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Arthroscopic Approaches to Proximal Realignment of the Patellofemoral Joint

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Abstract: Instability and pain from the patellofemoral joint continues to be a difficult problem for the orthopaedic surgeon. Numerous nonoperative modalities and operative procedures have been described with unpredictable and variable results. The natural history of patellar instability includes a high rate of recurrence, patient dissatisfaction, functional deficits, and subsequent surgical intervention. Unfortunately, the operative procedures are associated with unpredictable results and morbidities which may be severe. As new arthroscopically assisted procedures continue to be described, can these prevent recurrence or pain while limiting morbidity? This is particularly a concern in the skeletally immature patient or patient with normal femorotibial alignment where distal osteotomies may not be indicated. We present a literature review on the techniques and clinical results of arthroscopic approaches to proximal realignment, their relative indications, and an illustrated case example.

Introduction

Patellar instability and subsequent pain is a common problem encountered in orthopaedic surgery. The pathophysiology is poorly understood and treatment remains controversial. However, the natural history of nonoperative treatment for patellar instability is not benign. Longterm studies show the recurrence rate ranging from 20–44%, with up to 50% of patients unsatisfied and nearly 30% requiring surgical intervention [1,2,3]. Likewise, up to 50% of patients have significant functional deficits limiting return to sports participation [2,3]. Over 100 operative procedures have been described for the treatment of patellar instability [4]. Unfortunately, the operative morbidity includes stiffness, pain, recurrent instability, prolonged rehabilitation, and cosmesis.

As technological advances in arthroscopic approaches continue to improve, new techniques are being described to address patellofemoral problems. These focus on recreating the normal passive restraints to excessive patellar mobility without altering the dynamic effects of the quadriceps musculature. The goal is to prevent recurrence while limiting the morbidity associated with more aggressive open procedures. Under direct visualization, the surgeon can improve patellofemoral tracking and create more normal kinetics. This provides the benefit of a dynamic in-vivo evaluation to make whatever changes may be required intraoperatively. This is particularly attractive in the setting of a skeletally immature patient or one with normal skeletal alignment where a distal osteotomy may not be indicated. Ideally, in these patients, an arthroscopic approach will address the proximal soft tissue structures of the patellofemoral joint and reconstitute more normal anatomy and biomechanics.

Little has been written about these arthroscopic approaches. We present a literature review on the techniques and clinical results of arthroscopic approaches to proximal realignment, their relative indications, and an illustrated case example.

Anatomy and Biomechanics

The patellofemoral joint is an important component of the extensor mechanism which increases the efficiency of the quadriceps musculature while seeing loads up to 7.8 times body weight [5]. The stability of the joint is a balance of static and dynamic stabilizers. On cadavaric dissection, Warren and Marshall [6] identified the medial patellofemoral ligament (MPFL), the medial patellomeniscal ligament (MPML), and the medial retinaculum as distinct important static medial structures.

Multiple biomechanical studies have evaluated the importance of these medial structures to patellar stability [7, 8, 9]. In sectioning studies, The MPFL, running from the adductor tubercle just distal to the vastus medialis obliquus (VMO) to the medial border of the patella, has been shown to contribute 50–60% of the restraining force against lateral patellar displacement [8,9]. Sectioning of the retinaculum and MPML had little additional effect. Repair of the sectioned MPFL alone restored lateral mobility to within normal limits [7]. These findings have lead to the MPFL being coined the “check-rein” which limits lateral patellar displacement [10].

In the case of acute traumatic patellar dislocation or subluxation, these passive medial structures may be injured or completely torn. In cases of surgical exploration after an acute dislocation, the MPFL is typically avulsed off its femoral origin [11, 12]. MRI studies of acute patellar dislocations further identify distinct injury to the MPFL, MPML, and medial retinaculum in up to 90% of cases [13,14].

