HOW DO I DO MEDIAL PATELLAR LUXATION (MPL) SURGERY?

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Introduction:
Patellar luxation is a common cause of hind limb dysfunction in dogs. It is far less common in cats. Although some cases are associated with trauma, the majority have no specific incident that triggers the problem and these cases tend to have an intermittent or sometimes chronic gait abnormality. Both medial and lateral patellar luxations can occur but medial luxation is much more common. Left untreated patellar luxation can lead to a chronic gait anomaly, lameness, patellar pain, osteoarthritis and cranial cruciate ligament rupture. A firm understanding of the anatomy and pathogenesis of patellar luxation is required before recommending treatment options to owners of affected dogs.

The purpose of this lecture is to give practical tips on how I manage medial patellar luxation in dogs and cats

Note: Patellar luxation results in a mechanical lameness and most cases require surgical treatment.

Anatomy:
The patella is an ossified portion of the quadriceps tendon (i.e. a sesamoid bone) and plays an important role in the extensor mechanism of the stifle. The extensor muscles consist of three heads of the quadriceps group (the vastus muscles), which originate from the proximal femur, and the fourth head, the rectus femoris muscle, which originates from the ilium. These four heads converge on the patella and continue distally to form the strong patellar ligament which inserts on the tibial tuberosity.
The patella rides within the trochlear groove of the femur. The trochlear groove is formed by the lateral and medial trochlear ridges which project from the cranial surface of the distal femur, and thus cradle the patella.
The vastus muscles insert onto the patella via well-developed fibrocartilagenous plates called the parapatellar cartilages. These articulate with the trochlear ridges and increase the surface area of contact, thus spreading the force of the quadriceps muscle. Thickening within the joint capsule and retinaculum form the relatively weak medial and lateral femoro-patellar ligaments, which give further stability to the patella.

Medial patellar Luxation:
Medial patellar luxation (MPL) is most frequently associated with deformities in the entire limb not just the stifle. Most commonly, we see hip joint subluxation, reduced femoral neck anteversion, lateral femoral torsion, distal femoral bowing, medial tibial torsion, medial bowing of the proximal tibia and sometimes more distal changes in the hock and foot.

The exact aetiopathogenesis of MPL is not completely understood. Various authors have proposed that changes are initiated in the hips with reduced femoral head
anteversion (i.e. the femoral head is angled more caudally relative to the femoral diaphysis), which results in external rotation of the hip. This in turn requires internal rotation of the limb distally to place the foot in the normal position under the hip. Others have proposed that the chances are initiated at the foot, since the foot is the point of contact with the ground. In any case, this change in limb orientation places torsional forces on the developing bones, stretching of the lateral soft tissues of the stifle and places asymmetrical loads across active growth plates and epiphyses. Increased pressure on an area of growing cartilage slows growth whereas decreased pressure increases growth. The altered pull of the quadriceps results in increased pressure on the growth plates of the medial aspect of the distal femur resulting in hypoplasia of the medial femoral condyle, tilting of the growth plate with subsequent lateral bowing of the distal femoral shaft. The altered forces on the proximal tibia result in tilting of the proximal tibial growth plate and tibial plateau. The medially directed force exerted on the tibial tubercle by the displaced quadriceps results in torsion of the proximal tibia and medial displacement of the tibial crest.

**Note:** Patellar luxation in growing dogs is NOT just due to a shallow trochlear groove or weak femoropatellar ligaments. It is a dynamic problem involving the structure of the whole limb.

It is the presence of a stable patella and normal retropatellar pressure that is required to form a deep trochlear groove during growth. The groove grows around the patella if you like. With a medial shift in the orientation of the quadriceps group there is displacement of the patella. This results in poor development of the trochlear groove and the medial trochlear ridge and stretching of the lateral femoropatellar ligament. It should be remembered that this can be occurring from as early as 30 days of age.

