Technical Note

Lateral Patellar Retinaculum Z-Lengthening

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The lateral retinaculum is a 2-layered structure. The plane between the superficial oblique fibers and the deep transverse fibers allows for coronal plane Z-lengthening of the lateral retinaculum. The lengthening procedure can be used for treatment of lateral patellar hypercompression syndrome or as an adjunct to surgical procedures undertaken to address patellar instability. This article describes the surgical technique for lateral retinacular lengthening. **Level 1:** Knee. **Level 2:** Malalignment, patellofemoral, other.

Lateral retinacular release (LRR) was first described by Merchant and Mercer in 1974[1] for treatment of parapatellar pain and patellar instability. It was initially perceived to be a simple, low-morbidity procedure, and its indications were expanded to include various forms of knee pain and patellar instability. Since then, many authors have recognized and reported on the deleterious effects of an unindicated or overzealous LRR. Hughston and Deese published the first report of iatrogenic medial instability after LRR.[2] Besides medial patellar instability, other reported complications of LRR include quadriceps weakness, quadriceps atrophy, lateral patellar instability, and disabling pain.

As the role of the lateral retinaculum in patellar stabilization was increasingly recognized, lateral retinacular lengthening (LRL) was proposed as an alternative to LRR.[2] The advantages of LRL over LRR include controlled elongation of lateral retinaculum, maintenance of vastus lateralis/quadriceps tendon integrity and avoidance of lateral void, synovial herniation and joint swelling. The indications for LRL include lateral patellar hypercompression syndrome and as an adjunct to surgical procedures performed to address patellar instability. The lateral retinaculum is considered to be tight if the patellar tilt is 20° or more on axial imaging with the knee in extension and if it cannot be passively corrected to a neutral position[3] (Fig 1).

The anatomy of the lateral retinaculum has been widely studied. Despite some variations in terminology and the reported structures comprising the lateral retinaculum, the 2-layered arrangement of the

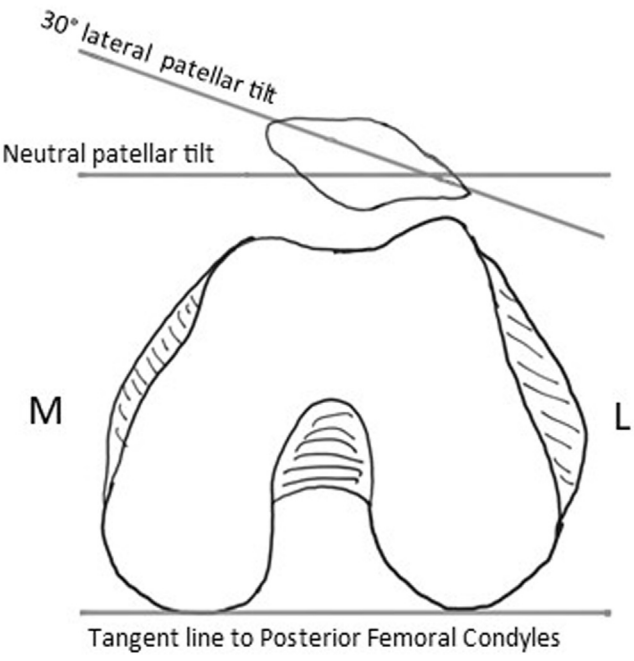

Fig 1. Illustration of excessive lateral patellar tilt greater than 20° with reference to the posterior femoral condyles.

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Table 1. LRL Technical Keys, Pearls and Pitfalls

Technical Keys	Pearls	Pitfalls
1. Imaging: Review axial views on MRI/CT to measure patellar tilt	• Patellar tilt is better measured on axial CT/MRI with knee in extension. • Transverse axis of the patella and tangen tial line to posterior femoral condyles • >20° lateral patellar tilt is considered abnormal.	• Axial radiographic views alone may underestimate patellar tilt due to trochlear engagement with knee flexed.
2. Examine under anesthesia: Bilateral knees. Confirm lateral retinacular tightness	• Subluxating or dislocatable patella • Quadrants of medial patellar mobility: ≤1 of 4 quadrants is considered to be tight. • Passively uncorrectable patellar tilt	
3. Incision: Knee is flexed 45°. Carefully incise and separate the 2 layers of the lateral retinaculum with the Z-type step-cut.	• Knee flexed position provides tension to the lateral retinaculum to aid in dissection and closure • Both retinacular layers are adherent and not easily identifiable. Use a sharp, fresh scalpel when dissecting between retinac ular layers. • Start midpatellar where these layers are the most robust and definable.	• Inadvertent violation of deep layer may occur during dissection. This may leave rents during closure but should not affect the overall integrity of the lateral retinaculum.
4. Extensile incisions: Avoid cutting into the vastus lateralis tendon (VLT) and superior lateral genicular artery (SLGA).	• Violating these structures increases pain, atrophy and postoperative quadriceps inhibition and risks patellar avascular necrosis. • SLGA runs along the inferior aspect of the VLT, near superolateral patellar border.	
5. Complete arthrotomy	• Though not necessary, it can ensure removal of all lateral tethers and allow joint inspection and is, therefore, recommended.	
6. Evaluate lengthening adequacy by patellar tilt and subluxation tests.	• Medially evert the lateral patellar edge to 30° but no more. • Prior described tilt of 60°-90° suggests over-release and risk of iatrogenic medial instability. • Medial translation of 1-2 quadrants is adequate.	• If the patella can be everted to 90 degrees, the lateral retinaculum is over-released or over-lengthened. This should be avoided.
7. Closure: Knee is in 45° flexion, and patella is engaged within the trochlea.	• Closure with the patellofemoral joint engaged aids with proper tensioning to avoid retightening laterally or excessive lengthening and medial instability unrecognized with the knee extended.	In long-standing or severe lateral contracture it may be difficult to lengthen the entire length. In such cases, start closure midpatella and proceed proximal and distal. It is better to leave a void proximal or distal rather than a tight closure.

retinaculum is accepted. The superficial oblique retinacular fibers receive contribution from the fascia of the vastus lateralis. The deep transverse retinacular fibers are composed of the lateral patellofemoral ligament and receive contribution from the iliotibial band. The plane between these 2 layers facilitates a coronal plane Z-plasty lengthening of the lateral retinaculum.

Surgical Technique

The surgery (Video 1) is performed under general anesthesia with regional nerve block. The patient is positioned supine on a radiolucent table. An examination under anesthesia is performed with the knee in extension to evaluate for patellar subluxation in medial and lateral directions and to evaluate the extent of passive correction of lateral patellar tilt (Table 1). If the medial subluxation is 1 quadrant or less, and if the patella cannot be everted up to a neutral position (Fig 1), then the lateral retinaculum is considered to be tight.

The tourniquet is inflated, and the knee is flexed about 45° over a triangle or bolster (Table 1). A 5-6 cm longitudinal skin incision is placed on the anterior aspect of the knee (Video 1). If both medial and lateral-sided surgery are planned, the incision is placed in the midline (Fig 2) (Video 1); otherwise, the incision is placed just lateral to the lateral border of the patella. Subcutaneous flaps are created, and the lateral retinaculum is identified (Fig 2).

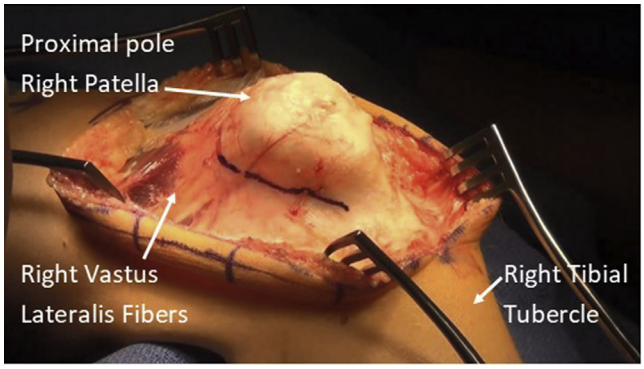

Fig 2. Midline approach to the right anterior knee with patient in supine position and planned lateral retinacular incision, with emphasis on avoiding proximal extension into the vastus lateralis tendon.

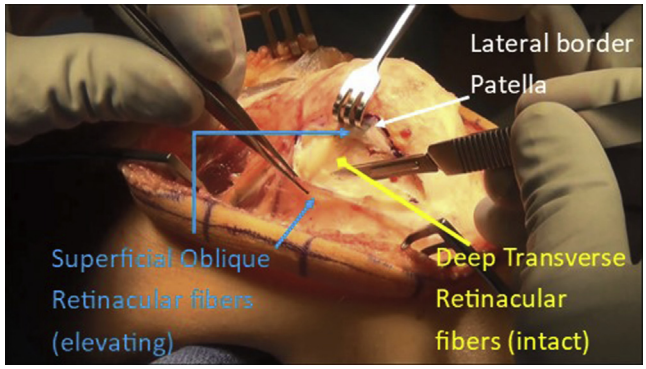

Fig 4. Patient's right knee, in supine position. Development of the fascial plane between incised superficial oblique (blue) and intact deep transverse fibers (yellow).

A longitudinal parapatellar retinacular incision is made about 8-10 mm lateral to the lateral border of the patella (Fig 2). The proximal-distal extent of the incision is from the superolateral aspect of the patella to its inferolateral aspect; care is taken to avoid transection of the vastus lateralis tendon proximally (Fig 2). The incision can be extended distally toward the Gerdy tubercle and farther along the lateral border of the patellar tendon if a concomitant distal stabilization procedure (e.g., tibial tubercle osteotomy) is planned. The depth of the incision is controlled to cut only the superficial oblique fibers of the lateral retinaculum (Fig 3) (Fig 4) (Video 1). Sharp dissection is then performed posteriorly (laterally) between the superficial oblique fibers and the deep transverse fibers of the lateral retinaculum (Fig 3) (Fig 4) (Video 1). The plane between the 2 retinacular layers is best defined along the midpatella, where the retinaculum is dense and thicker (Table 1) (Video 1), before becoming tenuous at its proximal and distal extent.[4] Once about 1.5-2 cm of posterior dissection has been performed, a second longitudinal incision is made through the deep transverse retinacular fibers, and synovial layer (Fig 3) (Fig 5). The arthrotomy is completed, and the knee is extended to assess for any intra-articular lesions (Fig 5). Arthrotomy is not always required. Care is taken to avoid lateral superior genicular vessels at the proximal extent of the dissection.

With the knee flexed 45° (Table 1), the 2 free edges of the retinaculum should lie at the desired length when at rest. The free posterior edge of the superficial retinaculum is tentatively sutured to the anterior free edge of the deep retinaculum/capsule using a few interrupted 0-Vicryl sutures (Fig 6), allowing for a coronal plane Z-plasty elongation of the lateral retinaculum (Fig 6) (Video 1). The amount of lateral retinacular length achieved is generally 1.5-2 cm, though it could range from 1-3 cm, depending on the amount of posterior dissection between the 2 retinacular layers (Fig 6). The knee is extended and the adequacy of the LRL is confirmed by the ability to evert the patella to about 30° past neutral (Fig 7) and achieve 1-2 quadrants of medial patellar translation (Fig 8) (Table 1). The lateral retinacular length can be adjusted as needed by imbricating the 2 free edges of the retinaculum. Once satisfied with amount of LRL, the repair between the 2 free retinacular edges is reinforced by using interrupted 0-

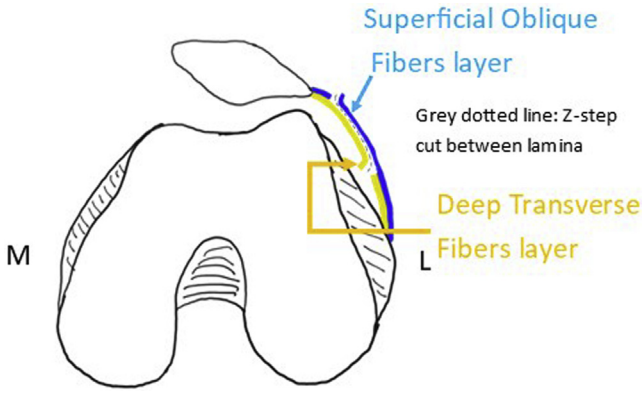

Fig 3. Illustration of 30° lateral patellar tilt superficial oblique fibers (blue) and deep transverse fibers (yellow) for coronal Z-lengthening step-cut (dotted black).

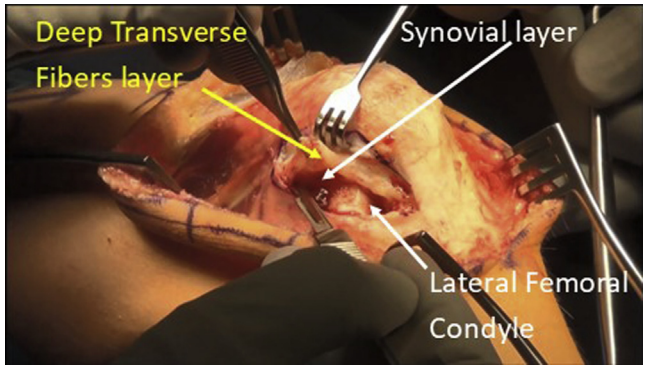

Fig 5. Patient's right knee, in supine position. Longitudinal incision through the deep transverse fibers (yellow) and capsular layer (white) completing the Z-incision. The lateral femoral condyle is visible in this example.

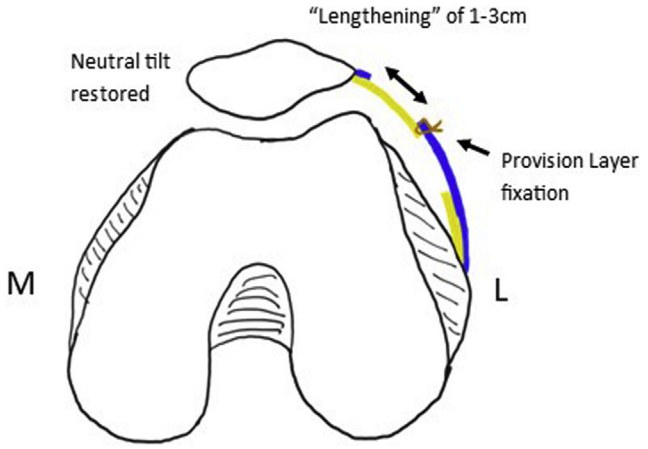

Fig 6. Illustration of neutral patellar position after lengthening the lateral retinaculum with provisional suturing.

Vicryl sutures (Fig 6) (Video 1). Subcutaneous tissues are closed using 2-0 Vicryl sutures, and subcuticular closure is performed using 4-0 Monocryl sutures. Steristrips are applied, followed by standard dressing.

The postoperative course is dictated by the concomitant procedures performed along with LRL. For isolated LRL, no knee immobilization or weight-bearing restrictions are applied. Active and passive range of motion and static quadriceps exercises are initiated in physical therapy in the first postoperative week. After pain and swelling have been controlled, resistive quadriceps exercises are initiated. The patient is released to full activities approximately 3 months postoperatively.

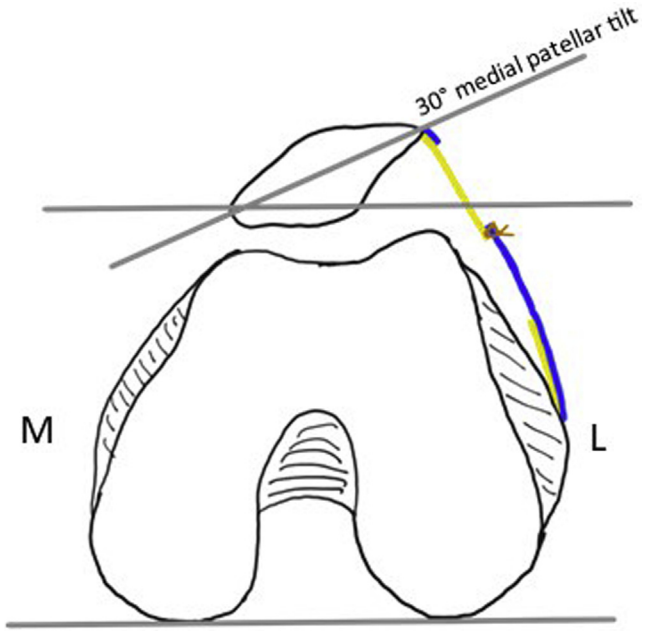

Fig 7. Illustration of 30° (maximum) medial patellar tilt after repair, verifying the adequacy of lengthening and provisional repair.

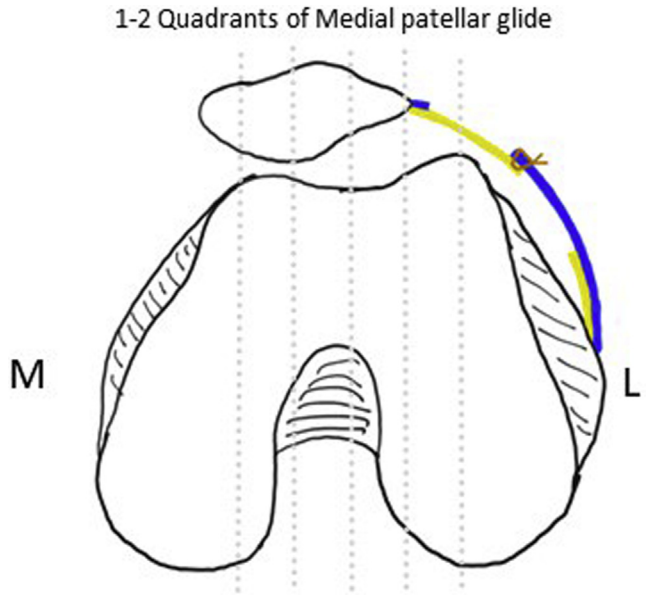

Fig 8. Illustration of acceptable 1-2 quadrants of medial patellar subluxation after retinacular lengthening.

Discussion

In a prospective double-blinded study comparing the complications and outcomes of open LRR and LRL in the treatment of lateral patellar hypercompression syndrome, LRL demonstrated less medial instability, less quadriceps atrophy and improved clinical outcomes at 2 years when compared with LRR.[5,6] In another randomized controlled study comparing arthroscopic LRR and LRL in patients with anterior knee pain and patellar tilt, patients with LRL had significantly better knee scores, were more likely to return to previous levels of athletic activity and demonstrated better quadriceps strength on isokinetic dynamometer testing.[7] In both studies, however, the LRR was considered complete only when the lateral border of the patella could be rotated 90° anteriorly, with the patella standing on its medial edge; this extent of LRR would be an over-release and should be discouraged.

Isolated lateral-sided procedures should not be performed when treating patellar instability.[8] If the patellar tilt is >20° on axial imaging (CT scan or magnetic resonance imaging) with the knee in extension and cannot be passively corrected to the neutral (0°) position, then LRL should be considered as an adjunct to other stabilizing procedures, including medial patellofemoral ligament reconstruction or tibial tubercle osteotomy.[9] During trochleoplasty, LRL may be used as an approach to access the dysplastic trochlea.[10] During quadricepsplasty for a complex patellar instability pattern, wide lateral releases are necessary. LRL during such procedures would prevent a large lateral void and synovial herniation and would provide a passive restraint to patellar eversion from medial over-pull of the transposed quadriceps mechanism. Additionally, a

Table 2. LRL: Advantages and Disadvantages

LRL	Advantages:	Disadvantages:
	• Controlled lengthening • Achieve Joint closure • Less swelling • Avoid iatrogenic medial instability • Avoid quadriceps atrophy	• Recurrence: Lateral retinaculum may can get scarred and/or shortened again, leading to recurrence • Incomplete release • Over-lengthening

competent lateral retinaculum has been confirmed in biomechanical studies to prevent lateral patellar instability.[11] Besides patellar instability, LRL would be indicated for patellofemoral pain secondary to lateral patellar hypercompression syndrome that is refractory to conservative treatment.[5]

Although LRR can also be performed without a formal arthrotomy of the joint by keeping the synovial layer intact and cutting the capsular layer, LRL as an alternative offers several advantages (Table 2). The advantages of LRL include controlled lengthening that maintains the continuity of the vastus lateralis (thereby decreasing quadriceps weakness and atrophy and allowing faster rehabilitation), prevention of iatrogenic medial instability, prevention of excessive swelling, and avoidance of egress of synovial fluid in the subcutaneous tissues. The potential complications of LRL include cosmesis, recurrence of a tight lateral retinaculum resulting from the scarring of tissues, injury to the superior or inferior lateral genicular arteries, saphenous neuroma, and wound-healing issues.[2]

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