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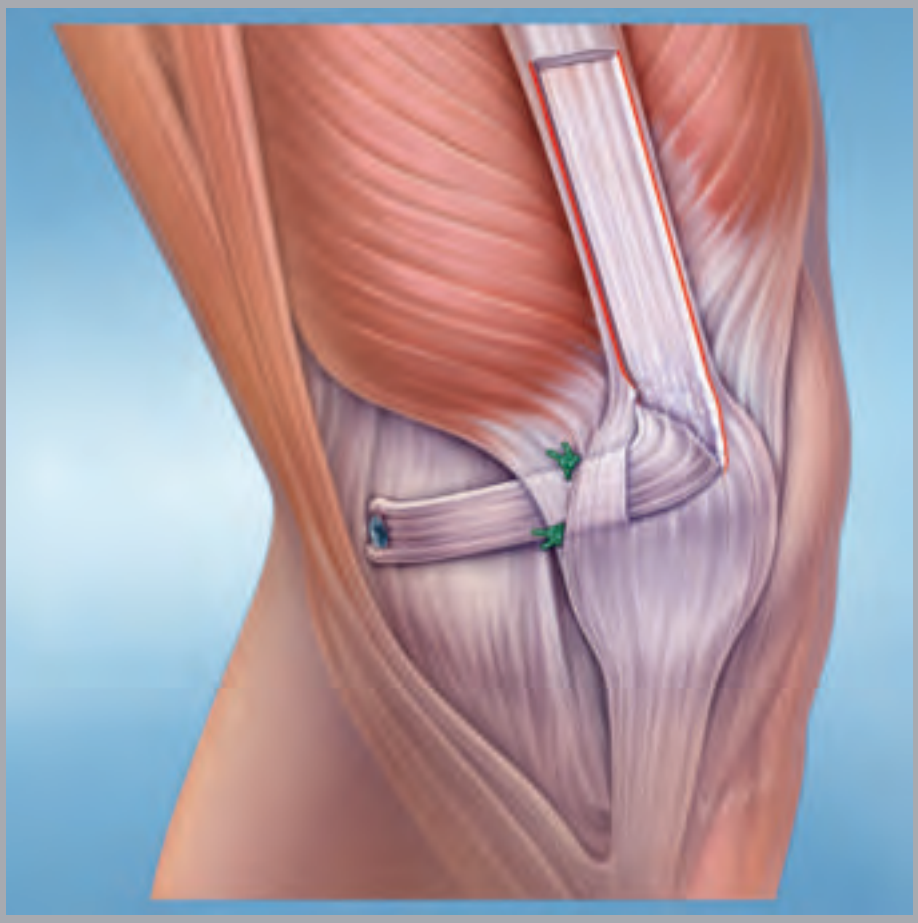
MINIMALLY INVASIVE RECONSTRUCTION OF THE MEDIAL PATELLOFEMORAL LIGAMENT (MPFL) USING A QUADRICEPS TENDON GRAFT



