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Original Research Article

Evaluation of the Results of Reconstruction of Medial Patellofemoral Ligament in the Treatment of Recurrent Patellar Instability using Hamstring Autograft by Dual Patella Docking Technique

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Conflict of interest: Nil

Abstract:

Background: Recurrent patellar instability can significantly affect a patient's life quality. This study evaluated the results of medial patellofemoral ligament (MPFL) reconstruction in the recurrent patellar instability treatment using hamstring autograft by dual patellar docking technique.

Methods: This prospective study was performed on 20 recurrent patellar instability patients. Magnetic resonance imaging and computed tomography scans were performed to confirm MPFL tear and assess the tibial tubercle-trochlear groove distance. Various clinical and radiographic evaluations were performed preoperatively. The surgical technique involved diagnostic arthroscopy, graft preparation, patellar preparation, graft passage, femoral tunnel preparation, and graft fixation.

Results: Postoperatively, a substantial progression was observed in the International Knee Documentation Committee score, Kujala score, Cincinnati score, and Lysholm score compared to preoperative values ($P < 0.001$). In addition, the postoperative measurements of patellar tilt angle and patellar congruence angle were significantly lower than their respective preoperative values ($P < 0.001$). All 20 (100%) patients had negative findings in the post apprehension test, indicating improved stability. In the post compression test, 3 (15%) patients showed positive results, whereas 17 (85%) patients had negative results. In terms of complications, 2 (10%) patients experienced patellofemoral pain, 1 (5%) patient had residual patellar translation without dislocation, 1 (5%) patient had limited flexion, and the majority of patients (16, 80%) had no complications.

Conclusion: MPFL reconstruction with patellar docking yielded good results with Kujala and Lysholm, as well as adequate, satisfactory congruence angles for most patients. This procedure has exhibited a high success rate in addressing patellofemoral instability.

Keywords: Docking, Hamstring Autograft, Medial Patellofemoral Ligament, Patellofemoral, Reconstruction, Recurrent Patellar Instability.

Introduction

Recurrent patellar instability is a challenging problem characterized by repetitive patellar subluxation or dislocation from its usual position in the femoral groove. This condition often leads to pain, functional limitations, and reduced quality of life for affected individuals.[1]

Medial patellofemoral ligament (MPFL) has an essential function in stabilizing patella during knee motion, and when it is damaged or deficient, surgical treatment might be required to restore stability and prevent further episodes of instability.[2] Various surgical approaches have been developed for MPFL reconstruction and address recurrent patellar instability. One such technique that has gained attention is the use of hamstring autograft by dual patella docking technique.[3] This approach involves utilizing a graft from the patient's own hamstring tendons to reconstruct the MPFL and stabilize the patella. The dual patella docking technique refers to graft fixation at both the patellar and femoral ends, providing a secure and stable construct.[4]

The selection of hamstring autograft for repair of the MPFL is dependent on its favorable characteristics, including its strength, low donor site morbidity, and abundant availability. The hamstring tendons, specifically the semitendinosus and gracilis tendons, offer suitable graft material

due to their similar size and biomechanical properties to the native MPFL. By utilizing this autograft, the risk of graft rejection or disease transmission is eliminated.[5,6] Previous studies have investigated MPFL reconstruction results by different techniques and graft materials.[5,7,8]

However, limited research has specifically focused on evaluating the results of MPFL reconstruction using hamstring autograft by the dual patella docking technique. Therefore, there is a need to assess the effectiveness of this technique in achieving stable patellar realignment and reducing the recurrence of patellar instability. Evaluation of MPFL reconstruction results using hamstring autograft by the dual patella docking technique holds significant clinical implications.

This study aimed to evaluate MPFL reconstruction results in recurrent patellar instability treatment using hamstring autograft by patellar docking technique.

Materials and Methods

This prospective study was performed on 20 patients at the Department of Orthopedics, Radha Devi Jageshwari Memorial Medical College & Hospital, Turki, Muzaffarpur, Bihar from February 2020 to July 2020.

