Canine patellar luxation part 2: treatments and outcomes

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ABSTRACT

The most important decision in cases of canine patellar luxation is whether surgical stabilisation is required. Surgical treatment is generally not recommended for asymptomatic cases. For clinically affected cases, conservative management is unlikely to result in significant improvement and surgical therapy is indicated.

Corrective surgical techniques focus on realignment of the quadriceps mechanism and stabilisation of the patella in the trochlea. Cases treated with tibial tuberosity transposition and femoral trochleoplasty have been associated with lower risks of patellar reluxation and major complications, and the use of these techniques should be considered in all developmental cases.

In cases where significant skeletal deformities have been identified preoperatively, or in cases that fail to respond to conventional surgical techniques, more advanced imaging and surgery may be required.

As discussed in part one (*VT*46.09), while patellar luxation (PL) is a common condition, not all cases require surgical intervention. Of those needing stabilisation, deciding which deformities require correction to achieve a comfortable and functional outcome is not always straightforward.

Corrective surgical techniques used in the management of clinically affected cases focus on realignment of the quadriceps mechanism and stabilisation of the patella in the trochlea.

The results of surgical correction vary with the severity of the anatomic abnormalities present, but if appropriate decision-making is employed, for the majority of cases, the outcome should be favourable.

Treatment

Decision-making

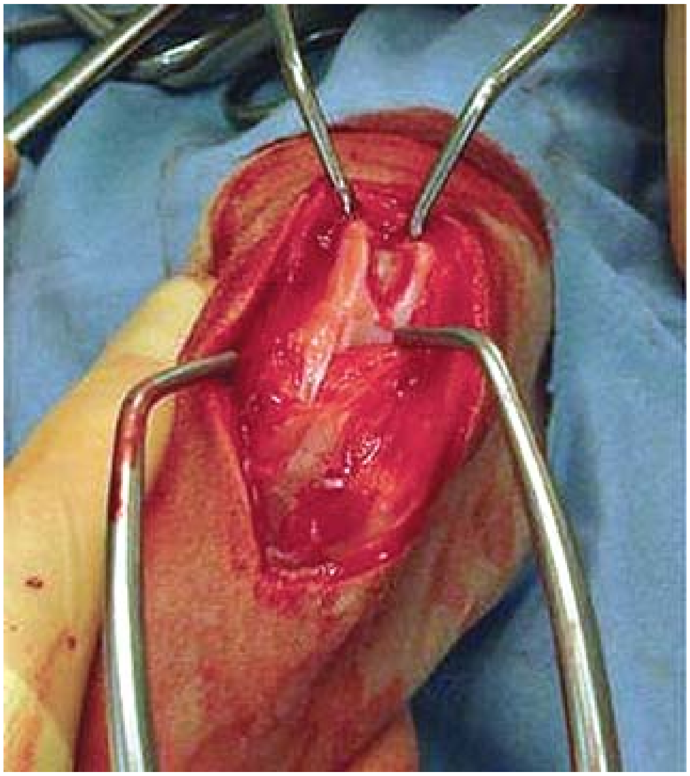

Figure 1. Intraoperative photograph demonstrating a trochlear wedge recession in a four-year-old cavalier King Charles spaniel.

While selection of conservative or surgical management may appear straightforward, decision-making with PL cases can become challenging. The decision to opt for conservative or surgical management should not be based on the presence or grade of the luxation, but on the global clinical picture, including the presence of pain, the type and duration of lameness and the clinical function of the limb.

A retrospective evaluation of dogs with bilateral medial patellar luxation (MPL) that underwent unilateral surgery documented a similar progression of degenerative joint disease (DJD) in operated and non-operated stifles (Roy et al, 1992) and, therefore, the argument to operate on non-clinically affected dogs in an effort to ameliorate DJD progression may not be appropriate.

