WALTHAM
FOCUS®
VOL 9 NO 4
1999

# Rational treatment options for medial patellar luxation

**Richard A. Read** BVSc, PhD, FACVSc
Murdoch University, Western Australia, Australia

*Rick Read is Associate Professor in small animal surgery at Murdoch University in Perth, where he is also director of the Small Animal Hospital. Rick has worked for the last 20 years in clinical academic life. His major clinical and research interests are in orthopedics, specifically developmental joint diseases in dogs and osteoarthritis. Rick is a registered specialist in small animal surgery and has been actively involved in the training and examination of other specialists in small animal surgery through the Australian College of Veterinary Scientists for the past 10 years. He currently holds the position of chief examiner of the college.*

## KEY POINTS

- Medial patellar luxation is an important developmental abnormality affecting the hind limb of predominantly small breed dogs and causing lameness and gait abnormality.
- The condition is graded on a scale of 1 to 4, based on the degree and permanency of patellar luxation.
- A permanently luxated patella is associated with displacement of the quadriceps muscle, which may result in severe bony deformity of the femur and tibia in growing dogs.
- Accurate assessment of the degree of luxation should be carried out with the dog standing.
- The choice of surgical technique for each case should be based on accurate preoperative assessment, and the aim should be to restore normal alignment of the quadriceps/patellar ligament mechanism.
- The prognosis of patellar luxation is fair to good for limb function but stifle osteoarthritis commonly develops and progresses over time.

## INTRODUCTION

Medial luxation of the patella is a common cause of hindlimb dysfunction in dogs, particularly smaller breeds (1). It is far less common in cats. Although some cases are obviously associated with trauma, the majority are not related to any specific incident. Apart from the traumatic cases, patellar luxation tends to cause a chronic lameness or gait abnormality. The majority of cases present as pups or young adults, and a diagnosis of congenital luxation is readily made.

Some cases of medial patellar luxation do not present until well into middle age, however, when it is more difficult to attach the 'congenital' label. In most cases the underlying anatomical problems have been present from a very young age, although the actual luxation of the patella may not be present at birth. The term 'congenital' is therefore not necessarily correct, and we should refer to most cases of patellar luxation as being 'developmental'. Medial luxation of the patella can also occur in association with other ligamentous instability of the stifle.

## FUNCTIONAL ANATOMY

The patella is an ossified portion of the quadriceps tendon and plays an important role in the extensor mechanism of the stifle. Power for the extensor mechanism comes from the four heads of the quadriceps femoris muscle group. Three of these (vastus lateralis, intermedius, and medialis) originate from the proximal femur, and the fourth (rectus femoris) originates from the ilium. These four converge to insert on the patella and then continue on to form the strong patellar ligament, which inserts on the tibial tuberosity.

The patella rides in the trochlear groove of the femur—its articular surface is convex and corresponds to the concave shape of the trochlear groove. The trochlear groove is formed by the lateral and medial trochlear ridges of the distal femur, which project from the cranial surface and thus cradle the patella. The vastus lateralis and vastus medialis insert onto the patella by 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. The vastus medialis counteracts the lateral pull of the vastus intermedius and lateralis on the patella as the stifle is extended, so that the patella remains in its normal position (2).

The patella has a number of important functions:

- Maintaining even tension as the stifle is extended.
- Increasing the mechanical leverage applied by the quadriceps group.
- Decreasing friction between the quadriceps and condyles.

As the stifle moves from flexion to extension, the patella follows a medial to lateral sinus arc, the center of which is based around the fabellae (3). At the end of extension the patella is found buttressed against the lateral trochlear ridge.

The trochlear ridges, the quadriceps group, the joint capsule, and retinaculum all help to stabilize the patella in the trochlear groove during an extension excursion. A normal balance and direction of the forces applied by these structures is essential for normal joint stability. In particular, abnormal alignment of the extensor mechanism results in abnormal mechanics and joint instability, which places abnormal stresses on the ligaments and menisci of the stifle and may directly result in osteoarthritis. In the growing dog, the consequences of these abnormal forces are compounded by their effects on the growing cartilages (growth plate and articular cartilage) of the distal femur and proximal tibia, leading to changes in bone architecture and shape.

## PATHOGENESIS OF MEDIAL PATELLAR LUXATION (MPL)

With the exception of those cases associated with trauma, it is important to recognize that patellar luxation involves developmental anomalies of the entire limb, not just the stifle. The relative importance of the different derangements of the pelvic limb have been a matter of dispute for some time. Anatomical changes that may be present in cases of MPL are shown in **Table 1** (4). Depending on the severity of the case, various degrees and combinations of the following features may be present.

