Patellar Instability


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Patellar instability is a generic term that describes patellar dislocation, patellar subluxation, and general symptomatic patellar instability. It is estimated that patellar instability affects between seven and forty-nine people per 100,000. It accounts for 11% of the musculoskeletal symptoms seen in the office setting as well as 16% to 25% of all injuries in runners. There is a higher incidence in females.

Anatomy and Biomechanics
Understanding the functional anatomy and basic mechanics of the patellofemoral joint will help the clinician to comprehend how instability occurs and how the described treatments can help stabilize the joint. In full extension, the patella is typically not engaged in the trochlear groove. Once motion is initiated in early flexion, only the distal part of the patellar articular surface is in contact with the superior aspect of the trochlear groove. Appropriate engagement of the trochlea is important for the stability of the patellofemoral joint. The quadriceps functions as a dynamic stabilizer of the patella within the trochlear groove, and the medial patellofemoral ligament is the primary static soft-tissue restraint to lateral patellar translation.

When engaged in the trochlear groove, the patella is held in place by both the soft-tissue tension of the medial soft-tissue sleeve of the knee and the lateral aspect of the trochlea. As flexion increases, the contact area of the patella moves proximally until 90° of flexion, at which point the proximal pole is in contact with the distal aspect of the trochlear groove. In this position of knee flexion, the patella is more deeply engaged in the trochlear groove, and increasing flexion further causes the lateral facet to articulate with the medial femoral condyle past 90° of flexion. After flexion is initiated, the patella typically lags in flexion within the sagittal plane by 30° to 40° compared with the tibiofemoral flexion angle.

The medial patellofemoral ligament is an important structure for patellofemoral stability. Warren and Marshall described the medial anatomy of the knee as being a three-layered system (Fig. 1). The superficial layer includes the deep crural fascia, which also incorporates the fascia over the vastus medialis. The second layer includes the superficial fibers of the medial collateral ligament and blending of the fibers of the posterior oblique ligament on the medial side of the knee. It is in this layer that the medial patellofemoral ligament is located. The deepest layer includes the knee capsule and the deep fibers of the medial collateral ligament as well as the meniscotibial and meniscofemoral ligament structures. The medial patellofemoral ligament is a medial structure that inserts on the superomedial border of the patella approximately 6 mm below the superior pole. Its origin is along the entire height of the anterior aspect of the medial femoral epicondyle. The structure has been reported in numerous studies as having an average length of between 5 and 6 cm (53 to 57 mm on the average, with standard deviations of 4 to 5 mm).

The medial patellofemoral ligament has been reported to have connections to the undersurface of the vastus medialis obliquis on its superior border in the second layer of the medial aspect of the knee as well. Its patellar attachment is typically broader than its origin on the
antior aspect of the medial epicondyle. The medial patellofemoral ligament has been reported to provide >50% of the medial restraint forces to the patella during testing in cadaver models. The anatomical and mechanical attributes of the medial patellofemoral ligament listed above have generated the attention that the ligament has been afforded in the literature over the past few years.

**Classification of Patellar Instability**

Patellar malalignment is a rotational or translational deviation of the patella. The movements of the patellofemoral joint are complex. The traditional classification of patellar instability includes congenital, traumatic, habitual, obligatory, subluxation, and dislocation. The classification by Dejour et al. is based on clinical symptoms (Table I).

**Etiology**

The etiology of patellar instability is multifactorial (Table II). Structural and functional imbalance of the patellofemoral joint leads to chronic instability and secondary flattening, or dysplasia, of the lateral part of the trochlea. This dysplasia and patella alta both reduce the containment of the patella within the femoral trochlea, a problem that is aggravated by underlying structural and functional imbalance. The consequence is that the patella is not securely engaged at the start of flexion, causing it to slip laterally. As flexion continues, it either dislocates completely or slips back medially to its correct position.

Imbalance and secondary osseous and retinacular adaptive dysplasia result in the lateral subluxation of the patella from the intercondylar groove. When the tibial tubercle is lateral to the long axis of the femur and the quadriceps muscle, the patella is subjected to laterally directed forces. Other aggravating factors, in some patients, are vastus medialis insufficiency and joint laxity.