Patients between the ages of 11 and 35 who had experienced two or more patellar dislocations and had failed to respond to conservative treatment for a minimum of 3 months. In addition, patients were required to undergo a magnetic resonance imaging (MRI) to confirm a torn MPFL and a computed tomography (CT) scan to evaluate tibial tubercle-trochlear groove (TT-TG) distance which needed to be <20 mm were included in this study.

Exclusion criteria for isolated MPFL reconstruction were as follows: presence of osteoarthritis greater than Grade 1, focal cartilage defects exceeding Grade 3 according to the Outerbridge classification, Trochlear Sulcus Angle of 145° or greater on the Merchant view, Dejour classification Grade B, C, or D, TT-TG distance exceeding 20 mm, Patella Alta with a Blackburne-Peel ratio >1, Q angle over 20° in females or 17^0 in males, and any injury to the knee's cruciate ligaments or medial collateral ligament. Each patient underwent a comprehensive evaluation, which included obtaining informed consent, conducting a general examination, and performing a detailed local examination of the knee. The local examination included the assessment of tenderness around the medial epicondyle, the evaluation of patellar mobility in full extension, a comparison with the contralateral side, and the determination of lateral patellar quadrant translation. Patellar tracking was assessed by evaluating the J sign and performing various tests such as the patellar compression test (patellar grind test), patellar tilt test, and patellar apprehension test. In addition, the limb alignment was evaluated for genu valgum, femoral anteversion, and external tibial torsion. We measured the strengths of the quadriceps and hip muscles while also assessing the presence of generalized ligamentous laxity. This assessment involved examining the elbow for hyperextension and assessing metacarpal hyperextension and knee recurvatum.

Knee radiographic examination includes typical lateral, axial, and anteroposterior weight-bearing scans. Pictures were carefully examined for osteochondral fractures and intra-articular bodies. Lateral radiograph was utilized to evaluate femoral trochlea depth and patellar height. On the axial radiograph, congruence angle, femoral sulcus angle, lateral shift ratio, lateral patellofemoral tilt angle, and absolute lateral patellar displacement were measured. In addition, TT-TG distance was calculated with CT scan, and MRI was used to assess other patellar dislocation-related injuries, as bone contusions on the medial patella, lateral femoral condyle MPFL tears, and articular cartilage injuries.

Statistical analysis was carried out using SPSS version 25 software (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY, USA: IBM Corp.). Qualitative presentation was done using frequency and percentage of variables. Quantitative presentation was done using mean and standard deviation. Comparison of means in the same group was done using paired Student's t-test.

Results

The demographic characteristics of the study participants are shown in Table 1.

Table 1: Demographic characteristics of the study participants (n=20)

Parameter	Mean±SD/n(%)
Age (years), mean±SD	25.2±5.91
Sex	
• Male	7 (35%)
• Female	13 (65%)
Profession	
• Student	6 (30%)
• Worker	3 (15%)

• Driver	1 (5%)
• Carpenter	1 (5%)
• Housewife	6 (30%)
• Athlete	1 (5%)
• Nurse	1 (5%)
• Employee	1 (5%)
Athletic activity	
• Football	5 (25%)

SD: Standard deviation

Trauma was the cause of patellar instability in 16 (80%) patients, whereas 4 (20%) patients were affected due to atraumatic causes. Forty-five percent (45%) of patients were affected on the right side, while fifty-five percent (55%) were affected on the left side. Regarding graft type, gracilis graft was used in 12 (60%) patients, whereas semi-T graft was used in 8 (40%) patients. Follow-up of the patients is shown in Table 2.

Table 2: Follow-up of the patients (n=20)

	Mean±SD (range)
Follow-up(months)	15.9±5.5 (6–24)
Full weight-bearing (weeks)	5.1±0.83 (4–6)
ROM (weeks)	7±0.89 (6–8)

SD: Standard deviation, ROM: Range of motion

International Knee Documentation Committee (IKDC) score, Kujala score, Cincinnati score, and Lysholm score were significantly higher postoperatively than preoperatively ($P < 0.001$), whereas patellar tilt angle and patellar congruence angle were significantly lower postoperatively than preoperatively [$P < 0.001$, Table 3].

Table 3: Knee Documentation Committee score, Kujala score, Cincinnati score, Lysholm score, Patellar tilt angle, and patellar congruence angle of the study patients pre and postoperatively

	Preoperative	**Postoperative**	**P**
IKDC score, mean±SD	43.1±12.74	68.4±15.71	<0.001*
Kujala score, mean±SD	49.6±14.95	74.4±14.22	<0.001*
Kujala score, mean±SD	48±15.4	76.5±14.82	<0.001*
Lysholmscore, mean±SD	57.8±14.37	83.6±12.42	<0.001*
Patellartiltangle, mean±SD (range)	24.1±2.23 (18–27.5)	9.3±1.39 (7–12)	<0.001*
Patellar congruence angle, mean±SD	26.4±5.36	−7.4±1.27	<0.001*

Regarding post apprehension test, all 20 (100%) patients were negative. Regarding post compression test, 3 (15%) patients were positive, whereas 17 (85%) were negative. Regarding complications, 2 (10%) patients had patellofemoral pain, 1 (5%) patient had residual subluxation, 1 (5%) patient had limited flexion, and 16 (80%) patients had no complications.

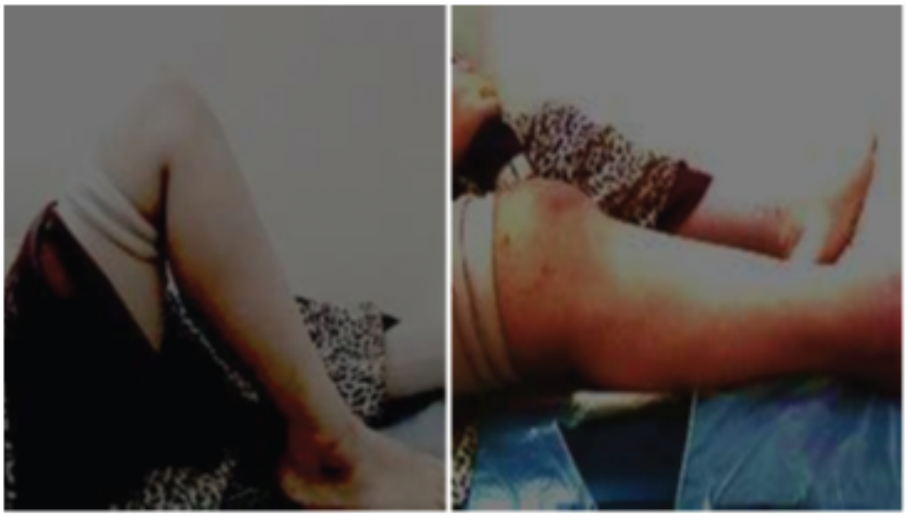

Figure 1: Confirmation by fluoroscopy of the appropriate placement of the guide pins at Schottle point

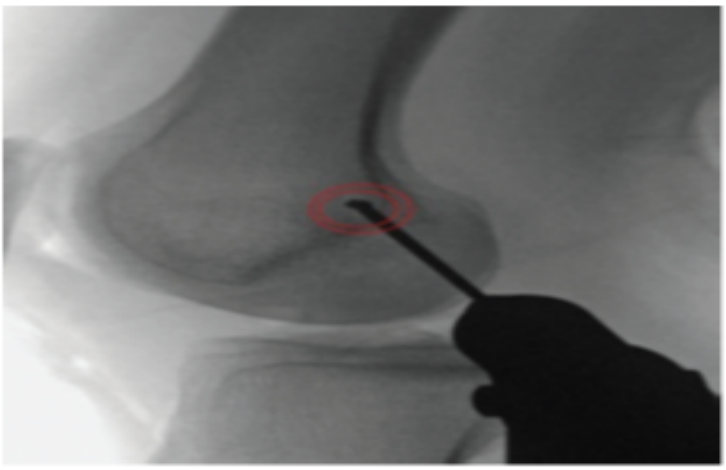

Figure 2: Postoperatively, the patient regained full range of motion (a) Flexion, (b) Extension

Discussion

The role of the MPFL as a crucial medial patellar stabilizer in lateral patellar dislocation has been noted throughout the last decade. Several biomechanical investigations have shown that the MPFL is the primary static restraint against pressures that displace the patella out of the sulcus, generating, on average 50%–60% of the total medial restraint force.[1]