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These findings indicate the all-important passive medial restraints are significantly injured at the time of patellar dislocation. Subsequently, the residual laxity of these structures due to tearing, plastic deformation, or subsequent healing in a nonanatomic, lengthened position effectively compromise the static restraint allowing for potential recurrence or altered patellofemoral mechanics. The same problem may exist in patients with connective tissue abnormalities and/or generalized ligamentous laxity. While the medial restraints are present, they may be lax secondary to the abnormal collagen.

Indications for Arthroscopic Proximal Realignment

These anatomic and biomechanical data indicate the importance of the proximal medial soft tissues as an etiology for patellofemoral problems. Clinically, these may be an important target in the surgical treatment. The question of what to do surgically with the skeletally immature patient or patient with normal alignment to prevent recurrence and limit morbidity presents a difficult scenario. In these situations, targeting the static restraints is preferable. Arthroscopically, these medial soft tissues are easily evaluated and may be addressed without the need for large incisions and dissections. This protects the all-important dynamic stabilizer, the vastus medialis obliquus (VMO). Surgical dissection and takedown of the VMO may result in proprioceptive deficits, dennervation, and prolonged postoperative rehabilitation upsetting the delicate soft tissue balance important to patellofemoral function.

At our institution, we have relative indications for arthroscopic proximal realignment of the patellofemoral joint (Fig. 1). For an acute dislocation in a highly competitive athlete with MRI confirmation of a tear of the MPFL, attempted arthroscopic repair may be indicated. More commonly, recurrent instability with laxity of the medial check-rein can be addressed with arthroscopic imbrication and capsular reefing or plication. This is ideal in a skeletally immature patient or patient with normal bony alignment. It may also be combined with a distal osteotomy and arthroscopic lateral release to avoid the morbidity of the surgical dissection medially. In the presence of an osteochondral fracture which would require removal, arthroscopic medial repair or imbrication may be performed to effectively shorten the injured, attenuated medial structures.

Relative Indications for Arthroscopic Proximal Realignment

1. Acute/chronic patellar instability
2. Failed nonoperative course
3. Skeletally immature
4. Normal bony alignment
5. Osteochrondral lesion

Fig. 1.

Procedures

Arthroscopic proximal realignment of the patellofemoral joint is analogous conceptually and technically to arthroscopic shoulder capsular plication or rotator interval closure. It requires the surgeon to be comfortable and proficient with arthroscopic suture passing, suture management, and arthroscopic knot tying. If not comfortable with this, an arthroscopically-assisted or open proximal realignment should be performed.

The surgical techniques in the literature can be described as either arthroscopically-assisted or all-arthroscopic. In both techniques, direct arthroscopic evaluation of the attenuated medial soft tissues, size and adequacy of the soft tissue bite, and improvement in patellar tracking can be appreciated. This allows the surgeon to "customize" the repair or plication by direct observation. Also, significant dissection of the vastus medialis obliques (VMO) and potential scarring and denervation is avoided. In each technique, the goal is to place sutures just off the patella and approximately 1–2 cm posterior to the initial suture to provide adequate imbrication or repair of injured structures.

The arthroscopically-assisted technique was first described by Yamamoto [15]. Over a seven year period, he performed surgical repair of the retinacular-capsular defect seen in 30 acute patellar dislocations. He recommended the transcutaneous passage of sutures through the retinaculum using a large curved needle under arthroscopic visualization. Subsequently, a small 1–2 cm medial incision was made, the sutures were all brought out through the incision and tied down. Small et al. [16], reported a modified version of the Yamamoto technique again using a small medial incision and passing suture with a large cutting needle. Henry and Pflum [17] described an arthroscopically assisted technique using two spinal needles to pass suture with the assistance of a wire loop lasso and arthroscopic grasper. Once the suture was placed, a 5 mm medial incision was made and the suture was tied down under direct visualization.

The all-arthroscopic medial proximal realignment eliminates the need for a medial incision and therefore any potential scarring or injury to the VMO. Halbrecht [18] described all-inside medial reefing by percutaneous passage of suture through a 17 gauge epidural needle followed by arthroscopic retrieval and knot tying inside the joint. Ahmed and Lee [19] described an all-arthroscopic technique creating a rent in the medial retinaculum and reefing these structures using horizontal mattress sutures placed with an arthroscopic suture passer and suture retriever. Arthroscopic knots were then tied within the joint. Finally, Haspl et al. [20], described a technique of placing a superomedial portal with a cannula up to but not through the medial retinaculum. Sutures are passed using a spinal needle and arthroscopic grasper and the knots are tied through the cannula superficial to the retinaculum.

While many techniques and variations have been described, the surgeon must choose a technique which is appropriate for his or her skill level and comfort. Ultimately, reproducible results are the goal, regardless of the technique chosen.

Clinical Results

The clinical results of both arthroscopically-assisted and all-arthroscopic procedures are limited to a few studies. Most combine acute dislocators, recurrent dislocators, and subluxators in their patient cohort. Also, most studies have a relatively small sample size making generalizable conclusions difficult.

The clinical results of the arthroscopically-assisted procedures have been promising. Yamamoto [15] showed normal range of motion (ROM) in the 30 operative knees with only one case of recurrent dislocation. No other outcome measure was presented. Small et al. [16] showed 92.5% good or excellent results in 27 knees. There was one case of arthrofibrosis requiring repeat surgery and two cases of recurrent subluxation.

The all-arthroscopic results are just as promising. Halbrecht [18] showed an improvement in the Lysholm score from 41.5 preoperatively to 79.3 postoperatively. The was no recurrent instability with all knees having full ROM. There was statistically significant subjective improvement in pain, swelling, and crepitus. Svoboda [21] presented his results using the same technique as described by Halbrecht. 90% of patients were good to excellent postoperatively. There was one recurrent dislocation. No patient with ten or more recurrent dislocations was rated as good or excellent. Haspl et al. [20] reported 100% good results with no recurrent instability in their series of 17 knees. Combining all case studies, the recurrent rate was less than 5% with no other significant complications noted.

Illustrated Case Example

The patient is an athletically active 17 year old female who suffered an acute patellar dislocation with subsequent multiple recurrences. She underwent a tibial tubercle osteotomy and arthroscopic lateral release at an outside facility. She had no further recurrent dislocations. However, she had persistent lateral subluxation and pain despite an exhaustive physical therapy regimen. This kept her from returning to her usual level of athletic activity. Radiographs showed no evidence of lateral subluxation (Fig. 2). However, physical exam showed significant lateral patellar translation and apprehension consistent with a functionally lax medial check-rein (Fig. 3). Because of these findings and a failed physical therapy program, we elected to take the patient to the operating room for examination under anesthesia and arthroscopic proximal realignment.

At arthroscopy, viewing from the superolateral portal revealed the patella engaging the lateral femoral condyle at 30 degrees of flexion (Fig. 4A). The medial retinaculum and capsule also appeared attenuated. Using a 17 gauge epidural needle to place #1 PDS sutures in the medial tissue, the retinaculum/capsule was imbricated and plicated (Fig. 4B). Evaluation of patellofemoral joint after the imbrication showed improved patellar tracking (Fig. 4C). Examination of patellar mobility after imbrication showed significantly less patellar mobility and reconstitution of the medial check-rein.

Postoperatively, the knee is immobilized in a hinged knee brace locked in full extension for four weeks. Weight bearing as tolerated is allowed. Gentle heel-slides form 0–90 degrees are allowed during this time. Progressive ROM and VMO strengthening is begun after four weeks. Return to sports in a patellar tracking brace was allowed at four months. The patient had significant improvement of pain with no further subluxation episodes. She was able to return to the same level of sports activity as prior to her original injury.