**Presentation and History**

Patients with patellar instability sometimes experience anterior knee pain, but episodes of collapsing or shifting in the knee are more prominent. A common clue is the feeling of the knee “giving way” or “going out.” It should be determined whether symptoms began with a sudden traumatic event. Previous treatment and the patient’s response to that treatment should be noted. If treatment was unsuccessful, it is essential to determine whether the failure was due to an incorrect diagnosis, inappropriate treatment, poor patient compliance, or instability that exceeded the effectiveness of nonoperative treatment.

**Physical Examination**

The patella is best examined with the patient flexing the knee to determine if the patella engages smoothly at the proximal end of the trochlea or more distally than normal. This also demonstrates whether knee flexion is restricted by tight structures or obstructed by an osteochondral fragment broken off during patellar dislocation. A thorough ligamentous examination is necessary to rule out concomitant cruciate or collateral ligament tears. It is not uncommon to confuse the symptoms of a torn anterior cruciate ligament with those of patellar instability. Medial collateral ligament injuries also commonly occur at the time of patellar dislocation. The examiner should identify the area of maximal tenderness along the course of the medial patellofemoral ligament, which usually identifies the location of the injury.

Patellar stability is assessed by the examiner pushing the patella laterally while flexing the knee. First, the medial patellofemoral ligament is palpated to establish if it is doing its normal job of pulling the patella into the trochlea during the first 20° of knee flexion. The examiner holds the relaxed knee in 20° to 30° of flexion while subluxating the patella laterally. If the patient is apprehensive during this maneuver, the test is considered to be positive. The patient will complain of pain and resist further lateral motion of the patella, and the examiner can assess the degree of medial patellofemoral ligament deficiency. If the patient continues to have

**TABLE I Classification of Patellar Instability as Described by Dejour et al.**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
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<tbody>
<tr>
<td>Major patellar instability</td>
<td>More than one documented dislocation</td>
</tr>
<tr>
<td>Objective patellar instability</td>
<td>One dislocation with associated anatomical abnormality</td>
</tr>
<tr>
<td>Potential patellar instability</td>
<td>Patellar pain with associated radiographic abnormalities</td>
</tr>
</tbody>
</table>
Elevation of the lateral aspect of the patella to less than neutral suggests an abnormal result, whereas 0° to 20° of elevation is normal. Limited upward movements indicate an excessively tight lateral retinaculum.

**Imaging**

**Radiographs**

The anteroposterior radiograph is of limited use. Occasionally, an osteochondral fracture of the medial patellar edge or loose bodies can be seen. The patellar height can be measured on the lateral radiograph. The Blackburne-Peel index relates the length of the articular surface of the patella to the distance of its inferior margin from the tibial plateau; it ranges from 0.85 to 1.09 in men and from 0.79 to 1.09 in women. The index provides a useful measure of the relationship of the patella to the trochea. Alternatively, the Insall-Salvati index can be used. This index compares the diagonal length of the patella with the length of the patellar tendon and ranges from 0.9 to 1.1 in men and from 0.94 to 1.18 in women. However, the measurement has limitations since the length of the patella is not always an indication of the length of its articular surface.

**Computed Tomography Scans**

Patellar tilt is measured on a computed tomography scan obtained with the knee in full extension with use of a line drawn through the posterior femoral condyles as the reference line and the long axis of the patella as the measurement line. The normal angle is <20°. Inoue et al. found that, with the knee extended, the lateral tilt of the patella was more pronounced in patients who had patellar subluxation than it was in a control group.

The tibial tubercle-trochlear groove (TT-TG) distance is also determined on the computed tomography scan but with the knee flexed 90°. This is a measurement of the offset of the tibial track relative to the true trochlear groove and is more accurate than the Q angle. With the knee flexed 90°, the tibial tubercle should lie <20 mm lateral to the midline of the femur at the proximal edge of the femoral condyles. Values of ≥20 mm are considered abnormal.

**Magnetic Resonance Imaging**

Magnetic resonance imaging is also used to evaluate the patella. Salay et al. demonstrated that a rupture of the medial patellofemoral ligament is visible on both sagittal and axial T2-weighted images. The characteristic bone bruise on the medial facet of the patella and the lateral femoral condyle in patients who have recently sustained a patellar dislocation can be seen on magnetic resonance imaging. Magnetic resonance imaging is also very useful for detecting an osteochondral fracture, which is an indication for early surgical intervention.

**Nonoperative Management**

Patellar instability can often be treated successfully without an operation. Ideal rehabilitation requires the avoidance of pain during exercise. Stretching and strengthening are used. While strengthening of the quadriceps muscle and the vastus medialis obliquus is the initial management of many patients, stretching of the lateral retinaculum, hamstrings, quadriceps, Achilles tendon, and iliotibial band should also be performed. Physical therapy should include closed-chain exercises and strengthening of the vastus medialis obliquus (the main dynamic stabilizer of the knee). Establishing proper core stability and functional alignment of the lower extremity is important. Weight loss is another way to reduce patellofemoral loads. Other methods include the use of a patellar brace to modify the position of the patella, patellar taping to pull the patella away from a painful area, use of an orthotic device in the shoe when a patient has excessive foot pronation, and use of analgesic medications.

**Operative Management**

If there is no clinical improvement with nonoperative management, operative treatment may be indicated. There are widely differing views regarding the correction of malalignment. The oper-
the patient’s age and level of activity as well as the condition of the joint. The traditional view has focused on two types of procedures: proximal realignment and distal realignment (Table III). Trochleoplasty is rarely indicated, particularly in young patients, as the long-term consequences of this procedure are not known.

**Proximal realignment:** The purpose of these procedures is to alter the medial-lateral position of the patella by manipulating the soft tissues—most importantly, the medial patellofemoral ligament—proximal to the inferior patellar pole.

**Distal realignment:** These procedures modify the position of the patella by the transfer of the tibial tuberosity.

### Table III Operative Techniques for Patellar Instability

<table>
<thead>
<tr>
<th>Proximal malalignment</th>
<th>Distal malalignment</th>
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<tbody>
<tr>
<td>Primary repair of medial patellofemoral ligament, medial imbrication and advancement of vastus medialis obliquus, lateral retinacular release, reconstruction of medial patellofemoral ligament</td>
<td>Anteromedial tibial tubercle transfer, tibial osteotomy</td>
</tr>
</tbody>
</table>

To decide whether a proximal realignment is appropriate, it is important to determine whether the patellar instability is due to a deficiency of the medial patellar stabilizers or whether the primary problem is abnormal alignment. Often the two problems coexist. If the patient has malalignment, then proximal realignment procedures alone may not be successful in restoring patellar stability. Myers et al.21 pointed out that proximal realignment does not work well in patients with patellofemoral pain and should be reserved for patients who have sustained a dislocation and require stabilization. When proximal realignment is selected as a treatment option, the surgeon should assess the medial patellofemoral ligament and retinaculum and decide if a primary repair of the medial patellofemoral ligament is indicated, or medial imbrication is sufficient, or if a reconstruction of the medial patellofemoral ligament with use of a tendon graft should be undertaken. The surgical treatment of patellar instability should be individualized.

### Primary Repair of the Medial Patellofemoral Ligament

For repair of the medial patellofemoral ligament, a horizontal incision is made parallel to the medial patellofemoral ligament starting anterior to the medial epicondyle and extending toward the proximal-medial part of the patella. The vastus medialis obliquus-investing fascia is then incised parallel to the skin incision, and the edge of the vastus medialis obliquus is elevated to reveal the deep surface of the medial patellofemoral ligament in its anatomical orientation just distal to the vastus medialis obliquus (Fig. 2). With use of this technique, the medial patellofemoral ligament can be palpated in its entirety and its point of disruption can be identified. To assist in identifying the medial patellofemoral ligament, traction is applied to the ligament and patellar stability is checked. This technique also allows one to determine the location of the injury to the medial patellofemoral ligament. If the medial patellofemoral ligament is torn off of the patella, stability cannot be established with longitudinal traction parallel to the medial patellofemoral ligament. In these cases, which are limited in number, the medial patellofemoral ligament is repaired back to the patella with use of nonabsorbable sutures placed through drill-holes in the patella as needed.