Numerous surgical methods have been successfully described to replicate its check-rein action. The objective of a successful surgical procedure must be the restoration of the MPFL, which restores the length and rigidity of the native medial soft tissue. Using various kinds of grafts and methods, the success rate for reconstructing the MPFL varies between 83% and 93%. However, it has been shown that isolated restoration of the MPFL is inadequate to give mechanical strength for optimal MPFL function and yield considerably superior functional results.[2]

According to our results, the postoperative IKDC score was substantially higher compared to the preoperative score ($P < 0.001$).

Supporting our findings, Lee et al.[9] demonstrated positive outcomes in 9 cases where soft tissue was sutured onto the patella and femur, resulting in an IKDC score of 81.1. In addition, Carnesecchi et al.[10] reported an increase in the mean raw IKDC score from 51.5 preoperatively to 71.7 at the last follow-up. Moreover, the mean overall IKDC score improved from 38.5 to 61.7, and the Kujala score increased from 48.3 to 82.4, further supporting our findings. In this study, the postoperative Kujala score was substantially greater than the preoperative score ($P < 0.001$). This finding is supported by a recent study conducted by Migliorini et al.,[11] which also reported improved postoperative Kujala scores (mean change ± 12.76; $P = 0.0003$) as well as improved Lysholm scores (mean change ± 15.69; $P < 0.0001$). Similarly, Kim et al.[12] observed a significant development in Kujala scores, with the average score increasing from 42.7 ± 8.4 before surgery to 79.6 ± 13.6 ($P = 0.008$) at the final follow-up.

In this study, the postoperative Cincinnati score was significantly higher compared to the preoperative score ($P < 0.001$). This finding is consistent with the results reported by Han et al.,[13] who found substantial changes between the mean preoperative modified Cincinnati scores and the scores at 12, 36, 60, and 84 months following MPFL reconstruction surgery ($P < 0.01$). Following surgery, the patients' ratings were much higher than their prior values.

In this study, results demonstrated that the postoperative lysholm score was substantially greater compared to the preoperative score ($P < 0.001$). This finding is supported by the study conducted by Kim et al.,[12] which revealed a significant improvement in the Lysholm score from 45.8 ± 5.7 to 82.0 ± 10.5 ($P = 0.008$). In addition, Lee et al.[9] reported a considerable rise in the Lysholm score from 47.8 points to 84.9 points ($P < 0.001$).

In the present study, we found that the postoperative patellar tilt angle and patellar congruence angle were significantly lower compared to the preoperative measurements ($P < 0.001$). These results align with those reported by Kim et al.,[12] who observed a significant improvement in the congruence angle from 26.5° ± 10.6° (range: 12° to 43°) before surgery to −4.0° ± 4.3° (range: −12° to 5; $P = 0.008$) at the final follow-up.

Regarding the post apprehension test, all 20 (100%) patients yielded negative results. As for the post compression test, 3 (15%) patients tested positive, whereas 17 (85%) patients tested negative. These findings are consistent with the results documented by Ballal et al.,[14] who reported no cases of apprehension, maltracking, facet tenderness, or

positive patellar quadrant tests postoperatively. However, in contrast to the findings in this study, Christiansen et al.[15] reported that 50% of their patients exhibited positive apprehension and pain with palpation. The differences observed may be attributed to the changes in patellar anatomy resulting from the reconstruction procedure and the influence of previous surgeries in some patients.

In our study, we propose a procedure, in which an anatomical reconstruction of the MPFL at both the femoral and patellar attachments is recreated. Our fixation approach employs a dual docking strategy, which provides potential advantages. By creating two incomplete transverse tunnels, we eliminate the need for implants for fixation, reducing surgical time, and lowering the risk of patellar fracture. In addition, this technique increases the surface area available for graft-to-bone healing.

A systematic review conducted by Jackson et al.[16] focused on the incidence of complications following primary MPFL reconstruction for recurrent patellar instability. The review analyzed data from 28 studies involving 1478 patients (1521 knees), with a mean age of 23.3 years (range: 19–34.3 years). The findings indicated that patellar fractures occurred in 0% to 8.3% of knees, primarily in patients who underwent full-length transverse tunnel reconstruction.