### Pressure and traction

The dysplastic femoral condyle and tilting of the tibial plateau are related to the effects of pressure and traction on the growing cartilage plates of the growth plate and articular cartilage of the immature dog. The altered pull of the quadriceps results in increased pressure on the growth cartilages of the medial aspect of the distal femur resulting in hypoplasia (or dysplasia) of the epiphysis (condyle) and 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 the tibial plateau. The medially directed force exerted on the tibial tuberosity by the displaced quadriceps results in torsion of the proximal tibia and medial displacement of the tuberosity, exacerbating the abnormal angulation of the quadriceps (5). These changes are best appreciated on radiographs of affected dogs **(Figure 1)**.

### Medial displacement

In some dogs with a severely bowlegged conformation **(Figure 2)**, the rectus femoris muscle may play a significant role in producing a medially directed force on the patella as a result of its origin on the iliopubic eminence, just cranial to the acetabulum. Because it arises medially on the pelvis rather than on the femur, this muscle may be responsible for displacing the quadriceps to the medial side of the long axis of the limb (6).

Bilateral medial patellar luxation is more common than unilateral (7) and females have an increased risk of patellar luxation (1, 7). Although the high prevalence, in small breeds, of bilateral disease with an early age of onset is suggestive of a heritable disorder, there has been no detailed research into the genetics of this disease.

### Initiating factors

In many cases, we still do not know what initiating factor(s) may alter the dynamics of the hindlimb action such that the forces acting on the patella and quadriceps muscle favor medial (or lateral) luxation of the patella. The important point is that patellar luxation is not just a problem of the stifle joint, it is a dynamic problem involving the structure and function of the whole of the affected pelvic limb.

## CLINICAL FEATURES OF MPL

The severity of clinical signs associated with medial patellar luxation vary from none to severe lameness and conformational

**Table 1**
**Anatomical changes associated with medial luxation (4)**

- Intermittent (recurrent) or permanent (fixed) medial patellar luxation
- Medial displacement of the quadriceps group, with or without muscular contraction
- Limited extension of the hip and stifle
- Decreased hip anteversion
- Coxa vara
- External rotation and/or torsion of the distal femur
- Internal rotational laxity of the tibia and/or medial torsion of the proximal tibia and lateral torsion of the distal tibia
- Medial displacement of the tibial tuberosity and cranial border of the tibia (probably an expression of internal torsion of the proximal tibia rather than medial migration of the tuberosity)
- Real or artifactual bowing of the distal femur with increased caudal and medial concavity
- Lateral angulation or tilting of the femorotibial joint space
- Shallow or absent trochlear groove
- Femoral and tibial condylar asymmetry
- Genu varum (bowlegged stance)
- Redundant or stretched lateral joint capsule and retinacula
- Contracted or inadequate medial joint capsule and retinacula
- Cartilage fibrillation or erosion on the articular surface of the patella
- Erosion on the medial aspect of a dysplastic medial femoral condyle
- Meniscal, cranial cruciate and lateral collateral ligament changes
- Degenerative joint disease

**Figure 1** *Ventrodorsal radiographic projection of the pelvis and hindlimbs of a Papillon with bilateral Grade IV MPL. There is lateral bowing of both femoral shafts, tilting of the transcondylar axis, and a 90° medial rotation of the proximal tibia, with the patella displaced medially.*

**Figure 2** *Photograph of a two-year-old Rottweiler with Grade III medial patellar luxation associated with a severely bowlegged conformation and external rotation of the stifles. This dog should be assessed for rectus femoris transposition surgery.*

deformity. The more severely affected cases tend to be diagnosed at two to four months of age because of the obvious clinical signs.

A grading system to classify cases according to severity of the clinical signs and pathological changes was first proposed by Putnam (8) and was modified by Singleton (9). In the author's opinion, the description of the four grades by Hulse and Shires (10) is the most clinically relevant **(Table 2)**.

These grades apply to medial luxation regardless of the size of the dog. The typical appearance of a dog with bilateral Grade IV MPL is shown in **Figure 3**.