Grade I cases with no associated clinical signs are typically managed conservatively. In the asymptomatic adult dog, surgical intervention is not recommended. As noted, no evidence exists that prophylactic surgery is beneficial (Roy et al, 1992) and should clinical signs become evident at a later stage, these dogs still respond well to late surgical stabilisation – even if the cranial cruciate ligament (CrCL) subsequently ruptures (Piermattei et al, 2006).

This issue is more contentious in immature asymptomatic animals; early surgical intervention may be more appropriate to prevent the development of subsequent severe limb deformities and contracture. This is especially true of large breed dogs, where intervention is recommended before the trochlea erodes and deforms (Piermattei et al, 2006). While the majority of small dogs with grade I luxation will never encounter lameness issues, large breed dogs are more likely to be clinically affected (Harasen, 2006).

In cases of grade II luxation, indications for surgery are based on the severity of clinical signs. Indications for surgical repair of a grade II luxation include significant episodes of lameness lasting two weeks to three weeks or longer and at least three significant episodes of lameness occurring over a short amount of time (three weeks to four weeks; Kowaleski et al, 2012).

Most cases of grade III or grade IV luxation require surgery early in the course of the disease to address the clinical signs and mitigate progression of skeletal deformities and DJD. Severe cases might already be associated with significant femoral varus or valgus and/or tibial deformity. In such cases, femoral osteotomy may be necessary instead of, or in addition to, other standard stabilisation techniques to achieve maintained reduction of the patella and realignment of the quadriceps mechanism (Piermattei et al, 2006; Roch and Gemmill, 2008).

However, do not lose sight of the clinical presentation and, despite severe anatomical abnormalities, some dogs with high-grade PL have good clinical function.

In their study, Gibbons et al (2006) reported two dogs with grade IV PL were managed conservatively because they were sound or only mildly lame.

As the grade of PL increases, the surgical complexity often increases, as do the complication rates and costs associated with surgical intervention. It is important the perceived improvement in function that can be achieved with surgery is weighed against the risks and costs associated with the procedure for each individual case.

Conservative management

Reasons for non-surgical management include owner reluctance to perform surgery and minimal, or absence of, lameness. Sound dogs with PL are likely to not benefit from surgical intervention since DJD is similarly progressive, despite the reduction of luxation (Roy et al, 1992).

As for many other orthopaedic conditions, the cornerstones of conservative management of PL are weight management, rest, anti-inflammatory therapy, exercise modification and physical rehabilitation. Limited data is available in the literature regarding the outcome of cases managed conservatively and further studies are warranted to evaluate the long-term outcome of these cases based on severity of lameness and grade of luxation on presentation.

In the authors' experience, in clinically affected cases, conservative management may reduce the frequency of clinical signs associated with PL, but is not likely to improve the grade of the luxation. A caveat to this may be in cases with severe muscle atrophy where rehabilitation may be of assistance.

Surgical options

Surgical treatment of PL can be subdivided into soft tissue reconstructive procedures that influence medial or lateral patellar support depending on the direction of the luxation and bone reconstruction procedures that improve alignment of the quadriceps mechanism (Gibbons et al, 2006; Remedios et al, 1992; Willaeur and Vasseur, 1987).

Soft tissue procedures

Soft tissue stabilisation techniques are generally not appropriate when used in isolation for developmental cases (Piermattei et al, 2006), as they do not correct the underlying skeletal deformities; a high rate of recurrence can, therefore, be anticipated. This may be appropriate in traumatic cases where no skeletal deformities are present.

Soft tissue balance can be achieved by release of contracted tissue in the direction of luxation and imbrication of lax tissue on the opposite side. Both the retinaculum and the joint capsule can be released (via a procedure called desmotomy) or imbricated depending on the direction of the luxation. The retinaculum of the stifle refers to various layers of fascia that help stabilise the patella.

