ISSN: 0975-1556

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2021; 13(3); 224-230
Original Research Article

A Prospective Research to Compare the Functional Results of Medial Patellofemoral Ligament (MPFL) Reconstruction v/s Graft Tissue Implantation

Bibek Kumar Rai[1], Ajoy Kumar Manav[2]

[1]Senior Resident, Department of Orthopaedics, Patna Medical College and Hospital, Patna, Bihar, India

[2]Associate Professor, Department of Orthopaedics, Patna Medical College and Hospital, Patna, Bihar

Received: 09-06-2021 / Revised: 06-07-2021 / Accepted: 20-07-2021
Corresponding author: Dr. Bibek Kumar Rai
Conflict of interest: Nil

Abstract

Aim: Study of functional outcomes of MPFL reconstruction vs. graft tissue placement. **Methods:** This prospective study was carried out in the Department of Orthopaedics, Patna Medical College and Hospital, Patna, Bihar, India from January 2017 to December 2017. 40 subjects who underwent MPFL reconstruction were retrospectively analyzed for MFPL graft tissue placement relative to the anatomic ideal. The total distance from anatomic ideal was determined trigonometrically by first measuring the two distances (anterior or posterior, and proximal or distal to ideal), then determining the actual geographic distance from anatomic ideal using the Pythagorean theorem. **Results:** The study population was comprised of 17 males and 23 females, with a mean age of 24.48 ± 7.31, an average height of 171.2 cm ± 10.15, and an average weight of 78.83 kg ± 18.5. 21 patients had their surgery on the right knee, and 19 on the left. All patients had both Fulkerson Osteotomy procedures involving MPFL reconstruction with intraoperative femoral nerve stimulation. A significant post-operative difference was found between groups in the following parameters: WOMAC pain (anatomic mean = 86.71 ± 11.34, non-anatomic mean = 76.00 ± 25.35 p = 0.015), function (anatomic mean = 86.85 ± 8.96, non-anatomic mean = 80.09 ± 23.45, p =0.021) and in KOOS symptom (anatomic mean = 76.63 ± 10.79, non-anatomic mean = 68.83 ± 21.40, p = 0.029), pain (anatomic mean = 78.54 ± 7.61, non-anatomic mean = 72.39 ± 24.18, p = 0.01), ADL (anatomic mean = 86.85 ± 8.97, non-anatomic mean = 80.09 ± 23.45, p = 0.014) and overall (anatomic mean = 75.61 ± 9.33, non-anatomic mean = 70.41 ± 23.25, p = 0.01) scores. No significant difference was observed for post-op instability, improvement in WOMAC or KOOS, 2-week, 6-week, or final 1-year range of motion, WOMAC stiffness, or KOOS sport/recreation or QOL. **Conclusion**: Within the range of graft placement values considered by this study, while no reduction in range of motion was seen, non-anatomic placement of MPFL graft tissue in MPFL reconstruction operations caused increased pain and decreased function, evidenced by post-operative KOOS and WOMAC scores.

Keywords: WOMAC scores, MPFL, Osteotomy

Introduction

The medial patellofemoral ligament (MPFL) is a structure that connects the patella and femoral medial epicondyle and acts primarily as a checkrein to avoid lateral dislocation of the patella. Research shows the MPFL serves the purpose to support the tissues' ability to withstand impact and prevent damage to the tendons and ligaments. The MPFL structure holds an important role which prevents the patella from lateral dislocation[1,2]. Anatomical structure of MPFL was known in 1957 as transversal structure which strengthen the patella and medial part of gastrocnemius[3]. When the knee is flexed to 20◦, MPFL holds 50e60% of the pressure from lateral pulling force, while other ligaments such as the patellomeniscal, medial retinaculum, medial patellotibial provide 13%, 3%, and 3% contribution, respectively.[3] MPFL receives the highest force during maximum knee extension or at the beginning of knee flexion which is the time when quadriceps muscles contract to pull the patella[3,4]. When there is a patellar dislocation due to injury, the chance of MPFL rupture is high. As the consequences, the incidence of MPFL rupture will also be higher (18 from 19 cases)[5] Injury of this ligament commonly due to sports, especially football players, and runners, and vehicular accidents, especially motocross riders[6].