## CLINICAL ASSESSMENT AND TREATMENT

It is very important to examine the whole limb in cases of patellar luxation and assess the relative anatomical positions of the quadriceps, patella and patellar ligament, trochlear groove, and tibial tuberosity. This is best carried out while the dog is standing **(Figure 4)**. It is extremely difficult to assess the degree of tibial tuberosity rotation when the dog is anesthetized. The depth of the trochlear groove should be assessed by palpation. If the patella remains in the groove only when the knee is in full extension (Grade III), some form of medial releasing procedure of the medial retinaculum may be required in addition to trochleoplasty and tibial tuberosity transposition. If the patella cannot be returned to the groove (Grade IV), corrective osteotomies may be indicated, although the combination of Grade III repair techniques accompanied by extensive medial release procedures may produce satisfactory results. This should not be attempted where there is severe bony deformity.

Once the patient is anesthetized, further palpation of the joint should be carried out to assess the range of movement of the stifle joint and to check for secondary changes, such as cruciate ligament rupture and osteoarthritis. In some severe Grade IV cases in small breeds, contracture of the quadriceps may develop, resulting in limited range of movement of the stifle joint. The presence of any of these complicating factors suggests a poorer prognosis.

Whatever the surgical techniques being employed, the aim is to be able to have the patella positioned correctly in the groove and remaining there throughout a full range of motion *before* closure of the lateral soft tissue support (retinaculum). The most common error in medial patellar luxation repair is inadequate surgery, which usually emanates from inadequate preoperative assessment.

The other important point is that severe cases are much better treated early. If Grade III or IV patellar luxation is diagnosed at first vaccination (six to 12 weeks of age) it may be possible to minimize

**Table 2**
**Clinical grading of medial patellar luxation**

*Grade I*
- Rarely lame, but may occasionally skip as patella slips over trochlear ridge
- Usually diagnosed as incidental finding
- Minimal medial tibial rotation
- Manual luxation of the patella possible but spontaneously reduces

*Grade II*
- Lameness varies from occasional skip to continuous weightbearing lameness
- Slight bowlegged conformation with slight medial tibial rotation ± slight angular and torsional deformity
- Patella may luxate on flexion/extension but reduces spontaneously

*Grade III*
- Occasionally not lame but usually chronic lameness of varying severity and moderate to severely bowleggedness
- 30–60° medial tibial rotation with moderate angular and torsional deformities
- Medial displacement of quadriceps
- Patella usually luxated but can be reduced; usually reluxates on manipulation of the stifle

*Grade IV*
- Almost always lame with conformational deformity
- Cannot extend stifle so, if bilateral, either crawls with stifles flexed or walks on forelegs only
- Stifle flexed with foot internally rotated
- Marked angular and torsional deformities
- Patella permanently luxated and nonreducible
- Patella hypoplastic and articulates with medial femoral condyle

**Figure 3**
*Photograph of the Papillon whose radiograph is shown in* Figure 1. *The stifles and feet are rotated inwards, and the dog is unable to extend either stifle due to permanent nonreducible MPL (Grade IV) associated with severe bony abnormalities.*

**Figure 4** *Assessment of alignment of the quadriceps, patella, trochlear groove, and tibial tuberosity is best performed with the patient standing. In this case, the tip of the proximal forcep is indicating the location of the trochlear groove, and the more distal forcep is indicating the location of the tibial tuberosity. The patella is medially luxated* (arrow) *but is reducible (Grade III). By assessing the distance between the tibial tuberosity and the mid sagittal axis of the limb, the distance that the tuberosity must be moved to realign the patellar ligament and quadriceps with the trochlear groove can be assessed.*

the secondary bony deformities by placing a derotational suture from the lateral fabella to the patellar ligament. This suture will almost certainly eventually break but if the pull of the quadriceps can be corrected during most of the dog's growth, the secondary effects of abnormal stress and pressure on the growing bone and cartilage, which lead to bony deformity, can be avoided or at least minimized. A potential Grade IV can be converted into a Grade I or II.

A slightly different presentation, which is seen occasionally, is a Grade II medial luxation in which the patella rides on the ridge of the trochlea. Dogs with this problem often present at two to three years of age with severe lameness because the articular cartilage of the patella becomes worn away by its articulation with the ridge of the trochlea. Bony crepitus can usually be palpated under the patella as the joint is flexed and extended. The patella is usually relatively stable in this position. In some cases, most of the articular cartilage of the patella has become eroded, leaving a rim of cartilage surrounding a large area of eburnated subchondral bone **(Figure 5)**. Although realignment techniques may be effective in alleviating lameness, the eroded patella may remain as a source of knee pain and lameness. In such cases, patellectomy is the treatment of choice (see Surgical techniques), although it should be regarded as a last resort procedure for intractable pain and dysfunction associated with the patellofemoral joint.

