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Medium-term outcome of medial patellofemoral ligament reconstruction using synthetic graft

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ABSTRACT

Background: Recurrent patella instability is a common and debilitating condition which affects mainly adolescents and young adults. Medial patellofemoral ligament (MPFL) reconstruction is the most popular surgical treatment for recurrent patella instability. The most common graft choice in the literature is ipsilateral hamstring tendon (gracilis or semitendinosis) but the complication rate remains high (11–26%). Conversely, there are very few papers on the use of modern, synthetic grafts.

Methods: A total of 85 patients who underwent MPFL reconstruction using a modern, synthetic graft (Xiros, UK) from 2014 to 2022 were retrospectively reviewed. Exclusion criteria were patella alta, malalignment, trochlea dysplasia and significant pain between episodes of instability. The author has developed an operative technique which is anatomic, minimally invasive and reproducible. Pre- and post-operative Kujala and Oxford knee scores were collected and analysed.

Results: The male to female ratio was 27:58, the average age was 28 years, and the follow up range was 1–9 years (mean follow up 4.84 years). We found a statistically significant improvement in mean Kujala and Oxford knee scores ($P < 0.001$) postoperatively. No major complications such as knee stiffness, soft tissue reaction, re-dislocation, patella fracture were identified in the series. There were nine minor complications (10.6%): five cases of medial knee pain, two cases of residual instability and two of superficial infection.

Conclusion: This study demonstrates that modern, synthetic graft is a viable option for MPFL reconstruction. The technique described, achieves good clinical outcomes with low complication rates when compared with the published literature.

1. Introduction

First-time patella dislocations account for approximately 3% of all knee injuries with an incidence of 23.2 per 100,000 person-years [1]. The medial patellofemoral ligament (MPFL) is the most important passive restraint to lateral patellar movement between 0° and 30° of flexion and is commonly damaged during the first dislocation event [2]. Most of these injuries can be treated conservatively, however, 33–50% of first-time patella dislocation patients go on to develop recurrent patella instability (two or more dislocations) [3]. MPFL reconstruction is the most popular method of treating recurrent lateral patella instability. However, despite being popularised more than 20 years ago, there remains a wide variety of operative techniques and a high complication rate (11–26%) [4–6].

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The vast majority of the literature pertaining to MPFL reconstruction uses hamstring autograft (gracilis or semitentinosis). In comparison, there is a paucity of publications relating to MPFL reconstruction using synthetic graft. However, the few published papers that do exist show promising results [7–9].

We present a single-surgeon, retrospective review of 85 MPFL reconstructions using a modern, synthetic graft (Xiros, UK) with a mean follow up of approximately 5 years. A minimally invasive, anatomic surgical technique was used in all cases.

In this paper, we will discuss the clinical outcomes and complications of our series and graft options available for MPFL reconstruction.

2. Materials and methods

We retrospectively reviewed the functional outcomes of a single surgeon (H.D.) series of 85 MPFL reconstructions using a modern, synthetic graft performed between 2014 and 2022. A minimally invasive, anatomic operative technique was used. The patients were scored pre- and postoperatively using Kujala and Oxford knee scores.

The patient inclusion criteria for this study group are as follows: (1) primary dislocation associated with an osteochondral fragment; (2) recurrent patella instability with more than two dislocations (failure of conservative treatment); (3) previous non-anatomic surgery for patella stabilization; (4) generalised ligamentous laxity; (5) mild/moderate trochlea dysplasia (concave or flat with no bump). The exclusion criteria are as follows: (1) patella alta (Caton–Deschamp Index (CDI) > 0.3); (2) malalignment on standing long-leg views (valgus or recurvatum > 10°); (3) increased femoral anteversion (>45°); (4) increased external tibial rotation (tibial tuberosity to trochlear groove distance > 20 mm); (5) high-grade trochlea dysplasia (domed trochlea/bump); (6) significant chondral damage to patellofemoral joint on arthroscopy/magnetic resonance imaging (Outerbridge > grade 3); (7) habitual dislocator.

2.1. Surgical technique

The periosteum is dissected off the medial border of the proximal half of the patella using sharp dissection to expose cortical bone. A shallow trough into the cortical is created using a 4-mm shaver blade (Stryker) or burr on forward. The depth of the trough is approximately 5 mm. Two 2.4-mm suture anchors (Iconix, Stryker) are placed and deployed 1 cm apart at the base of the trough.

A socket is made in the medial femur with a 6-mm cannulated reamer to a depth of 25 mm. The periosteum around the tunnel entrance is cleared to aid graft insertion.