Christian FINK
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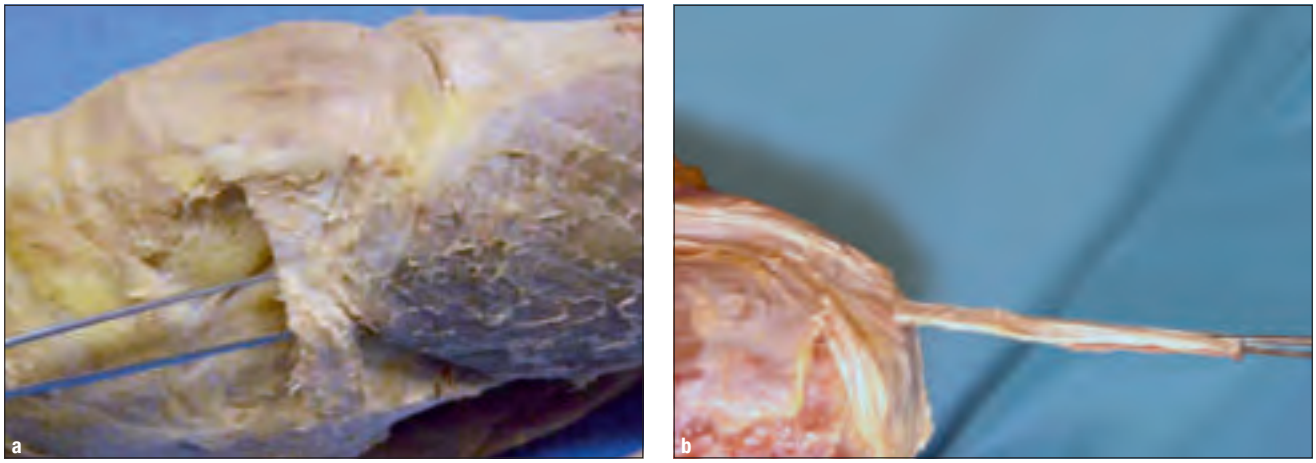
1.0 Introduction

In recent years, medial patellofemoral ligament (MPFL) reconstruction has gained in popularity for the treatment of patellofemoral instability. Numerous surgical techniques have been published, most of them using semitendinosus or gracilis tendon grafts.[2, 5, 8, 9, 12, 13]

The majority of these techniques, tunnels and/or anchor systems are used for graft fixation in the patella. While these surgical techniques are largely associated with very good clinical results[3], several problems have arisen.[1, 9] In a meta-analysis of MPFL reconstruction, *Shah et al.*[14] described a complication rate of 26.1%. The most common problems were reduced knee flexion and patellar fractures (through already existing bone tunnels).

As an alternative to hamstring tendon grafts for MPFL reconstruction, surgical techniques using quadriceps tendon have been described; these techniques do not require tunnels or anchor systems in the patella.[7, 11, 15] Morphologically, quadriceps tendon is more similar to the native MPFL (**Figs. 1a, b**).



1 Macroscopic anatomy of the native MPFL, demonstrated on a dissected human specimen (**a, b**).

2 Top view of the scar of a longitudinal skin incision following conventional tendon graft harvesting.

Its biomechanical properties (maximum pullout force, stiffness) also match the native MPFL.[4] In contrast, hamstring tendon grafts have an approximately threefold higher stiffness than native MPFL.[6] However, the cosmetic drawbacks of a longitudinal skin incision at the thigh (**Fig. 2**) and the technically challenging harvest of constant-thickness quadriceps tendon grafts may have limited the popularity of these techniques in the past.

The following describes a modification of the existing techniques. For this minimally invasive surgical technique specific instruments are used to ensure a safe and reliable harvesting of the quadriceps tendon graft.

2.0 Surgical Technique

2.1 Patient Positioning

For MPFL reconstruction, the patient is placed in supine position. Ideally, the knee should be freely movable in the range of 0° to 120°. This can be achieved on a normal operating table or using stirrups. Prior to surgery, it is important to make sure that an accurate lateral radiograph can be taken using intraoperative fluoroscopy. We prefer positioning the healthy leg in lithotomy position and the other in a motor-driven stirrup to provide good surgical access and permit flexible intraoperative use of the fluoroscope (**Fig. 3**).