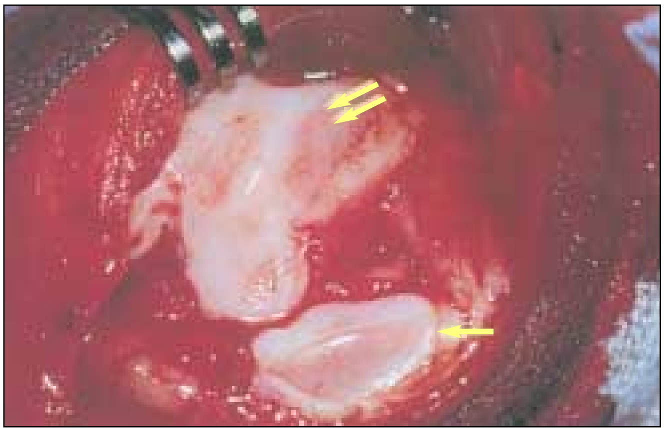

**Figure 5** *Intraoperative photograph of the patellofemoral joint from a dog with patellar subluxation and severe erosion of the articular cartilage of both the patella* (single arrow) *and medial aspect of the medial trochlear ridge* (double arrow). *This is one of the indications for patellectomy.*

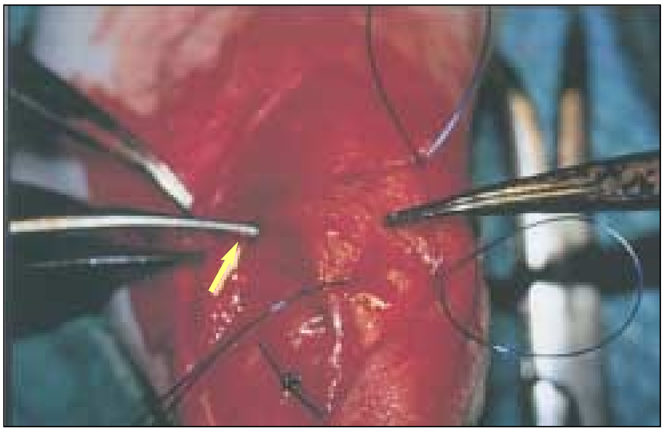

**Figure 6** *Intraoperative photograph of tibial antirotational sutures. The thumb forceps are indicating the position of the lateral fabella* (arrow). *The tied suture has been placed around the lateral fabella and through the distal patellar ligament to rotate the tibia externally. The other suture, which has not yet been tied, has been placed around the lateral fabella and encircles the patella, which is being indicated by the tip of the mosquito forcep. The function of this second suture is to strengthen the lateral fabellopatellar ligament and help maintain the patella in the trochlear groove while other soft tissue structures adapt to the realigned quadriceps function.*

## MPL ASSOCIATED WITH TRAUMA OR OTHER STIFLE INSTABILITY

Acute patellar luxation due to trauma to the supporting structures of the patella is relatively rare. The signs of trauma and acute inflammation tend to mask evidence of patellar luxation. Other injuries such as ruptured patellar ligament and patellar fractures produce similar clinical signs. The affected limb is carried in flexion with the foot internally rotated. Patellar luxation may also occur associated with other ligamentous instability of the stifle, particularly cranial cruciate rupture. The increased internal rotation of the tibia that occurs in cruciate-deficient stifles results in a medial displacement of the tibial tuberosity and subsequent medial displacement of the quadriceps. Malunion of fractures of either the distal femur or proximal tibia involving rotation around the long axis of the limb can predispose to patellar luxation. Care should be taken when reducing such fractures, particularly in growing dogs.

## SURGICAL TECHNIQUES TO REPAIR MPL

Far more skill and experience is required in the selection of the appropriate surgical procedure for each individual case of patellar luxation than in the actual performance of the surgery. Surgical procedures for patellar luxation can be divided into soft tissue reconstructive techniques and bone reconstructive techniques. Each case must be carefully assessed to determine which procedures are indicated. The correction of bony deformities is paramount—reliance on soft tissue techniques alone to overcome the effects of bony deformities is a frequent cause of failure. Probably the most important technique of all is transposition of the tibial tuberosity.