The ends of the Infinity Lock 5-mm tape (Xiros, UK) are pulled apart to reduce the pre-made loop. The mid-section of the graft is placed into the medial patella trough and the anchor sutures are used to secure the graft into the trough. The trough encourages tissue ingrowth on to the tape and ensures that the attached graft and sutures are flush with the medial patella border. The tape limbs are then double breasted and whip stitched (Figure 1). The graft is delivered through the medial soft tissue tunnel developed between layers 2 and 3.

The graft is completely de-tensioned at the patella attachment site with the knee in flexion by passing a small clip underneath the two limbs. The graft limbs were then clipped to the soft tissue to prevent the graft from being overtightened during docking of the graft and during screw insertion.

The knee is taken through a full range of movement. The tension of the graft is tested in full extension with the clip still attached and adjusted if needed before committing to fixation of the graft to the femur. The lateral glide in full extension should equal the other knee (if anatomically normal). The graft is then docked into the socket.

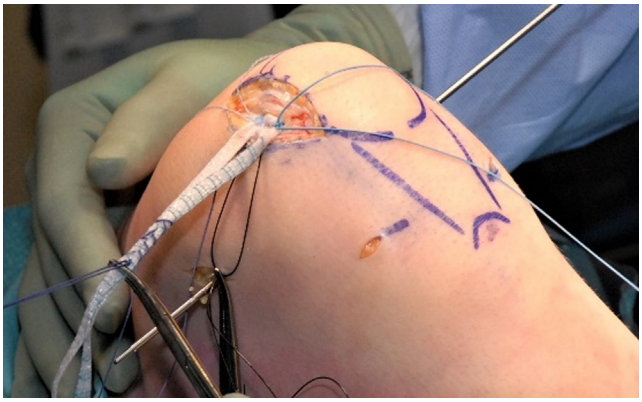

Figure 1. Infinity lock 5 mm attached to medial patella and whip stitched 20 mm beyond Schottle's point.

Figure 2. Intra-operative photograph demonstrating the 'crab view' to obtain a skyline view.

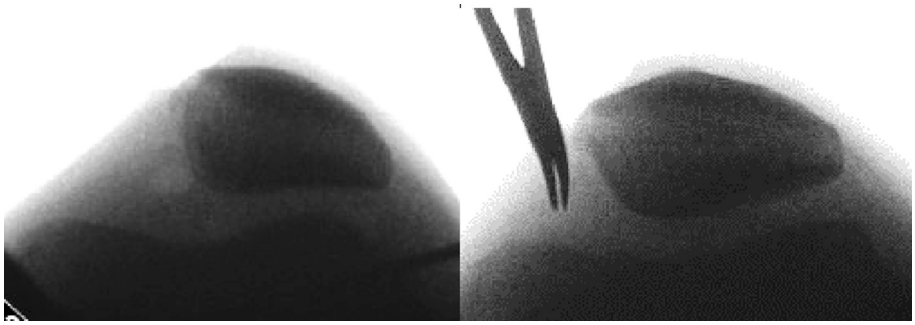

Figure 3. Intra-operative radiographs (both at 35° of flexion). Patella lateral maltracking and tilt prior to fixation (left). Concentric patella after graft docking and before screw fixation (right).

A skyline view is taken with the image intensifier (Figure 2) with the knee at 35° to confirm that the patella is concentric prior to femoral screw insertion (i.e., no medial translation or lateral tilt) (Figure 3).

2.2. Statistical analysis

The pre- and post-op scores were analysed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp, USA). Shapiro–Wilk was used to verify the normality of distribution of variables, Comparisons between periods were assessed using Wilcoxon signed ranks test. Significance of the obtained results was judged at the 5% level ($P < 0.05$).

3. Results

The demographic data are shown in Table 1. Mean pre- and postoperative Kujala and Oxford knee scores are shown in Table 2. A statistically significant increase in mean Kujala and Oxford scores from pre- to postoperative was demonstrated. We found a statistically significant improvement in both postoperative scores ($P = 0.001$). Mean follow up was 4.8 years (range 1–9 years).

Table 1
Distribution of the studied cases according to demographic data (n = 85).

Demographic data	n (%)
Age (years)	
<20	11 (12.9%)
20–30	47 (55.3%)
>30	27 (31.8%)
Min–max	17.0–55.0
Mean ± SD	28.06 ± 9.40
Median (IQR)	25.0 (21.0–35.0)
Sex	
Male	27 (31.8%)
Female	58 (68.2%)
Follow up period (years)	
1–3	40 (48.1%)
>3	45 (52.9%)
Min–max	1.0Y – 9.0Y
Mean ± SD	4.84 ± 2.68
Median (IQR)	4.0 (2.0–6.0)

IQR, interquartile range; SD, standard deviation.

