



Plication of The Medial Patellofemoral Ligament for The Treatment of Chronic Patella Dislocations and Refractory Patellofemoral Syndrome. A Retrospective Case Series and Review

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Citation: Hoang V, Moyer B, Talle M, Vanier C, Watson T, Bascharon, R, Lee, D, Liu, N (2019) Plication of The Medial Patellofemoral Ligament for The Treatment of Chronic Patella Dislocations and Refractory Patellofemoral Syndrome. A Retrospective Case Series and Review. Sports Injr Med 03: 155. DOI: 10.29011/2576-9596.100055

Received Date: 07 August 2019; **Accepted Date:** 17 August 2019; **Published Date:** 28 August 2019

Aim

The goal of this project was to evaluate the outcomes associated with Medial Patellofemoral Ligament plication for the treatment of Chronic Patella dislocations and Refractory Patellofemoral Syndrome.

Abstract

Background: Anterior knee pain accounts for 25-40% of knee pain visits in sports medicine clinics. Refractory Patellofemoral Syndrome (RPS) and Chronic Patella Dislocations are often multifactorial but commonly the pain originates from impaired patellar tracking and increased lateral patellar tilt. The compression of the subchondral bone has been correlated to the pain as well as from the synovium, retinaculum, and associated neuromuscular structures. The plication of the Medial Patellofemoral Ligament (MPFL) counteracts these compressive and tilting forces improving symptoms of RPS and recurrent patella dislocations. The goal of this project was to evaluate the outcomes associated with MPFL plication.

Study Design: Case Series; Level IV

Methods: A retrospective analysis of patients with recurrent patella dislocations, Refractory Patellofemoral Syndrome (RPS) or Patellofemoral Pain Syndrome (PFPS) treated with plication of the MPFL between 2009 - 2018 with minimum four month follow up. The primary outcome variable was patient overall satisfaction, Visual Analogue Scale for Pain (VAS) and Kujala (Anterior Knee Pain) Score.

Results: Seven patients met the inclusion criteria. Their demographic and pre-surgery details are in Table 1. A large majority of patients (85.7%) were satisfied, and VAS pain scale ratings were four or less. Only one of the seven patients was not satisfied (Table 2), and that individual also had the lowest Kujala score. The VAS pain scale and the Kujala score were not correlated (Spearman rank correlation, $\rho = -0.218$, $P = 0.638$; Figure 1), nor was there a clear relationship between time since surgery and Kujala score ($\rho = 0.607$, $P = 0.167$; Figure 2).

Conclusion: Plication of the MPFL has a high success in improving both Kujala (Anterior Knee Pain) Score and Visual Analogue Scale (VAS) as well as return to regular activities. We believe this is a safe and effective technique in improving chronic patella dislocations and Refractory Patellofemoral Syndrome with minimal perioperative morbidity.

Introduction

Patella Instability/ Patella Dislocation

Patella instability and dislocation are not covered under the umbrella of RPS or PFPS, however it can be a source of anterior

knee pain, especially in younger female patients ages 10-17 [1]. The average incidence of primary patellar dislocation is roughly 5.8 per 100,000 cases [1]. Causes of patella instability/subluxation and dislocation include trauma, general lateral ligamentous laxity,

lateralized Q-angle, recurvatum, tibial external rotation, vastus medialis weakness, trochlear dysplasia, and/or genu valgum without displacement from the groove in subluxation and complete displacement in dislocation [2-4]. The excessive lateral tilt and glide in subluxation produces a redistribution of forces along the patellar articular surface causing pain and feelings of instability. Dislocations are also a source of pain and involve complete displacement, often laterally, but in rare cases can occur medially and superiorly [2,3,5,6].