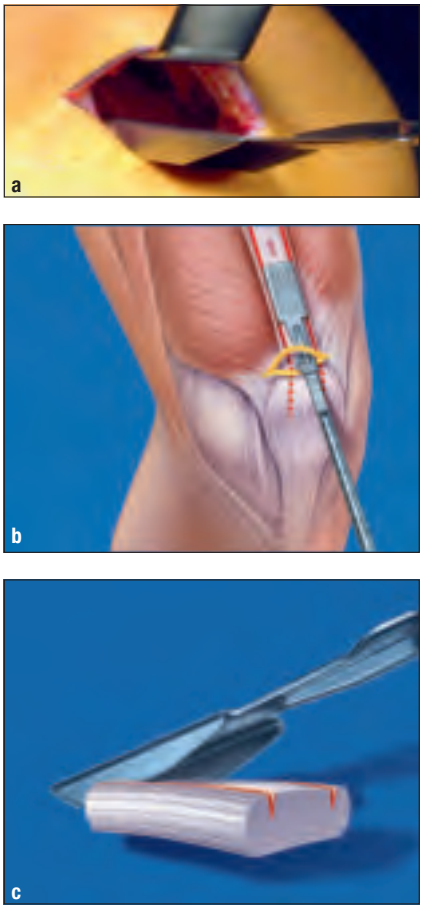
3 Patient positioning in the operating room.

4 Marking of anatomical landmarks and skin incision.

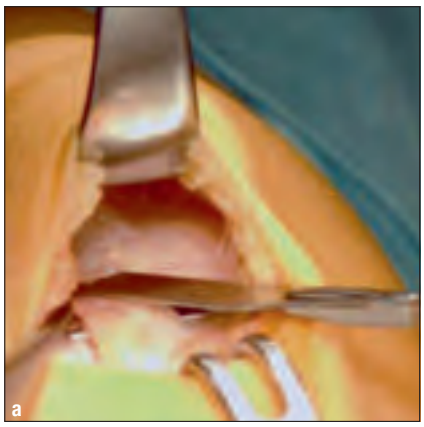
Schematic diagram showing the position of the skin incision.

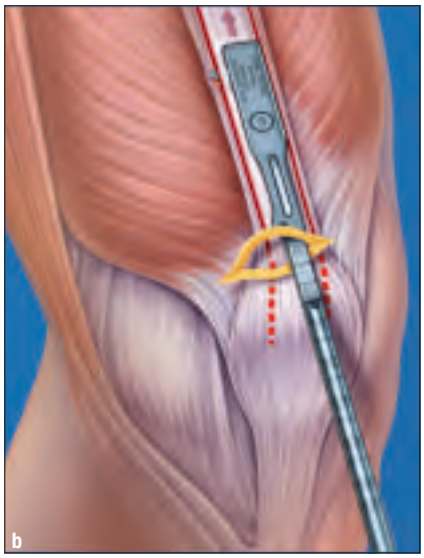
2.2 Graft Harvesting

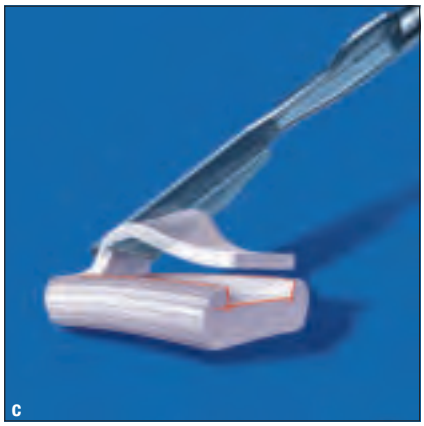
For harvesting a strip of quadriceps tendon, the knee is held in 90° of flexion, and a transverse skin incision of about 3 cm in length is made over the superomedial patellar pole (**Figs. 4a, b**). This is followed by subcutaneous dissection and exposure of the quadriceps tendon; the superficial bursa layer must be carefully removed to allow reliable identification of the tendon surface. Now, a Langenbeck retractor can be placed proximally in order to provide good visualization of the surface of the quadriceps tendon. Next, a tendon knife of 10 mm or 12 mm in width (depending on patient size) is placed over the medial third of the upper patellar edge and is proximally advanced subcutaneously by 8–10 cm (depending on patient size). Length is measured using the graduation at the handle of the knife (**Figs. 5a–c**).