When indicated, bilateral surgery is performed as a single operation in small breeds, despite the slightly more difficult postoperative management. Separate surgeries with an interval of at least two weeks are preferred in medium and large breed dogs or where bilateral corrective osteotomies are required.

### Soft tissue reconstructive techniques

*Lateral retinacular overlap*

The retinaculum and joint capsule on the opposite side to the direction of patellar luxation becomes stretched over time so that when the patella is reduced there is redundant tissue present and a lack of tension on the patella. An incision is made through these layers, 3–5 mm from, and parallel to, the patellar ligament, extending from the tibial plateau to above the patella. The fascial (retinacular) incision is continued further proximally into the fascia lata. The more caudal edge is then sutured over the cranial edge using mattress sutures in a 'vest-over-pants' pattern. This overlapping pattern can be continued up into the fascia lata if needed. An alternative procedure is to excise the redundant tissue and directly suture the two remaining edges.

*Patellar and tibial antirotational sutures*

An additional lateral (or medial) support to the retinaculum can be constructed by placing a nonabsorbable suture around the lateral fabella and anchoring it through the patellar ligament to encircle the patella on three sides. This suture reinforces the patellofabellar ligament and should maintain tension on the patella throughout the normal range of movement. A technique using a strip of fascia lata instead of suture material has been described. The strip of fascia is passed in the same direction as the suture material and sutured to itself (11). A second nonabsorbable suture can be placed from the

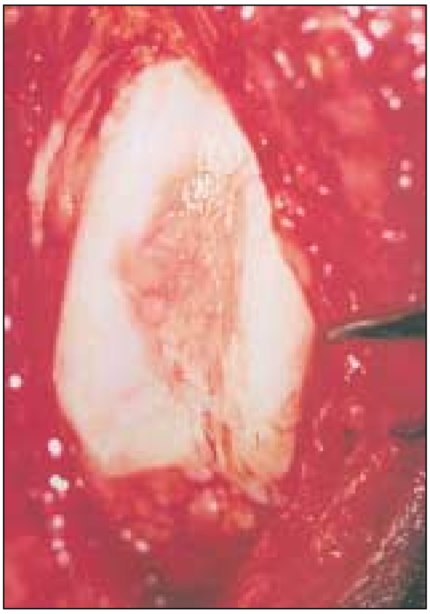

**Figure 7**
*Intraoperative photograph of the articular cartilage of the trochlear groove of a dog which had a trochleoplasty six months previously. The surface of the trochlea is covered by a thin layer of fibrocartilage, which is inferior to hyaline articular cartilage.*

**Figure 8**
*Intraoperative photograph of trochlear wedge recession in a dog. Two converging saw cuts are made, commencing just inside the tip of the trochlear ridge and converging on a point in the subchondral bone to create a V-shaped wedge of bone.*

lateral fabella to the patellar ligament or tibial tuberosity to 'derotate' the proximal tibia **(Figure 6)**.

It must be emphasized that these techniques should not be used as substitutes for techniques to correct bony deformities such as torsion of the proximal tibia and medial deviation of the tibial tuberosity. They are indicated in the young patient where diagnosis and treatment are initiated prior to the development of major bony deformities. Even in these cases, these sutures probably eventually break or loosen, but changes in the soft tissues in these young patients tend to maintain the reduction of the patella.

The suture must not be placed through the tendon of origin of the gastrocnemius. If adequate anchorage is to be achieved, the needle must pass either around the fabella itself or through the femorofabellar ligament. In the author's opinion, the preferred suture is polypropylene (2-0 or 0) on a 30 or 35 mm Mayo half circle needle. Care must be taken to ensure that the suture material does not come directly into contact with the articular cartilage. Lateral retinacular overlap can be performed at the same time.

*Medial release (desmotomy)*

The retinaculum on the side to which the patella has luxated contracts down over time, just as the tissues on the opposite side become stretched. The degree to which this occurs is directly proportional to how much time the patella spends in the luxated position (and therefore to the grade of patellar luxation). This contraction either prevents reduction of the patella or places such tension on the reduced patella so that it tends to reluxate. Incising these contracted tissues relieves this tension.

On the medial side, the incision is made through the medial fascia and the fibrous and synovial layers of the joint capsule. It extends from the level of the tibial plateau to separate the vastus medialis and the caudal belly of the sartorius. In severe cases, it may need to be extended proximally up the medial edge of the vastus medialis to the level of the proximal third of the femur. In most cases of Grade IV patellar luxation, displacement of the whole quadriceps group necessitates extensive dissection to free it from the femur up to the midfemoral level and move it into a more correct alignment. This will involve incision of the joint capsule proximal to the trochlea.

