mechanism, the patella included, to align it with the trochlear groove. This approach most often (but not always) involves a tibial tuberosity transposition primarily and then a modification of the soft tissue supports to further stabilize the patella in its proper position. The latter approach is less often done and more controversial but possibly the better choice in select cases; usually larger breeds of dogs with either excessive femoral varus or valgus conformation. With this approach, the patella is relocated by, in effect, reversing some of the abnormal conformational change in the limb that allowed the patella to begin luxating in the first place. This approach always involves very careful planning and then a corrective osteotomy (bone cut) of the distal femur just above the stifle joint in order to straighten the femur. The re-aligned femur is then stabilized with a bone plate while it heals. With either approach, the shape, orientation, and depth of the trochlear groove are assessed. If it is suspected that the trochlear groove is not close enough to normal to hold the patella securely, a trochleoplasty may be needed to modify the width, depth, or orientation of the trochlear groove so it may receive and hold the relocated patella.

Traumatic luxations of the patella do not involve an inherent limb alignment issue and, as such, can sometimes heal without surgery given enough rest and time. However, some do not and even in those cases that do, the patella does not often re-stabilize efficiently allowing some irreversible joint surface damage to develop while the patella is still unstable. For these reasons, while conservative care is sometimes an option, surgery is the usual treatment of choice for this form of patellar luxation. With traumatic luxation of the patella, realignment of the quadriceps mechanism is not usually necessary nor is restoration of normal limb conformation or modification of the trochlea. Instead, the objectives are to rule out any congenital contributing factors, to inspect the joint for any concurrent occult damage, and to repair the joint capsule and femoropatellar ligament that were disrupted by the trauma.

Once the surgery is done, what care is needed? During the post-operative period, we become concerned with the healing process of two types of tissues; bone and connective tissue structures. Muscle, subcutaneous tissue and skin all heal relatively quickly and would not require any considerations above and beyond those of bone and connective tissue. With either a tibial tuberosity transposition or a femoral osteotomy, we need to be sure to minimize activities that cause extreme strain such as jumping or hard starts, stops, or abrupt changes in direction that might disrupt the bone-metal implant relationship. We also need to minimize sustained cyclic strain as would result from repeated long walks or jogs that tends to fatigue metal implants causing them to bend or break. So, with these surgical procedures, we are very careful to seriously restrict activity, while the bone heals, for the first 4 to 8 weeks depending on the procedure and the size and age of the patient.

Connective tissues typically take longer to heal, remodel, and strengthen than bone does. So, with joint capsule imbrications and trochleoplasties we usually continue activity restriction, at a less strict level, for an additional 4 to 6 weeks beyond that required to heal bone. After this, if your pet is using his or her operated limb well, the patella is reduced and stable, the stifle joint is comfortable, and the range of motion is good, we begin a gradual increase in activity, to strengthen muscles, tendons, and ligaments, working back to “normal” over an additional 4 to 6 weeks.

Cats have a tendency to seek elevated areas and as such pose a particular concern during the post-operative period. With cats, it is important to prevent jumping by restricting activity to smaller areas with no elevated features. It is best to assess the environment and make any changes or arrangements necessary prior to surgery.

Your pet may or may not have a bandage in place following surgery. Use of a full limb bandage, and for how long, will be up to the discretion of your surgeon; but rest assured, if your pet has a bandage, careful thought was involved in the decision and its use is no doubt important to avoid complications or suboptimal results or both. Therefore, it will be

very important to care for the bandage properly and return for follow-up visits as requested. If your pet has a bandage, your discharge instructions will contain bandage monitoring and care information. The number, nature, and timing of follow-up visits will vary depending on what was done, prior progress, and patient factors as well. With some certainty, your pet will need to return 10 to 12 days following surgery for suture removal and possibly bandage removal or change. Depending on your surgeon's wishes, you may also have the option of scheduling this appointment with your family veterinarian. At the discretion of your surgeon, we may wish for you to return for a brief recheck about 3 weeks following surgery. Regardless of this 3 week visit, we will want to recheck your pet 6-8 weeks following surgery and this visit may or may not involve radiographs as well. We may wish to see your pet one last time anywhere between 12 and 16 weeks following surgery; again, depending on procedure, patient factors, and prior progress.

