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## Clinical and radiological outcome of medial patellofemoral ligament reconstruction with a semitendinosus autograft for patella instability

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**Abstract** *Background:* Recurrent patellar instability is a common problem after dislocation. The medial patellofemoral ligament (MPFL) contributes 40–80% of the total medial restraining forces. This study assessed the clinical and radiological outcome after a follow-up of 4 years after linear MPFL reconstruction using an ipsilateral Semitendinosus tendon autograft. *Study design and methods:* 15 knees in 12 patients were examined with a mean of 47 months after linear reconstruction of the MPFL at a mean age of 30 years. 3 knees underwent previous surgery. 3 patients had mild trochlear dysplasia grade I or II, according to the classification of Dejour. If preoperative tibial tuberosity-trochlear groove distance (TTTG) was more than 15 mm, patients underwent additional medialisation of the tibial tuberosity (n = 8) creating a similar postoperative situation for all patients. All patients were available for a postoperative evaluation, which consisted of a subjective questionnaire, the Kujala score, and the recording of potential patellar redislocation and apprehension. Patellar height and tilt was measured on plain radiographs. Postoperative

CT scans were performed in patients with an additional tibial tuberosity-transfer. *Results:* Postoperatively, one patient reported on recurrent bilateral redislocation. Physical examination however revealed no findings. Three knees presented with persistent patellar apprehension. Thirteen knees had improved subjectively after surgery. The mean Kujala score improved significantly from 55.0 to 85.7 points. The patellar tilt decreased significantly from 11.3° to 9.2°. Four knees had patella alta preoperatively, but only two at the latest follow-up visit. Previous surgery or additional trochlear dysplasia had no influence on the clinical outcome. *Conclusion:* MPFL reconstruction improves clinical symptoms, reduces the patellar tilt substantially, and may correct patella alta. Additional mild trochlear dysplasia did not compromise the outcome; however, this fact needs further attention in a larger study group.

**Keywords** Patella instability · Medial patellofemoral ligament · TTTG · Reconstruction · Tibial tuberosity

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## Introduction

Persistent instability is common after patellar dislocation [23, 29, 32, 34], particularly if the medial soft tissues become lax. A number of abnormalities such as effusion, retraction of the distal part of the vastus medialis obliquus (VMO) muscle, bone bruises of the lateral femoral condyle or medial patellar facette, or increased T2 weighted signal in the patellotibial ligament near the tibial insertion on MR images [36] have been associated with an increased redislocation rate [39]. Several factors such as trochlear dysplasia, a lateralised tibial tuberosity, patella alta, or a weak quadriceps muscle have been made responsible for persisting patellar instability. Most operation techniques intend to realign the extensor mechanism, reducing the lateralisation of the patella when the quadriceps is loaded [5, 12, 13, 24–26, 29, 31, 41]. However, those procedures do not respect the underlying pathologic condition of patellar instability. Distal realignment procedures like the medial transfer of the tibial tuberosity have been shown to be of limited clinical success [1]. Proximal realignment procedures depend on quadriceps contraction to maintain the patella in the trochlear groove. In contrast, intact passive stabilizers, like the medial patellofemoral ligament seem to play an important role regardless of the malalignment. Cadaver studies have proven the importance of the medial soft tissue in resisting lateral patellar motion [10, 12, 19, 29]. The medial patellofemoral ligament as a primary stabilizer of the patella contributes 40–80% of the total medial restraining force [7, 19, 29].

Reconstruction of the medial patellofemoral ligament has been advocated by several authors for patellofemoral

instability as it seems more effective than proximal or distal realignment procedures [20, 28, 35, 38, 39]. This retrospective study analyses the results of reconstruction of the medial patellofemoral ligament using a Semitendinosus autograft.