Another analysis and survey by Wierer et al.,[17] conducted within the International Patellofemoral Study Group, concluded that Patellar fracture risk after reconstruction of the MPFL relies on the drilling method and placement of the patellar bone tunnels. The study found that violating the anterior or lateral patellar cortex increased the likelihood of postoperative patellar fracture.

Compared to hardware-free fixation procedures, the use of screws and anchors for patella fixation is considered to be less time-consuming and easier to implement. However, it has been linked to possible side effects, including discomfort and inflammation at the insertion site. However, implant-free patellar fixation procedures have the benefit of being less expensive. As stress risers, thorough reaming and the use of entire transverse bone tunnels may enhance the likelihood of patellar fractures or collapse of the bone bridge.[18]

This technique has several advantages. First, it avoids breaching the anterior cortex of the patella, minimizing the need for extensive bone tunnels. Instead, blind transverse tunnels (not transpatellar tunnels) are utilized, which helps prevent the devascularization of the superior pole of the patella due to the use of a small incision and minimal exposure.

Furthermore, our technique enables the assessment of graft isometry before finalizing the tunnel location on the femur. Using small guide pins during drilling across the patella, we ensure accurate isometric placement of the graft while minimizing the risk of chondral surface injury. Proper graft placement and isometry are crucial for the success of MPFL reconstruction.[19]

In this study, the graft was fixed to the femur with the knee flexed to 30°–60°, as this position has been reported to provide optimal graft length without over tightening. Furthermore, due to passive tension in the quadriceps and the patellofemoral articulation, the patella adopts its typical and repeatable position at this flexion angle. McCarthy et al.[20] emphasized the importance of anatomically placing the MPFL femoral tunnel to maximize outcomes. Proximally placed tunnels have been associated with increased stress and contact pressure on the medial patellar facet cartilage, potentially leading to medial overload, arthritis, pain, and disability. Malpositioned femoral tunnels can also increase stress on the nonisometric MPFL graft, resulting in reconstruction failure and recurrent lateral patellofemoral instability or iatrogenic medial patella subluxation.

Regarding complications in this study, two patients (10%) experienced patellofemoral pain, with one having a pre-existing mild degree of patellofemoral arthrosis and the other presenting a small osteochondral lesion from the initial injury. In both cases, postoperative pain was mild and did not significantly affect their daily activities. One patient (5%) exhibited residual instability with increased patellar translation, but since they did not experience the same apprehension and recurrent dislocation episodes as before, they opted for quadriceps strengthening exercises instead of revision surgery. Another patient (5%) had limited flexion (up to 100°) without interference in daily activities, and postoperative CT scan confirmed satisfactory femoral tunnel placement. Sixteen patients (80%) had no complications. Shah et al.[21] reported that after surgery, 3.7% of patients suffered new subluxations/dislocations, and 8.3% of knees displayed fear, patellar hypermobility, or episodic instability, which could be attributed to underlying pathologies and the reliance on the reconstructed MPFL for patellar stability.

A systematic review by Jackson et al.[16] concluded that complications after initial reconstruction of the MPFL ranged from 0% to 32.3% of knees and consisted mostly of persistent anterior knee discomfort. Failure rates varied between 0% and 10.7%, whereas patellar fractures were observed in between 0% and 8.3% of knees.

It is important to acknowledge the limitations of our study. This is a single-center study with a relatively small sample size and a relatively short

follow-up duration. The clinical evaluations were not blinded, and there was a lack of a control group and long-term follow-up.

Conclusion

MPFL reconstruction with patellar docking has demonstrated favorable outcomes, as evidenced by the improvement in Kujala and Lysholm scores, as well as the achievement of satisfactory congruence angles for the majority of patients. This surgical technique has shown a high success rate in addressing patellofemoral instability and effectively preventing future episodes of patellar subluxations or dislocations. By providing enhanced postoperative patellar stability, MPFL reconstruction significantly contributes to improving patients' quality of life and it is a cost-effective procedure.

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