Studies have shown that dislocations can lead to recurrent instability, decrease in activity, cartilage damage, fractures, and progression of osteoarthritis [1,7-10]. In the interest of pain relief, joint preservation, and restoration of biomechanics, either conservative or surgical intervention can be beneficial. Extensive long-term clinical study on conservative treatment of patellar dislocations is lacking. However, a study done by Maenpaa and Lehto found that immobilization of the knee in extension after a primary dislocation for six weeks reduced the risk of secondary dislocation three-fold compared to patients that were not [7]. This may provide enough of an opportunity for the MPFL to heal or other structures to tighten up prior to therapy, but more research is required in this area [3].

Patients with patellar instability and dislocations are at a higher risk of subsequent dislocations and even after conservative treatment, experience a 15-44% rate of recurrence [1,3,7]. These patients may benefit from surgical intervention. This, however, remains controversial. According to a review included in a study by Jain, et al. (2011), there is insufficient evidence to support immediate surgical stabilization of the patella after an initial dislocation, and only after a second dislocation should it be considered due to an increased risk of subsequent dislocations. In patients with lateral subluxations and repeat dislocations, the MPFL may be damaged or stretched and in need of repair. This procedure's utilization has increased in recent years, and in spite of a noted complication rate of 26%, [11] a number of retrospective studies claim excellent outcomes from 80-96% of patients improving even when used to repair previously failed surgical interventions for instability [2,12-15].

Refractory Patellofemoral Syndrome (RPS) or Patellofemoral Pain Syndrome (PFPS)

Anterior knee pain has a high incidence affecting 22/1000 patients/year and accounts for 25-40% of knee pain visits in sports medicine clinics [16,17]. Pain originating from impaired patellar tracking as a result of tight lateral soft tissues with compression of the lateral facet against anterolateral femur and increased lateral patellar tilt is often classified as Refractory Patellofemoral Syndrome (RPS) or Patellofemoral Pain Syndrome (PFPS) [18]. The compression of the subchondral bone has been correlated to the pain, but pain can also be associated with the synovium,

retinaculum, and associated neuromuscular structures [19].

Development of Refractory Patellofemoral Pain Syndrome is multifactorial. RPS has been often observed in active individuals and affects more women than men as a result of a widened Q-angle [17,20,21]. Other anatomical and biomechanical contributing factors include tight lateral retinaculum, tight IT band, foot pronation, externally rotated tibia, weak hip abductors and external rotators, weak vastus medialis, and injury to the extensor mechanism [8,21]. Weakness in the external rotators or abductors of the hip resulting in internal rotation of the femur, over eversion of the foot resulting in internal tibial rotation, or a combination of both may result in a functional or dynamic valgus deformity, also contributing to patellar maltracking [22].

Patients present with anterior knee pain from overuse, positive theatre sign (pain with activity after prolonged sitting), positive patellar compression test, and pain climbing/descending stairs [16,23-25]. Symptoms are exacerbated with flexion and can be recreated in the clinic utilizing a squat test. If hip abductor strength is in question, a single leg squat test can be utilized to identify hip muscle dysfunction [22].

Nonoperative Treatment of Refractory Patellofemoral Syndrome (RPS) or Patellofemoral Pain Syndrome (PFPS)

Current treatments are centered on pain relief with eventual return to presymptomatic activity and improved patellar alignment. Treatment plans are evaluated on a per patient basis beginning with a focus on non-operative methods. Initially, patients are to avoid activities that cause pain (ie. running, high impact, stair running/hill climbs) and are prescribed NSAID pain relievers. According to a meta-analysis of the Cochrane database of pharmacotherapy in the treatment of patellofemoral pain, one study showed use of Naproxen provided significant pain relief for 2-3 weeks, but was not significant in long term treatment. The same analysis found there is little evidence supporting the use of NSAIDS for reduction of knee pain in acute or chronic cases [26]. The analysis also explored the use of intra-articular corticosteroid injections and Glycosaminoglycan (GAG) derived viscosupplementation and it was determined that this form of treatment also lacks support from literature [26,27]. Over the course of five weeks, four test groups were compared, including one group consisting of GAGs with lidocaine injections, one group of two injections of saline and lidocaine, and no injections in two other groups participating in quadriceps strengthening physical therapy. The study found a significant difference in relief of symptoms between the GAGs with lidocaine versus the no injection group, but the injections failed to completely remedy patients' symptoms which returned within six months [26,27].

