Anatomical Medial Patellofemoral Ligament Reconstruction in Management of Cases of Patellar Instability

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Abstract

Objectives: The purpose of this study was to evaluate the technique of anatomical Medial Patellofemoral Ligament (MPFL) reconstruction for lateral patellar instability, and to assess clinical, radiographic results and complications associated with this procedure.

Patients and Methods: From February 2013 to February 2016, 30 knees with patellar instability met the inclusion criteria and underwent MPFL reconstruction; 15 cases by suture anchors technique (50%), and 15 cases by patellar bone tunnels technique (50%). The mean duration of follow-up in our series was 8.93±5.32 months (6-29). There were 12 Males (40%) and 18 Females (60%) with a mean age of 25.97±6.79 years (15-42).

Results: There was statistically significant improvement in postoperative Modified IKDC score from 40.93 to 65.72 (p<0.001), Kujala score from 49.63 to 72.50 (p≤0.001), Cincinnati score from 46.33 to 73.63 (p≤0.001), Tegner-Lysholm score from 51.37 to 77.30 (p≤0.001). At latest follow-up, the apprehension test was negative in all patients while compression test was positive in 6 patients (20%). No patient experienced patellar redislocation or subluxation between surgery and the latest follow-up. There was no significant difference in clinical or radiographic outcome between both techniques; suture anchor fixation technique, and patellar bone tunnels technique.

Conclusion: Anatomic MPFL reconstruction is a reliable treatment option with little associated morbidity for the treatment for patellar instability, especially in patients without bony abnormalities. The procedure described here offers the opportunity of an anatomical MPFL reconstruction.

Key Words: Anatomical reconstruction – Patellar instability – Medial Patellofemoral Ligament (MPFL) – Anchors.

Introduction

THE medial patellofemoral complex, consisting of the Medial Patellofemoral Ligament (MPFL), the medial patellotibial ligament, and the vastus medialis obliquus, is the main passive stabilizer of the patellofemoral joint. Recently, it has been shown that the medial patellofemoral complex is the main pathoanatomy after patellar dislocation [1-3]. In addition, biomechanical studies have demonstrated that the MPFL is the main restraint against lateral patellar displacement and that repair or reconstruction of the MPFL restores normal patellar tracking [4-8]. Since it is known that distal realign-ment procedures do not restore patellofemoral stability and can even increase the medial patellofemoral pressure, leading to arthrotic degeneration [9], surgical interventions have focused on the passive joints stabilizers. Furthermore, lateral release procedures have been shown to increase patellofemoral instability in biomechanical investigation and thus reconstruction or repair of the MPFL has become the preferred treatment [10].

Recently, numerous techniques for reconstruction of the medial patellofemoral complex have been described with promising clinical results [11-18]. However, it is known that a non-anatomical reconstruction of the MPFL can lead to non-physiological patellofemoral loads and kinematics [18], as a too proximal femoral fixation can lead to an increased patellofemoral pressure in higher knee flexion and vice versa [4], the goal of a surgical intervention should be an anatomical reconstruction. Here, a technique is presented, where the patellar as well as the femoral insertion anatomy is respected while reconstructing the MPFL with an ipsilateral gracilis autograft.

Patients and Methods

The study was conducted to investigate the functional outcome of anatomical MPFL reconstruction on 31 patients with 33 affected knees from February 2013 till February 2016 including
patients with patellar instability presenting mainly to Kasr Al-Ainy Hospital (Outpatient Clinic and E.R.).

Two patients had no complete clinical and radiographic data and missed in follow-up, so they were excluded. One patient had trochlear dysplasia Dejour type D, and TTTG distance=24.3mm, to whom additional medial tibial tuberosity transfer was done in addition to Medial Patellofemoral Ligament (MPFL) reconstruction, so he was also excluded. As a result, a total of 28 patients (30 knees) were enrolled in this study.

Medial patellofemoral ligament reconstruction was done for 15 out of 30 knees using suture anchor fixation technique. The other 15 knees had medial patellofemoral ligament reconstruction using patellar bony tunnels technique. The decision of which technique used was assigned randomly.

One out of 30 cases was failed previous MPFL reconstruction by patellar bone tunnels technique using semitendinosis tendon graft, to whom revision MPFL reconstruction was done by suture anchor fixation technique using gracilis tendon graft.

Inclusion criteria included age between 10-50 years old, males and females, cases of patellar dislocation (acute-chronic-recurrent), patellofemoral subluxation, and failed another previous procedure in treatment of patellar instability in patients with deficient MPFL.

Exclusion criteria included medial patellar instability, intraarticular patellar dislocation, superior patellar dislocation, severe patellofemoral arthritis, congenital patellar dislocation, and TTTG distance in CT scan >20mm.