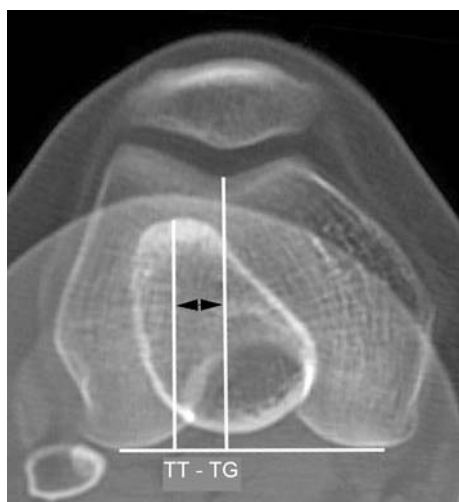
## Materials and methods

### Indication

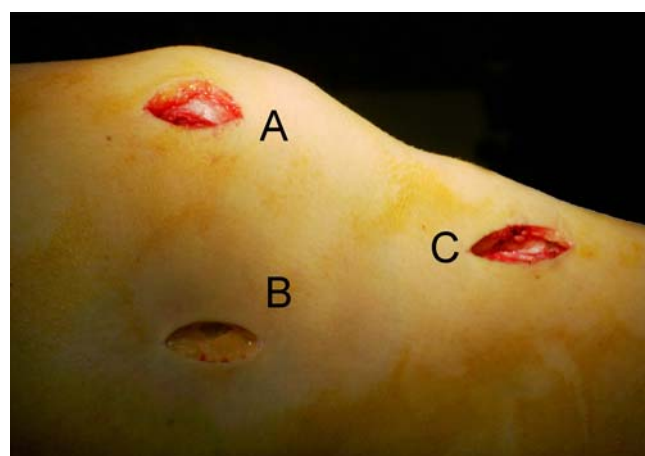
The indication for surgery included patients with two or more patellar dislocations or one dislocation and a persistent apprehension sign. In the clinical examination, all patients had an increased lateralisation of the patella combined with a medial tenderness due to the insufficient medial patellofemoral ligament. All patients underwent reconstruction of the medial patellofemoral ligament using an ipsilateral Semitendinosus autograft. Patients who presented with a TTTG more than 15 mm in the axial scan [3, 28] underwent medialisation of the tibial tuberosity (Fig. 1) for creating a postoperative normal TTTG in all patients.

### Surgical technique

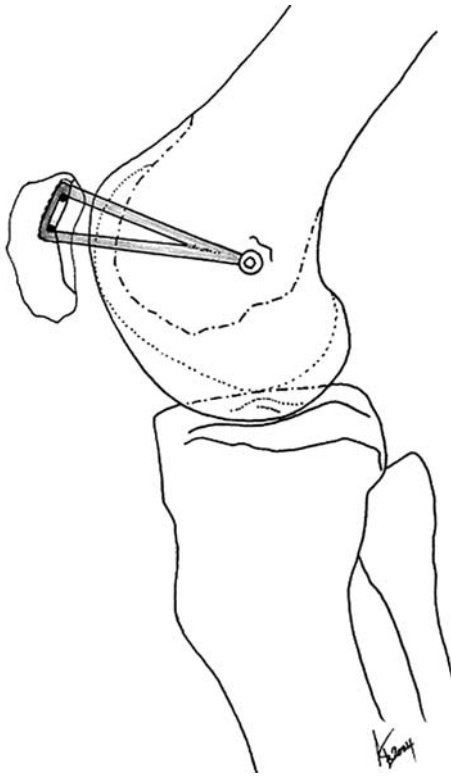
The proximal one-third aspect of the patella is exposed through a 1–2 cm long incision (Fig. 2, A) and a bony groove is performed. Two suture anchors carrying No. 3 non-absorbable braided suture are placed into that groove. The adductor tubercle is exposed through a 2 cm long incision (Fig. 2, B) and a guide wire is placed across the epicondyles. A hole of 6 mm diameter and 2.5 cm depth is drilled over the guide wire. Then, the



**Fig. 1** The tibial tuberosity-trochlear groove distance (TT-TG): distance (arrow) between the deepest point of the trochlear groove (TG) and the most prominent point of the tibial tuberosity (TT) in a perpendicular reference to a tangent to the posterior condyles



**Fig. 2** The incisions used for the MPFL reconstruction at a left knee: **A** incision over the superomedial patellar border; **B** incision over the adductor tubercle; **C** incision over the pes anserinus to harvest the Semitendinosus-graft



**Fig. 3** Attachment of the Semitendinosus graft by two sutures anchors at the superomedial border of the patella and tendon to bone tunnel fixation by an interference screw at the adductor tubercle

Semitendinosus tendon is harvested through an additional 2–3 cm long oblique incision (Fig. 2, C). The anserine bursa is incised and the tendon of the Semitendinosus muscle harvested with the tendon stripper. Muscle fibres are removed from the proximal aspect of the harvested tendon and the proximal end is tubed using 4–0 absorbable non-braided sutures. Krackow stitches with No. 0 absorbable-braided sutures are used for both ends of the tendon. The graft is then folded in half, and its centre portion is sutured to the anchors at the patella. The two free endings of the Semitendinosus graft are pulled into the drill hole at the adductor tubercle by removing the guide wire through the medial epicondyle. Tensioning of the graft is performed with the patella aligned in the trochlear groove throughout entire range of motion of the knee. An absorbable soft tissue interference screw is then inserted into the drill hole at the adductor tubercle (Fig. 3). Subcutaneous tissues and skin are approximated in the normal fashion.