Table 2
Comparison between pre- and postoperative scores (n = 85).

	Preoperative	Postoperative	Z	*P*
Kujala score (0–100)				
Min–max	11.0–71.0	39.0–100.0	7.987*	<0.001*
Mean ± SD	42.12 ± 12.55	78.79 ± 14.92		
Median (IQR)	40.0 (35.0–49.0)	82.0 (71.0–90.0)		
Oxford score (0–48)				
Min–max	12.0–40.0	18.0–48.0	7.971*	<0.001*
Mean ± SD	23.15 ± 5.43	38.62 ± 6.68		
Median (IQR)	22.0 (20.0–27.0)	40.0 (36.0–44.0)		

IQR, interquartile range; *P*, *P*-value for comparing between pre- and postoperative; SD, standard deviation; Z, Wilcoxon signed ranks test.
* Statistically significant at $P \leq 0.05$.

4. Discussion

We retrospectively reviewed the outcomes of 85 MPFL reconstructions using a synthetic graft with a mean follow up of 4.8 years (range 1–9 years). To our knowledge this is the largest, single-surgeon cohort review of synthetic MPFL reconstructions to have been studied [7]. We found a statistically significant improvement in mean Kujala and Oxford knee scores.

The incidence of postoperative complications following MPFL reconstruction reported in the literature remains high (11–26%) [4–6]. This has mainly been attributed to patient selection and technical errors. Our overall complication rate was 10.6% (9/85) (Table 3).

Isolated MPFL reconstruction is the operation of choice for recurrent patella instability. However, it is not suitable for patients with significant patellofemoral chondral damage, lower limb malalignment or malrotation, patella alta or moderate to severe trochlea dysplasia. Steenson et al. found that recurrent patella instability patients had a statistically higher incidence of these anatomic abnormalities compared with non-instability patients [10]. It is therefore vital that these patients are identified prior to performing isolated MPFL reconstruction to avoid poor outcomes. The most common technical errors are over-tensioning of the graft and femoral tunnel misplacement [11–18]. Drilling tunnels into the patella to secure the graft risks fracture of the patella [19–21]. This is a devastating complication which patients are unable to recover from in

Table 3
Summary of complications in our series.

Complication	Cause	Treatment
5 medial knee pain	Unknown (screws buried)	Removal of screw (pain settled)
2 wound infection	Infection (femoral site)	Oral antibiotics
2 residual instability	Patient selection (CDI 1.4)	Distalising TTO (MPFLR not revised)

CDI, Caton–Deschamp Index; MPFLR, Medial patellofemoral ligament (MPFL) reconstruction; TTO; tibial tubercle osteotomy.

the long term. Attachment with 2.4-mm anchors negates this risk and provides more than enough pull-out strength (approximately 500 N per anchor). There has been one report of patella fracture using larger 4.75-mm suture anchors, but it was conceded by the authors that this was likely due to surgical error [22]. In a systematic review by Weinberger et al., double-limbed reconstructions were shown to have lower failure rates and better outcomes when compared with single-limb reconstructions [23].

Graft choice for MPFL reconstruction in the literature almost exclusively describes using hamstring autograft (semitendinosus or gracilis) [24]. The next most popular graft choice is hamstring allograft. A comparison study of autograft and allograft demonstrated no significant differences in clinical outcomes [24]. Other graft options include quadriceps or adductor magnus tendon [25,26].

The literature pertaining to the use of synthetics for MPFL reconstruction is very limited. Nomura et al. reported on this as far back as 2000 [27]. Migliorini and Escweller performed a systematic review in 2022 of 199 patients treated with a synthetic MPFL and found improved clinical outcomes and a complication rate of 8% [7]. McNeilan et al. performed a systematic review and meta-analysis of 1504 patients in 2018 and compared outcomes of autograft, allograft and synthetic graft for MPFL reconstructions. He found no significant advantage of autograft or allograft over synthetic graft [8]. Lee et al. prospectively compared the outcomes of MPFL reconstruction using gracilis autograft versus synthetic. There was no difference in the postoperative scores at 2-year follow up [9].

The available evidence, therefore, suggests that a modern, synthetic graft gives equal or better outcomes when compared with autograft or allograft, thus the relative lack of use of this graft option is surprising. This may be due to the cost of the implant or the legacy from early synthetics used in knee surgery which led to soft tissue reactions and high revision rates (e.g., Dacron, Gore-Tex and carbon fibre ACL grafts) [28].