5 Exposure of the tendon and insertion of the tendon knife (**a**). Subcutaneous parallel cutting of the tendon width, control of length using the handle (**b**). Schematic diagram (**c**).







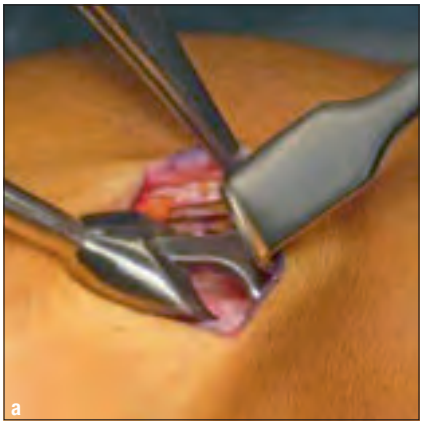
6 Lateral insertion of the tendon separator (**a**). Schematic diagram of the subcutaneous separation of the proper tendon width, control of length using the handle (**b, c**).

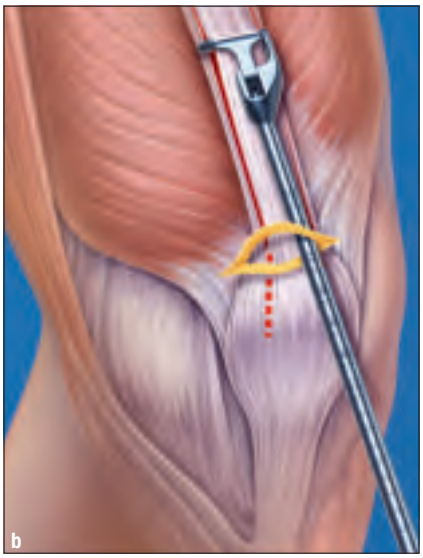
Subcutaneous horizontal cutting of the tendon is performed to define the thickness with a tendon separator. For this purpose, two tendon separators, sized 2 mm or 3 mm, are available (depending on patient size).

The tendon separator is laterally inserted into the vertical incision (**Fig. 6a**). The horizontal cutting edge should emerge at the medial cutting edge. The tendon separator is advanced subcutaneously in a proximal direction by 8–10 cm (**Figs. 6b, c**).

Next, the tendon cutter is laterally inserted for subcutaneous transection of the tendon at its proximal end (**Fig. 7a**). The knee is slightly extended (at approx. 50° of flexion) for threading the quadriceps tendon strip into the quadriceps tendon cutter. Now, the cutter is advanced to the desired graft length (8–10 cm) (**Fig. 7b**). Once transection of the tendon is complete, it is distally everted (**Fig. 8**).

This technique allows pedicled quadriceps tendon grafts to be harvested atraumatically and partially, with 10/12 mm in width and 2/3 mm in thickness.





7 Lateral insertion of the tendon cutter (**a**). Schematic diagram demonstrating how the cutter is advanced to the desired tendon length, followed by transection of the graft (**b**).

8 The tendon strip is distally everted.

2.3 Graft Preparation

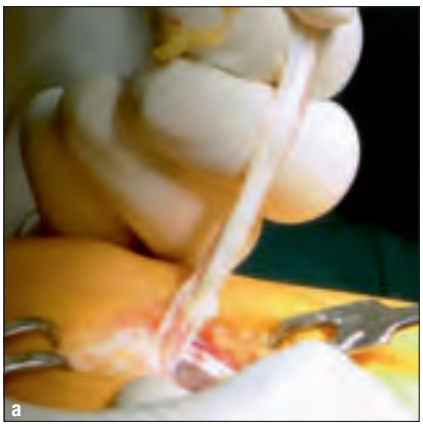
For MPFL reconstruction, the harvested graft remains distally pedicled. At its proximal end, an absorbable 2-0 suture is attached using a whip stitch technique.

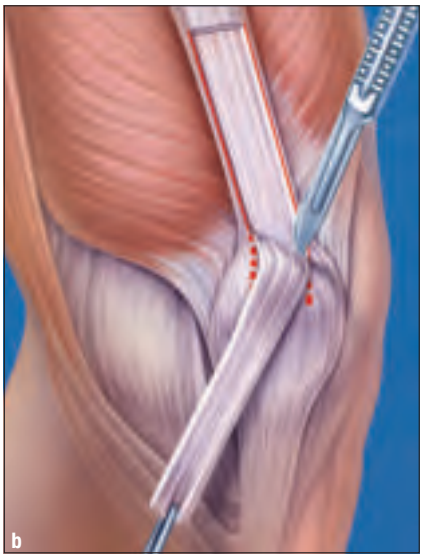
The skin incisions are extended distally over the patella by 1.5–2 cm according to the width of the graft, and the tendon strip is then cautiously elevated in the subperiostal plane from the anterior patellar surface (medially 0.5–1 cm, laterally 1.5–2 cm) (**Figs. 9a, b**).

In the next step, the medial patellar margin is exposed. The bony patellar margin should be debrided with a Luer rongeur to enhance a rapid onset of healing (**Fig. 10**).

Now, the prepatellar tissue is laterally mobilized as far as the medial margin of the quadriceps tendon graft. This is best accomplished using a raspatory (**Fig. 11**).

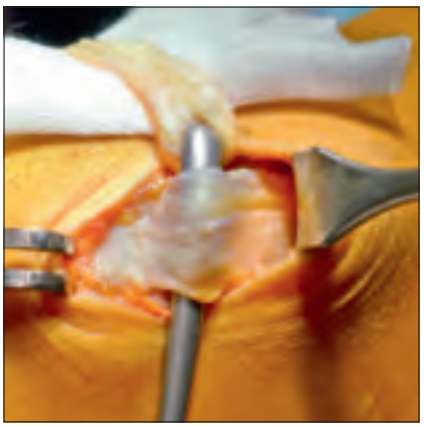
A forceps is medially inserted underneath the mobilized tissue to grasp the ends of the sutures that have been attached to the proximal end of the quadriceps tendon graft (**Fig. 12**). The sutures are passed medially and threaded out, then the graft is everted by 90° and pulled through.





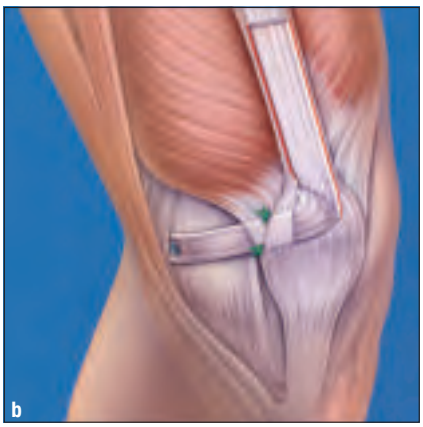
9 Subperiostal dissection of a tendon strip elevated from the patella (**a, b**).

10 Debridement of the patellar margin.



11 Mobilizing the prepatellar tissue.

12 A forceps is inserted for pulling the tendon strip through the prepatellar tissue.



13 Once guided through the tissue, the tendon graft is secured using fixation sutures (**a**). Schematic diagram (**b**).

At the medial patellar margin, the graft is now fixed in place proximally and distally using two fixation sutures (2.0 sutures, absorbable) (**Figs. 13a, b**).

14 The femoral insertion point is determined under fluoroscopic guidance.

2.4 Femoral Anchoring

The adductor tubercle is palpated and a 1.5-cm long skin incision is made at this site. Using a curved forceps, a soft tissue tunnel is created from the medial patellar margin to this incision. It should be placed underneath the insertion of the vastus medialis muscle making sure that an extracapsular layer is maintained. A suture loop is inserted in the tunnel and used to pull through the graft.