**Warning:** Do not overlook a cranio-dorsal hip luxation as a cause of sudden onset medial patellar luxation in mature cats.

**Physical examination:**
Examination for patella luxation **MUST be carried out whilst the dog is conscious** and standing. It is extremely difficult to assess the degree of tibial crest rotation and in some cases, if the patella is even luxating, in the anaesthetised animal. Normal tone within the quadriceps group must be maintained during the examination as this is integral to the problem.

The whole limb is examined as it is important to assess the relative positions of the quadriceps, patella, patellar ligament, trochlear groove, and tibial crest. The depth of the patella should be assessed, although this is sometimes difficult. The presence of patellar pain should be noted. Check for a cranial draw sign and increased internal tibial rotation. CrCL rupture occurs in approx 25% of cases of MPL.

**Tip:** Stand the dog and place the hindlimbs in their normal position, assess patellar position. Place your hand under the pelvis and lift the hind limbs off the ground, then lower them back to the ground again, reassess patella position. Repeat again. By loading and unloading the quadriceps like this you will often detect a patellar shift or “snap”.

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A complex grading system has been assigned to MPL but I like to keep things simple based on clinical signs and palpation findings.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Clinical findings</th>
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<tbody>
<tr>
<td>1</td>
<td>The patella can be completely luxated manually but it immediately returns to its normal position when released. There is only a mild or intermittent lameness, if any, or the dog may skip occasionally.</td>
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<tr>
<td>2</td>
<td>The patella is located within its groove but can be manually luxated. However it only returns to its normal position with manipulation of the limb by the examiner. Luxate the patella then allow the dog to run around. Reassess, the patella should have relocated itself.</td>
</tr>
<tr>
<td>3</td>
<td>The patella is found to be luxated and remains luxated with stifle manipulation. The patella can be manually repositioned into its groove but it immediately reluaxes itself.</td>
</tr>
<tr>
<td>4</td>
<td>The patella is permanently luxated and cannot be manually manipulated back into its groove</td>
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**Surgical treatment:**
Patella luxation can be treated medically or surgically however nearly all cases will benefit from surgical intervention. Conservative treatment, if used, is only appropriate for Grade 1 luxations in skeletally mature dogs. However, surgery may still be indicated in some of these individuals if lameness is frequently identified and limiting normal activities.

The other important point to remember is that MPL is a dynamic process and affected individuals who present at a young age, say at the time of their first vaccination, MUST be treated early, as they may be a whole lot worse by the time growth has finished. In these cases, it is often possible to minimize secondary bone deformities by placing an anti-rotational PDS suture from the lateral fabella to the patellar ligament (similar to an extra-capsular cruciate repair). This suture will almost certainly break eventually but if the pull of the quadriceps can be corrected early then the secondary effects of abnormal pressure on active growth plates and cartilage can be avoided or at least minimized. This is one of the rare situations in which I will use anti-rotational sutures in MPL treatment. Similar success has been reported by lateralizing the tibial crest in patients less than 60 days of age; however I tend not to use this method to avoid the potential risk of interfering with normal tibial crest growth plate function.

Many techniques have been prescribed for the surgical treatment of MPL and each case must be carefully assessed to determine which procedure is indicated. The correction of bone deformities and alignment of the quadriceps mechanism with the trochlear groove is paramount. Reliance on soft tissue techniques alone to overcome the effects of boney deformities is a frequent cause of failure. Probably the most important technique of all is transposition of the tibial crest. I do this in nearly all cases (the exception is the immature puppy cited above).
Soft tissue reconstructive techniques:
The lateral retinaculum and joint capsule becomes stretched over time so that when the patella is reduced there is redundant soft tissue present medially and lack of tension on the patella. Various over-lapping techniques (e.g. singlet-over-stubbies (NZ), vest-over-pants (Oz)) have been described however I don’t use these as they create an unnatural ugly thickening of tissue over the patella and I find them unnecessary. I prefer to excise the redundant tissue and suture the two edges together. The amount excised should be just enough to allow slight tension on the patella. The area I pay most attention to is the thickening within the joint capsule, the lateral femoro-patellar ligament. This must be trimmed to the correct length and carefully sutured together with cruciate pattern sutures of PDS. The joint capsule in close association with the patella is also carefully sutured; more distally along the patella ligament the joint capsule has very little strength and a continuous pattern can be used here. The overlying fascia is trimmed in a similar way and apposed with a continuous pattern suture.