Preoperatively, the patellar apprehension and compression tests were performed. ROM was observed and recorded. Modified IKDC, Kujala, Cincinnati, and Tegner-Lysholm scores were documented pre and postoperatively. Pre and postoperative radiographs, and CT were done to assess patellar height (MIS ratio), congruence angle (CA), lateral patellofemoral angle (LPFA), and TTTG distance. Patients were reassessed at 3 months, and 6 months postoperatively.

Surgical technique:

After induction of anesthesia, patients are placed supine on the operating room table. A tourniquet is applied to the thigh and is used for this procedure, since it is known that it has no influence on quadriceps activity and pressure is applied at 350mmHg. The affected leg is disinfected and drapped in the usual fashion.

An examination under anesthesia was performed to confirm the diagnosis of patellar instability and hypermobility.

Initially, an arthroscopy is performed to inspect the cartilaginous situation, to evaluate any intraarticular lesions and patellar tracking throughout the knee motion. Chondroplasty or removal of loose bodies was performed as needed. Medial meniscal repair was done in one patient (3.3%). Partial medial meniscectomy was done for 3 patients (10%). Partial lateral meniscectomy was done for 1 patient (3.3%).

In acute traumatic patellar dislocation in patients with moderate to severe effusions aspiration of the knee joint was performed for both diagnostic and therapeutic reasons.

Harvesting and preparing of the graft:

After completion of the arthroscopy, a 2cm long incision is performed over pes anserinus about 5-10mm distal to the tibial tuberosity on the anteromedial side. After incising the sartorius aponeurosis, the gracilis tendon was our first choice since it is known that the mean load to failure force of the MPFL is 208N, which can be easily sustained by a single bundle gracilis tendon graft.

After harvesting the tendon with the stripper, the tendon is placed on a preparation board and cleaned of muscle tissue. The graft is cut to 20-24cm and over-doubled to create an 10-12cm graft (depending on the size of the patient). After scraping off the muscle, both ends of the tendon were sutured with No. 2 absorbable sutures in a whipstitch style leaving equal ends of suture on each side. Graft length is assessed externally to the skin so underestimation of length can be avoided.
Preparing the patellar insertion site:
1- Suture anchor technique:

At 90º of knee flexion, with the limb in figure of four position, a 2cm skin incision is performed directly over this insertion area, followed by opening first and second layers in medial retinaculum along medial border of patella. The bony insertion area of the MPFL is prepared and a bony rim of 2cm length is created, using the rongeur. The rim must be deep enough, so the gracilis autograft can be completely embedded. Next, two suture anchors with a diameter of 5.5mm, each carrying two No. 2 Fiberwire sutures, are placed at the proximal and the distal end of the created rim with the eyelet of the suture anchor directed 45º to the created rim until the horizontal laser line is flush with the subchondral bone.

Preparing the femoral insertion site:
The second and the third layer of the medial patellofemoral complex, where the MPFL is anatomically situated, were separated from each other down to the femoral insertion side, with care to avoid injury of the capsule. In 30º knee flexion, a 1 cm longitudinal skin incision is performed in the area of the medial epicondyle and the adductor tubercle. A first suture loop for pulling the graft from the patellar to the femoral site is inserted in between the second and the third layer with the loops towards anterior.

Graft fixation:
The graft was first pulled into the femoral tunnel maximally in full extension. The knee was then brought to full flexion several times to accommodate the graft, a movement that consistently retracted the graft slightly out of the femoral tunnel. The graft was fixed with a biodegradable interference screw (7*25mm) in 30º of knee flexion, since biomechanical studies have shown that the MPFL has its maximal restraint against patella lateralisation in 30º of knee flexion. The screw is turned

be easily anchored in the patella without implant.

2- Patellar bony tunnels technique:

Another method for tendon graft insertion in the patella, is by using a special aimer (MPFL Aimer Karl Storz) applied to the proximal part of medial border of patella. The aimer permits drilling a V-shaped tunnel in the patella using 4.0mm drill bit. This ensures that the tunnels are congruent. As a result, the tendon graft can be easily anchored in the patella without implant.
into the tunnel, when the lateral patellar edge is in line with the lateral femoral condyle edge, thus reconstructing the anatomy of the original MPFL. Full range of motion is controlled before screw driver removal and patellar tracking is checked between 0° and 40° of knee flexion, when the medial patellofemoral complex has the main restraint against patellar lateralisation. Next, the medial retinaculum and remnant MPFL were sutured to cover the embedded graft. Leaving suction drainage through the anterolateral portal, both incisions were irrigated and closed in layers. Tourniquet was deflated prior to closure to achieve adequate hemostasis. Sterile dressings were applied, and the knee was placed in a hinged calibrated brace.