Most commonly, the medial patellofemoral ligament is torn from its origin on the medial epicondyle. For primary repair, a longitudinal incision is made in the deep fascia and periosteum just anterior and superior to the medial epicondyle to expose the osseous origin. The medial patellofemoral ligament is

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**FIG. 2**

The medial patellofemoral ligament has been localized deep to the vastus medialis obliquus. Traction is applied to determine its point of disruption.
generally more palpable than it is directly visible as a thickening in the medial retinaculum. Lateral patellar translation is checked as the forceps are used to stabilize the medial patellofemoral ligament to ensure that the appropriate tissue is incorporated in the repair. Two suture anchors are then placed into the femur at the origin of the medial patellofemoral ligament, and the repair is performed with the knee in 30° to 45° of flexion (Fig. 3). Mattress sutures are used to advance and secure the medial patellofemoral ligament to its osseous origin in this position (Fig. 4). In cases in which the tissue is attenuated, and the origin and insertion sites of the medial patellofemoral ligament are intact, an imbrication of the medial patellofemoral ligament is performed (Fig. 5). The optimal physiometric position is confirmed by moving the knee through a range of motion. The investing fascia is repaired prior to skin closure. After the repair has been performed, patellar tracking is assessed and a firm end point to lateral patellar displacement should be appreciated. Postoperatively, a hinged knee brace is applied to allow 50% weight-bearing and a range of motion of 0° to 30°, which is advanced in 30° increments every two weeks. Use of the brace and crutches is discontinued by six weeks postoperatively. Progressive quadriceps-strengthening exercises are advanced, with a return to sports activities usually after three months.

In an ongoing study at one institution, twelve patients (fourteen knees) who had undergone repair of the medial patellofemoral ligament had an average IKDC (International Knee Documentation Committee) score of 75.1 points and a mean Kujala patellofemoral subjective evaluation score of 80 points (maximum, 100 points) at a mean of forty-five months (range, twenty to seventy-five months) postoperatively. The scores on the Tegner activity scale were 6.0 points before the surgery and 6.9 points after the surgery, indicating that patients were able to resume activity at a level that was at least the same as their preoperative level. The visual analog score showed good pain relief, with an average score of 1.2 points (on a 10-point scale) after the procedure. Two patients had an episode of subluxation postoperatively, but there were no recurrent dislocations and no patient required revision surgery. Although the patients had completed the postoperative physical therapy program and had returned to sports activities, side-to-side comparison of quadriceps muscle function showed an average 35% deficit in the strength of the repaired knee during contraction in a more flexed position (at 60°). In addition, there was an average 63% reduction in quadriceps activity of the vastus medialis obliquus on electromyography.
We currently recommend repair of the medial patellofemoral ligament for patients with chronic recurrent patellar instability following failed nonoperative treatment or those with acute patellar instability and a loose osteochondral fragment following dislocation (Fig. 6). Diagnostic arthroscopy is done first to address any associated intra-articular pathological conditions and to visualize patellar tracking. Occasionally, the point of disruption of the medial patellofemoral ligament can be visualized arthroscopically (Fig. 7). If a tibial tubercle osteotomy is to be performed, it is done prior to the repair of the medial patellofemoral ligament to allow the surgeon to obtain correct tensioning of that ligament after the transfer of the tuberosity.

Reconstruction of the Medial Patellofemoral Ligament

Indications for reconstruction of the medial patellofemoral ligament include lateral patellar instability secondary to laxity of the medial patellar stabilizers with or without trochlear dysplasia. As is the case with primary repair, this procedure should be done to treat patellar instability and not to correct malalignment or to treat patellofemoral arthritis. Over-tightening of the graft will result in an overconstrained patella that is painful, perhaps leading to arthritis due to increased joint contact forces.