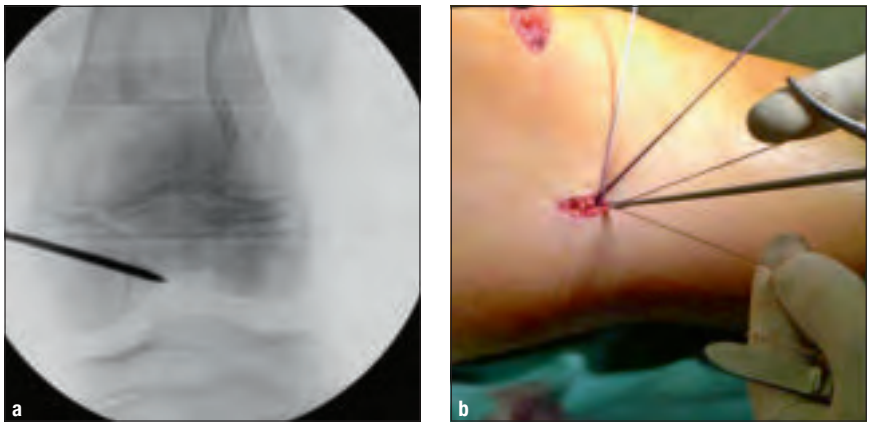
Under fluoroscopic guidance, a 2.4-mm guide wire is inserted at the site of MPFL insertion[12] (**Fig. 14**). The sutures of the graft can be wrapped around the guide wire, and the knee is ranged through from full extension to flexion (isometric assessment). Flexing the knee should not increase tension on the graft.

Provided appropriate positioning is confirmed, a cannulated bone drill (6–8 mm, depending on graft size, determined in advance using a conventional gauge) is used to drill over the guide wire to a depth of about 30 mm.

Now, the sutures of the graft are inserted into the guide wire eyelet, and the graft is pulled into the drilled tunnel. The knee is ranged through from full extension to flexion again and then placed in 20° flexion to fix the graft in place using a MEGAFIX® interference screw matching the diameter of the tunnel (**Fig. 15**). The lateral margin of the patella should be flush with the lateral trochlear margin.

■ **Note:** In case of open epiphyseal plates, the graft is secured at the femur using a bone anchor. It should be placed distally to the epiphyseal plate at the medial femoral condyle. It is important to confirm appropriate positioning in two planes using fluoroscopy[10] (**Figs. 16a, b**).

15 Femoral fixation using a MEGAFIX® interference screw.



16 Femoral graft fixation using a suture anchor in a patient with an open epiphyseal plate (**a, b**).

2.5 Follow-up Care

Postoperatively, patients are maintained in an adjustable hinged knee brace with a motion range of 0°–90°. For the first 3 weeks after surgery, partial weightbearing to about 20 kg of body weight, which is then gradually increased to full weightbearing.

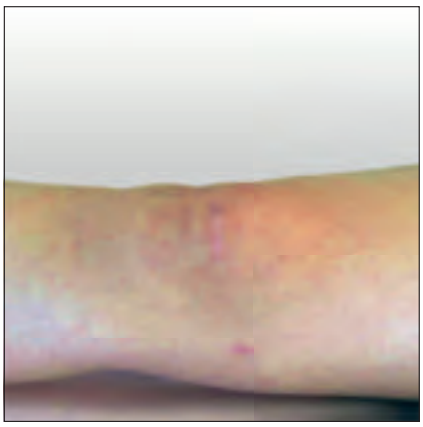
Passive and active-assisted exercises in the range of 0°–90° can be started on the first postoperative day. Exercises on a stationary bike may typically be initiated following the 6th posteroperative week. Most patients can resume their full sports activities after 4–5 months.

3.0 Summary

MPFL reconstruction with a pedicled quadriceps tendon graft is a valid alternative option to the commonly used MPFL reconstruction techniques with hamstring tendon grafts. Unlike the latter techniques, use of a pedicled quadriceps tendon graft obviates the need for implants or bone tunnels usually required for patellar anchoring. Therefore, this surgical technique is also applicable as revision procedure in case of failed MPFL reconstruction, particularly in patients with a history of previous tunnels or implants in the patella.

