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ORIGINAL ARTICLE

Pedicled Strip of Quadriceps Tendon Graft for Primary Medial Patellofemoral Ligament Reconstruction in Recurrent Patellofemoral Instability: A Systematic Review

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Abstract

Background: **To determine the benefits and drawbacks, a comprehensive literature review was performed. In patients with recurrent patellofemoral instability, it is important to evaluate the efficacy of using a pedicled quadriceps tendon autograft for primary medial-patellofemoral ligament (MPFL) restoration.**

Aim: **Examining the outcomes of primary medial patellofemoral ligament reconstruction using a pedicled strip of quadriceps tendon in patients with recurrent patellofemoral instability was the focus of this research.**

Patients and methods: **The current systematic review followed the protocol established by the PRISMA statement. In September 2020, we searched the available literature. Patients with recurrent Patellofemoral instability were eligible for inclusion if their primary MPFL repair involved a pedicled strip of quadriceps tendon autograft. Research examining the effectiveness of MPFL repair in conjunction with other surgical procedures, with the exception of lateral retinacular release, was not included. The quality of the methodology was evaluated using a modified version of the Coleman index.**

Results: **The Outcome was reported by six studies; after the procedures, all of the clinical measures significantly improved. The incidence of different complications was reported by eight studies; such as wound edge necrosis, non-displaced patellar fracture, peroneal neuropraxia, and re-dislocation.**

Conclusion: **When reconstructing the MPFL, a pedicled strip of the quadriceps tendon is a good option for individuals with recurrent patellar instability. Although a lateral release is often used in conjunction with this method, it is not known whether or not this is essential to the technique's success.**

Keywords: Patellofemoral ligament, Pedicled strip, Quadriceps tendon graft

1. Introduction

When the knee is fully extended, the medial patellofemoral ligament (MPFL) is the main soft tissue barrier to lateral patellar dislocation. In most cases of acute patellar dislocation, the MPFL is ruptured.[1] In some cases, an MPFL reconstruction is necessary to restore joint stability and avoid additional redislocation.[2]

Selecting the appropriate graft for MPFL reconstruction is essential. Currently, autografts of the gracilis and semitendinosus muscles are the most frequently taken for reconstructive purposes. The procedure resulted in high success; however, it has complication rate of up to 26%.[3] The complications were mainly patellar fractures and impairment of knee flexion. Intra-operative iatrogenic patellar fractures have also been described.[4]

Being stronger and stiffer, this graft tends to overload the graft-patellar junction, weakening the medial patellar ridge, and causing stress risers and late patellar fractures after many years.

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The length of the MPFL, a thin ligament, is between 4.5 and 6.5 cm.[5] The MPFL is about twice as wide at the patellar insertion as it is on the femoral side, making it broad and sheet-like.

On the other hand, the average lengths of gracillis and semitendinosus tendons were 20–25 cm and 23.5–28 cm, respectively.[6] Hence, their widths are larger, making them thick and cord-like. In the study of[7] the reported Quadriceps tendon superficial slip measured between 5.0 and 8.5 cm in length, 4.1 cm at the aspect of the patella, and 2.2 cm in the center. Further, the attachment of this superficial slip is as broad as the native MPFL. Biomechanically, the strength, stiffness, yield load and Like the original MPFL, this one has a high maximum load to failure while tested as reconstruction.

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.[8]

2. Patients and method

We assessed the data from studies that met our inclusion criteria. Included studies were analyzed for differences in study populations, study designs, and intervention outcomes. This allowed us to ascertain whether or not data from different studies may be combined. From 2014 to 2022, the following online resources were researched: We searched MED-LINE, PubMed, Google Scholar, the Cochrane Bone and Muscle Trauma Group Specialized Register, and the Cochrane Register of Controlled Trials (The Cochrane Library) with the following terms: Patellar dislocation that occurs repeatedly reconstructing the medial patellofemoral ligament with a pedicled strip of the quadriceps tendon.

2.1. Criteria of eligibility of an article

An article was found eligible when it concerned: English-language original articles published from 2014 to 2022.

2.2. Types of studies

Case reports, Case series studies, and Cross-Sectional Studies will not be considered, however Randomized Controlled Trials (RCTs), Controlled Clinical Trials, and Retrospective Cohort Studies will.

2.3. Types of intervention

Isolated MPFL reconstruction using pedicled strip of quadriceps tendon.

2.4. Types of outcome measures

Revision rate, re-dislocation rate, complication rate (e.g. infection, physical arrest) and functional outcomes.

2.5. Inclusion criteria

All studies that fulfilled the following criteria were included in this systematic review: population: chronic patellofemoral instability; intervention: isolated medial patellofemoral ligament reconstruction; original articles provided sufficient data for meta-analysis; publication language: English. Since no patient consent was required for this investigation, IRB approval is not required.

2.6. Exclusion criteria

Single time patellofemoral dislocation and combined MPFL reconstruction with one or more ligament.

2.7. Methods

2.7.1. Locating and selecting studies

Studies were located in search engines like PubMed and Google scholar in the duration from 2014 to 2022. These search engines were searched for studies only in English language.

2.7.2. Statistical considerations

The methodologies for data synthesis were taken from the Cochrane Collaboration's group of experts on systematic reviews of diagnostic test accuracy. If statistical or clinical heterogeneity was found, it was investigated visually or using the χ^2 test. Subgroup studies based on these categories were performed when diversity was detected.

2.7.3. Evidence of publication bias

The studies were revised by special committee for possible publication bias.

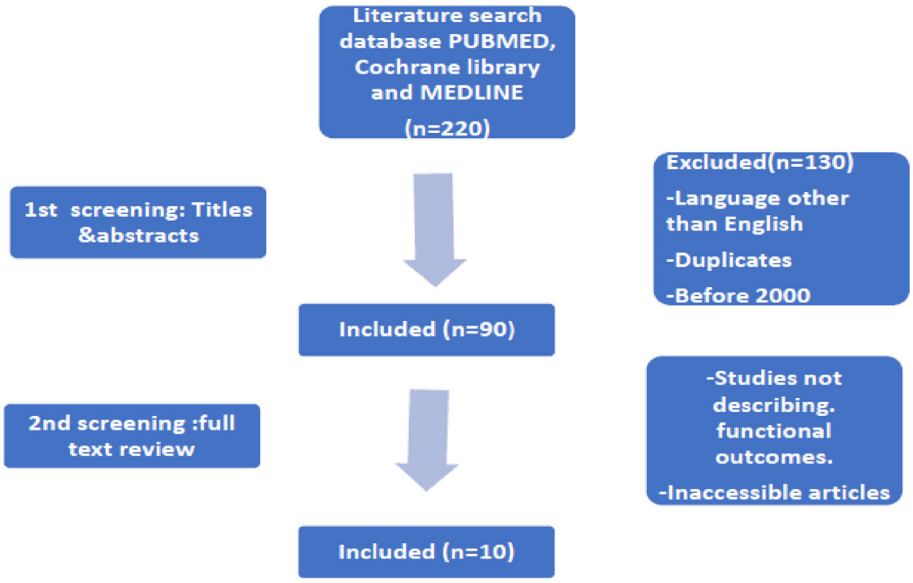
2.7.4. Description of included studies

In all, 220 documents were found after a main database search. Once duplicates were removed, 90

items with potential were found. A total of 10 studies fulfilled the inclusion criteria, and were included in the final systematic.

3. Results

A total of nine studies[8–16] (five retrospective studies and four prospective studies) were included in this systematic review (Table 1).



Only three studies[9,13,15] reported the side of the lesion. Most lesions were on the right side (Right/Left: 38/24). Trochlear status was reported by five studies.[10,12,13,17,18] Only 37 cases showed normal trochlea, 44 showed type A dysplasia, and 22 cases showed type B dysplasia. Type C and D dysplasia were reported in five and seven patients, respectively (Table 2).

Clinical outcomes include functional outcomes and complications. Functional outcomes comprise the Tegner score, KSS function score, IKDC score, KSS knee score, visual analog scale (VAS) score, Lysholm, Kujala scores, and patients' satisfaction. Complications included the incidence of wound edge necrosis, nondisplaced patellar fracture, peroneal neurapraxia, dehiscence, superficial infection, and redislocation. This Outcome was reported by two studies.[14,16] A total of 38 patients out of 39 were satisfied with the results after the operation.

Three studies[10,12,16] mentioned this outcome. According to Ref. 10 the median postoperative Tegner score was 6 versus 4.5, 6 and 6 at 6, 12, and 24 months, respectively, and did not substantially differ from the preoperative score. Similar findings were made by[12] who discovered no appreciable variation in pre- and postoperative Tegner scores. For those diagnosed with both severe and mild cases of dysplasia, they found that postoperative Tegner scores were comparable; $P = 0.81$. Only[11] recorded both scores. Comparing the postoperative KSS knee scores to the preoperative score, they noticed a considerable rise; 93.87 ± 1.73 versus 83.25 ± 11, respectively; $P = 0.011$ additionally, after surgery, there was a notable improvement in the KSS function score compared with the preoperative

Table 1. Shows the general characteristics of the included studies and participants.

Study ID	Level of evidence	Sample size	Age/years	Sex (M/F)	Follow-up duration
Sherchan B *et al.*[9]		33	19.48	15/18	26.88
Peter G *et al.*[10]	IV	36	25.1	17/19	24
Rhatomy S *et al.*[11]	III	8	20	1/7	
Allen MM *et al.*[12]	IV	28	22.6	14/14	48
Calapodopulos CJ *et al.*[13]		22	23.4	3/19	30
Vavalle G *et al.*[14]	IV	16	22	9/7	38
Hinckel BB *et al.*[15]		7	15.4		5.46
Abouelsoud MM *et al.*[16]		16	11.5	5/11	29.25

Table 2. Shows lesion characteristics of the included participants.

Study	Side of lesion		Trochlea status		Dysplasia type B	Dysplasia type C	Dysplasia type D
	Right	Left	Normal	Dysplasia type A			
Sherchan, B. *et al.*[9]	23	10					
Peter, G. *et al.*[10]			30	8	.	.	.
Rhatomy, S. *et al.*[11]							
Allen, MM. *et al.*[12]				8	8	5	7
Calapodopulos, CJ. *et al.*[13]	9	13					
Vavalle, G. *et al.*[14]							
Hinckel, BB. *et al.*[15]	6	1		4	3		
Abouelsoud, MM. *et al.*[16]							

one; 88.13 ± 3.72 versus 57.50 ± 11.65, respectively; $P = 0.011$.

Two studies[9,10] reported on this outcome. The VAS scores reported after surgery were far lower than those recorded beforehand.[10] It dropped from 1.51.1 prior to surgery to 10.9 afterwards; $P = 0.01$. In the study of[9] he reported similar findings. The VAS score dropped from 3.581.39 prior to surgery to 1.030.98 thereafter.

In two trials[11,12] this outcome was reported. IKDC scores postoperatively significantly improved, according to Ref. 11 findings. Postoperative IKDC score increased from 88.36 3.64 to 62.93 7.52 preoperatively. The postoperative IKDC scores were only published by Allen *et al.*[12] and had a mean score of 84.9 16.5. IKC scores below 90 were only present in 7 out of 28 individuals.

Four studies[10,11,13,14] reported on this Result. According to Ref. 10 The Lysholm score increased to 83.2 at Month 6, 14.4 at Month 12, and 90 at Month 24 after surgery, with a *P* value of 0.02, which was a substantial improvement when compared with the preoperative score (79.3 16.1). The Lysholm score was shown to significantly improve from 64.37 8.23 prior to surgery to 90.87 3.23 following it by[11] in their study.

Six studies[9–12,14,16] provided information on this outcome. 94.944.25 versus 72.0912.69 preoperatively, according to Ref. [9] study, represents a considerable improvement in Lysholm scores.

The postoperative Kujala score significantly increased, according to Ref. [10] at 6, 12, and 24 months, it rose from the preoperative score of 82.12–84.5, 88.2 to 5.8, and 88.7 to 4.5. By comparing the postoperative mean of 88.37 4.34 to the preoperative score of 60.87 7.94. The increase in the Kujala score was found to be statistically substantial.[11]

Eight studies[9–16] reported the occurrence of various problems. There were 7 out of 166 cases of complications[8] reported complications in 3 out of 33 cases; two with superficial infection and one with redislocation. Moreover[12] reported complications from 4/28 cases; wound edge necrosis, nondisplaced patellar fracture, peroneal neuropraxia, and redislocation, one case each. Finally[15] reported one case of dehiscence. The remaining studies did not report complications (Table 3).

4. Discussion

There is no need for implants or bone tunnels in the patella with the method we utilized in this study; therefore the danger of patellar fracture is greatly reduced.

Therefore, when patellar tunnels or devices already exist, this method is also excellent for revision MPFL surgery.

In order to prevent unnecessary stress and pressure on the patella, some writers have stressed the importance of a graft having properties that are as close to those of the native MPFL as possible.[19]

The surgeon uses the method described in this article to make a graft that is 12–15 mm in width, 90–100 mm in length, and has a thickness that is comparable to the superficial quadriceps slip (2–3 mm, in our experience). Baldwin's description of a healthy MPFL has proportions that are very similar to these.[19]

The MPFL insertion at the patella measures 28.2 (SD 5.6) mm in width, while the MPFL insertion at the femur is 10.6 (SD 2.9) mm.[20]

Embryologically, the MPFL and quadriceps tendon are derived from the ventral mesenchyme, whereas the hamstring tendons are derived from the dorsal mesenchyme.[19]

Different dynamic femoral fixation procedures have been developed in an effort to prevent iatrogenic violation of the physics, which is responsible for 70% of the femur's growth. Since the femoral insertion of the MPFL is determined either by the medial collateral ligament or the adductor magnus tendon, neither of the presented procedures is strictly anatomic.

On the other hand, studies by other writers have located the MPFL's insertion to be between 5 and 6.4 mm distal to the femoral physics.[21,22]

Table 3. Shows the summary of functional outcomes and complications.

Study	Patients' Satisfaction	Tegner score pre	Tegner score post	KSS Function pre	KSS Function post	KSS Knee Score pre	KSS Knee Score post	VAS pre	VAS post	IKDC pre	IKDC post
Sherchan *et al.*[9]								3.58 ± 1.39	1.03 ± 0.98		
Peter *et al.*[10]		6 ± 1.8	6 ± 1.4					1.5 ± 1.1	1 ± 0.9		
Rhatomy *et al.*[11]				57.50 ± 11.65	88.13 ± 3.72	83.25 ± 11.00	93.87 ± 1.73			62.93 ± 7.52	88.36 ± 3.64
Allen *et al.*[12]		5±(2.3)	5 ±(2.1)								84.9 ± 16.5
Calapodopulos *et al.*[13]											
Vavalle *et al.*[14]	16										
Hinckel *et al.*[15]	7										
Abouelsoud *et al.*[16]	15	4.5 ± 1.03	5.25 ± 0.86								
Study	**Lysholm score\pre**	**Lysholm score\post**	**Kujala score/pre**	**Kujala score/post**	**Complicates**	**wound edge necrosis**	**nondisplaced patellar fractur**	**peroneal neurapraxa**	**dehiscence**	**Superficial Infection**	**redislocation**
Sherchan *et al.*[9]			72.09 ± 12.69	94.94 ± 4.25	3⧹33	ND	ND	ND	ND	2	1⧹33
Peter *et al.*[10]	79.3 (16.1)	90.2 (9.6)	82.1 (12.5)	88.7 (4.5)	0/36	ND	ND	ND	ND	ND	0⧹36
Rhatomy *et al.*[11]	64.37 ± 8.23	90.87 ± 3.23	60.87 ± 7.94	88.37 ± 4.34	0/8	ND	ND	ND	ND	ND	0⧹8
Allen *et al.*[12]				88.6 ± 16.04	4/28	1	1	1	ND	ND	1/28
Calapodopulos *et al.*[13]		84.6 ± 14.7			0/22	ND	ND	ND	ND	ND	0/22
Vavalle *et al.*[14]	43.3 ± 6.4	89.3 ± 3.1	35.8 ± 5.5	88.8 ± 4.3	0/16	ND	ND	ND	ND	ND	0⧹16
Hinckel *et al.*[15]					1/7	ND	ND	ND	1	ND	0/7
Abouelsoud *et al.*[16]			56 ± 12.7	94 ± 8.3	0/16	ND	ND	ND	ND	ND	0⧹16