Recurrent patellar dislocation could happen to any patient with history of acute patellar dislocation. The incidence reached 30e60% after conservative treatment of acute patellar dislocation. Another study reported 44% redislocation happened after surgical inter- vention. Up to 19% of patients experienced patellofemoral pain, and 63% patients reported dissatisfaction during follow up[2]. While many surgical procedures are available to do MPFL reconstruction, no gold standard in repair methods and graft of choice is established[7,8]. MPFL reconstruction is commonly recommended for patients with patellar instability.

Various methods of MPFL reconstruction in the literature considering graft of choice, patellar fixation, femoral fixation, and graft tensioning[7]. Hamstring tendon usually used as graft choice[9,10]. Even though, MPFL reconstruction has some risks by drilling bone tunnels and/or creating anchors for graft attachment to the patella, concerns also exist regarding the potential com- plications such as implant breakage or patellar fractures from the patellar tunneling as well as considerable implant costs[9]. MPFL reconstruction usually done in combination with lateral release because lateral release alone did not show good result[11]. In the past, the lateral release technique is performed to reduce excessive pull from the retinaculum and restore the patella to its normal position. There are many MPFL reconstruction techniques which vary in terms of grafts and fixation methods. Up to now, there is no consensus as to which method is the best.

Material and methods

This prospective study was carried out in the Department of Orthopaedics, Patna Medical College and Hospital, Patna, Bihar, India from January 2017 to December 2017. after taking the approval of the protocol review committee and institutional ethics committee.

Methodology

Patients who underwent Fulkerson Osteotomy procedures involving MPFL were included in this study. Patient had adequate post-operative radiographs that clearly displayed MPFL tunnel and surgical placement of MPFL graft tissue in the femur. Patient’s electronic medical record contained both pre-operative and post-operative functional scores (WOMAC and KOOS) as well as range of motion at two weeks, six weeks and final 1 year follow-up. These 40 subjects who underwent MPFL reconstruction were retrospectively analyzed for MFPL graft tissue placement relative to the anatomic ideal. The total

distance from anatomic ideal was determined trigonometrically by first measuring the two distances (anterior or posterior, and proximal or distal to ideal), then determining the actual geographic distance from anatomic ideal using the Pythagorean theorem.

A guide pin is placed intraoperatively to mark the desired location of the MPFL tunnel, then a cannulated drill bit (7 mm in diameter) is placed over the pin. Since the drill bit is 7 mm in diameter (used for radiographic location of the intended tunnel), the distance from the center of the drill bit to the edge (its radius, 3.5 mm) plus a one-drill-bit-diameter (7 mm) margin of error was found to equal 10.5 mm. Clinical exam by intraoperative femoral nerve stimulation of the quadriceps muscle is used in each case to determine isometry of the graft and maximum patellofemoral congruency.

Placement of the MPFL tunnel center less than 10.5 mm from the anatomic ideal was designated to be anatomic, and placement greater than 10.5 mm was designated to be non-anatomic. This determination was calculated using a 7 mm margin of error from the edge of Schottle's ideal femoral tunnel point, and based on intra-operative practices during MPFL reconstruction operations. Functional scores including WOMAC (pain, stiffness, and function) and KOOS (symptom, pain, function in daily living (ADL), sport/recreation, knee related quality of life (QOL), and overall scale) were then recorded and analyzed at two weeks, six weeks and final 1 year follow-up. Range of motion at two weeks, six weeks and final 1 year follow-up was recorded, and patient-reported problems with knee flexion were recorded. Inter- and intra-rater reliability were pursued by performance of all measurements twice each by two investigators.

In the final step of the data analysis, the clinical data that was gathered was compared with the placement of the MPFL graft tissue tunnel on the lateral radiographs. SPSS Statistical software (IBM Corp) was used to per- form statistical comparison and analysis of the data gathered. Chi square and independent samples t-tests were performed.