All releasing incisions are left unsutured, and the superficial tissues closed over the top. The synovial membrane rapidly proliferates to seal the joint, and the fibrous layer of the joint capsule is gradually restored. Postoperative bandaging may be indicated to prevent subcutaneous fluid accumulation.

*Rectus femoris transposition*

Large breed dogs presenting with medial patellar luxation associated with severe bowlegged conformation and severe outward rotation of the stifles may benefit from transplantation of the origin of the rectus femoris muscle from its normal position on the pelvis to the trochanteric region of the femur. A wedge of bone is excised with the muscle origin, passed under the remaining heads of the quadriceps, and reattached to the femur using a wire suture, care being taken to preserve the blood supply to the rectus muscle (6). Early results suggest this may be a useful technique for this selected group of cases, which should be referred for specialist assessment and treatment.

**Bone reconstructive techniques**

*Techniques to deepen the trochlear groove*

Trochleoplasty refers to the removal of the articular cartilage and some of the subchondral bone from the trochlear groove, leaving a raw cancellous bone surface. Repair by fibroplasia results in a layer of fibrocartilage which is inferior to hyaline cartilage **(Figure 7)**. In addition, postoperative pain from the patella articulating with the raw subchondral bone surface makes the patient more reluctant to use the leg in the immediate postoperative period.

Trochlear wedge recession avoids these problems. In this technique, a small saw is used to make two converging angled incisions through the articular cartilage and the subchondral bone **(Figure 8)**. These incisions start medially and laterally, just inside the trochlear ridges. When they meet deep in the subchondral bone they free a wedge shaped piece of bone, with the articular cartilage attached, from the sulcus of the trochlea **(Figure 9)**. This piece is carefully saved while the edges of the V-shaped defect are removed. This can be done using the same saw or, in small dogs, with a scalpel blade. The original wedge is then replaced, leaving only a thin strip of cancellous bone exposed on each side of the trochlea **(Figure 10)**. There is no need to fix the wedge in position as it is held in place by the pressure of the patella and the enmeshing of the cancellous bone underneath. This technique avoids the problems of the trochleoplasty and is very simple to perform.

It is important to realize that even trochlear wedge recession causes a significant insult to the joint. There is some evidence that the clinical outcome following patellar luxation surgery is better in cases where trochlear groove deepening is avoided (12). As in all cases, careful preoperative assessment is required in each case to ensure that the appropriate choice of surgical repair is made to correct the underlying anatomical defects.

**Figure 9** *The wedge of bone has been removed from the femur, allowing the edges of the defect to be excised to widen the defect.*

**Figure 10** *The completed wedge recession procedure with the wedge replaced, showing effective deepening of the trochlear groove. The pressure of the patella when reduced will stabilize the wedge of bone.*

**Figure 11** *Intraoperative photograph of the first stage of tibial tuberosity transposition. A small hacksaw blade has been passed under the patellar ligament* (outlined by the arrows) *and is being used to remove the tip of the tibial tuberosity, leaving a fibrous attachment to the cranial border of the tibia.*

*Transposition of the tibial tuberosity*

The tibial tuberosity is the tip of the cranial border of the tibia. The patellar ligament inserts onto the tibial tuberosity but the fibers of the ligament blend with the fibrous layer of the periosteum so that the functional area of insertion extends down the cranial border of the tibia. This extension is utilized in transposition of the tibial tuberosity.

Lateral and medial parapatellar incisions are required to mobilize the patellar ligament. The cranial tibial muscle is also elevated, and the patellar ligament is freed from the infrapatellar fat pad. The author uses a mini hacksaw blade without the handle to osteotomize the tuberosity, which gives excellent control over the depth of the cut. The blade is passed under the freed patellar ligament, and the top 2–5 mm of the tibial tuberosity is freed using the saw, leaving the periosteum (which is the extension of the insertion of the patellar ligament) intact **(Figure 11)**. The saw is then removed, and the osteotomized piece of bone is further mobilized by gently levering under it using a periosteal elevator or osteotome.