Use of a soft-tissue graft such as an ipsilateral hamstring tendon is especially helpful when the medial patellofemoral ligament is deficient or attenuated, as it often is in patients with chronic instability, in revisions, and in association with a congenital dislocation. A variety of graft sources is available for reconstruction of the medial patellofemoral ligament. We prefer to use the semitendinosus tendon, which is near the reconstruction site and is easy to harvest. The tendon is doubled over and is measured with a tunnel sizer. A closed-loop EndoButton fixation device (Smith and Nephew Endoscopy, Andover, Massachusetts) is used for patellar fixation. The exposure of the medial patellofemoral ligament is the same as
that described above. A Beath pin is drilled from medial to lateral in the midportion of the medial patellofemoral ligament insertion on the patella, which is located in the proximal third of the patella (Fig. 8). The pin is then carefully advanced to the lateral edge of the patella without violating the anterior cortex or the articular surface. Lateral fluoroscopy is used to confirm appropriate positioning of the pin. The patellar tunnel is then drilled with the appropriately sized cannulated drill-bit to the depth required to flip the EndoButton (Fig. 9). The Beath pin is used to pull the graft through the patellar tunnel, and the previously placed sutures are employed to flip the EndoButton so that it sits flush along the lateral side of the patella (Fig. 10). The position of the EndoButton is confirmed fluoroscopically. The location of the medial patellofemoral ligament is identified, a Beath pin is drilled just anterior to the medial epicondyle, and its location is confirmed fluoroscopically. The graft is wrapped around the Beath pin, allowing an assessment of graft isometry as the knee is brought through a full range of motion. The pin is then overdrilled with a 4.5-mm cannulated drill-bit to the appropriate depth, which is verified fluoroscopically. A 6.5-mm screw and washer are then used for femoral fixation with the knee in 30° to 45° of flexion (Fig. 11).

Alternatively, to minimize the risk of patellar fracture due to the transosseous graft tunnel, the graft can be placed into a shorter tunnel and fixed with a soft-tissue interference screw, such as the Biotenodesis screw (Arthrex, Naples, Florida). Farr and Schepsis used semitendinosus autograft or allograft with Biotenodesis screw fixation on the femur and either Biotenodesis screw fixation or suture-anchor fixation on the patella. Suture-anchor fixation on the patella eliminates the complication of a patellar fracture associated with the transosseous tunnel.

Multiple techniques have been described for reconstruction of the medial patellofemoral ligament, and they all differ with regard to graft choice and fixation method. They are all designed to reestablish the checkrein against lateral patellar motion. The medial patellofemoral ligament is most important during the first 30° to 45° of knee flexion, during which it allows the patella to engage the trochlea properly. Increased flexion causes the medial patellofemoral ligament to relax as the trochlear anatomy provides stability to the patellofemoral joint. After graft fixation is obtained, the knee should be examined to ensure that there is a full range of motion with a good end point to lateral translation in full extension and at 30° of flexion. When the surgeon is tensioning the medial
patellofemoral ligament graft, it should tighten only on lateral patellar translation. Obtaining the appropriate amount of tension in the reconstruction guarantees that the patella is not overconstrained. It is extremely important to not overtighten the medial structures and constrain patellofemoral motion, regardless of the realignment procedure that is chosen. Elias and Cosgarea showed that small errors in graft length and position in medial patellofemoral ligament reconstructions involving use of a hamstring autograft can dramatically increase the force and pressure applied to the medial patellofemoral cartilage.

Another important step during a reconstruction of the medial patellofemoral ligament is placement of the femoral attachment. The origin of the medial patellofemoral ligament is located on the ridge between the adductor tubercle and the medial femoral epicondyle. When the femoral fixation is too proximal, the medial patellar facet can become overloaded with increasing flexion. When the femoral fixation is too distal, the medial patellofemoral ligament can become inappropriately tight in extension and prevent the patella from engaging the trochlea correctly. The principle of isometry enables the graft and the trochlea to function in tandem to allow the patella to enter the trochlea smoothly at about 30° to 45° of knee flexion. Placement of guidewires to secure a length of suture as the knee is moved through a range of motion can help to determine isometry prior to drilling of the graft tunnels. In addition, fluoroscopic images can be helpful to confirm graft placement on the femur and to prevent violation of the patellar articular surface. When these principles have been strictly followed, reconstruction of the medial patellofemoral ligament has been found to have good results at up to five years postoperatively.

weeks. Use of the brace and crutches is discontinued by six weeks after the surgery. Progressive quadriceps-strengthening exercises are advanced, with return to sports activities usually after three months.