The Future

Before arthroscopic proximal realignment can be applied to all cases, validation of these initial clinical results is required. Further longterm studies looking at specific sub-

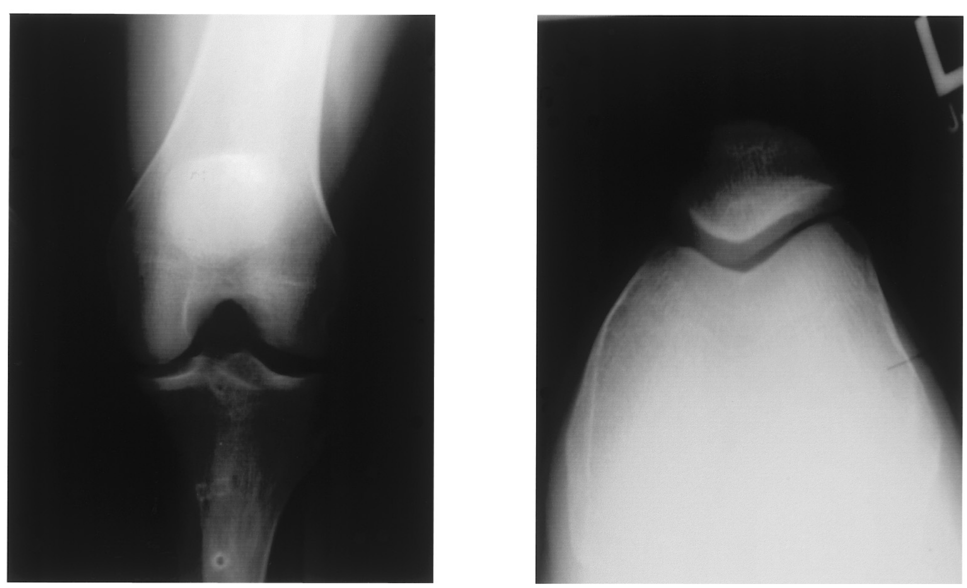

Fig. 2. Preoperative AP and lateral radiographs. Note normal bony alignment and no evidence of significant patellar lateralization.

Fig. 3. Preoperative examination showing significant patellar lateralization and incompetence of medial check-rein.

groups of patients (i.e. acute dislocators, recurrent dislocators, subluxators) is warranted. With these results, the indications for arthroscopic stabilization can be further defined. Also, a randomized, matched trial comparing open and arthroscopic proximal realignment will help to assess outcomes and complications of each procedure and identify which procedure is most predictable. The surgeon must feel comfortable with arthroscopic suture placement, management, and knot tying in order to produce consistently successful results. Regardless, with the data available, arthroscopic proximal realignment of the patellofemoral joint is a promising technique which the orthopaedist may keep in his or her armamentarium to treat this difficult and controversial problem.