Patellar Taping and Bracing

A number of studies have found use of patellar taping and

bracing reasonable when coupled with exercise therapy. Pfeiffer, et al. utilized tape in a medial direction and evaluated its ability to decrease lateral patellar displacement. The results were significant, but only before intense exercise, indicating that tape coupled with supervised, low intensity exercise therapy can be beneficial [28]. Two meta-analyses, one published in 2002 and another in 2008, also found that tape coupled with exercise provided significant improvement in reduction of pain compared to exercise alone. Sham tape also showed positive results, indicating that a placebo effect can also play a role in improvement of symptoms [29,30]. Unfortunately, the studies involved were focused on short-term results and the long-term effects of tape coupled with exercise have yet to be explored. According to Lan, et al. taping was also found to be less effective in patients with high BMI [31].

The results on bracing are also inconclusive. A study done by Draper, et al. utilized a patellar brace with medial force and measured patellar lateralization and tilt using MRI found the brace was effective and significantly reduced pain [32]. Another study done by Powers et al. had similar statistically significant findings that a knee brace applying medial force to the patella was effective in reducing pain [33]. The aforementioned meta-analyses by D'hondt, et al. and Warden et al. also analyzed non-adhesive bracing. D'hondt, et al. did find improvements in pain reduction, function, and patellofemoral congruence, but the authors noted that the quality of the studies was lacking and concluded the results were limited [29]. Warden, et al. and Chew, et al. both found disputable and statistically non-significant evidence from multiple studies related to reduction of pain and improvement of function [30,34]. The definitive recommendation of bracing requires further investigation, especially given the multifactorial nature of the source of pain.

Physical Therapy

Physical rehabilitation remains the most studied form of conservative treatment for PFPS/RPS. Evidence from multiple studies summarized by the Consensus Statement from the 5th PFP Research Retreat recommends implementing exercise regimens for the lower extremity focused on strengthening and mobilizing the joints and musculature to decrease pain and improve mobility and overall function [35]. The Consensus Statement and two other systematic reviews noted that the randomized clinical trials available consisted of low quality studies yielding results that did not support a specific singular protocol for treatment for PFPS [35-37]. This is consistent again with the multifactorial nature of the condition. Physical rehabilitation programs should be tailored to the biomechanical findings of the individual focused on strengthening hip abductors and the extensor mechanism (in particular the Vastus Medialis Oblique).

There is limited published evidence in direct support of hip strengthening regimens on reducing patellofemoral pain.

However, a meta-analysis performed by Lack, et al. suggests that increased hip strength can decrease patellofemoral pain and increase function in PFPS patients [38]. There are also two smaller short-term studies (one a single blind randomized control trial and the other cohort study) that analyzed the effects of isolated hip and knee and combination exercise programs. Both studies reported improvements in the groups that utilized programs that strengthened the hip. In the single blind randomized trial by Avraham et al. improvements were seen in all groups that utilized exercise therapy [39,40].

A weak extensor mechanism as mentioned above is suspected to be a causative factor of PFPS and a number of authors suggest use of physical rehabilitation of those muscles as a potential treatment option for pain relief and resolution of symptoms [41-43]. Weakness in the vastus medialis has been observed in a number of PFPS cases. There have been multiple studies aimed at finding exercises that effectively isolate the VMO for use in physical rehabilitation for patients with VMO weakness and, although they were able to do so, further research is required to determine if those protocols significantly reduce pain from PFPS [44-46]. Again, there is little evidence on effectiveness of extensor mechanism strengthening on pain reduction in patients with PFPS, however, according to Werner, a program that incorporates Closed and Open Kinetic Chain exercises should be utilized to provide a balanced approach to quad strengthening [41].

According to McCarthy and Strickland, conservative treatment should be pursued for a minimum of 3 months before exploring alternative options [25]. Conservative treatment is preferred and has been shown to resolve symptoms in some patients, but the Consensus Statement from the PFP research retreat in 2013 found that about 40% of patients diagnosed with PFP were still symptomatic after one year of conservative treatment methods [47]. Surgical intervention is seldom recommended for treatment of patellofemoral pain. According to a RCT with five-year follow-up by Kettunen, et al. general arthroscopic treatment (involving shaving inflamed synovium, medial plication, meniscal debris, but no realignment) showed improvement, but did not perform better than a nonoperative exercise program [48]. However, given appropriate criteria there are patients that can benefit from surgical intervention involving patellar realignment procedures and those options should be explored [47].

Surgical Treatment of Refractory Patellofemoral Syndrome (RPS) or Patellofemoral Pain Syndrome (PFPS)

Surgical interventions for PFPS/RPS seek to restore patellar alignment, stability, and biomechanical function. The types of surgical treatment can modify realignment through a lateral retinacular release, distal and/or proximal realignment, or reconstruction of the MPFL. A number of studies have found lateral retinacular release to resolve pain in patients with tight

lateral retinacular tissues associated with rotational malalignment of the patella, but if over-released or performed on the wrong patient it can lead to medial patellar subluxation [49-52]. Distal realignment involves a tibial tubercle transfer, usually coupled with a lateral release. The Elmslie-Trillat procedure in the appropriate patient has been shown to yield positive results in pain reduction and restoration of biomechanical function when the tubercle is medially translated with solid fixation for quicker use of related musculature [53-55].

Reconstruction of the MPFL is typically indicated for patients with continued laxity after exhausting the aforementioned nonsurgical treatments. Recent studies of this procedure have shown favorable results, with Kujala scores averaging in the mid to high 80's and patients returning to sport and normal activity 17-21 weeks' post-op [15,56-58]. The amount of data on this procedure continues to grow, but a fixed criterion for ideal candidates does not exist and has been mentioned that it may not be ideal for patients with less severe anatomic variances [58]. Open or arthroscopic proximal realignment procedures used to treat patients with patellar dislocations and maltracking are currently contraindicated for patients with increased Q angle, medial patellar lesions, and patella alta [59]. The procedure involves reinforcing tissues by utilization of multiple PDS sutures in the medial soft tissues and is sometimes coupled with a lateral release to aid in patellar realignment. It is important to restore anatomic balance, but not overdo the medial tightening or lateral release to avoid increase of pressure on the medial facet or increased lateral tilt. According to Halbrecht and Ali, et al. arthroscopic plication of the medial soft tissues in a proximal realignment procedure is a viable and acceptable method of treating patients with patellar instability [60,61].

The anatomic and biomechanical findings that overlap between patients suffering from PFPS and patellar instability and dislocations, namely tight lateral retinaculum and maltracking of the patella, begs the question if plication of the MPFL could be a viable option for patients with PFPS/RPS. If there is anterior knee pain with tight lateral retinaculum, lax medial retinaculum or MPFL, and/or patellar maltracking then plication of the MPFL would be a reasonable treatment option to apply a direct medial force at the level of the patella and distal VMO to proximally realign the patella and eliminate painful symptoms. This procedure favors a minimally invasive, purely soft tissue adjustment approach aimed at relieving symptoms, restoring alignment, and return to normal activity. The aim of this retrospective study is to evaluate the effectiveness of plicating the MPFL in patients with recurrent patellar dislocations/subluxations, RPS, or PFPS as a means to elimination of painful symptoms.

Methods

Patient Cohort/Demographics

Patients were contacted to determine whether they had experienced any dislocations, subluxations, pain, or other symptoms since surgery. Each patient was also administered a Kujala knee score questionnaire, asked to rate their pain using the VAS scale, and asked whether they were satisfied with the results of the procedure. All patients who consented to follow-up were included in the study.