Postoperatively, the patient is placed in a knee immobiliser and weight bearing is allowed no more than half-body weight for 6 weeks. In the first two weeks, passive range of motion up to 60° is performed with the physiotherapist. After two weeks leg raising and quadriceps setting exercises are instituted, and range of

motion is increased up to 90°. After four weeks, range of motion is increased with no restriction. Full activity is permitted after 6 months if full range of motion and normal quadriceps strength is achieved. Postoperative regime did not alter, if an osteotomy of the tibial tuberosity was performed.

### Patients and methods

Between January 1998 and November 2001, reconstruction of the medial patellofemoral ligament for patellar instability was performed in 15 knees in 12 patients (8 female, 4 male) by the senior author. The average age at surgery was 30.1 years (range, 19 to 36 years). Eight operations were performed on the left knee and 7 on the right knee (3 bilateral). Preoperatively 2 patients reported on recurrent subluxation after initial dislocation, while all other patients had recurrent full dislocation. Four patients had had traumatic dislocations, while 11 suffered of patellar instability without initial trauma. Three patients (B.R., B.S., P.M.-left) had had previous surgery, such as lateral release, medial transfer of the tibial tuberosity and shortening of the vastus medialis obliquus muscle.

Preoperative physical examination consisted of the apprehension sign, retropatellar crepitus and pain on patellar compression. Complete history of dislocation and subluxation was recorded. The Kujala knee score was recorded pre- and postoperatively [33]. In addition, a subjective questionnaire [20] was completed postoperatively. Radiographic examination consisted of a straight lateral and axial view in all patients. CT scan was performed in all cases preoperatively, and postoperatively only in those patients, who had undergone additional transfer of the tibial tuberosity.

The trochlear bump, the trochlear depth and the crossing sign as qualitative and quantitative signs for trochlear dysplasia as well as the Caton index were measured on the straight lateral x-rays [8, 9, 17, 18]. Patellar tilt was measured on axial views.

The TTTG was measured on the computed tomography images as described by Goutallier (Fig. 1). Pre- and postoperative data obtained from the radiographs were compared using the Man-Whitney-U test. The significance level was set at 0.05. The mean follow up was 47.5 months (range, 24 to 70 months).

### Results

The subjective assessment revealed, that 13 of 15 knees had improved after surgery. 8 knees (53%) had excellent results, 5 (33%) had a good and 2 (13%) had a fair result. The fair results were in both knees of a patient who was on treatment for schizoid psychosis. Overall

86% of the patients believed that the procedure had improved their knee. The objective findings of the knees did not correlate with the patients described discomfort. Preoperatively, 14 of 15 knees had a positive apprehension sign, which remained positive in 3 knees of 2 patients postoperatively, including the above-mentioned patient (N.G.). That particular patient complained of severe pain during normal activities of daily living, but felt that her knees had improved since the operation. No patient had an abnormal medial tenderness, medial patellar glide or pain with patellar compression against the trochlear groove (crepitus).

The mean Kujala score improved statistically significant from 53.3 points (range, 31 to 76 points) to 85.7 points (range, 55 to 100 points) at latest follow-up ( $p < 0.001$ ).

The mean patellar tilt decreased statistically significant from  $11.4^\circ$  (range,  $4^\circ$  to  $18^\circ$ ) preoperatively to  $8.5^\circ$  (range,  $2^\circ$  to  $16^\circ$ ) at latest follow up ( $p = 0.03$ ). The mean preoperative Caton ratio averaged 1.14 (range 0.92 to 1.3) with 4 cases of patella alta (ratio  $> 1.2$ ), while at the most recent follow up it averaged 1.04 (range 0.8 to 1.26) with 2 remaining cases of patella alta ( $p = 0.258$ ).

Eight knees with preoperative TTTG of more than 15 mm had a medial transfer of the tibial tuberosity. In those patients (marked with \* in Table 1) the mean preoperative TTTG decreased from 19.1 mm (range, 16 to 24 mm) preoperatively to 11.8 mm (range, 9 to 14 mm) postoperatively ( $p < 0.001$ ). The other patients ( $n = 7$ ) had a mean preoperative TTTG of 13.4 mm (range, 12 to 14). There was no significant difference in any outcome parameter between the patients with or without transfer of the tibial tuberosity.

Three patients had a trochlear dysplasia (marked with # in Table 1) according to the criteria of Dejour [18]. They also showed no difference with respect to clinical and radiological outcome.