Medial release is required in chronic cases where the medial soft tissues have contracted down with time and prevent patella reduction. The incision starts distally at the level of the tibial plateau and extends proximally to separate between the vastus medialis and the caudal belly of the sartorius muscle. In severe cases, it is necessary to extend proximally along the medial side of the vastus to the proximal femur. I use blunt dissection with my finger to release these proximal soft tissues.

Once the medial soft tissues are released and the patella is relocated, a large gap is left within the medial retinaculum. Some surgeons leave this area open however; I find the patella will sometimes tip slightly without any soft tissue tension on its medial side. Also, the large gaping hole left in the soft tissues can result in seroma formation. Besides, “the closure of dead space” is one of the tenants of surgery. I free up the distal edge of the caudal Sartorius muscle and transpose this to patch the gap. Again, like lateral imbrication, only slight tension is desirable when suturing. It’s a delicate balancing act!

Tip: The most common error in MPL repair is the reliance on soft tissue techniques alone to realign the quadriceps mechanism. These techniques will invariably fail as the soft tissues are not strong enough. They will eventually stretch and the patella will re-luxate again.

Tibial crest transposition techniques:
Lateral transposition of the tibial crest is the mainstay of medial patellar luxation surgery. Classically the tibial crest is cut as a transverse osteotomy and rongeurs are used to shape the lateral corner of the osteotomy to create a flat bed for the laterally repositioned crest. However, by doing this, a twist is induced in the patellar ligament fibres which results in uneven loading through the patellar ligament. Also, when a larger lateral transposition is required, the tibial crest is moved further around the lateral side of the proximal tibia. This induces internal tibial rotation and internal foot rotation. In addition, the more caudal positioning of the tibial crest increases retro-patellar forces and may enhance patellar pain or hasten degenerative changes within the patellar articular surface.
For these reasons I use the **tibial crest cranialisation technique**. In this technique an oblique tibial crest osteotomy is made, that is, an osteotomy angled obliquely from a caudo-medial to cranio-lateral direction. Lateralisation of the crest segment results in simultaneous advancement of the patellar ligament thereby reducing retropatellar forces. Also, no twist is induced in the fibres of the patellar ligament. Stabilisation of the transposed tibial crest is similar to the tradition technique with k-wires. The crest is advanced and lateralized and when the desired amount of correction is achieved a K-wire is driven *alongside* the medial edge of the segment. This is a temporary means of fixation so that patellar stability can be assessed.

**Goal:** My aim is to have the patella positioned correctly in the groove and remain there throughout a full range of motion whilst applying some tibial internal rotation, **BEFORE** I close the lateral soft tissues.

The tibial crest is then fixed in its desired position; the pin or pins (depending on the size of the dog) are position proximally at the level of the tibial tuberosity (i.e. the patellar ligament enthesis) and directed slightly caudally and medially. Pins are inserted by hand using a Jacobs chuck to avoid thermal necrosis associated with high-speed power insertion. If you do choose power-drive then use slow-speed a lot of irrigation as this is very hard bone in mature patients.