Surgical Treatment

All of the plication procedures were performed by a single fellowship trained surgeon (N.L.) in Michigan. Each patient prior to surgery had experienced knee pain and either patellar subluxation or dislocation(s) and had attempted nonsurgical interventions such as taping, bracing, and therapy with no relief of symptoms. The next step in their care was offering an arthroscopic debridement with plication of the MPFL.

Standard lateral and medial parapatellar portals are made. Documentation of lateral tilt of patella was accessed and documented, with usual diagnostic arthroscopy. With epidural needle, a 0 PDS suture was utilized to plicate the medial patellofemoral ligament. A superolateral portal was used as a working portal. Post plication knee flexion is accessed under fluoroscopic guidance to identify improved patella tracking as well as alignment. Patients were placed in a knee immobilizer for 2 weeks with weight bearing as tolerated. At 2 weeks, patients began physical therapy to progress out of the immobilizer with increasing range of motion as tolerated.

Statistical Analysis

Within the cohort averages with 95% CI were calculated for the VAS and Kujala scores. The Spearman rank correlation was used to examine the relationship between the two scores as well as time since surgery and Kujala score.

Results

Cohort Demographics

Twenty-seven patients underwent MPFL plication for lateral patella instability between April 3, 2009 and November 9, 2018. Seven patients met the inclusion criteria and were included in the final cohort. Mean patient age was 30 years (range, 14-48 years). Two patients were of male gender, four were of female gender, and one left gender undisclosed. Five of the cases were performed on the right knee and two on the left. In regard to knee stability

prior to surgery, two patients reported one subluxation, five reported one dislocation, and one reported one dislocation and multiple subluxations. The mean duration of symptoms prior to surgery was 13.2 months (range 0.5-48 months). Mean follow-up was 44 months (range, 4-70 months) (Table 1).

Patient Number	Age	Gender	Side of Surgery	Dislocation or Subluxation	Dislocations	Duration of Symptoms (months)
1	27	M	Right	Subluxation	0	48
2	41	-	Right	Subluxation	0	12
3	39	M	Right	Dislocation	1	0.5
4	48	F	Right	Dislocation	1	3
5	24	F	Left	Dislocation	1	1
6	18	F	Left	Dislocation	3	4
7	14	F	Right	Dislocation, then repeated subluxations	1	24

Table 1: Demographic and pre-surgery information.

Patient Number	Time since Surgery	Kujala (Anterior Knee Pain) Score	VAS Pain	Satisfied?
1	5 Yr, 2 Mo	94	0	Yes
2	5 Yr, 9 Mo	90	2	Yes
3	5 Yr, 1 Mo	66	3	No
4	4 Yr, 7 Mo	89	2	Yes
5	4 Yr, 1 Mo	83	4	Yes
6	0 Yr, 4 Mo	70	0	Yes
7	0 Yr, 6 Mo	82	1	Yes

Table 2: Outcomes after surgery.

Visual Analogue Score (VAS) Pain Scale, Kujala Score, and Patient Satisfaction

All patients reported VAS pain scale ratings of 4 or less (mean, 1.7; range, 0-4). The mean Kujala (Anterior Knee Pain) score was 82 (range, 66-94). Patient satisfaction was largely positive, with only one of seven patients reporting dissatisfaction. The aforementioned patient also reported the lowest Kujala score (66). The VAS pain scale and Kujala score were not correlated (Spearman rank correlation, $\rho=-0.218$, $P=0.638$; Figure 1). Time since surgery and Kujala score did not show a clear correlation either ($\rho=0.607$, $P=0.167$; Figure 2).