What is the prognosis and what are the risks? Patellar luxation is a biomechanically and anatomically complex problem. Considerable thought and careful attention to detail are always necessary when treating this condition. Close post-operative monitoring is a necessity and the need for revision surgery always a possibility. Even with all of this, however, the overall prognosis for patients with patellar luxation is generally good. Some potential complications generally associated with anesthesia and surgery and some associated with patellar luxation surgery more specifically deserve mention.

Whenever we consider giving general anesthesia, we listen closely to medical histories, carefully review any provided medical records, do detailed physical exams, and perform pre-operative screening blood tests and possibly radiographs all to identify and control anesthetic risk factors. Even with these measures, anesthesia remains a small, but known risk. For this reason, we use the safest general anesthetics available including Isoflurane and Sevoflurane. Our technical staff is highly experienced and well trained in the administration and monitoring of all types of sedation and general anesthesia. Your pet is carefully monitored by a formally trained and experienced licensed technician during anesthesia and is not left unattended the evening following their procedure. We have devised standard operating protocols with efficiency as a priority so your pet spends as little time under general anesthesia as possible.

Even with today's operating room technology and protocols, post-operative infection remains a small, but present risk occurring in about 1% of hospitalized veterinary surgical patients. It is very important that you give all post-operative medications as directed. As one of these medications, we routinely send patients home with a peri-operative course of antibiotics to help guard against infection. It is also important to watch your pet closely to be sure he or she does not chew or lick at the incision. Indications of a possible post-operative infection may include lethargy, loss of appetite, excessive swelling, redness, or discharge from the incision. It is important to contact us or your family veterinarian if you suspect an infection is present.

Patellar luxation surgery is an orthopedic procedure and, as with any such procedure, the possibility of implant (pins, screws, plates, and suture) failure cannot be eliminated. However, with proper selection and placement of the implants and strict adherence to post-operative instructions, we can minimize this group of risks. With the possible surgical options we use to manage patellar instability, tibial tuberosity transposition seems to carry the greatest risk of implant-associated complications; especially when needed for larger dogs. Most often, the tibial tuberosity is stabilized with pins while it heals. The tibial tuberosity is not a very large structure. The pins used to stabilize the tuberosity are sized properly for the bone, but are under-sized for the patient and the forces placed upon them. As a result, we see these pins bend and break on occasion and additional surgery may be necessary to manage this issue. We can minimize this concern with very strict adherence to post-operative instructions. Even if the pins do not fail, they can back out or "migrate" during the healing process or any time thereafter. While this is rare, it does happen enough to deserve mention and if it happens before bone healing is complete, the surgery may need to be revised. If it happens after the bone heals, the pins may need to be removed if they are a source of discomfort or dysfunction.

Unique to patellar luxation surgery, it is possible to either under-correct or over-correct the patellar instability resulting in ongoing instability in the original direction or instability in the opposite direction instead. When attempting to decide what to move and how far, your surgeon has to try and predict the dynamic aspects of the condition under static,

artificial circumstances with your pet on their back or side and with the limb out of use and relaxed due to anesthesia. This part of the procedure is more “art” than actual “science” and is largely based on experience and an element of educated guess work. Because of this, although rarely necessary, there is always the possible need for surgical revision. In general, we tend to follow patellar luxation surgery patients closely during the early post-operative period, before extensive healing has taken place, in order to detect those that have ongoing instability and may be in need of revision.

Traumatic patellar luxation prognosis following surgery is predictably good provided there are no significant complications and care during the post-operative period.

Notes: