Treatment of patellofemoral malalignment with anterior knee pain

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Background
Despite its high incidence, anterior knee pain syndrome is the most neglected, the least known, and the most problematic pathological knee condition. It was related to the presence of patellofemoral malalignment and patellofemoral arthritis. In this study the clinical results of arthroscopic lateral release of the patella with radiofrequency ablation in patients with recalcitrant anterior knee pain unresponsive to conservative treatment were reported.

Patients and methods
Between 2007 and 2009, 13 consecutive patients with anterior knee pain associated with patellofemoral malalignment were treated by arthroscopic lateral release of the patella. Patients were followed up prospectively for at least 1 year from surgery.

Results
The mean Feller patellofemoral score increased from 9 preoperatively to 27.5 at the final follow-up. There was significant relief from patellofemoral pain postoperatively compared with before operation.

Conclusion
Arthroscopic lateral release of the patella with radiofrequency ablation is effective in relieving pain and in correction of patellar maltracking with decreased loading of the lateral patella/trochlea.

Keywords:
anterior knee pain, arthroscopic, patellofemoral malalignment

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Introduction

Anterior knee pain is the most common knee complaint seen in adolescents and young adults in both the athletic and nonathletic population, although in the former its incidence is higher. The rate is around 9% in young active adults [1,2]. Its incidence is 5.4% of the total injuries and as high as a quarter of all knee problems treated at a sports injury clinic [3,4]. Furthermore, it is to be expected that the number of patients with this complaint will increase because of the increasing popularity of sport practice. Further, a better understanding of this pathology by orthopedic surgeons and general practitioners should lead to this condition being diagnosed increasingly more frequently. Despite its high incidence, anterior knee pain syndrome is the most neglected, the least known, and the most problematic pathological knee condition. For many years, patellofemoral malalignment (PFM), an abnormality of patellar tracking that involves lateral displacement or lateral tilt of the patella (or both) in extension that reduces in flexion, was widely accepted as an explanation for the genesis of anterior knee pain and patellar instability. Acute patellar dislocation is a common injury that can lead to disabling knee pain and/or recurrent instability. In the past 10 years, research has begun to focus on the injuries associated with acute patellar dislocation and the specific contributions the injured structures make to patellar stability in intact knees. The implication is that injury to specific structures may have important consequences in converting a previously asymptomatic, though perhaps abnormal, patellofemoral joint into one that is painful and/or unstable. These studies have been intended to improve the precision of surgical treatment for patellar instability [5].

Arthroscopic lateral release of the patella with electrocautery was first reported in the literature in 1982 [6]. Its prime advantage over standard lateral release procedures is the potential to minimize postoperative bleeding and subsequent hemarthrosis. The reported rate of significant postoperative hemarthrosis has decreased from more than 15% to less than 5% with the use of electrocautery [7]. Other advantages of this technique include improved arthroscopic visualization during transection of the lateral retinaculum and a decrease in postoperative pain by minimizing the potential for significant postoperative hemarthrosis.

This allows the patient to participate in an earlier, aggressive rehabilitation program that may improve the ultimate results of surgery.

Patients and methods

Between 2007 and 2009, 13 consecutive patients with anterior knee pain associated with PFM were treated by arthroscopic lateral release of the patella with electrocautery. All were men with a mean age of 29.5 years (range = 21–33 years). Nine were treated for the right knee and four for the left knee. Patients were excluded if they had a previous ipsilateral fracture of the patella, additional injury to the ipsilateral lower extremity, a pathological condition of the bone, a terminal disease, or polytrauma, or were unwilling or unable to attend follow-up.

Indications for arthroscopic lateral release of the patella included recalcitrant anterior knee pain unresponsive to conservative treatment with the following:

(1) Tightness of the lateral retinaculum associated with lateral patellar tilt (excessive lateral pressure syndrome);
(2) Patellofemoral arthritis associated with lateral patellar tilt; or
(3) Recurrent patellar subluxation/dislocation.

Seven patients had patellofemoral subluxation and six patients had patellofemoral arthritis.

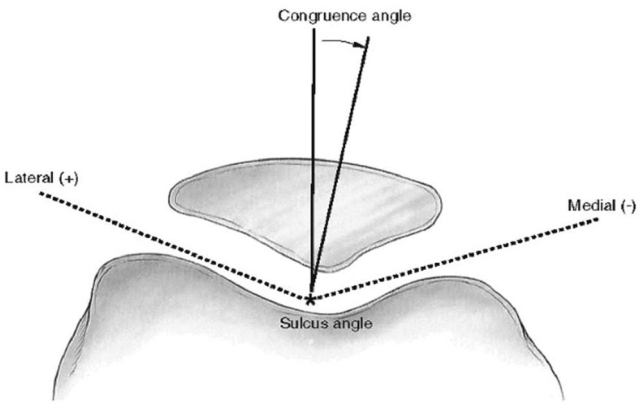
Preoperative planning

Patient evaluation began with a careful detailed history. It was important to note whether the onset of the presenting pain was insidious or related to a specific or repetitive trauma. The history was then confirmed by a thorough physical examination. Key points of the physical examination included assessment of the sitting Q_angle, patellar apprehension test, active and passive patellar tracking, and specific muscle tightness. In addition, the presence of vastus medialis obliques (VMO) atrophy was assessed.

The evaluation for patellar tilt and glide was an important part of the physical examination. Patellar tilt was performed with the patient in the supine position and the knee in full extension. Normally, the lateral side of the patella can be elevated above the horizontal. Inability to do this indicates tightness of lateral restraints, and correlates with a higher success rate with surgery in symptomatic patients who undergo lateral release. Testing of the patellar glide was performed with the knee in 30° of flexion. A lateral glide of greater than 75% of the patellar width suggests incompetent medial restraints, whereas a medial glide of less than 25% indicates tightness of the lateral restraints [8].

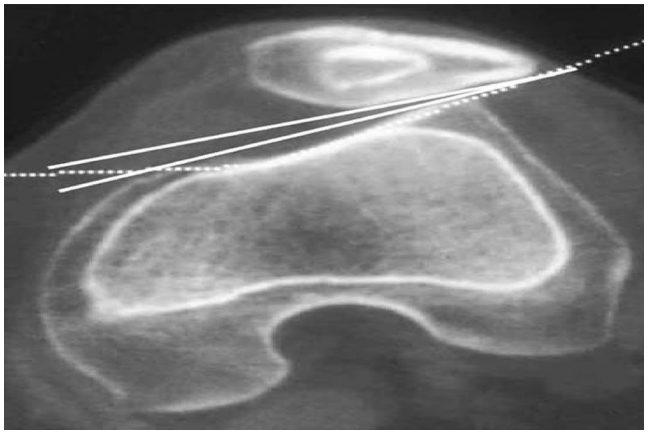
Radiographic evaluation consists of a standing posteroanterior view in 30° of flexion, a lateral view in 30° of flexion, and a Merchant tangential view. These radiographs were evaluated for bipartite patella, occult fractures, tibiofemoral arthritis, patella alta, and patellar malalignment. Abnormalities in patellar height can be associated with symptomatic anterior knee pain. Insall and Salvati's ratio, normally 0.8 to 1.2, was calculated from the lateral view in 30° of flexion. It is determined by the diagonal length of the patella divided by the length of the patellar tendon. A ratio of 0.8 or less demonstrates patella alta, whereas a ratio greater than 1.2 indicates patella baja. The lateral radiograph was used to measure trochlear depth and dysplasia. The Merchant view was obtained with the patient supine and the knee flexed 45° [9]. The x-ray beam was directed from cephalad to caudad, 30° from the horizontal. Both patellofemoral joints were imaged on a single cassette, allowing calculation of the sulcus angle (normal: 130°; range: 126–150°; SD: 6°) and the congruence angle (normal: −6°; SD: 11°). The congruence angle was determined by bisecting the sulcus angle to establish a reference line. A second line was then drawn from the apex of the sulcus to the lowest point on the articular ridge of the patella. A negative value was designated if the apex lies medial to the reference line. Any angle greater than +16° was associated with PFM (Fig. 1). The mean preoperative congruence angle was 22 (range: 18–26°). Computerized tomography has a higher significance in evaluating patellar alignment and tracking. Computerized tomography cuts at 0, 15, 30, and 45° were performed, which allowed the relationship of the patella to the tibial tubercle, as well as calculation of the patellar tilt angle (Fig. 2).

Figure 1



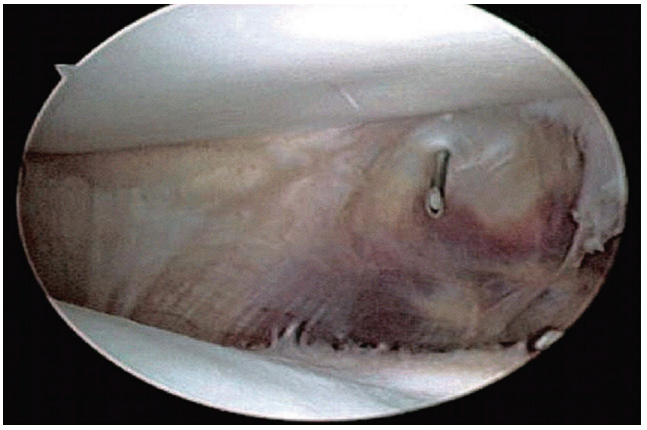
Calculation of the congruence angle.

Figure 2



Computed tomography (CT) showing patellofemoral malalignment.

Figure 3



An 18-G needle placed through the lateral patellar retinaculum just proximal to the level of the superior pole of the patella for orientation.

Surgery

Patient positioning: The patient was placed on the operating table in the supine position. Routine diagnostic arthroscopy was performed using two standard portals. A separate superolateral viewing portal was also used to assess tracking. An 18-G needle was placed through the lateral patellar retinaculum just proximal to the level of the superior pole of the patella for orientation. This denotes the upper level of the retinacular release (Fig. 3) and should help prevent transection of the quadriceps tendon and extension of the release too proximally into the vastus lateralis muscle fibers. The arthroscopic and working portals were then switched; the radiofrequency ablation was inserted through the anterolateral portal and the arthroscope anteromedially. The lateral retinaculum was released from a proximal to a distal direction, beginning at the level of the needle, 1 cm proximal and lateral to the superior edge of the patella, with the knee in full extension. The tissue was released in layers in a controlled and well-visualized manner. The proximal release was not extended into the muscle fibers of the vastus lateralis or quadriceps tendon. The release was continued distally to just below the inferior pole of the patella. The resection was proceeded stepwise through the tissue layers until the superficial fat was seen; this layer was preserved (Fig. 4). Upon completion of the release, the positive inflow pressure was reduced and supplemented with gentle suction to allow identification and coagulation of any additional source of bleeding. After a full release has been completed, there should be strong outflow of irrigant from the inferior lateral portal once the wand has been removed. Adequate release is confirmed by the ability to manually evert the patella in the femoral groove with the knee in full extension.

Postoperative management

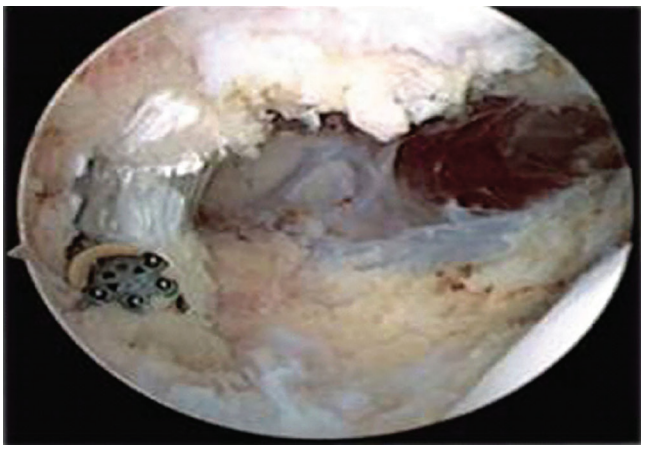
The immediate postoperative management and treatment was aimed at decreasing pain and swelling with rest, ice, compression, and elevation. Patients were encouraged to start isometric exercises in the immediate postoperative course. They were allowed range of motion and weight-bearing as tolerated. Ice and crutches were used for comfort and ambulation until muscle control of the extremity was re-established. Formal physical therapy usually began at the first postoperative visit 5–7 days after surgery. The knee was not immersed in water for 2 weeks postoperatively. Patients returned to work within 3–4 days after surgery. Crutches were recommended for several weeks for walking any distance, but shorter distances were negotiated without crutches after only a few days. Limiting prolonged standing and walking for the first few weeks after surgery helps prevent the development of a large effusion, which may slow the recovery process. It took 3–4 months for most patients to reach maximum recovery.

Preoperative and postoperative functional evaluation was done using a Feller patellofemoral questionnaire [10] that evaluates the patellofemoral function (Table 1). It evaluates the presence of anterior knee pain, the quadriceps strength, and the ability of the patient to rise from a chair and to climb stairs. It gives 15 points for a nonpainful patellofemoral joint, 5 points for good quadriceps muscle, 5 points for ability to arise from a chair with ease, and 5 points for normal stair climbing. Thus, a well-functioning patellofemoral joint will be given 30 points. Excellent results ranged from 25 to 30, good results ranged from 20 to 24, fair results ranged from 15 to 19, and poor results were those below 14.

Statistical methods

Quantitative data were expressed in means and ranges. Statistical analysis was undertaken using the χ^2-test

Figure 4



The use of electrocautery to release the lateral retinaculum.

and the Fisher's exact test for qualitative data. Statistical significance was defined as a *P* value less than 0.05.

Results

Examination under anesthesia revealed that all patients had tightness of the lateral patellar retinaculum. The mean follow-up period was 13.2 months (range = 11–15 months). Three patients had postoperative hemoarthrosis. The mean Feller patellofemoral score increased from 9 preoperatively to 27.5 at the final follow-up. There were eight excellent, three good, and two fair results. None of the patients had poor results. The mean preoperative congruence angle was 22, which improved to 14 postoperatively. There was no postoperative infection. There was significant relief from patellofemoral pain postoperatively compared with before operation. Patients with preoperative patellofemoral subluxation gave better results than patients with patellofemoral arthritis (Table 2). No patients reported infection, thermal injury to the skin, or quadriceps weakness postoperatively. Two patients reported postoperative pain.

Discussion

For many years, PFM, an abnormality of patellar tracking that involves lateral displacement or lateral tilt of the patella (or both) in extension that reduces in flexion, was widely accepted as an explanation for the genesis of anterior knee pain and patellar instability, the most common knee complaints in clinical practice in young patients. Moreover, this concept had a great influence on orthopedic surgeons, who developed several surgical procedures to 'correct the malalignment', such as Insall's proximal realignment [11]. Currently, however, this concept is questioned by many and is not universally accepted to account for the presence of anterior knee pain and/or patellar instability. In fact, the number of realignment surgeries has dropped dramatically in recent years because of a reassessment of the paradigm of PFM. Despite a large body of literature on patellofemoral realignment procedures, little information is available on the in-depth long-term result of these surgical procedures. In the 1970s anterior knee pain was related to the presence of PFM. In 1968, Jack and Hughston published an article on subluxation of the patella, which represented a major turning point in the recognition and treatment of patellofemoral disorders. In 1974, Merchant *et al.* [12] in an attempt to better understand patellofemoral biomechanics introduced the axial radiograph of the patellofemoral joint. The same author suggested, also in 1974, the lateral retinacular release as a way of treating recurrent patellar subluxation [13]. In 1975, Ficat and Bailleux [14] from France popularized the concept of patellar tilt, always associated with increased tightness of the lateral retinaculum, which caused excessive pressure on the lateral facet of the patella, leading to the 'lateral patellar compression syndrome'. According to Ficat, lateral patellar compression syndrome would cause hyperpressure in the lateral patellofemoral compartment and hypopressure in the medial patellofemoral compartment. Hypopressure

Table 1 Details of the patellar score

Function	Score
Anterior knee pain	
None	15
Mild	10
Moderate	5
Severe	0
Quadriceps strength	
Good	5
Fair	3
Poor	1
Ability to rise from a chair	
Able with ease (no arms)	5
Able with ease (with arms)	3
Able with difficulty	1
Unable	0
Stair climbing	
1 foot/stair, no support	5
1 foot/stair, with support	4
2 feet/stair, no support	3
2 feet/stair, with support	2