Results

Clinical assessments:
Modified IKDC score improved from a mean of 40.93±12.38 to a mean of 65.72±15.16 (p<0.001; statistically significant).

Kujala score improved from a mean of 49.63±14.10 to a mean of 72.50±13.61 (p<0.001; statistically significant).

Cincinatti score improved from a mean of 46.33±17.99 to a mean of 73.63±14.54 (p<0.001; statistically significant).

Tegner-Lysholm score improved from a mean of 51.37±18.35 to a mean of 77.30±14.48 (p<0.001; statistically significant).

Table (2): Mean values for timing of full weight bearing and range of motion in weeks.

<table>
<thead>
<tr>
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<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
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<td>Full WB</td>
<td>4.57</td>
<td>.94</td>
<td>4.00</td>
<td>8.00</td>
</tr>
<tr>
<td>ROM</td>
<td>8.43</td>
<td>.90</td>
<td>8.00</td>
<td>12.00</td>
</tr>
</tbody>
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The apprehension test and patellar compression test were positive in all patients preoperatively. At latest follow-up, the apprehension test was negative in all patients while compression test was positive in 6 patients (20%).

Radiographic assessments:
The MIS index, CA, and LPFA are summarized in table. No patient had patella alta (MIS index >2.0) neither preoperatively nor at latest follow-up.

Table (3): Mean values for preoperative and postoperative CA and LPFA.

<table>
<thead>
<tr>
<th></th>
<th>Preoperative</th>
<th>Postoperative</th>
<th>p-value</th>
</tr>
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<tbody>
<tr>
<td>MIS</td>
<td>1.42±0.16</td>
<td>1.36±0.16</td>
<td>0.073</td>
</tr>
<tr>
<td>CA</td>
<td>−7.70±4.63</td>
<td>−9.17±4.26</td>
<td>0.031</td>
</tr>
<tr>
<td>LPFA</td>
<td>13.07±4.34</td>
<td>12.80±3.09</td>
<td>0.700</td>
</tr>
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No patient experienced patellar redislocation or subluxation between surgery and the latest follow-up. Sex patients experienced postoperative patellofemoral pain (20%).

Postoperative wound infection at graft site was witnessed in a single patient (3.3%). Infection was noticed in patients on the second week, and was controlled by repeated sterile dressing and parenteral antibiotics.

Failure to harvest gracilis tendon occurred in 5 patients, so ipsilateral semitendinosis tendon was harvested in 4 out of 5 patients, and contralateral gracilis tendon was harvested in last patient.

There were no complications, such as patellar fracture, neurovascular injury, knee stiffness, or iatrogenic medial patellar instability.

Fig. (4): Postoperative X-rays of left knee.
Discussion

The optimal surgical treatment for chronic patellar instability is controversial. Numerous techniques have been used with varying success. Proximal realignment procedures, which cover medial capsule plication and lateral capsule release, have been investigated in a few studies. Scuderi et al., reported a low redislocation rate of 3% with isolated proximal realignment [19]. A similar finding was reported by Aglietti et al., and Zeichen et al., [20]. Medial transfer of the tibial tuberosity, called distal realignment, has been used in isolation, with unsatisfactory results in approximately 20% to 25% of patients [21,22]. However, in a study by Shelbourne et al., a redislocation rate of 0% was found in 34 patients with patellar instability but 25% had persistent symptomatic instability [23]. A combination of all 3 of the previously mentioned procedures, called the Roux procedure, has resulted in better redislocation rates of 5% to 10% [24,25].

Due to high failure and redislocation rate with previously mentioned procedures, medial patellofemoral ligament reconstruction is becoming the most widely adopted procedure for recurrent patellar dislocation. The first English-language report of an MPFL reconstruction method was in 1992, with an artificial polyester ligament fixed in a transverse drill hole of the patella, and then fixed to the medial femoral condyle with a metal screw [26]. Before this, in 1990, Suganuma et al., described an MPFL reconstruction method involving an autograft tendon or an artificial ligament in the Japanese literature [27]. From the 1990s onward, numerous different techniques for MPFL reconstruction have been described, including use of a free semitendinosus, gracilis, quadriceps, or adductor tendon, or a vastus medialis retinaculum autograft [28,29].

Many surgeons like Nomura, Christiansen, Ronga, and Song SY published their results after anatomic MPFL reconstruction in cases with history of patellar dislocation. In our study, cases with previous patellar dislocation; either a single event or recurrent dislocations categorized as objective and major patellar instability comprises 19 out of 30 cases [30-33].