Results

The study population was comprised of 17 males and 23 females, with a mean age of 24.48 ± 7.31, an average height of 171.2 cm ± 10.15, and an average weight of 78.83 kg ± 18.5 (Table 1). Inter- and intra-rater reliability values were found to be very strong. Intra class correlation values for intra-rater reliability of investigator 1 were 0.898 (95% CI 0.896- 0.899, $p < 0.05$) for single measures and 0.899 (95% CI 0.898-1.000, $p < 0.05$) for average measures. Intra class correlation values for intra-rater reliability of investigator 2 were 0.895 (95% CI 0.888-0.898, $p < 0.05$) for single Table 5: WOMAC, KOOS, and ROM measures and 0.897 (95% CI 0.894-0.899, $p < 0.05$) for average measures. Intra class correlation values for inter- rater reliability were 0.893 (95% CI 0.887-0.896, $p < 0.05$) for single measures and 0.898 (95% CI 0.897-0.899, $p < 0.05$) for average measures (Tables 2-4).

21 patients had their surgery on the right knee, and 19 on the left. All patients had both Fulkerson Osteotomy procedures involving MPFL reconstruction with intraoperative femoral nerve stimulation.

A significant post-operative difference was found between groups in the following parameters: WOMAC pain (anatomic mean = 86.71 ± 11.34, non-anatomic mean = 76.00 ± 25.35 $p = 0.015$), function (anatomic mean = 86.85 ± 8.96, non-anatomic mean = 80.09 ± 23.45, $p = 0.021$) and in KOOS symptom (anatomic mean = 76.63± 10.79, non-anatomic mean = 68.83 ± 21.40, $p = 0.029$), pain (anatomic mean = 78.54 ± 7.61, non-anatomic mean = 72.39 ± 24.18, $p = 0.01$), ADL (anatomic mean = 86.85 ± 8.97, non-anatomic mean = 80.09 ± 23.45, $p = 0.014$) and overall (anatomic mean = 75.61 ± 9.33, non-anatomic mean = 70.41 ± 23.25, $p = 0.01$) scores. No

significant difference was observed for post-op instability, improvement in WOMAC or KOOS, 2-week, 6-week, or final 1-year range of motion, WOMAC stiffness, or KOOS sport/recreation or QOL (Table 5). Non-anatomic graft placement did not predispose patients to reported flexion problems (p = 0.17), post- op chondromalacia (p = 0.15), or continued post-op patellofemoral articulation pain (p = 0.57), as there was no statistically significant difference noted between the anatomic and non-anatomic groups in these parameters.

Table 1: Patient Demographic Data

Parameter	Mean	Standard Deviation
Age (yrs)	24.48	7.31
Height (cm)	171.2	10.15
Weight (kg)	78.83	18.5

Table 2: Intra-rater reliability, Investigator 1

Interclass Correlation	Value	95% CI	P Value
Single Measures	0.898	.896-.899	<.001
Average Measures	0.899	.898-1.000	<.001

Table 3: Intra-rater reliability, Investigator 2

Interclass Correlation	Value	95% CI	P Value
Single Measures	0.895	.888-.898	<.001
Average Measures	0.897	.894-.899	<.001

Table 4: Inter-rater reliability

Interclass Correlation	Value	95% CI	P Value
Single Measures	.893	.887-.896	<.001
Average Measures	.898	.897-.899	<.001

Table 5: WOMAC pain, KOOS symptom, ROM

Parameter (all values post-op)	Anatomic Mean	Non-Anatomic Mean	P Value
WOMAC pain	86.71 ± 10.34	76.00 ± 25.35	.015
WOMAC stiffness	68.86 ± 17.98	72.25 ± 23.33	.44
WOMAC function	86.85 ± 8.96	80.09 ± 23.45	.021
KOOS symptom	76.63 ± 10.79	68.83 ± 21.40	.029
KOOS pain	78.54 ± 7.61	72.39 ± 24.18	.01
KOOS ADL	86.85 ± 8.97	80.09 ± 23.45	.014
KOOS sport/rec	37.90 ± 17.79	39.50 ± 31.92	.08
KOOS QOL	67.66 ± 22.08	42.32 ± 31.81	.32
KOOS overall	73.61 ± 9.33	70.41 ± 23.25	.01
2-week ROM	56.00 ± 18.49	66.36 ± 19.89	.87
6-week ROM	96.50 ± 11.34	101.45 ± 19.06	.32
1-year ROM	130.70 ± 6.056	127.50 ± 10.80	.37

Discussion

Patellar dislocation is a disabling condition that often results in disruption of the MPFL.

Recurrence of the dislocation occurs in up to 44% of conservatively treated patients, and appears to be more common in women and patients with predisposing factors. Patient selection, tunnel positioning, graft fixation, and tensioning were considered as the key pillars for successful MPFL reconstructive procedures[12-16]. Shah et al.[14] performed a systematic review about complications and pitfalls in MPFL reconstruction. They found that a total of 164 complications occurred in 629 (26.1%) knees. These adverse events were common with cases of patellar tunnels more than aperture anchor fixation. The most two common complications were patellar fractures and loss of knee flexion. In this study, there were no reported cases of patellar fractures or loss of knee flexion due to overtight grafts. This may be explained by the technique used, as the knee was fixed at 30°–45°. This is the angle of engagement of MPLF and respecting this angle of fixation, complications due to over tensioning can be avoided. Matthews et al. (2010)[15] used semitendinosus autograft for MPFL reconstruction in 25 knees. The cases were followed up for 31 months. The mean Kujala score improved to 87 points and the Tegner score improved significantly from 3 to 4.4 points. They reported no cases of redislocation or positive apprehension after the final follow-up. Christiansen et al.[17] used the gracilis autograft through two transverse patellar tunnels. They reported one case of redislocation among 44 patients followed up to 3 years. Also, four patients had chronic knee pain and three of them had recurrent subluxation.

The medial patellofemoral ligament (MPFL) is essential for the maintenance of correct biomechanical function of the knee. Reconstruction of the MPFL is commonly used in the restoration of patellofemoral stability after traumatic lateral subluxation of the patella. Although a method to accurately determine the MPFL's insertion point has been described, it remains unclear if anatomic placement of MPFL graft tissue is essential for preservation of knee function after MPFL reconstruction. Thus, the purpose of this study was to determine the importance of anatomic placement of medial patellofemoral ligament (MPFL) graft tissue for the preservation of knee function following MPFL reconstruction operations.

Intra- and inter-rater reliability were likely strong due to measurement simplicity and investigator agreement regarding key parameters prior to their performance. The measurements were relatively easy to perform, and the investigators agreed on placement of the line perpendicular to the posterior femoral cortex, the line tangential to the posterior condyle, and the line tangential to the posterior aspect of the Blumensaat line. Within the range of graft placement values considered by this study, non anatomic placement of the femoral MPFL tunnel appears to cause increased pain and decreased function as evidenced by post-operative KOOS and WOMAC scores. However, no significant difference was noted in apprehension, range of motion, quality of life, sport and recreation, patellofemoral pain, or incidence of chondromalacia. These parameters commonly serve as clinical benchmarks, and are generally considered to be the most important indicators of early success of the MPFL reconstruction operation.

It is recommended that particular attention be paid during surgery to the tightness of the graft during active extension and passive flexion to 90 degrees[18,19]. Clinical exam is performed intra-operatively using femoral nerve stimulation to determine the isometry of the graft. If it were felt that there was tightening of the ligament in flexion, then loosening of the graft would be allowed without compromising its check-reign function in the extended position. If this pivotal portion of the MPFL re- construction procedure is performed correctly, it seems that the patella tracks correctly into the trochlear groove post-operatively regardless of graft tissue placement site. Also, the graft tissue

will not be damaged by the normal flexion and extension of the knee joint, and no limits to range of motion or apprehension should occur if correct isometry is achieved intra-operatively[18].

Conclusion

Within the range of graft placement values considered by this study, while no reduction in range of motion was seen, non-anatomic placement of MPFL graft tissue in MPFL reconstruction operations caused increased pain and decreased function, evidenced by post-operative KOOS and WOMAC scores.