References

1. Hawkins RJ, Bell RH, Anisette G. Acute patella dislocations: The natural history. Am J Sports Med 1986;14:117–120.
2. Cofield RH, Bryan RS. Acute dislocation of the patella: Results of conservative treatment. J Trauma 1977;17:526–531.
3. Maenpaa H, Lehto MUK. Patellar dislocation: The long-term results of non-operative management in 100 patients. Am J Sports Med 1997; 25:213–217.
4. Hughston JC. Subluxation of the patella. J Bone Joint Surg Am 1968;50:1003–1026.
5. Reilly DT, Martens M. Experimental analysis of the quadriceps muscle force and patellofemoral joint reaction force for various activities. Acta Orthop Scand 1972;43:126.
6. Warren RF, Marshall JL. The supporting structures and layers on the medial side of the knee. J Bone Joint Surg Am 1979;61:56–62.
7. Hautamaa PV, Fithian DC, Pohlmeyer AM, et al. The medial soft tissue restraints in lateral patellar instability and repair. Clin Orthop 1998;349:174–182.
8. Conlan T, Garth WP, Lemons JE. Evaluation of the medial soft-tissue restraints of the extensor mechanism of the knee. J Bone Joint Surg 1993;75:682–693.
9. Desio SM, Burks RT, Bachus KN, et al. Soft tissue restraints to lateral patellar translation in the human knee. Am J Sports Med 1998;26: 59–65.
10. Fithian DC, Meier SW. The case for advancement and repair of the medial patellofemoral ligament in patients with recurrent patellar instability. Operative Techniques in Sports Medicine 1999;7:81–89.
11. Avikainen VJ, Nikku RK, Seppanen-Lehmonen TK. Adductor magus tenodesis for patellar dislocation. Technique and preliminary results. Clin Orthop 1993;297:12–16.
12. Sallay PI, Poggi J, Speer KP, et al. Acute dislocation of the patella: A correlative pathoanatomic study. Am J Sports Med 1996;24:52–60.
13. Marangi K, White LM, Brossmann J, et al. Magnetic resonance imaging of the knee following acute lateral patellar dislocation. 63rd AAOS, February 1996.
14. Burks Rt, Desio SM, Bachus KN, et al. Biomechanical evaluation of lateral patellar dislocations. Am J Knee Surg 1997;10:24–31.
15. Yamamoto RK. Arthroscopic repair of the medial retinaculum and capsule in acute patellar dislocations. Arthroscopy 1986;2:125–131.
16. Small NC, Glogau AI, Berezin MA. Arthroscopically assisted proximal extensor mechanism realignment of the knee. Arthroscopy 1993; 9:63–67.
17. Henry JE, Pflum FA. Arthroscopic proximal patella realignment and stabilization. Arthoscopy 1995;11:424–425.
18. Halbrecht JL. Arthroscopic patella realignment: An all-inside technique. Arthroscopy 2001;17:940–945.
19. Ahmed CS, Lee FY. An all-arthroscopic soft-tissue balancing technique for lateral patellar instability. Arthroscopy 2001;17:555–557.
20. Haspl M, Cicak N, Klobucar H, et al. Fully arthroscopic stabilization of the patella. Arthroscopy 2002;18:E2.
21. Svoboda v. Recurrent dislocation of the patella-arthroscopy therapy. Acta Chir Traumatol Cech 2002;69:254–258.

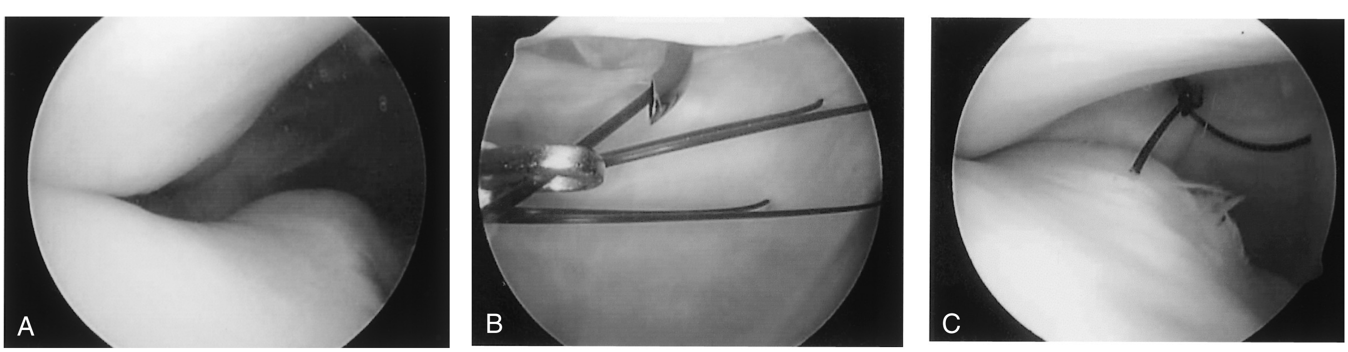

Fig. 4. Arthroscopic pictures from case example. (**A**) lateralized patella at 30 degrees of flexion as viewed from superolateral portal. (**B**) arthroscopically placed sutures for capsular plication. (**C**) patellofemoral tracking at 30 degrees of flexion after arthroscopic proximal medial realignment.