A rongeur is used to cut off the sharp corner of the osteotomy site laterally in order to create a flat bed for the repositioned tuberosity. The tip of the tibial tuberosity is then deflected laterally using a periosteal elevator **(Figure 12)**. When the desired position is reached, it is fixed into position with a single Kirschner wire driven through the osteotomized piece of bone and into the tibial metaphysis **(Figure 13)**. Because the insertion of the patellar ligament onto the cranial border of the tibia has not been completely severed, there is no need for a full tension band wire fixation of the tibial tuberosity. The K-wire is cut short, leaving only 1 mm projecting above the surface of the bone. In very small dogs, there is a great risk of breaking the small piece of mobilized bone if the tip of the pin is bent over to protect the soft tissues. On rare occasions in very small breeds, the sharp end may cause a reaction which will require removal of the pin.

The tibial tuberosity can be moved up to 5 mm by this technique. The assessment of the distance required should be made prior to anesthesia as mentioned above. Greater distances require complete severance of the attachment of the patellar ligament, in which case a tension band wire fixation is necessary.

*Patellectomy*

The patella is sharply dissected from the ligament using a number 15 blade and shelling the patella out by cutting as close to the bone as possible. The defect in the patellar ligament is supported by a suture of 2/0 or 0 prolene placed in the modified Kessler pattern **(Figure 14)**. The function of the knee without a patella appears to be satisfactory in the author's experience of 13 cases (13). However, it is only indicated when there is intractable patellofemoral pain.

*Corrective osteotomy of the tibia and femur*

In severe grade IV cases, the angular and rotational deformities of the tibia and femur are so severe that it may be impossible, using the above techniques, to correct the abnormal forces acting on the patella. In these cases, wedge osteotomy of the femur and, very rarely, osteotomy of the tibia may be necessary to return the line of force of the quadriceps to normal. These procedures are complex because both angular and rotational corrections must be made. Arthrodesis may be preferred in cases of complicated corrective osteotomies.

## POSTOPERATIVE MANAGEMENT AND PROGNOSIS

Early, controlled postoperative weightbearing is desirable for all cases of patellar luxation surgery. Weightbearing will aid healing following wedge recession of the trochlear groove. In addition, some toy breeds can develop a habit of carrying a hindlimb if there is no early postoperative ambulation. Judicious use of analgesics such as carprofen may help. However, vigorous activity and, in particular, jumping should be discouraged for the first four to six weeks. Unilaterally-treated dogs should be weightbearing on the treated limb within ten days and certainly by four weeks post-surgery. Bilateral surgery can cause some problems with postoperative ambulation, and analgesic therapy may be required for five to seven days. In most cases, the author does not apply external dressings or splints, except in cases where large releasing incisions have been left unsutured, leaving large defects in the synovial membrane. In such cases the bandage is designed to support the soft tissues rather than the joint.

**Figure 12** *The same case as in* Figure 11. *The patellar ligament, patella, and mobilized tibial tuberosity are being deflected to the lateral side using a periosteal elevator. The bone bed of the original position of the tibial tuberosity is outlined by the arrows. Note that the distal attachment of the ligament to the cranial border of the tibia remains intact* (blue arrow).

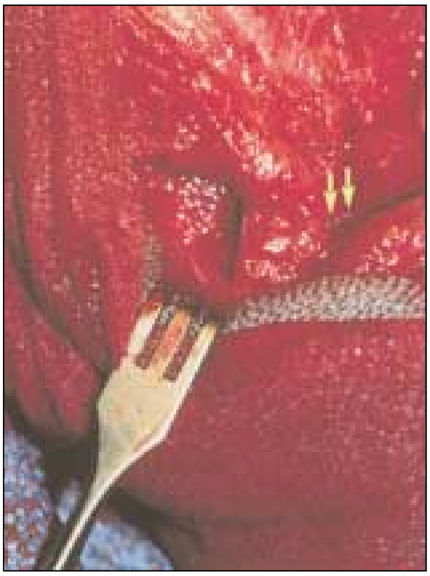

**Figure 13** *The same case as in* Figure 11. *The mobilized tibial tuberosity has been fixed in its new, more lateral position using a single Kirschner wire* (arrows) *directed into the tibial metaphysis.*