Depending on each individual case, a combination of capsular/retinacular release on one side of the luxation and capsular/retinacular imbrication on the opposite side can be performed. For example, in the case of MPL, a medial desmotomy allows the release of contracted tissue that prevents the patella from returning into the trochlear groove. The joint capsule is typically left open. Medial desmotomy is often performed in conjunction with lateral imbrication. The joint capsule and fascial tissues can be tightened by a variety of aforementioned methods (Kowaleski et al, 2012).

Bone reconstruction procedures

The most common procedures to modify bone structures in the stifle are trochleoplasty techniques and tibial tuberosity transposition.

Trochleoplasties (or sulcoplasties) aim at deepening and widening the trochlear groove to contain the patella and prevent luxation.

Trochlear wedge recession (TWR) and trochlear block recession (TBR) are the two trochleoplasty techniques most commonly used in adult dogs. In the former, a V-shaped wedge of articular cartilage and subchondral bone is removed from the trochlea using a saw. The cut wedge is carefully displaced from the femoral trochlea and a further thin section of the exposed subchondral bone of the femoral sulcus is removed before the wedge is replaced in the recessed sulcus (**Figure 1**).

TBR follows the same principle, but instead of a V-shaped wedge, the piece of trochlea removed is rectangular. A cadaveric study performed on 24 stifles comparing TBR and TWR, using CT and biomechanical evaluation, showed TBR to be superior to TWR in terms of proximal patellar depth, patellar articular contact with the recessed proximal trochlea and size of the recessed trochlear surface. It also demonstrated TBR to result in a greater resistance to PL in an extended position when compared with TWR (Johnson et al, 2001).

In young dogs up to 10 months old, a trochlear chondroplasty can be used to recess the articular surface. A cartilage flap is carefully elevated, subchondral bone removed from beneath it and the flap pressed back into the deepened sulcus (Piermattei et al, 2006).

Abrasion trochleoplasty techniques have also been described. Since TWR and TBR allow the preservation of articular cartilage, these are less commonly used. However, in some severe cases of PL, where the articular cartilage has already been severely damaged, they may still play a role.

For all techniques, stability and depth of the trochlear recession achieved are assessed and adjusted until satisfactory. It has been suggested the femoral sulcus should be recessed sufficiently so 50% of the patella is seated in the trochlear ridges (Slocum and Devine, 1985).

Tibial tuberosity transposition (TTT) is an osteotomy technique that allows realignment of the quadriceps mechanism by repositioning the tibial tuberosity, the point of insertion of the patellar ligament on the tibia.

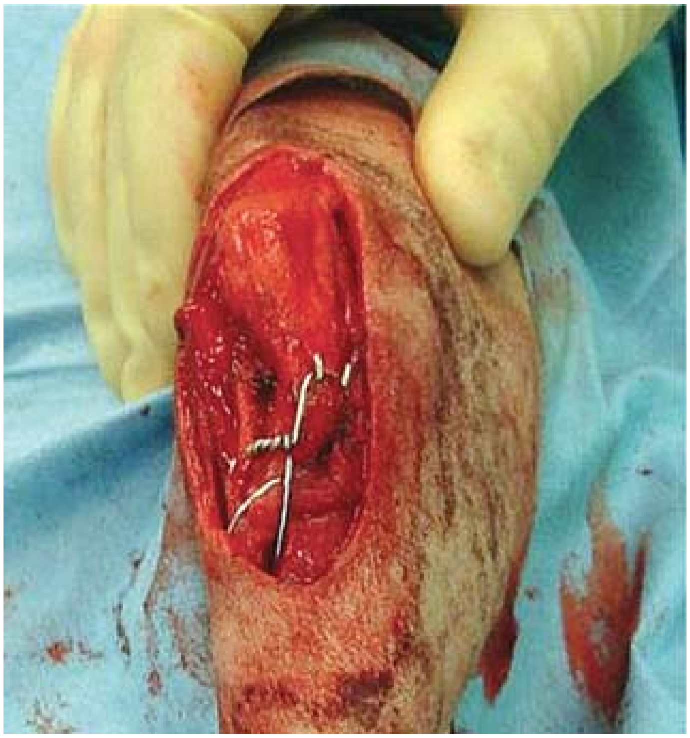

Figure 2. Intraoperative photograph demonstrating a lateral tibial tuberosity in a four-year-old cavalier King Charles spaniel stabilised using two Kirschner wires and a tension band wire.