This study demonstrates that there is adequate space for the implantation of a suture anchor or tunnel in an anatomic position without compromising future development.[22]

Also[23] demonstrated that ten patients, with an average age of 27.2 years (ranging from 18 to 42 years), were followed for an average of 3 years and 7 months after undergoing MPFL reconstruction using a median strip of patellar tendon auto graft (the same concept of our technique as the patellar tendon proximally based). A prospective analysis was performed on all patients. No patient showed recurrent dislocation at the most recent follow-up, and the mean preoperative and postoperative Kujala scores were 59.7 and 84.4, respectively.[23]

Also[24,25] described Objective assessment was performed and Kujala scores were obtained prior to surgery and at the time of final follow-up for a total of 32 patients (10 males, 22 females; mean age, 25 years) who underwent MPFL reconstruction using the superficial quad technique and were followed for a mean duration of 38 months.

Traditionally, a full or partial thickness auto graft of quadriceps tendon has been used for MPFL restoration. This graft is taken from the middle one-third of the tendon.

Consistent with previous research,[25] we believe that removing only the superficial most medial portion of the quadriceps tendon while retaining a narrow strip of the VMO insertion is advantageous because it reduces the risk of extensor mechanism weakness and yields a superior graft.

Pedicled superficial quadriceps tendon grafts can be anatomically fixed to the femur and patella using the outlined approach for MPFL reconstruction in children and adolescents.

In addition, 45 patients who underwent MPFL reconstruction between June 2009 and June 2011 with a horizontal Y-shaped semitendinosus tendon auto graft with two bundles tensioned at 0° and 30° of knee flexion were described; patellar stability was assessed with the apprehension test and an axial computed tomography (CT) scan at 30° of knee flexion. Congruence angle, patellar tilt angle, lateral patellar angle, and lateral displacement were all brought back within normal ranges on CT scans. At the last follow-up, the mean Lysholm score improved from 51.8 ± 6.2 to 91.7 ± 4.1 and mean Kujala score was from 53.4 ± 5.3 to 90.9 ± 6.6 ($P < 0.01$).

Redislocation of the patella was not one of the problems seen in this study, and the average Kujala score increased from 49.31 (range, 23–62) to 91.25 (range, 73–100) after surgery.[19]

We provide several improvements to the method over the report by Goyal, including a more conservative skin incision, the use of extra periosteal sutures to secure the MPFL graft to the medial patella, and femoral anatomic fixation distal to the physics.

Our study is different from the previous study in patients' number and skin incision, as With the same graft and technique, 25 cases had MPFL reconstruction but with longitudinal incision (19 females and 6 males) with a mean age 19.36 ± 7.16 (range, 9–42 years). Also, all patients had at least one attack of patellar dislocation following conservative treatment, significant improvement occurred in lysholm score 6 weeks, 6 and 12 months (P value < 0.001), 92% of patients had full range of motion, one patient had reflex sympathetic dystrophy, one patient had redislocation.

4.1. Conclusion

MPFL reconstruction using distally based quadriceps tendon is; Safe for the patella, save the cost of patellar implants, spare the hamstring for future ligamentous injury, simple procedure, single incision and reliable technique with good results.

Ethics information

Its was approved by faculty.

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Conflicts of interest

No conflict of interest.

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