**Tip:** The K-wires are never cut until the stability of the patella is assessed.

I have applied experience gained from performing the Triple Tibial Osteotomy (TTO) technique in cruciate surgery in determining the most appropriate length of the tibial crest osteotomy for optimal stabilisation of the crest segment in MPL surgery. I use the length of the patellar ligament as a guide to how long to make the tibial osteotomy. The distal end of the tibial crest osteotomy is terminated just caudal to the cranial cortex of the tibia; the cranial cortex is left intact to act as an endogenous tension band. Creating a long tibial crest like this allows maximum lateralisation of the tibial crest segment with less risk of fracture distally. Also, should a fracture occur intra-operatively or post-operatively, experience with the TTO technique has shown that the soft tissue attachment to this long tibial crest segment is sufficient to prevent proximal migration (or avulsion) of the tibial crest. So it is rare for me these days to place a wire tension band to the distal tibial crest.

**Tip:** Measure the patellar ligament length on the pre-operative radiograph. Make the tibial crest osteotomy a similar lengthy to the straight patellar terminating just caudal to the cranial tibial cortex.
Methods to deepen the trochlear groove:
The other aspect to consider is the depth and the orientation of the trochlear groove. The normal trochlear groove has a depth of about 50% of the height of the patella. It is orientated in a slight proximo-lateral to disto-medial direction. A trochlear groove would be considered shallow if its depth is less than 50% the height of the patella or where there is erosion of the proximal aspect of the medial trochlear ridge. The objective, when considering a trochlear groove deepening technique, is to achieve adequate trochlear depth and width whist optimising preservation of hyaline articular cartilage.

Historically, the trochleoplasty technique, where the articular cartilage and subchondral bone were rasped to form a deeper sulcus was commonly used however, it did not preserve the important frictionless articular cartilage surface of the trochlea and has shown to result in severe patellar erosion in as soon as four weeks postoperatively. For this reason trochleoplasty has been largely surpassed by more modern cartilage sparing techniques and is no longer recommended.

Trochlear wedge recession (TWR) is probably the most common method used by general practitioners these days to deepen the trochlear groove. It basically involves removal of a V-shaped wedge of bone and cartilage from the trochlear sulcus, removal of underlying bone, followed by replacing the original wedge in a recessed position. This is a relatively simple technique and is a great improvement on the trochleoplasty technique of the past but it has some shortcomings:
1. Although there is preservation of some cartilage, there is still exposure of bone along the proximal, distal, and abaxial margins of the wedge. As the depth of the resection increases, exposure of subchondral bone increases proportionately. This is undesirable due to the reasons mention above under trochleoplasty.
2. The wedge resection narrows proximally and comes to a point at its proximal end and so the sulcus is still shallow in this area. This “lead-in” area of the trochlear groove is very important in guiding the patella into the trochlear groove as the stifle is flexed from an extended position.
3. The wedge is held in position by retro-patellar forces, which are variable, and an unsecured wedge is at risk of migration and may dislodge from the trochlear recipient bed.
4. Finally, the wedge cannot be easily transposed proximally, in cases of Patella Alta, or reoriented more in line with the sagittal plane, in cases of genu varum.

Trochlear block recession (TBR) or rectangular recession sulcoplasty is my treatment of choice for deepening the trochlear groove as it preserves maximal amounts of articular cartilage and addresses the weaknesses of the TWR listed above. It is perhaps slightly more technically difficult than the TWR but worth learning.

The main advantages of the TBR I see is that it results in a deeper sulcus proximally, which provides better biomechanical stability to the patella when the stifle is in an extended position. It is in the extended position that the patella is most vulnerable to luxation. Also the block may be easily transposed proximally to improve patella stability in dogs with very straight hind limb conformation (hyper-extended stifles) or dogs with excessively long patellar ligaments (Patella Alta). I have modified the technique to address an obliquely orientated sulcus (in conjunction with femoral varus deformity) by taking a wedge segment from the medial trochlear ridge adjacent
to the block, reorienting and repositioning the block within the recipient bed of the
wedge and then transposing the wedge to the lateral trochlear ridge to fill the gap.
Results have been very encouraging --paper to follow!