Since a bone anchor can be used for fixation to the femur, this technique may also be used effectively in patients with open epiphyseal plate.

Furthermore, minimally invasive harvesting of the quadriceps tendon graft is usually feasible with an excellent cosmetic outcome (**Fig. 17**).



17 Scar following minimally invasive MPFL reconstruction using a quadriceps tendon graft.

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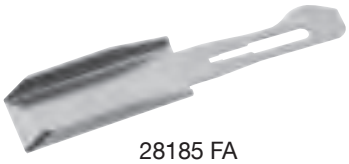
Instruments for Quadriceps Tendon Graft Harvesting and MPFL Reconstruction

28185 QS

28185 QS **Quadriceps Tendon Cutter,** for subcutaneous terminal cutting of quadriceps tendon

28185 MH

28185 MH **Handle,** for use with Quadriceps Tendon Separators 28185 EA-EC and Quadriceps Tendon Knives 28185 FA-FF



28185 FA

28185 EA

28185 FA **Tendon Knife,** for removal of the quadriceps tendon for MPFL reconstruction, vertical parallel cutting, width 10 mm, height 4 mm, sterile, for use with Handle 28185 MH

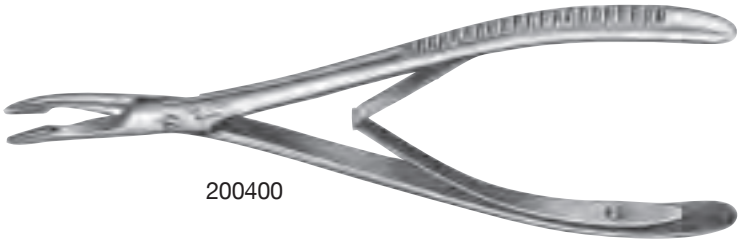
28185 FB **Same,** width 12 mm

28185 EA **Tendon Separator,** for removal of the quadriceps tendon for MPFL reconstruction, horizontal parallel cutting, height 2 mm, sterile, for use with Handle 28185 MH

28185 EB **Same,** height 3 mm

It is recommended to check the suitability of the product for the intended procedure prior to use.

Instruments for Reconstruction of the Medial Patellofemoral Ligament (MPFL)

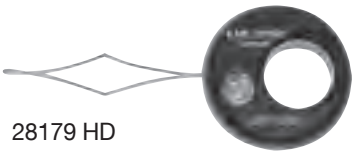


200400

200400 BEYER **Rongeur,** slender, curved, length 17 cm

28729 D

28729 D **Drilling Wire spiral shape,** with eyelet, diameter 2.4 mm, length 38 cm



28179 HD

28179 HD **Threading Device,** for use with Suture Hooks 28179 HA-HC

Instruments for Reconstruction of the Medial Patellofemoral Ligament (MPFL)

28729 BA-BH

28729 BA	**Bone Drill,** cannulated, diameter 4.5 mm, for use with Drilling Wire 28729 D and Larding Wire 28729 E
28729 BB	**Same,** diameter 5 mm
28729 BI	**Same,** diameter 5.5 mm
28729 BC	**Same,** diameter 6 mm
28729 BK	**Same,** diameter 6.5 mm
28729 BD	**Same,** diameter 7 mm
28729 BL	**Same,** diameter 7.5 mm
28729 BE	**Same,** diameter 8 mm
28729 BM	**Same,** diameter 8.5 mm
28729 BF	**Same,** diameter 9 mm
28729 BN	**Same,** diameter 9.5 mm
28729 BG	**Same,** diameter 10 mm
28729 BO	**Same,** diameter 10.5 mm
28729 BH	**Same,** diameter 11 mm