## Discussion

Non operative treatment of first time dislocation has a redislocation rate of 14 to 44% [11, 15, 16, 30]. Distal realignment procedures and the lateral retinacular release for the treatment of instability have a success rate of only 65% [1, 4, 6]. The role of the medial patellofemoral ligament as the primary ligamentous restraint against lateral patellar displacement has been described by several authors [7, 12, 13, 19, 29]. Cadaver studies have proved that the MPFL acts as restraint against lateral forces [7, 19, 29]. A tear of the medial patellofemoral ligament has been found in 8 of 10 cases of experimentally performed cadaveric patellar dislocations [7], and in 15 of 16 cases in an in vivo study [39]. In a cadaver study Davis and Fithian have shown that an insufficient medial patellofemoral ligament is a critical factor for an asymptomatic patella to become unstable if any predisposition is present [16]. The reconstruction of the medial patellofemoral ligament, which restores normal length and stiffness of the medial soft tissue, must be the aim of an evident procedure. As a consequence, Hautamaa proved the repair of the medial patellofemoral ligament alone to be sufficient restoring lateral mobility within normal values [29]. Success rates of procedures which restore the medial restraints using different types of grafts and techniques ranges between 83% and 93% [2, 20, 21, 27, 37]. To our knowledge, this is the first outcome report of a minimum 2 year clinical and radiological follow up after reconstruction of the medial patellofemoral ligament, using Semitendinosus autograft only. The technique which reconstructs the torn or elongated medial patellofemoral ligament with a Semitendinosus graft was first described by Erasmus [22] and treats the primary pathoanatomical lesion of patellar dislocation. The subjective assessment, the Kujala score and objective signs improved in all patients. Only one

**Table 1** pre- and postoperative Kujala score, postoperative subjective assessment, postoperative apprehension sign, and postoperative patellar instability

Name	preoperative Kujala score	postoperative Kujala score	subjective assessment	postoperative apprehension sign	recurrent instability
R.F.#	51	94	good	negative	no
N.G. right	31	55	fair	positive	yes
N.G. left	36	55	fair	positive	yes
M.I.	49	87	excellent	negative	no
B.R.	44	89	good	negative	no
B.S.	34	71	good	positive	no
S.T.	76	100	excellent	negative	no
P.M. right,*,#	58	93	excellent	negative	no
P.M. left,*,#	58	93	excellent	negative	no
D.B.*	73	93	good	positive	no
C.F.*	56	90	excellent	negative	no
M.K. right, *	64	90	excellent	negative	no
M.K. left, *	68	95	excellent	negative	no
C.R. *,#	58	85	good	negative	no
O.O.*	47	95	excellent	negative	no
mean value	53,53	85,67			

Patients marked with (\*) had an additional transfer of the tibial tuberosity, patients marked with (#) had an additional trochlear dysplasia

patient reported on recurrent instability postoperatively, but the objective findings did not correlate with the patient's described discomfort (N.G.). A persistent apprehension sign was found in the same patient. No other patient suffered from a persistent apprehension sign or a dislocation postoperatively. The mean Caton index did not change postoperatively. There was no postoperative patella baja, since the patellotibial ligament is not reconstructed which might act as additional tibial rein and pull the patella distally. A favorable effect on patellar tracking was also noticed, since the patellar tilt was significantly improved by the dorsal pull of the medial border of the patella through the graft. In patients with a TTTG more than 15 mm a transfer of the tibial tuberosity was performed in addition although it has been reported that a distal realignment procedure is unnecessary when proximal realignment is carried out [14, 40]. However, Gomes et al. have reported that the best results in MPFL reconstruction are obtained in patients with a normal Q angle [21]. We performed the tibial tuberosity transfer to obtain a normal TTTG in all patients postoperatively and to avoid the influence of a pathologic value onto postoperative data. No negative effect was seen from an additional tibial tuberosity transfer. The

lack of bony constraint in case of trochlear dysplasia can put the ligament at risk for repeated failure, because of structural deficiency, increasing or supporting the native medial tether [2, 21, 35, 37]. Trochlear dysplasia in the 3 patients of the present series was not pronounced enough to have an effect on the clinical outcome. None of these 3 patients complained of retropatellar pain after reconstruction, although an exaggerated tightening of the medial patellofemoral ligament reconstruction may result in a medial retropatellar hyperpression syndrome in the dysplastic trochlear groove. Using the technique already described by Gomes [21, 27], which consists of three small incisions on the medial side (Fig. 2), a favorable cosmetic result is achieved.

In conclusion, linear reconstruction of the medial patellofemoral ligament, using a Semitendinosus autograft is successful. Patellar stability can reliably be restored without creating further complications such as retropatellar pain or hyperpression. The study does not answer the question whether patients with a TTTG more than 15 mm or with major trochlear dysplasia will benefit from isolated reconstruction of the medial patellofemoral ligament, or if an additional procedure of an underlying bony malalignment may be necessary.

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