Because of a high prevalence of medial articular lesions after dislocation, caution must be exercised when performing a reconstruction of the medial patellofemoral ligament, with a need to consider the location of the articular lesions in the design of the procedure. There is a risk that the reconstruction of the medial patellofemoral ligament will add a load to a medial articular lesion. According to Myers et al., this procedure should be reserved for patients who have sustained a dislocation and require stabilization. In the opinion of one of us (J.P.F.), reconstruction of the medial patellofemoral ligament with a tendon graft should be reserved for patients with more severe dysplasia (in whom the procedure is often combined with tibial tubercle transfer), a grossly deficient medial structure with failure of the medial patellofemoral ligament to heal, or generalized laxity and for salvage following a failed imbrication of the medial patellofemoral ligament in patients with a normal TT-TG index. One alternative for medial patellofemoral ligament reconstruction is to completely avoid drilling into the patella and pass the tendon graft deep to the vastus medialis obliquus tendon and through it at its patellar attachment site, suturing the patellar side of the graft to the vastus medialis obliquus tendon and also to the quadriceps tendon immediately above (Fig. 12).

Medial Imbrication and Vastus Medialis Obliquus Advancement

Insall et al. initially described an extensive medial imbrication procedure. After exposure of the quadriceps mechanism, two incisions are made. The first incision is a medial parapatellar arthrotomy that passes over the medial quarter of the patella. The second is a lateral release extending just distal to the fibers of the vastus lateralis. Realignment is performed by advancing...
the medial flap containing the vastus medialis obliquus laterally and distally in the line of the fibers of the vastus medialis. After suturing, the incision lies in a straight line across the front of the patella, and the lateral release should be left open. Insall et al.\(^3\) reported a 91% rate of good or excellent results at forty-eight months following the performance of this procedure to treat symptoms of recurrent patellar subluxation in fifty-three knees. Hughston and Walsh\(^4\) recommended isolated proximal realignment in patients with instability when the Q angle is $<10^\circ$ and the addition of medialization of the tibial tubercle when the angle is $>10^\circ$. This strategy resulted in a 71% rate of good or excellent results. The extensive medial imbrication described by Insall et al. is not utilized as frequently now because it is more likely to cause abnormal contact stresses in the patellofemoral joint and to be followed by postoperative stiffness. Nam and Karzel\(^5\) described a less invasive surgical technique that included a mini-open medial reefing and an arthroscopic lateral release for the treatment of patellar dislocation. Of twenty-three knees that were treated with this procedure, one had recurrent dislocation and one had subluxation at a mean of 4.4 years postoperatively. The redislocation rate compared favorably with that following use of traditional, more extensile open approaches. The authors concluded that the mini-open technique provides anatomical restoration with limited morbidity and cosmetically appealing results.

Many methods of realigning the patella have been described. Most techniques for proximal realignment involve an open medial reefing or advancement of the vastus medialis obliquus. A less extensive imbrication of the medial retinaculum may also be accomplished arthroscopically. Ali and Bhatti\(^6\) reported a 78% rate of good or excellent results at a mean of fifty-one months after arthroscopic proximal realignment. With this technique, spinal needles are utilized to pass a series of sutures medial to the patella; the sutures are subsequently retrieved under the skin and tied to plicate the medial retinaculum in a nonspecific fashion. Halbrecht\(^7\) described a similar technique, in which the medial imbrication was performed by percutaneous passage of sutures followed by knot tying inside the joint, thus eliminating the need for extra incisions. All patients also had a lateral release. At two years postoperatively, 93% of their twenty-six patients reported substantial subjective improvement with no redislocations. Whether the imbrica-
tion is open or arthroscopic, the goal is to rebalance the patella within the trochlea without overtightening the medial structures, which ultimately would increase patellar contact pressures. The main feature of this surgery is reestablishing the proper length and tension of the medial patellofemoral ligament.

Lateral Retinacular Release
Historically, a lateral retinacular release was added to a medial stabilization procedure in the treatment of lateral patellar instability. The release was performed because it was believed that a tight lateral retinaculum was a predisposing factor for lateral patellar instability. More recently, indications have been refined, and a lateral release is considered to be appropriate only for patients with a tight retinaculum and patellar tilt. Dainer et al. reported worse results when a lateral release was added to medial capsular repair, with a higher prevalence of redislocation and fewer good or excellent results. Kolowich et al. found that the most predictable criterion for the success of a lateral release was a negative passive patellar tilt on physical examination. In this study, all twenty-eight patients who received a lateral release alone for the treatment of patellar instability continued to have episodes of dislocation.