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- **Optimum torsion stability due to fine-tuned transmission of force between screwdriwer and interference screw**

28789 SK

28789 SK	**CrossDrive® Screwdriver,** cannulated, size 8 – 11, for use with bioresorbable Mega Fix® screws diameter 8 – 11 mm
28770 SK	**CrossDrive® Screwdriver,** cannulated, size 7, for use with bioresorbable Mega Fix® screws diameter 7 mm
28760 SK	**CrossDrive® Screwdriver,** cannulated, size 6, for use with bioresorbable Mega Fix® screws diameter 6 mm
28789 GW	**Nitinol Guide Wire,** diameter 1.1 mm, length 38.5 cm
28789 KW	**Nitinol Guide Wire,** short, diameter 1.1 mm, length 25.5 cm

Implants for Medial Patellofemoral Ligament Reconstruction

Mega Fix® B

2870619 B **Mega Fix® B,** bioresorbable interference screw, diameter 6 mm, length 19 mm, sterile
2870623 B **Same,** length 23 mm

2870719 B **Mega Fix® B,** bioresorbable interference screw, diameter 7 mm, length 19 mm, sterile
2870723 B **Same,** length 23 mm
2870728 B **Same,** length 28 mm

2870819 B **Mega Fix® B,** bioresorbable interference screw, diameter 8 mm, length 19 mm, sterile
2870823 B **Same,** length 23 mm
2870828 B **Same,** length 28 mm

2870923 B **Mega Fix® B,** bioresorbable interference screw, diameter 9 mm, length 23 mm, sterile
2870928 B **Same,** length 28 mm

Mega Fix® P

2870823 P **Mega Fix® P,** bioresorbable interference screw, perforated, diameter 8 mm, length 23 mm, sterile
2870828 P **Same,** length 28 mm

2870923 P **Mega Fix® P,** bioresorbable interference screw, perforated, diameter 9 mm, length 23 mm, sterile
2870928 P **Same,** length 28 mm
2870935 P **Same,** length 35 mm

2871028 P **Mega Fix® P,** bioresorbable interference screw, perforated, diameter 10 mm, length 28 mm, sterile
2871035 P **Same,** length 35 mm

2871135 P **Mega Fix® P,** bioresorbable interference screw, perforated, diameter 11 mm, length 35 mm, sterile

Implants for Medial Patellofemoral Ligament Reconstruction

Mega Fix® C

2870619 C **Mega Fix® C,** bioresorbable composite interference screw, diameter 6 mm, length 19 mm, sterile
2870623 C **Same,** length 23 mm

2870719 C **Mega Fix® C,** bioresorbable composite interference screw, diameter 7 mm, length 19 mm, sterile
2870723 C **Same,** length 23 mm
2870728 C **Same,** length 28 mm

2870819 C **Mega Fix® C,** bioresorbable composite interference screw, diameter 8 mm, length 19 mm, sterile
2870823 C **Same,** length 23 mm
2870828 C **Same,** length 28 mm

2870923 C **Mega Fix® C,** bioresorbable composite interference screw, diameter 9 mm, length 23 mm, sterile
2870928 C **Same,** length 28 mm

Mega Fix® CP

2870823 CP **Mega Fix® CP,** bioresorbable composite interference screw, perforated, diameter 8 mm, length 23 mm, sterile
2870828 CP **Same,** length 28 mm

2870923 CP **Mega Fix® CP,** bioresorbable composite interference screw, perforated, diameter 9 mm, length 23 mm, sterile
2870928 CP **Same,** length 28 mm
2870935 CP **Same,** length 35 mm

2871028 CP **Mega Fix® CP,** bioresorbable composite interference screw, perforated, diameter 10 mm, length 28 mm, sterile
2871035 CP **Same,** length 35 mm

2871135 CP **Mega Fix® CP,** bioresorbable composite interference screw, perforated, diameter 11 mm, length 35 mm, sterile

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Notes: