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# Medial Patellofemoral Ligament Reconstruction Using Superficial Quadriceps Tendon Offers Satisfactory Results in Recurrent Patellar Dislocation.

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## ABSTRACT

**INTRODUCTION:** This study aims to assess the functional outcomes of patients undergoing medial patellofemoral ligament reconstruction using superficial quadriceps tendon and also assess the postoperative complication and patient's satisfaction level.

**METHODS:** We retrospectively reviewed 33 patients (15 males, 18 females) with an average age of 19 years with recurrent patellar dislocation, operated from August 2015 to January 2018. Inclusion criteria of the study was patients with a recurrent patellar dislocation undergoing medial patellofemoral ligament reconstruction with a minimum follow-up of 1 year. Exclusion criteria of the study were: (1) associated ligamentous injuries of the knee joint, and (2) previous history of bony correction along with medial patellofemoral ligament reconstruction. The clinical evaluation was performed using Kujala knee score and visual analogue scale scores. Postoperative satisfaction level was performed using a self-constructed questionnaire.

**RESULTS:** At the final follow-up, the mean Kujala score was significantly improved from 72 points (range 53-94) to 95 points (range 87-100) ($p<0.001$). Similarly, the VAS score is significantly reduced from 3.5 points (range, 0-6) preoperatively to 1 point (range, 0-3) postoperatively ($p<0.001$). Postoperatively, 25 patients (76%) were very satisfied with the surgery, 7 patients (21%) were satisfied and 1 patient (3%) was neutral with the surgery. One patient reported frequencies of subluxation of the patella with a positive apprehension, others did not report any cases of dislocation. Superficial infection was evident in 2 patients with a complete resolution with oral antibiotics and regular dressing change.

**CONCLUSION:** medial patellofemoral ligament reconstruction using superficial quadriceps tendon for the recurrent patella dislocation provides satisfactory functional outcomes with minimal complications and is a cost-effective method for the countries like Nepal.

KEYWORDS: Recurrent patellar dislocation, Medial patellofemoral ligament, Quadriceps tendon, Hamstring tendon

## INTRODUCTION

First-time patellar dislocation is treated conservatively in various stages.[1] However, redislocation has been reported in 44% of patients undergoing conservative management.[2] Further, chronic instability and pain occur when recurrence is neglected. Studies suggest that when the second dislocation occurs or conservative treatment fails, surgical management should be performed. These include proximal or distal realignment procedures or combination of both.[3] Among proximal procedures, Medial patellofemoral ligament(MPFL) reconstruction has gained popularity. Non-reconstruction

techniques like plication and realignment disturb the native patellofemoral biomechanics and repair involves already compromised tissue. Many MPFL reconstruction techniques have been described, but there is no consensus about the choice of graft, graft positioning, type of fixation, correct tension and outcome. Commonly used grafts are gracillis, semitendinosus and quadriceps tendon.[4–6]

The use of autologous partial-thickness quadriceps tendon was first described by Steensen et al. in 2005.6 They used central one-third of the first layer of the quadriceps tendon, leaving the patellar attachment intact. After harvesting, it was rotated 900 medially and fixed with trans-osseous sutures on the femoral side. One year later, Noyes et al.[7] presented a similar technique with the same graft but fixed to the medial intermuscular septum. However, it gained little attention at that time. The technique was revived and popularized by Goyal[8] as "superficial quad technique". There are several advantages of this graft over others. Hamstring and other tendon grafts are thicker and stronger than the native MPFL.[9] Further, they require osseous tunnels and some form of fixation at the patellar side. This may emanate complications like patellar fracture, hardware irritation, violation of chondral surface of the anterior cortex of patella, and increase stress risers.[10] Additionally, the structural and biochemical properties of the quadriceps tendon graft are similar to that of native MPFL.[11]

This study aims to assess the functional outcomes of patients undergoing MPFL reconstruction using superficial quadriceps tendon and also assess the postoperative complication and patient's satisfaction level.

## METHODS

We retrospectively reviewed 33 patients (15 males, 18 females) with recurrent patellar dislocation, operated from August 2015 to January 2018. Inclusion criteria of the study was patients with a recurrent patellar dislocation undergoing MPFL reconstruction with a minimum follow-up of 1 year. Exclusion criteria of the study were: (1) associated ligamentous injuries of the knee joint, and (2) previous history of bony correction along with MPFL reconstruction. Detailed demographic characteristics of the participants are well depicted in Table 1. Intervention was carried out on 23 right and 10 left knees. Mean age of the patient was 19 years (range, 12-35 years). The mean follow- up was 27 months from index surgery (range, 12-44 months). All patients suffered at least 3 unilateral dislocations (mean 5, maximum of 11 episodes).

Table 1: Demographic Parameters of the patients

| Parameters | Mean±SD or n | Range |
|---|---|---|
| Age (years) | 19.48±6.02 | 12-35 |
| Male/Female | 15/18 | |
| Right/Left | 23/10 | |
| Follow-up (months) | 26.88±9.85 | 12-44 |
| n=number of patients, SD=standard deviation | | |

Detailed clinical examination to rule out any patellofemoral pathology was done. Plain radiographs (anteroposterior, lateral and bilateral skyline views at $30^0$ flexion) were studied in each patient. Geometric parameters of the patellofemoral joint like trochlear dysplasia, patella alta, abnormal tibial tuberosity-trochlear groove (TT-TG) distance were documented using computed tomography (CT) scans. Magnetic resonance imaging (MRI) was also done in each subject. Other regional and generalized causes of patellofemoral instability were also examined.

All procedures were carried out under spinal anesthesia in the supine position. Patient positioning was done to allow free knee motion from 0 to $120^0$. Access to fluoroscope was checked before draping. We used the technique as Goyal[8] and Fink et al.[12] described. Initially, diagnostic arthroscopy was performed detailed assessment and management of intra-articular pathologies and chondral injuries. After arthroscopy, a longitudinal incision measuring 7-8 cm was made on the anterior aspect of the knee, starting at the midpoint of the patella and progressing proximally.

The superficial and deep fascia were incised along the line of skin incision until a fatty tissue layer was encountered. This tissue was removed from the surgical field using blunt dissection with dry gauze, exposing quadriceps tendon. Another thin fascial layer of tissue over the quadriceps was incised and extended proximally to mid-thigh and distally to the lower pole of the patella. The next and the most crucial step was to identify a naturally occurring plane of separation between the superficial and middle lamina about 2-3 cm proximal to the patella. The superficial lamina was lifted, and the two laminae were separated by blunt dissection. Then, approximately 10 mm wide mid-portion of the superficial slip was dissected proximally for the required length (10 cm). The graft was further dissected distally and obliquely on the subperiosteal plane of the patella. Medial point of this dissection was aimed till the superomedial corner of the patella, and lateral point of dissection was made till the level of the midpoint of the medial border of the patella. Care was taken not to amputate the graft at this level. The proximal portion of the graft was sutured with No. 2 Ethibond.

The prepared graft was then rotated medially such that the superior and inferior edges of the rotated graft matched the anatomic attachments of native MPFL. Next step was to lift the insertion of vastus medialis and creation of subvastus space. The graft was then routed through this space. A 2 cm incision was centered over the medial epicondyle, and adductor tubercle and medial epicondyle were located. By using artery forceps, the graft was pulled out of the medial incision, avoiding re-rotation. An isometric point on femur was identified by Schottle's method.[5]

A Beath pin was passed from medial Schottle's point to the lateral side. Drilling was done with 6.5 mm reamer through this pin till the desired intraosseous diameter of the graft. The graft was then passed through this point by pulling the Beath pin laterally. Optimum length without over tensioning the graft was checked in $30^0$ flexion and full extension, and then the graft was fixed in $30^0$ flexion with an appropriately sized absorbable interference screw. At the end of the procedure, medial retinaculum was repaired for any damage, and diagnostic arthroscopy performed to recheck patellar tracking.