The size of the osteotomised segment is important to minimise the chance of fracture; as a guide, the craniocaudal depth of the osteotomised tibial tuberosity should be a maximum of 30% of the craniocaudal dimensions of the tibia at that point. The distal periosteum of the osteotomised tuberosity is typically left intact. The degree of medial or lateral transposition of the tuberosity needed varies with each case.

Excessive and insufficient transposition can result in luxation in the opposite direction to that noted preoperatively and recurrence of luxation in the original direction, respectively. The degree of correction required is assessed intraoperatively and the appropriate position of the tuberosity is generally where the entire quadriceps mechanism runs in a straight line, but, more importantly, where the patella can no longer be luxated. The patella should be assessed for continued luxation by putting the stifle through a full range of normal physiological movement, including internal and external rotation, prior to soft tissue closure.

Adequate fixation of the tuberosity is important to prevent iatrogenic avulsion fractures. The tuberosity is secured into the new location using Kirschner wires (K-wires) of an appropriate size, with or without a tension band wire. If the distal periosteal attachment has been transected then a tension band wire is almost certainly indicated. If this remains intact, the placement of a tension band wire varies between surgeons.

In the hands of the authors, a tension band wire is used in almost all cases (**Figure 2**), with the only exceptions being small breed dogs with a satisfactory distal periosteal attachment or dogs where a substantial bony attachment has been maintained distally. Anticipated client compliance postoperatively is important in this decision-making.

Deciding which procedure, or combination of procedures, is necessary is often not straightforward and demands sound clinical judgement and experience. Piermattei et al (2006) proposed an algorithmic approach be used to achieve patellar stability based on grade and direction of luxation.

When PL and CrCL rupture occur concurrently, both conditions must be addressed to regain normal stifle function (Newman et al, 2014). Although this can be achieved using staged surgical procedures, combining surgeries in a single event represents advantages, such as decreased patient morbidity and decreased total postoperative recuperation time.

Surgical treatment of concomitant CrCL disease and PL during the same surgery can be achieved using standard stabilisation techniques; for example, extra-capsular stabilisation of the CrCL with concomitant TTT, and trochleoplasty, with or without MPL soft tissue stabilisation techniques previously described. The placement of an extracapsular suture does not involve an osteotomy of the tibial tuberosity and, as such, can be combined with a TTT without increasing the risk of tibial crest avulsion (Langenbach and Marcellin-Little, 2010).

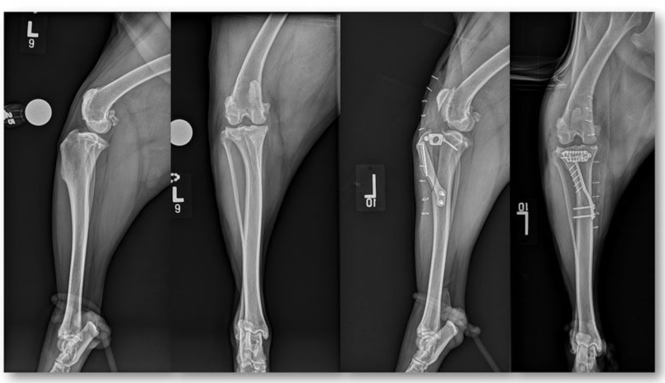

Figure 3. Preoperative mediolateral and caudocranial, and postoperative mediolateral and caudocranial radiographs of a five-year-old golden retriever with concomitant medial patellar luxation and cranial cruciate ligament disease stabilised using tibial tuberosity transposition and advancement.