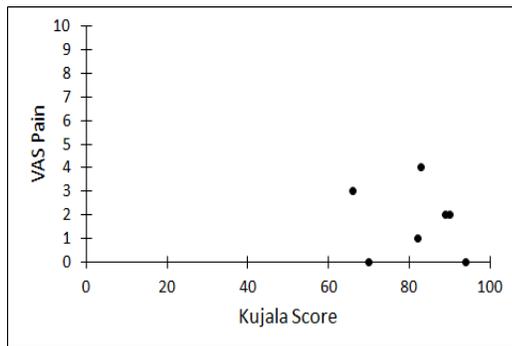


Figure 1: Relationship between VAS and Kujala Score.

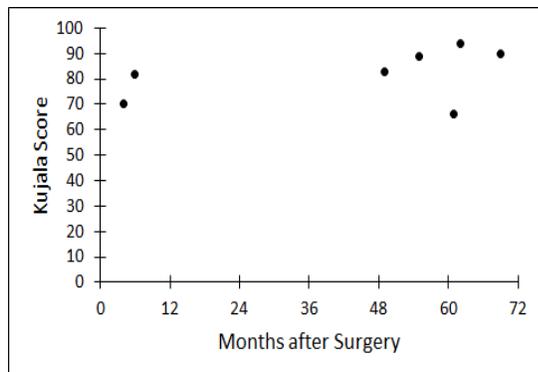


Figure 2: Relationship between Kujala Score relative to time elapsed after surgery.

Discussion

Using a VAS score of <4 , Kujala >80 , and patient satisfaction as the benchmark for success, this study found that the majority of outcomes were favorable. The goal of plication of the MPFL is to limit or eliminate patients pain and feelings of instability with a minimally invasive procedure. The results of this study are consistent with similar studies exploring MPFL imbrication, reconstruction, and other mpfl/medial patellar stabilization procedures [58,60,61]. Systematic reviews of MPFL reconstruction research articles noted Kujala Scores with an average of 89.0-89. (SD 3.7-4.9) [60,62]. One study in particular showed that 21% of patients who

underwent MPFL imbrication experienced a dislocation post-op, but also exhibited less pathoanatomical complications than their counterparts who had the MPFL reconstructed [58]. The same study also discussed that anterior knee pain and instability requires an ala carte approach to care, which this study and others have also found to be true [58,63].

These results are indicative of the one size does not fit all approach to treatment of anterior knee pain and does not claim MPFL plication is superior to other operative and non-operative treatments. The continuum of care should be explored sequentially, beginning with the least invasive until symptoms are resolved. This study also shows encouraging results in support of another procedural tool. In the right patient, plication of the MPFL is an effective treatment method for relief of symptoms, as we believe it is a relatively simple, fast, less invasive surgical option available to patients suffering from anterior knee pain and instability and should be adopted.

This study sought to examine the effectiveness of MPFL plication on an introductory/exploratory level, and therefore has its limitations. The sample size of this study is extremely low, with even fewer patients available for follow-up, and the majority of patients were from the Southwest United States. With a cohort, such as patients with anterior knee pain and patellofemoral instability, a larger sampling is necessary to gain a more accurate understanding of the results, especially given the large degree of variability seen in these patients. The follow-up time was also a limitation. Longer term follow-ups are necessary in future studies, as complications and failures are more likely as time goes on. Another limitation is the subjective nature of the VAS score, as different patients interpret pain differently and therefore makes it difficult to draw accurate correlations to other scores such as the Kujala score.

Future investigations of this procedure should aim to increase sample size and follow-up in more of a nationwide format to obtain a more accurate representation of the affected patient population. As a part of the study a set of standardized criteria for appropriate patient selection should be established and then a comparison study should be completed to determine whether plication of the MPFL is indeed more effective than the other aforementioned techniques. Currently, a side-by-side comparison does not exist.

Conclusion

This study has shown plication of the MPFL has a high success in improving both Kujala (Anterior Knee Pain) Score and Visual Analogue Scale (VAS), as well as return to regular activities within the limits of our sample. We believe this is a safe and effective technique in improving chronic patella subluxations/dislocations and refractory patellofemoral syndrome with minimal perioperative morbidity and therefore warrants further investigation.

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