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Minimally invasive medial patellofemoral ligament reconstruction with fascia lata allograft: surgical technique

Stefano Zaffagnini · Giulio Maria Marcheggiani Muccioli · Alberto Grassi · Tommaso Bonanzinga · Maurilio Marcacci

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Abstract The present paper describes a new minimally invasive anatomic medial patellofemoral ligament reconstruction, using a fascia lata allograft as graft source and arthroscopy to obtain balanced fixation throughout the range of motion.

Keywords Medial patellofemoral ligament · Fascia lata · Allograft · Arthroscopy · Minimally invasive surgery

Introduction

Patellar dislocation represents a frequent condition, as its incidence has been reported to be 5.8 in 100,000 people [3]. Moreover, this rate is approximately five times higher in young patients between 10 and 17 years old [3, 11]. Conservative treatment is advocated as the primary management for first episode acute patellar dislocation; however, recurrence rate has been reported to involve 15–44 % of cases. Studies have proven that the medial patellofemoral ligament (MPFL) is ruptured in nearly all the cases after acute patellar dislocation [2, 6, 8, 17].

The MPFL is a ligament of the second layer of the medial side of the knee, which extends from the superior two-thirds of the patellar medial edge to the femoral insertion located between the adductor tubercle and the medial femoral epicondyle [18, 25, 27].

It is recognized that the MPFL represents the major restraint of the patella that prevents lateral dislocation [1, 20, 33]. Furthermore, it has been shown that the MPFL provides 50–60 % of the medial patella-stabilizing force biomechanically [4, 7, 14]. For these reasons, the MPFL reconstruction has been proposed as an important landmark technique for the treatment of recurrent patellar instability.

The first reports of MPFL reconstruction were by of Sugamuna et al. in 1990 [28] and Ellera Gomes in 1992 [9], with autograft tendon and artificial polyester ligament, respectively. In the subsequent decades, this type of procedure has gained popularity and a large number of techniques have been proposed (using different approaches, grafts and fixation methods) [10, 23, 26].

The present paper describes a new minimally invasive anatomic MPFL reconstruction, using a fascia lata allograft as graft source and arthroscopy to obtain balanced fixation throughout the range of motion (ROM).

Surgical note

Preparation of patellar insertion

A 2- to 5-cm skin incision (according to patient size) is performed directly over the proximal two-thirds of medial margin of the patella. The insertion of the vastus medialis muscle is found and used as the superior margin of the fascial incision. The MPFL is anatomically situated in the second and the third layer of the medial patellofemoral complex. The injured MPFL is separated from these layers, trying to leave the capsule intact (to

S. Zaffagnini · G. M. Marcheggiani Muccioli · A. Grassi · T. Bonanzinga · M. Marcacci
Clinica Ortopedica e Traumatologica II, Istituto Ortopedico Rizzoli, Via Pupilli, 1, 40136 Bologna, Italy

S. Zaffagnini (✉)
Laboratorio di Biomeccanica ed Innovazione Tecnologica, Istituto Ortopedico Rizzoli, Via di Barbiano, 1/10, 40100 Bologna, Italy
e-mail: s.zaffagnini@biomec.ior.it; stefano.zaffagnini@unibo.it

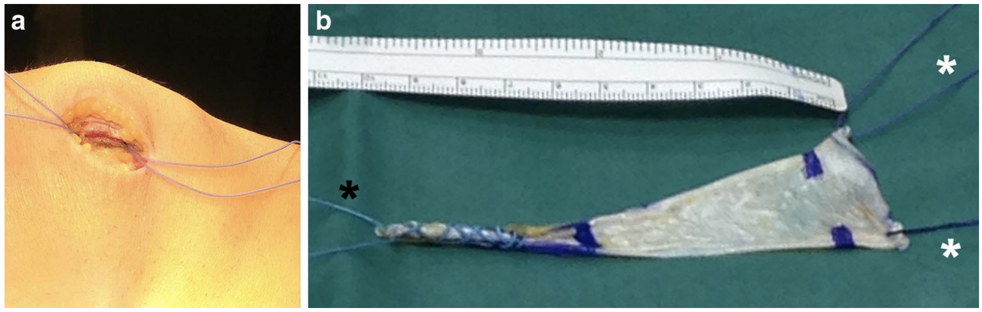

Fig. 1 **a** Anchors inserted into the medial border of patella, **b** final appearance of the graft, with *marks* highlighting the FP distance previously measured, handling sutures placed at the corners of the longer base (*white asterisks*) and a graft-pulling suture placed at the thinner tubularized end (*black asterisk*)