In the case of concomitant MPL and CrCL disease, TTT and advancement is another described technique (Yeadon et al, 2011; **Figure 3**).

Modification of the tibial tuberosity advancement technique to include lateral transposition of the tibial tuberosity, when used in conjunction with ancillary procedures, such as block recession trochleoplasty and lateral parapatellar fascial imbrication, has been shown to be a valid treatment modality for simultaneous management of MPL and CrCL pathology (Yeadon et al, 2011).

In the authors' experiences, this technique can also be adapted to transpose the tibial tuberosity medially in cases of lateral patellar luxation (LPL).

As mentioned in part one, while most canine femora have some degree of varus shape, the degree of varus conformation appears to vary both within and between breeds. Failure to correct excessive femoral varus has been proposed as a cause of postoperative recurrence of MPL in large breed dogs (Kowaleski, 2006; Palmer, 2004; Palmer and Swiderski, 2007; Slocum and Slocum, 1998; Slocum and Slocum, 2000).

Corrective distal femoral osteotomy (DFO) has been advocated for treatment of MPL in large breed dogs when femoral varus more than 10° is measured from radiographs (Kowaleski, 2006; Palmer 2004; Slocum and Slocum, 2000), but this criterion was based on subjective clinical experience rather than objective measurements using a validated method.

While a cadaveric study performed on 10 femora found it to be of adequate specificity when radiologically assessing the need for DFO (Swiderski et al, 2008), this criterion remains contentious. While it may be useful as a guideline, in the authors' experiences, several other considerations are equally important when deciding whether DFO is necessary for an individual case.

For example, if a patient presents with grade III MPL on the left with associated clinical signs and a femoral varus angle of 11°, but also has a femoral varus angle of 11° on the right with no associated PL, it is unlikely the varus angle is contributing significantly enough to the aetiopathogenesis of the MPL on the left to warrant DFO. DFO is relatively complex and costly to owners and can have complications. Further work is needed in this area to establish more objective selection criteria.

Where DFO is considered, the most commonly practised method is a lateral closing wedge ostectomy stabilised using a lateral bone plate and screws.

An alternative, which may facilitate the procedure, is a medial opening wedge osteotomy stabilised using an interlocking nail (**Figure 4**).

This is a complex procedure that warrants referral to a specialised facility in most instances. For the general practitioner, the most important thing is to recognise cases warranting more specialised imaging and treatment to avoid disappointing outcomes following more routine surgical treatment.

Prognosis and complication rates

Complications after surgical treatment of PL include patellar reluxation, patellar reluxation with implant failure (loose or broken K-wires), tibial tuberosity avulsion fracture, fracture of the proximal tibia and fibula, luxation in the opposite direction due to overcorrection and wound-related problems, such as dehiscence, infection, implant-related discomfort and seroma formation (Gibbons et al, 2006; Arthurs and Langley-Hobbs, 2006).

In a retrospective analysis of 109 dogs, the overall frequency of postoperative complication was 18%, with major complications requiring revision surgery occurring in 13% of cases (Arthurs and Langley-Hobbs, 2006).

Weight appeared to play a role in overall complications and patellar reluxation was higher for dogs weighing more than 20kg.

In another study evaluating outcome associated with surgical correction of MPL in 124 dogs, the frequency of major complication was 18.5% (Cashmore et al, 2014).