Among 30 cases in our study with mean follow-up period of 8.93, no cases of redislocation were seen. Nomura had two cases of re-dislocation/subluxation among 24 knees with mean follow-up period of 11.9 years. Christiansen et al., followed 44 patients for 12-32 months and they had one case of patellar redislocation and 3 cases with subluxations. Ronga had seen 3 cases of redislocation after MPFL reconstruction for 28 knees followed for 3.1 years. Song SY had done MPFL reconstruction for 20 knees with mean follow-up period of 34.5 months with no cases of redislocation [30-33].

Kujala score has improved in our cases from 49.63 to 72.50. In Nomura study Kujala score was 94.2 (from 63.2). In Christiansen cases Kujala scores improved overall from 46 to 84 points compared to improvement from 45 to 83 with Ronga. Song SY had Kujala scores increased from 52.6 to 90.9 [30-33].

Our Cincinatti score improved from 46.33 to 73.63, while with Ronga, Cincinnati improved from 52 to 89. Our Tegner-Lysholm score improved from 51.37 to 77.30 compared to Song SY who had improvement from 49.2 to 90.9 [33].

In our study postoperative apprehension and glide test was negative in all 19 cases with patellar dislocation. This parameter was not mentioned in postoperative assessment by other authors.

Christiansen had one patient with reported patellar fracture. While in our study we had no cases of patellar fracture [31].

Regarding patellar fixation, in our study 15 out of 30 cases had MPFL reconstruction using Bone Tunnels (BT) technique. The other 15 cases had MPFL reconstruction using Suture Anchors (SA) technique.

IKDC improved in our BT group from 50.83 to 76.63, while in our SA group IKDC changed from 43.33 to 74.04 with no significant difference between both groups.

Diduch who followed 24 cases of MPFL reconstruction using SA technique had postoperative Kujala score of 65.8, compared to another 19 cases done with BT technique with postoperative Kujala score of 78.8. In our SA group postoperative Kujala was 84. While in our BT group it was 79; which means that it is not significantly different from Kujala score our SA group. Song SY had 20 knees done with SA technique, Kujala scores increased from 52.6 to 90.9 [33,34].

There was a single case of redislocation in both groups by Diduch. In our cases in both groups there was no redislocation or patellar fracture, and this was the same with Song SY cases done by SA technique [33,34]. Mountney et al., reported that there was no significant difference in tensile strength between suture anchors and blind tunnel
(117). In a saw bone study, Hapa et al., described that no difference was found in ultimate load values between the suture anchor group and the bone tunnel group, although the suture anchor group had lower stiffness than the bone tunnel group [38].

The limitation of this study is that it was conducted on a small number of cases (30 cases) without a control group. Another weakness point is short term follow-up duration; 8.93 months (Min 6: Max 29 months). Lack of previous data about the role of MPFL reconstruction in potential patellar instability cases is another limiting factor. The longterm, comparative studies with large number of patients were required to corroborate our findings.

The clinical relevance of the present study is that MPFL reconstruction is a good treatment option with little associated morbidity for the treatment for patellar instability, especially in patients without bony abnormalities.

Conclusion:
This study shows that anatomic MPFL reconstruction is a reliable treatment option with little associated morbidity for the treatment for patellar instability, especially in patients without bony abnormalities. The procedure described here offers the opportunity of an anatomical MPFL reconstruction. Reproducing the anatomy of the native MPFL enables the reconstructed ligament to have an isometric function and therefore being effective through a greater range of motion, enabling an early functional rehabilitation and avoiding an increase of patellofemoral pressure in higher degrees of knee flexion. The two methods used to fix the reconstructed MPFL to the patella resulted in a similar postoperative outcome.

References


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ملاحظات

بعد الرباط الداخلي للرضفة هو المثبت الأساسي ضد الزجالة الخارجية لعظمة الرضفة، ويظهر ذلك أثناء حركة الركبة وخصوصا أثناء نزول الرضفة EUR

وقد أظهرت الدراسة الحالية أن زيادة الرباط التشريحي للرباط الداخلي للرضفة في الطريقة الأمثل لعلاج حالات عدم انتزاع عظمة الرضفة، ويرتبط إجراءها بالقرار من الاضطلاع المستمر بالعمليات الجراحية الأخرى التي تجري في هذه الحالات.

وإجراء العملية بالطريقة الموصوفة في هذه الدراسة يؤدي إلى استعادة الشكل التشريحي للرباط الداخلي الأصلي لعظمة الرضفة، مما يعيد إلى استعادة الفائدة الوقائية والفاعلة للمفصل بين الرضفة والفك، وإدارة فرآمن الفك، مما يتيح إعادة التأهيل المبكّر وتبني زيادة الضغط بين الرضفة والفك في الدرجات الأعلى من الرينة.

وقد تم إجراء الجراحة من خلال هذه الدراسة بشكل طبيعي، وقد أثبتت الدراسة الحصول على نتائج مماثلة في الحالات.