Reference

1. Desio SM, Burks RT, Bachus KN. Soft tissue restraints to lateral patellar translation in the human knee. Am J Sports Med 1998;26(1).
2. Panagopoulos A, Van Niekerk L, Triantafillopoulos IK. MPFL reconstruction for recurrent patella dislocation: a new surgical technique and review of the literature. Int J Sports Med 2008;29.
3. Kyung H-S, Kim H-J. Medial patellofemoral ligament reconstruction: a comprehensive review. Knee Surg Relat Res 2015;27.
4. Conlan T, Garth WP, Lemons JE. Evaluation of the medial soft-tissue restraints of the extensor mechanism of the knee. J Bone Jt Surg - Ser A. 1993;75.
5. Nomura E, Horiuchi Y, Kihara M. Medial patellofemoral ligament restraint in lateral patellar translation and reconstruction. Knee 2000;7.
6. Steensen RN, Dopirak RM, Iii WGM. The anatomy and isometry of the medial patellofemoral ligament implications for reconstruction. Am J Sports Med 2004;32(6):1509e13.
7. Shah JN, Howard JS, Flanigan DC, Brophy RH, Carey JL, Lattermann C. A systematic review of complications and failures associated with medial patellofemoral ligament reconstruction for recurrent patellar dislocation. Am J Sports Med 2012;40.
8. Lee D, Park Y, Song S, Hwang S, Park J, Kang D. Which technique is better for treating patellar Dislocation? A systematic review and meta-analysis. Arthrosc J Arthrosc Relat Surg 2010;34(11):3082e93.
9. Fink C, Veselko M, Herbort M, Hoser C. Minimally invasive reconstruction of the medial patellofemoral ligament using quadriceps tendon. Arthrosc Tech 2014;3(3):e325e9.
10. Jacobi M, Reischl N, Bergmann M, Bouaicha S, Djonov D, Magnussen, et al. Reconstruction of the medial patellofemoral ligament using the adductor magnus tendon: an anatomic study. Arthrosc J Arthrosc Relat Surg 2012;28(1):105e9.
11. Ricchetti ET, Mehta S, Sennett BJ, Huffman GR. Comparison of lateral release versus lateral release with medial soft-tissue realignment for the treatment of recurrent patellar instability: a systematic review. Arthrosc J Arthrosc Relat Surg 2007;23.
12. Tanaka MJ, Bollier MJ, Andrish JT, Fulkerson JP, Cosgarea AJ. Complications of medial patellofemoral ligament reconstruction: common technical errors and factors for success. J Bone Joint Surg Am2012; 94:e87.
13. Kang HJ, Wang F, Chen BC, Su YL, Zhang ZC, Yan CB. Functional bundles of the medial patellofemoral ligament. Knee Surg Sports Traumatol Arthrosc 2010; 18:1511–1516.
14. Shah JN, Howard JS, Flanigan DC, Brophy RH, Carey JL, Lattermann C. A systematic review of complications and failures associated with medial patellofemoral ligament reconstruction for recurrent patellar dislocation.Am J Sports Med 2012; 40:1916–1923.
15. Matthews JJ, Peter S. Reconstruction of the medial patellofemoral ligament using a longitudinal patellar tunnel technique. Int Orthop 2010; 34:1321–

1325. DOI: 10.1007/s00264-009-0918-7

16. Geßlein M, Roessler P, Schüttler K, Biber R, Bail H, Efe T. Complications and failure of MPFL reconstruction with free tendon grafts in cases of patellofemoral instability. Technol Health Care 2015; 23:659–666.
17. Christiansen SE, Jacobsen BW, Lund B, Lind M. Reconstruction of the medial patellofemoral ligament with gracilis tendon autograft in transverse patellar drill holes. Arthroscopy 2008; 24:82–87.
18. Steiner TM, Teitge RA, Torge-Spak R. "Medial patellofemoral ligament reconstruction in patients with lateral patellar instability and trochlear dysplasia." American Journal of Sports Medicine, 2006; 34.8: 1254-261.
19. Albright J. Personal interview. 11 Jun. 2012. <http://www.uihealthcare.org/physician.aspx?id=19111>