The cost of the Xiros implant in the UK is approximately £600. This is significantly cheaper when compared with the cost of an allograft (approx. £2500 20–24 cm semitendinosus, NHS tissue services). Autograft may be free financially, however the other 'costs' that need to be considered when harvesting autograft include increased theatre time, increased postoperative pain and weakness and hamstring harvest complications, all of which may culminate in an overnight hospital stay (Table 4). All of the patients in our series were day cases.

Infinity lock 5 mm (Xiros, UK) is part of a family of modern, polyester grafts. It is a non-absorbable, sterile, flat tape (polyethylene terephthalate) (Figure 4). Polyester tapes are commonly used in orthopaedic surgery to stabilise acromio-clavicular joints, medial collateral ligament and posterolateral corner injuries of the knee and syndesmoses of the ankle.

There is good evidence of host tissue growth on to and into the open-weave, mesh-like structure of polyester grafts [29,30]. Macroscopically, host tissue on growth has been confirmed by the authors on the five occasions when screw removal was needed for persistent medial pain.

In hyper-laxity patients (e.g., Ehlers–Danlos Syndrome), the viscoelasticity of autograft is higher which explains why the rate of postoperative residual instability and re-dislocation is increased in this group [31]. During MPFL reconstruction, the autograft is rarely pre-tensioned prior to implantation and thus there is an inherent viscoelasticity which could eventually lead to residual instability. Given the concerns about autograft from hyper-lax patients stretching over time, there may be a

Table 4
Advantages of synthetic graft in medial patellofemoral ligament reconstruction.

Advantages of synthetic graft
No risk of hamstring haematoma
Decreased postoperative pain
No risk of tibial skin numbness
Decreased risk of wound infection
Decreased operative time
Hamstring strength maintained (quicker rehabilitation)
Cheaper and more available than allograft in the UK
Hamstrings can be used for other reconstructions (e.g., ACL)
No risk of graft stretching over time (generalized ligamentous laxity)
Quicker discharge and rehabilitation (no brace)
Good graft option for revision surgery

ACL, anterior cruciate ligament.

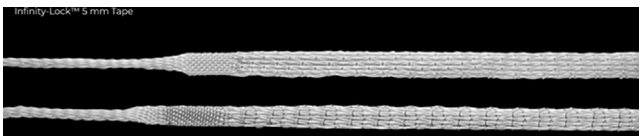

Figure 4. Infinity Lock 5 mm (Xiros, UK).

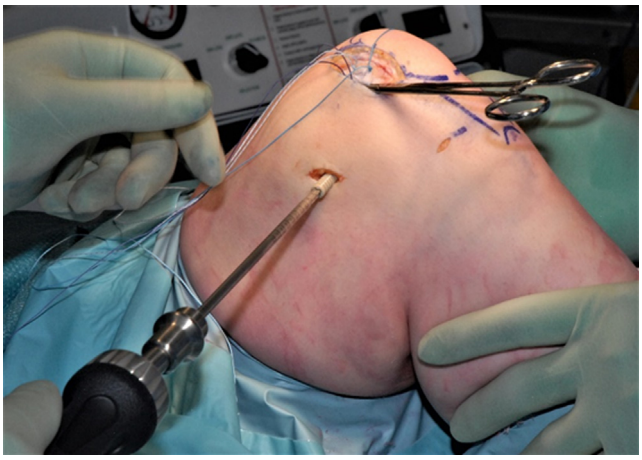

Figure 5. The graft is secured to soft tissue to avoid it getting dragged into the femoral socket whilst advancing the interference screw.

subconscious tendency to over-tension the graft during surgery. This problem can be overcome using a synthetic graft. The author's (H.D.) operative technique prevents over tensioning by ensuring that the graft is completely slack in flexion before femoral fixation. The graft is also secured to soft tissue to prevent it from getting dragged into the socket during screw insertion (Figure 5), thus preventing over-tensioning. As long as the femoral tunnel position is correct, the graft will tighten slightly coming into full extension which mimics normal MPFL anisometry [32].

5. Conclusion

We have demonstrated that MPFL reconstruction using modern, synthetic graft combined with the Author's (H.D.) technique and careful patient selection has resulted in good, mid-term, clinical outcomes.

The operative technique described in this paper is minimally invasive, anatomic and reproducible. Our complication rate of 10.6% compares very favourably to the published data. Of note, the Author (H.D.) has had no re-dislocations, patella fractures, knee stiffness or issues with soft tissue reactions.

Hopefully, this will reassure surgeons that modern, synthetic graft is both a safe and effective graft choice for primary MPFL reconstruction and may be especially useful in patient groups such as generalised ligamentous laxity, paediatrics and revision cases.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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