An improperly performed lateral release can cause medial patellar subluxation, a particularly debilitating problem. In the majority of cases, a lateral release extending just proximal to the proximal patellar pole is all that is needed. Maintaining an intact vastus lateralis helps to reduce medial patellar subluxation and pain. Hemarthrosis is the most common postoperative complication.

Most surgeons recommend that a lateral release never be used in isolation for the treatment of patellar instability. However, it may be performed as an adjunct when there is residual patellar tilt due to an excessively tight lateral retinaculum after the medial structures, specifically the medial patellofemoral ligament, have been addressed.

Distal Realignment
Distal realignment is the preferred treatment if there is an abnormal trochlea or a high patella. It is accomplished by the transfer of the tibial tubercle distally to allow the patella to engage correctly in the trochlea. As a result, the Blackburne-Peel index is lowered to the normal range.

Anteromedial Tibial Tubercle Transfer (Fulkerson Procedure)
Transferring the tibial tubercle has long proven to be effective for the treatment of patellar instability. This procedure is meant to correct the Q angle by medializing the tibial tubercle, and it should be used only when the patella does not track in the central part of the trochlea. Following the transfer, cortical screws are used to secure the transferred tubercle. The tubercle is anteriorized as well to unload the patellofemoral joint and produce a proximal shift of contact area for any given degree of flexion. The shift in contact area is attributed to a change in the angle between the patellar tendon and the quadriceps tendon and the distal shift of the patella in relation to the trochlea.

When the use of an anteromedial tubercle transfer is being considered, it is helpful to consider the severity and pattern of articular degeneration. Some patients with patellofemoral instability may also have secondary dysplastic changes, and the trochlea may be flattened from long-standing lateral patellar tracking. As a result, any lateral tracking will be exacerbated by this secondary trochlear deficiency. This may produce continued strain on the medial patellofemoral ligament. As the medial patellofemoral ligament is stretched over time, it leads to a further predisposition of the patella to dislocate.
laterally. The hallmark reason for moving a tibial tubercle medially is an increased TT-TG index. Imaging with either computed tomography or magnetic resonance imaging allows specific measurement of the distance in millimeters between the tibial tubercle and the center of the trochlear groove. Complications from this procedure include tibial fracture, a prominent tubercle, and skin necrosis. Patients should remain non-weight-bearing for six to eight weeks postoperatively. The rates of good results following the procedure range from 89% to 93%.

Trochleoplasty
Trochleoplasty procedure was first described by Albee. It is an elevating osteotomy of the lateral trochlear facet, and it is performed to correct trochlear dysplasia. A consistent complication of the procedure is disruption of the cartilage surface and changes in the contact pressure, potentially of the cartilage surface and changes in the contact pressure. Complications from this procedure include tibial fracture, a prominent tubercle, and skin necrosis. Patients should remain non-weight-bearing for six to eight weeks postoperatively. The rates of good results following the procedure range from 89% to 93%.

Overview
Patellofemoral instability is a difficult condition to treat, and the anatomy of the joint and its stabilizing structures must be taken into account. The aim of the surgical technique should be to restore the normal anatomy of the joint. We recommend restoring the balance of patellar tracking as a first step for the treatment of patellar instability. The restoration of normal restraints should then follow. Treatment of patellar instability with a repair or reconstruction of the medial patellofemoral ligament, in conjunction with a tibial tubercle osteotomy if indicated to correct the Q angle, provides acceptable results. When the medial patellofemoral ligament is intact but attenuated, an imbrication of that ligament and the medial retinaculum can be performed. Alternatively, when medial patellar stabilizers are attenuated, when the patient has congenital dislocation or severe generalized ligamentous laxity, or when a revision is being performed, reconstruction of the medial patellofemoral ligament with a tendon graft is a viable option to restore patellar stability. There is a need for future studies to compare repairs of the medial patellofemoral ligament with reconstructions of the medial patellofemoral ligament with use of a graft for the treatment of lateral patellar instability. A tibial tubercle osteotomy is an essential adjunct to repair of the medial patellofemoral ligament in patients with a large Q angle or severe trochlear dysplasia. Most surgeons recommend that a lateral release never be used in isolation for the treatment of patellar instability. However, it may be performed as an adjunct when there is residual patellar tilt after the medial retinacular structures, specifically the medial patellofemoral ligament, have been addressed.

References