minimize surgical trauma to the knee joint). The medial border of the patella is prepared with electrocautery, in order to allow the placement of two 2.9-mm titanium anchors (Helix Transtend®, DePuy Mitek, Raynham, MA, USA), each loaded with one high strength number 2 composite suture (Orthocord®, DePuy Mitek, Raynham, MA, USA). The anchors should be inserted through the cancellous bone in the supero-medial corner of the patella and in the middle point of its medial border, directed perpendicularly to the long axis of the patella (Fig. 1a). This distance is measured to ensure an accurate preparation of the graft's shape.

Preparation of femoral insertion site

A longitudinal skin incision of about 2 cm in length is made over the area of the medial epicondyle and the adductor tubercle. These landmarks and the shape of the medial condyle are palpated with the tip of the finger to find the correct entrance of the femoral tunnel. Then, the tip of a Beath pin is positioned into the isometric point of the native MPFL under fluoroscopic guidance, between the medial epicondyle and the adductor tubercle, proximal to the junction of Blumensaat's line and a line extending down from the posterior cortex of the femoral shaft (according to Schottle et al. [22]).

After the correct point has been located, the Beath pin is inserted through the femoral bone until exiting the lateral cortex and over drilled for 35 mm with a 7-mm reamer (8 mm in the case of large knees). The femoral half-tunnel is made slightly longer than required, in order to allow flexibility in graft tensioning when the suture is pulled from the lateral side. The two ends of a no. 2 nonabsorbable suture loop (Ticron™, Medline Inc., Mundelein, IL, USA) are passed into the eye of the Beath pin, and the pin is pulled out laterally, dragging the free ends of the suture loop through the femoral bone. The distance from the anchors to the femoral half-tunnel (FP distance) is determined by inserting a flexible measuring device into the subvastus space with a Kelly clamp, following the anatomic MPFL's route, in order to allow correct graft sizing.

Graft preparation

The fascia lata fresh-frozen allograft is defrosted. A trapezoidal shape is marked on its flat surface with a demographic pen, according to the measures obtained previously, and then, the graft is shaped with a scalpel. The width of the graft on the patellar side should be equal to the distance measured between the anchors. The total length of the graft should be 40 mm longer compared to the patellar-femoral insertions distance, to allow the placement of the graft in the femoral half-tunnel and to permit the folding of the patellar portion of the graft. Two no. 0 absorbable sutures (Vicryl, Ethicon Inc., Somerville, NJ, USA) are placed at the corners of longer base of the trapezoidal graft to ease the graft handling (white asterisks, Fig. 1b). The thinner base of the graft is folded in order to obtain 30 mm of tubularized graft, sutured with one no. 2 nonabsorbable suture (Ticron™, Medline Inc., Mundelein, IL, USA) using Krakow's stitches to obtain a graft-pulling suture (black asterisk, Fig. 1b). At the end, 2 marks are made on the graft to mark the FP distance previously measured (Fig. 1b).

Graft positioning and fixation

One small retractor is used to expose the medial patellar access, and the flat free end of the graft is stretched on the medial border of the patella. Then, a free needle is used to tightly suture the graft using the sutures from the anchors. The stitches should be placed 5–10 mm medial to the free border of the graft (in order to leave a free-end flap to cover the knots) over the mark showing the FP distance. At this mark, the sutures from the two anchors are crossed above the graft and sutured together, thereby increasing the contact area between the graft and the patella. The sutures previously placed at the corners of the free longer side of the graft, used to handle the graft during the last step, are now pulled down, and the anchor sutures knots are covered suturing the free-end flap onto the body of the graft with no. 0 absorbable stitches (Vicryl, Ethicon Inc., Somerville, NJ, USA). Then, the handling sutures are removed (Fig. 2).