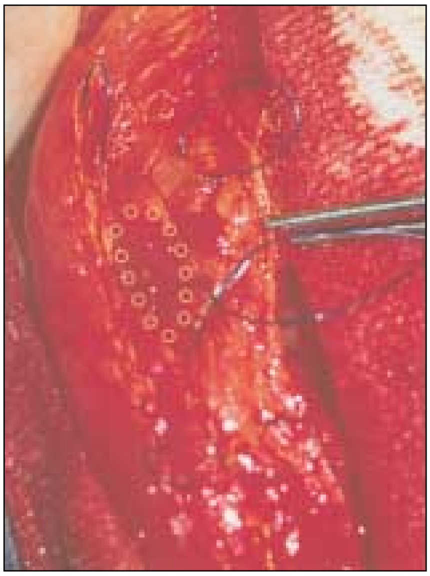

**Figure 14** *Intraoperative photograph of a dog's patellar ligament following patellectomy. The area outlined by the open dots is the defect in the patellar tendon. A modified locking loop suture has been placed through the quadriceps tendon proximally and the patellar ligament distally to bridge the defect.*

The prognosis for cases of Grade I and II medial patellar luxation is generally very good for re-establishment of full and pain-free use of the limb. For Grade III and IV cases the prognosis is fair to good if treated early in life but secondary changes such as osteoarthritis and cruciate ligament rupture can complicate long-term function. Surgical correction of MPL does not prevent the progression of osteoarthritis, regardless of the initial grade, despite improved limb function. This suggests that joint biomechanics may still be abnormal postsurgically (14). In the cited study, the rate of progression of osteoarthritis was similar in nonoperated contralateral limbs with MPL.

Recurrence of luxation is most likely in the more severely affected cases in which the repair is heavily dependent on soft tissue reconstructive procedures. In many of these cases, the surgery should probably have been extended to include other more aggressive techniques.

## REFERENCES

**1.** Hayes, A. G., Boudrieau, R. J., Hungerford, L. L. Frequency and distribution of medial and lateral patellar luxation in dogs: 124 cases (1982–1992). *Journal of the American Veterinary Medical Association* 1994; **205**: 716–720.

**2.** Olmstead, M. L. Lateral Patellar Luxation. In: Bojrab, M. (ed.) *Disease Mechanisms in Small Animal Surgery*. Philadelphia: Lea and Febiger, 1993: 818–820.

**3.** Piermattei, D. L., Flo, G. L. The Stifle Joint. *Handbook of Small Animal Orthopedics and Fracture Treatment* 3rd edn. Philadelphia: Saunders, 1997: 516–580.

**4.** Trotter, E. J. Medial patellar luxation in the dog. *Compendium on Continuing Education for the Practicing Veterinarian* 1980; **2**: 58–67.

**5.** Hulse, D. A. The Stifle Joint. In: Olmstead M. (ed.) *Small Animal Orthopedics*. St Louis: Mosby, 1995: 395–416.

**6.** Slocum, B., Slocum, T. D. Rectus Femoris Transplantation for Medial Patellar Luxation. In: Bojrab, M. J. (ed.). *Current Techniques in Small Animal Surgery*, 4th edn. Philadelphia: Williams and Wilkins, 1998: 1234–1237.

**7.** Hulse, D. A. Medial Patellar Luxation in the Dog. In: Bojrab, M. (ed.) *Disease Mechanisms in Small Animal Surgery*. Philadelphia: Lea and Febiger, 1993: 808–817.

**8.** Putnam, R. W. *Patellar luxation in the dog*. MSc thesis, 1968. University of Guelph, Canada.

**9.** Singleton, W. B. The surgical correction of stifle deformities in the dog. *Journal of Small Animal Practice* 1969; **10**: 59–69.

**10.** Hulse, D. A, Shires, P. K. Stifle Joint. In: Slatter, D. H. (ed.). *Textbook of Small Animal Surgery*. Philadelphia: Saunders, 1985: 2193–2247.

**11.** Hulse, D. A. Pathophysiology and management of medial patellar luxation in the dog. *Veterinary Medicine/Small Animal Clinician* 1981; **76**: 43.

**12.** Matis, U., Fritz, R. Patellar luxation – long term results of surgical treatment. *Veterinary and Comparative Orthopaedics and Traumatology* 1990; **3**: 39.

**13.** Read, R. A. Patellectomy as a treatment for patellar pain associated with medial patellar luxation (MPL): review of 13 cases in dogs. *Proceedings, Veterinary Orthopaedic Society 22nd Annual Conference*. Whistler/Blackcomb, Canada, 1995; **22**: 33.

**14.** Roy, R. G., Wallace, L. J., Johnston, G. R., Wickstrom, S.L. A retrospective evaluation of stifle osteoarthritis in dogs with bilateral medial patellar luxation and unilateral surgical repair. *Veterinary Surgery* 1992; **21**: 475–479.