Postoperatively, patients were allowed to fully weight-bear since day 1. Long knee immobilizer was applied until the patients gained good quadriceps control. Quadriceps strengthening physiotherapy was administered.

The clinical evaluation was performed using Kujala knee score[13] and visual analogue scale (VAS) scores. Preoperative data were obtained from the hospital database, whereas postoperative data were collected during the last follow-up visit. Postoperative satisfaction level was performed using a self-constructed questionnaire consisting of very satisfied, satisfied, neutral, dissatisfied and very dissatisfied.

We used SPSS Statistics version 25 for statistical analysis. Continuous variables were analyzed using the paired t-test and categorical variables were analyzed using the chi-square test. Results of continuous data were presented as the mean ± standard deviation (SD) and range, whereas the results of categorical data were presented as frequencies and percentages. A p-value of $<0.05$ is regarded as statistically significant.

## RESULTS

Functional outcome of the patients is well depicted in Table 2. At the final follow-up, the mean Kujala score was significantly improved from 72 points (range 53-94) to 95 points (range 87-100) ($p<0.001$). Similarly, the VAS score is significantly reduced from 3.5 points (range, 0-6) preoperatively to 1 point (range, 0-3) postoperatively ($p<0.001$). Postoperatively, 25 patients (76%) were very satisfied with the surgery, 7 patients (21%) were satisfied and 1 patient (3%) was neutral with the surgery. None of the patients was dissatisfied or very dissatisfied.

Table 2: Preoperative and postoperative functional outcomes of the patients.

| Parameters | Preoperative Mean±SD (Range) | Postoperative Mean±SD (Range) | p-value |
|---|---|---|---|
| Kujala score | 72.09±12.69(53-94) | 94.94±4.25 (87-100) | <0.001* |
| VAS Score | 3.58±1.39 (0-6) | 1.03±0.98(0-3) | <0.001* |
| SD=Standard deviation, * Statistically significant difference exists | | | |

Post-operative complication occurred in 3 patients (9%) (Table 3). One patient reported frequencies of subluxation of the patella with a positive apprehension, others did not report any cases of dislocation. Superficial infection was evident in 2 patients with a complete resolution with oral antibiotics and regular dressing change.

Table 3: Complications following MPFL reconstruction.

| Complications | n (%) |
|---|---|
| Superficial Infection | 2 (6) |
| Patella fracture | 0 |
| Knee stiffness 0 | |
| Redislocation/subluxation | 1 (3) |
| Overall | 3 (9) |
| n=Number of patients | |

## DISCUSSION

Most important finding of this study was that MPFL reconstruction using a strip of superficial quadriceps tendon provides satisfactory functional outcomes with minimum complications. Ninety-seven per cent of the patients were very satisfied or satisfied with the surgery.

Of numerous proximal patellar realignment procedures, MPFL reconstruction has become one of the most frequently used methods for addressing recurrent patellar dislocation. For many years, this ligament has been thought of only an inconstant anatomic structure.[14] However, today lesion of the MPFL is considered to be an 'essential lesion', comparable to Bankart lesion in anterior shoulder instability, without which the patella cannot laterally dislocate.[15]

Multiple procedures have been described for the reconstruction of this structure, depending upon the type of graft and the fixation technique used in patella and femur. However, there is no consensus to which one is better and clinically superior over another.

Hamstrings tendon was utilized as the most frequent source of autologous graft. The procedure resulted in high success; however, it has complications rate of up to 26%.[16] The complications were mainly patellar fractures and impairment of knee flexion.[17] Intra-operative iatrogenic patellar fractures have also been described.[18] Being stronger and stiffer, this graft tends to overload the graft-patellar junction, weakening the medial patellar ridge, causing stress risers as well as late patellar fractures after many years.[10] Further, Mountney et al.[19] showed that the strength of various fixation methods of grafted tendons was remarkably lesser than the native MPFL. Hence, they would fail at patellar fixation site amongst others. Similarly, using more substantial and stiffer graft than the original ligament will increase the stress in the patella, aggravating any pre-existent anatomic abnormality and potentiating early patellofemoral osteoarthritis. Hence, to maintain the exact native dimensions and strength, graft used for reconstruction must have similar properties to that of the latter.

MPFL is a thin ligament with a length ranging from 4.5 to 6.5 cm.[20] The width of MPFL at patellar insertion is almost double than the femoral side, making it broad and sheet-like.[21] On the other hand, the average lengths of gracillis and semitendinosus tendons were 20-25cm and 23.5 to 28 cm, respectively.[22,23] Hence, their widths are larger, making them thick and cord-like. Andrikoula et al.[24] reported the length of the superficial slip of the quadriceps tendon ranged from 5.0 – 8.5cm, width at the superior aspect of patella being 4.1cm and at the middle of the tendon to be 2.2cm. Further,

the attachment of this superficial slip is as broad as the native MPFL.[25] Biomechanically, the strength, stiffness, yield load and maximum load to failure of this slip match those of original MPFL while tested as reconstruction.[11]

Another advantage of this technique is the cheaper procedural cost because this technique requires only a single bioabsorbable screw for the fixation at the femoral insertion site and few Ethibond stitches at the patellar side. Whereas in the hamstring and other fixation techniques may require fixation at both in the patellar and femoral side, it demands the further economic burden to the patients of countries like Nepal where most of the payment has to be made by patients themselves.[26]

Superficial quadriceps technique is free from complications as mentioned above of hamstring tendon, including patellar fracture. Similarly, it is also possible to use in revision MPFL surgery, that have previously used tunnels or hardware in the patella. Use of superficial quadriceps tendon also reserves the source of autologous graft from hamstrings to be used in any other reconstruction, if required. A careful dissection of the superficial lamina is the most pivotal step in this technique. Harvesting the desired length is another critical aspect. A hasteful dissection on the anterior surface of the patella may lead to graft amputation. Another point of attention should be while gaining access to the subvastus space by carefully dissecting the medial border of the patella.[27]

Patients satisfaction following surgical stabilization of the patella depends on the postoperative functions and redislocation. Most of our patients were satisfied with the surgery. The average Kujala score in our cohort was improved from 72 points preoperatively to 95 points postoperatively at the final follow-up. Similar improvement was noted in the studies of Goyal et al.[27] (from 49 to 91 points), Nelitz et al.[28] (from 63 to 89 points), Bouras et al.[29] (from 60 to 92 points), Vavalle et al.[3] (from 36 to 89 points). Similarly, Fink et al.[30] used Lysolm score for the clinical assessment and reported to improve from 69 points preoperatively to 88 points postoperatively at the final follow-up.

As of postoperative satisfaction level, 97% of patients in our cohort were very satisfied or satisfied with the surgery, and the results were similar to that of previous studies by Fink,[30] Vavalle,[3] Hinckel[31] and Leal-Blanquet et al.[32] However, many previous studies did not report any complications except by Hinkel et al.[31] They reported 1 postoperative wound infection requiring regular washout and debridement. We also had superficial wound infection in 2 patients who required regular dressing changes and oral antibiotics. One of our patients reported episodes of patellar subluxation and a positive apprehension. However, he did not undergo any further surgical stabilization procedure.

Although this is the first study from Nepal, it has all the limitations that a retrospective with a limited number of the sample and non-randomized study would have. Prospective randomized control trials assessing the outcomes, complications with a cost-effective analysis would provide a robust result in the future.

## CONCLUSION

MPFL reconstruction using superficial quadriceps tendon for the recurrent patella dislocation provides satisfactory functional outcomes with minimal complications and is a cost-effective method for the countries like Nepal.

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