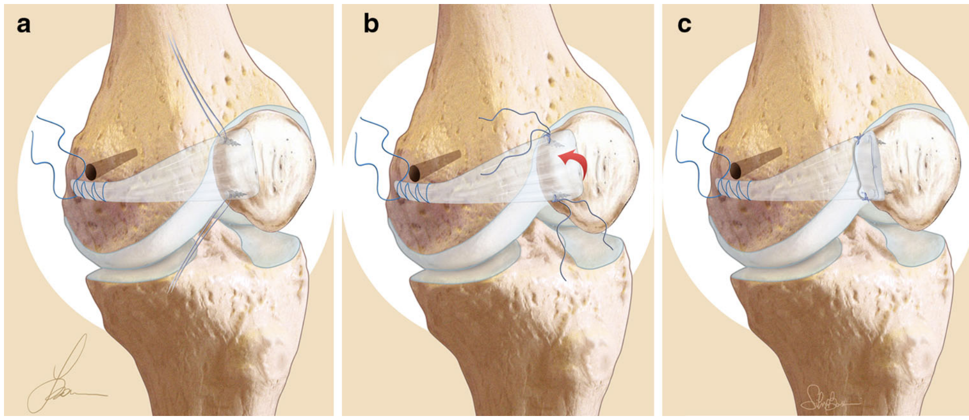

Fig. 2 **a** The graft is fixed to the patella using the sutures from the anchors, **b** the sutures from the two anchors are crossed above the graft and sutured together, **c** the free-end flap of the graft is pulled down, and the anchor sutures knots are covered

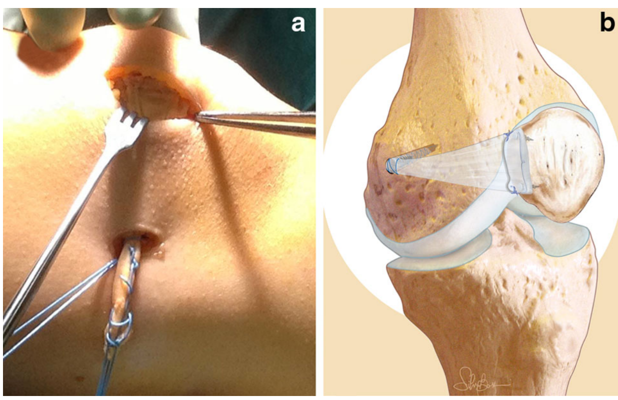

Fig. 3 **a** The graft pulled through the medial tissue planes (along the native MPFL's route) and exiting from the medial incision above the epicondyle, **b** final aspect of MPFL reconstruction after graft pulling into the femoral half-tunnel

A curved Kelly clamp is inserted from the epicondyle incision and directed to the patella along the MPFL's route. Then, the graft-pulling suture placed at the tubularized end of the graft is pulled through the medial tissue planes using a clamp, bringing this end of the graft though the medial epicondyle incision (Fig. 3a). The same suture is then placed into the suture loop, which is pulled from the lateral side of the knee dragging the graft into the femoral half-tunnel, and the graft-pulling suture out from the lateral femoral drill hole.

The suture is pulled from the lateral side in order to tension the graft with the knee at 30° of flexion, while the arthroscope is inserted in the AL portal checking the correct patellar tilt.

When the graft tensioning has been reached without excessive medial constraint, the assistant stabilizes the patella in the desired position with fingers and maintains tension on the graft-pulling suture. The surgeon inserts a cannulated soft tissue type titanium interference screw (Citieffe S.r.l., Calderara di Reno, BO, Italy) into the femoral half-tunnel (Fig. 3b), maintaining at the same time under arthroscopic control the patella position into the trochlea. The screw length is 25 mm, and its diameter is the same as the femoral tunnel.

Post-operative rehabilitation

The knee is immobilized in a brace in full extension for 4 weeks. Starting on post-operative day, number 10 the brace is removed three times daily to allow passive mobilization (while seated and nonweight bearing), within a 0°–90° ROM according to pain. After day number 30, a full passive ROM was allowed as tolerated. Partial weight bearing is allowed 15 days after surgery, and complete weight bearing is reached near the end of the first month after surgery.

Quadriceps sets and straight-leg raises were begun as soon as symptoms permitted. The knee brace was discontinued when the patient had gained a good quadriceps control.

Sport activity resumption is allowed after 6–8 months, when quadriceps strength is recovered.

Discussion

The most important finding of the present work was that is possible to anatomically reconstruct the MPFL in a minimally invasive way (using allograft and an arthroscopically assisted technique).