Table 2 Relation between preoperative diagnosis and postoperative results

	Excellent	Good	Fair	Total
P/F subluxation	5	1	1	7
P/F arthritis	3	2	1	6
Total	8	3	2	13

and the disuse of the medial patellar facet would cause malnutrition and early degenerative changes in the articular cartilage because of the lack of normal pressure and function. Hyperpressure also would favor cartilage degeneration, which might explain the injury of the lateral facet. In fact, before the 1970s only two diagnoses were used relating to anterior knee pain or patellar instability: chondromalacia patellae and recurrent dislocation of the patella. In 1979, Insall [15] published a paper on 'patellar malalignment syndrome' and his technique for proximal patellar realignment, which was used to treat this syndrome [16]. According to Insall, lateral loading of the patella is increased in malalignment syndrome. In some cases, this causes chondromalacia patellae, but it does not necessarily mean that chondromalacia is the cause of pain [17]. In this way, in 1983 Insall *et al*. [18] reported that anterior knee pain correlates better with malalignment rather than with the severity of chondromalacia found during surgery. Fulkerson *et al*. [19] have also emphasized the importance of PFM and excessively tight lateral retinaculum as a source of anterior knee pain. In a previous paper [11] it was postulated that PFM in some patients with patellofemoral pain produces a favorable environment for the onset of symptoms, and neural damage would be the main 'provoking factor' or 'triggering factor.' Overload or overuse may be another triggering factor. In this study, it was found that in patients with symptoms in both knees, when the more symptomatic knee was operated on, the symptoms in the contralateral less symptomatic malaligned knee disappear or decrease in many cases, perhaps because the load is reduced in this knee; that is, it allows us to restore joint homeostasis. In this connection, Thomee *et al*. [20] suggested that chronic overloading and temporary overuse of the patellofemoral joint, rather than malalignment, contribute to patellofemoral pain. For many years, PFM has been widely accepted as an explanation for the genesis of anterior knee pain and patellar instability in young patients. Moreover, this theory greatly influenced orthopedic surgeons, who developed several surgical procedures to 'correct the malalignment.' Unfortunately, when PFM was diagnosed it was treated too often by means of surgery. A large number of surgical treatments have been described, which have yielded extremely variable results. In fact, the number of realignment surgeries has dropped dramatically in recent years because of a reassessment of the paradigm of PFM. Moreover, we know that such procedures are, in many cases, unpredictable and even dangerous; they may lead to reflex sympathetic dystrophy, medial patellar dislocations, and iatrogenous osteoarthrosis.

Arthroscopic lateral release of the patella with radiofrequency ablation is effective in relieving pain through decreased tension in the lateral retinaculum, partial denervation of the patella, and correction of patellar tilt with decreased loading of the lateral patella/trochlea. Complications of arthroscopic lateral release include the following: hemarthrosis, thermal injury to the skin, infection, medial subluxation following excessive lateral release, patellar hypermobility, quadriceps weakness, transection or rupture of the vastus lateralis insertion and/or quadriceps tendon, reflex sympathetic dystrophy, and persistent knee pain. The incidence of hemarthrosis can be reduced by careful attention to surgical detail, obtaining adequate visualization, and meticulous cauterization of all bleeding vessels. The lowest setting that allows adequate cutting and coagulation should be used to decrease the incidence of thermal injury to the overlying skin. Postoperative medial subluxation and patellar hypermobility occur primarily in those cases in which the lateral retinacular release is carried too proximally, or was misdiagnosed and not appreciated preoperatively. This represents a formidable treatment problem; if it exists but is not recognized preoperatively, it is often made worse by a lateral retinacular release. Superficial infections require special attention because of the potential for subcutaneous accumulation of blood that communicates with an underlying hemarthrosis. Intra-articular postoperative infections are rare. Patients with unusual postoperative pain and/or slow progress regaining knee motion deserve special attention. Two patients in this study had postoperative pain that related to the presence of significant arthritis of the patellofemoral joint preoperatively. The current study reported success rate in the range of 65–92%. These results bring to light the fact that it is imperative to reserve lateral release for those cases with definitive clinical, radiographic, and arthroscopic findings consistent with the surgical indications previously outlined. I believe that ~75% of my patients have achieved significant improvement following surgery. The degree and timing of improvement vary a great deal.

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Nil.

Conflicts of interest
There are no conflicts of interest.

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