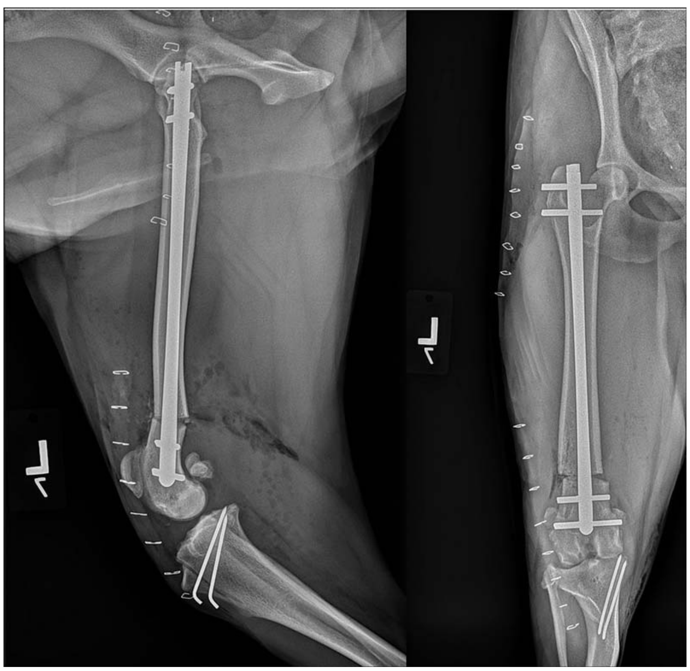

Figure 4. Postoperative mediolateral and caudocranial views of the left femur of the same case as seen in **Figures 1** and **2** following an opening osteotomy of the distal femur, stabilised using an interlocking nail and a tibial tuberosity transposition to correct grade III medial patellar luxation.

The successful clinical use of trochleoplasty techniques has been extensively described (Rousk, 1993; Slocum and Devine, 1985) and multiple studies have showed a lower incidence of patellar reluxation in cases where initial surgical stabilisation included trochleoplasty. Indeed, reported reluxation rates after surgical correction range from 6% to 8% in studies evaluating dogs receiving a trochleoplasty as part of surgical treatment (Alam et al, 2007; Arthurs and Langley-Hobbs, 2006) to 19.8% in dogs where a trochleoplasty was not performed (Linney et al, 2011).

In another retrospective analysis of 124 dogs, the incidence of patellar reluxation increased from 4.5% in cases where trochleoplasty had been performed to 23.4%t in cases without (Cashmore et al, 2014).

TTT has been associated with lowers risks of postoperative patellar reluxation and major complications (Arthurs and Langley-Hobbs, 2006). As this procedure is the only one routinely performed that corrects malalignment of the quadriceps mechanism, this is perhaps not surprising. Given cases treated with both TTT and femoral trochleoplasty have been associated with a lower risk of patellar reluxation and major complications, the use of these techniques should be considered in all developmental cases of PL (LaFond et al, 2002; Gibbons et al, 2006; Cashmore et al, 2014).

Implant failure and tibial tuberosity avulsion are complications reported when performing TTT. A study evaluating 124 dogs found tibial tuberosity avulsion to be 11.1 times less likely in dogs in which two K-wires had been used to stabilise the transposition instead of one.

Independent to the number of K-wires used, the more caudodistally the K-wires were directed, the higher the risk for tibial tuberosity avulsion. Along with the number of wires used and the direction of their insertion, the use of a tension band wire might help lower the risk of tibial tuberosity avulsion. None of the dogs in which a tension band wire was used in the study suffered tibial tuberosity avulsion (Cashmore et al, 2014).

The results of surgical correction vary with the severity of the anatomic abnormalities. Grade II and grade III are considered to have a favourable prognosis, whereas grade IV cases carry a poorer prognosis (DeAngelis, 1971; Remedios et al, 1992; Willaeur and Vasseur, 1987).

While most cases can be managed successfully using a combination of the conventional surgical techniques, such methods still fail to restore patellar stability or satisfactory limb function in a few cases.

Persistent PL, despite appropriately performed TTT and trochleoplasty, should raise suspicions of inadequate appreciation of an underlying skeletal deformity and subsequent inadequate selection and application of corrective surgery (Roch and Gemmill, 2008).

- Canine patellar luxation part 1: pathophysiology and diagnosis

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