The ideal MPFL graft should have anatomic and biomechanical similarities with those of the native MPFL. The literature reports that the MPFL is a sheetlike ligament, with anatomic course in the subvastus space, with a length varying from 45 to 65 mm and width varying from 10 to 32 mm [18, 21, 25]. The study by Philippot et al. [21] showed that the width at the patellar insertion was larger (24.4 ± 4.8 mm, range 17–32 mm) than at the femoral one (12.2 ± 2.6 mm, range 8–16 mm).

Autologous semitendinosus and gracilis tendons (ST/G) are the most frequently used grafts for MPFL reconstruction [12, 16, 24]. Unfortunately, they are much longer than required (average lengths of ST/G are 235–280 and 200–251 mm, respectively) [31, 34], and they are cordlike grafts. Ntagiopoulos et al. [19] as recently shown that a tubular graft is not closely reproducing the functional behaviour of the native MPFL and could result in a different patellar kinematic, altering contact force on patellar cartilage. In fact, ST/G ligaments are also much stronger and stiffer than the native MPFL [8]. A graft material that is stronger and stiffer than the original MPFL will put more load on the patella, with potential cartilage injury [8, 30].

A MPFL graft with a broad patellar attachment should provide better rotational control of the patella in different ranges of flexion compared to narrow ST/G. Moreover, as already shown by Zaffagnini et al. [35] and Victor et al. [32], the superior part of the MPFL is more isometric than the inferior one. Therefore, a two bundle graft has difficulties in reproducing this behaviour.

The MPFL has an aponeurotic nature. It works as a restraint during motion, with an active role under high stress on lateral side, but with a small contribution during normal knee flexion. Its biomechanical behaviour under loading conditions should be kept into account when performing surgical reconstruction of this ligamentous structure [35]. In an attempt to reproduce as closely as possible the native MPFL, Cossey and Paterson [5] used an autologous strip of medial retinaculum and Goyal [13] used a superficial slip of autologous quadriceps tendon as graft material for MPFL reconstruction. These techniques have the advantage of using a sheetlike graft, but they have the disadvantage of weakening anatomic structures that play a significant role in the stabilization of the patella. The fascia lata allograft used in the presented technique meets the requirements of using a completely aponeurotic graft source without weakening any important autologous structure.

Regarding fixation, all techniques have their advantages and problems.

Patellar fixation should be anatomic and use a bony fixation technique that minimizes problems. The MPFL reconstruction has a high rate of success for patients with patellofemoral instability, but the complication rate of 26.1 % associated with this procedure is not trivial. The most dangerous complication is patella fracture, and the risk of this terrible event is increased by the use of tunnel fixation on patella [23]. To avoid this, we prefer to use small anchors for graft fixation on the patella. The folding of the broad patellar end of the graft covers the knots and prevents irritation of the thin tissue overlying the patella.

Femoral fixation should be isometric to avoid abnormal stresses. It is equally important not to over tension the graft but keep its length optimum [30]. For this important reasons, we use fluoroscopy to find the isometric femoral insertion point (according to Schottle et al. [22]) arthroscopic control during the fixation phase. Furthermore, the use of titanium anchors and interference screw reduce the risk of hardware failure [29] and of formation of bone cysts [15].

Rehabilitation with a brace works to safely achieve strength, ROM and stability during the first phase.

Two recent systematic reviews have found no strong evidence to support any particular MPFL reconstructive technique over the other [10, 26].

This study has some limitations. First of all, we did not made any biomechanical evaluation of this technique in order to know the strength of the construct, but we combined a number of methods and take advantage of other authors' biomechanical studies. Secondly, this is a technical note, not presenting clinical and radiological follow-up data.

Therefore, in order to demonstrate the clinical significance and safety of this technique, clinical and radiological follow-up studies will be needed. A case series will be presented shortly when operated patients will have reached a significant follow-up.

Conclusion

The presented technique reconstructs the MPFL using a fascia lata allograft trying to preserve as much as possible autogenous tissues and to mimic the normal anatomy and kinematics of the MPFL. The use of small incisions and arthroscopy to check for optimal patellar tracking make this procedure minimally invasive. Thus, this technique is an ideal method for MPFL reconstruction.

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