Trochlear block recession (TBR) technique:
The abaxial cuts of the TBR are performed with the same instruments you would use
for the TWR. A fine-toothed hobby saw or Exacto saw is perfect. However additional
instruments such as 4mm, 6mm, or 8mm wide, fine-tapered osteotomes and a small
mallet are required to remove the block. In some small toy breeds a #64 Beaver
blade is used instead of a saw or osteotome.
The abaxial margins of the block are scribed with a #11 blade. This minimizes
slipping and damaging the cartilage with the saw. The abaxial margins are position
wide enough apart to accommodate the patellar articular surface while maintaining
medial and lateral trochlear ridges. Each abaxial cut is made parallel but angles
approximately 5-10 degrees axially toward the sagittal plane. This results in slight
narrowing of the bed and ensures a snug press-fit within the recipient bed. The cuts
are extended from the proximal trans-trochlear margin within the suprapatellar region
to the distal trans-trochlear margin just proximal to the CaCL origin.

**Tip:** It is important to position the proximal trans-trochlear cut proximal to
the patello-femoral articulation to ensure preservation of proximal trochlear
cartilage.

**Tip:** The distal trans-trochlear cut should not damage the CaCL origin or
enter the intercondylar fossa.

The transverse cuts are made perpendicular to the trochlear sulcus to a depth of 1-2mm. To complete the rectangular graft, a straight basilar cut connecting proximal
and distal transverse cuts is performed. It is best to undermine the graft alternating
between proximal and distal ends to meet at the centre of the graft --be careful here,
you don't want to fracture the block!

**Tip** DO NOT attempt to release the block from the parent bone by levering
it up prior to completing the basilar cut. This will fracture it every time!

Wrap the resected block in a blood soaked swab. Prepare the recipient bed using a
beaver blade or a small osteotome depending on the size of the patient. Additional
trochlear depth is achieved by removing bone from the bed or from the basilar
surface of the resected block. Once trimmed to fit, the block is replaced within its
recipient bed and firmly pressed into place with any smooth handled instrument or
the back of a periosteal elevator. The small step created at the proximal end of the
block is contoured with a rongeur to make a smooth transition between bone and the
block articular surface.
Other techniques used in MPL treatment:

**Rectus femoris transposition**
In this technique the rectus femoris is transected from its pelvic origin with a small piece of attached bone, and then laterally transposed by tunneling under the vastus lateralis and reattaching it to the third trochanter of the proximal femur with wire suture. This redirects or lateralizes the pull of the quadriceps mechanism. It is indicated for use in very bow-legged dogs. I have only used it twice with good results but I found it a bit of a fiddle and use in preference the techniques described above.

**Corrective osteotomy of the femur**
Varus (medial bowing) of the femur is a contributing factor to MPL can be quite dramatic in some large breed dogs. Accurate anatomical radiographic assessment of the distal femur is needed to measure the angulation. If the distal femur has a varus deviation of greater than 10 degrees then a varus corrective osteotomy may be needed. This can be quite challenging surgery as trying to realign a 3-D deformity by using calculations made from a 2-D radiograph can be difficult. In most cases of these I tend to re-orientate the block rather than correct the distal femoral angulation as it is much more expedient, easier to do and requires no implants.

**Corrective tibial osteotomy**
Valgus deformity of the proximal tibia may require corrective osteotomy using a medial closing wedge ostectomy. This is typically only needed in extreme cases in individuals who have growth deformity and MPL as young puppies.

**Patellectomy**
Patellectomy is a reasonable treatment option in cases where there is significant patellar pain. Returning a painful patella to its sulcus may in fact increase patellar pain and limb dysfunction and so checking for the presence of patellar pain is an important part of the clinical examination. Having said that, patellectomy is a relatively rare procedure in my experience – I have performed it only once in my career and that was in a bull dog with painful retro-patellar chondromalacia. Limb function following patellectomy was surprisingly good.