ANATOMIC RECONSTRUCTION OF THE ANTERIOR CRUCIATE LIGAMENT
Quadriiceps Tendon and Rectangular Bone Tunnels

Christian FINK, Christian HOSER, Peter GFÖLLER and Mirco HERBORT
ANATOMIC RECONSTRUCTION OF
THE ANTERIOR CRUCIATE LIGAMENT
Quadriiceps Tendon and Rectangular Bone Tunnels

Christian FINK,1,2 Christian HOSER,1
Peter GFÖLLER1 and Mirco HERBORT3

1 Center for Sports and Joint Surgery, Innsbruck, Austria
2 Research Unit for Orthopedic Sports Medicine and Injury Prevention, ISAG/UMIT, Hall in Tirol, Austria
3 Department of Trauma, Hand and Reconstructive Surgery, Munster University Hospital, Munster, Germany
# Table of Contents

1 Basic Principles .......................................................... 6  
   1.1 Introduction .......................................................... 6  

2 Operating Technique .................................................. 8  
   2.1 Harvesting the Graft with a Bone Plug ................. 8  
   2.2 Harvesting the Graft without a Bone Plug ........... 10  
   2.3 Femoral Bone Tunnel ........................................... 11  
   2.4 Tibial Bone Tunnel ............................................... 13  
   2.5 Graft Passage ...................................................... 15  

3 Postoperative Care ..................................................... 17  

4 Summary ................................................................. 17  

5 References ............................................................... 18  

Instrument Set for Anatomic Reconstruction  
of the Anterior Cruciate Ligament .............................. 19
1 Basic Principles

1.1 Introduction

The selection of a graft for reconstructing the anterior cruciate ligament (ACL) continues to be a controversial issue.

While the patellar tendon was long considered the “gold standard” for ACL reconstructions, in recent years it was surpassed in popularity by the semitendinosus and gracilis tendons. Meanwhile, relatively little attention was given to the quadriceps tendon (QT) as a graft source. During the 1990s, only a few surgeons favored the QT for cruciate ligament surgery. Stäubli et al. demonstrated the advantages of the graft in their anatomic, biomechanical and clinical studies. While many knee surgeons currently regard the QT as a good revision graft, to date it has not been widely utilized as a standard graft for primary ACL reconstructions. We feel that this is mainly because harvesting of the QT graft is more technically demanding and often yields less favorable cosmetic results when using a conventional technique (Fig. 1).

Meta-analyses have shown that the various graft options are equivalent in terms of their overall clinical outcomes. A more detailed look at the data shows that the patellar and quadriceps tendons offer advantages in terms of objective stability. Use of the patellar tendon is associated with greater pain and discomfort on kneeling, however. Höher et al. found in a prospective study that the QT and hamstring tendons were equivalent in terms of donor-site morbidity. Other studies have found significantly less donor-site morbidity with the QT than with the patellar tendon. Numerous clinical studies have also shown excellent short- and intermediate-term clinical results with QT grafts.

On the whole, the debate about double-bundle versus single-bundle reconstructions has changed traditional views about the placement of the bone tunnels. While no established clinical data are available to prove the superiority of double-bundle reconstruction, biomechanical studies have yielded convincing results. Moreover, recent anatomic studies have shown that the ACL has a flat cross section and that its anatomic femoral insertion site is not round but has an oval or rectangular shape (Fig. 2). In a biomechanical cadaver study, Shino et al. showed that a modified single-bundle reconstruction using rectangular bone tunnels and a patellar tendon graft could produce biomechanical stability.

Fig. 1 Classic technique for harvesting a QT graft through a longitudinal incision approximately 6–8 cm long.

Fig. 2 Flat, bandlike area of ACL attachment to the femur (a rectangular dilator is shown for comparison).
Anatomic Reconstruction of the Anterior Cruciate Ligament – Quadriceps Tendon and Rectangular Bone Tunnels

comparable to that of a double-bundle reconstruction with the semitendinosus tendon. A study by our own group of authors demonstrated the biomechanical superiority of an anatomic reconstruction with a patellar tendon graft and with a QT graft over a classic single-bundle reconstruction with the semitendinosus tendon (Fig. 3).

Neither a QT graft nor a patellar tendon graft is inherently round. Only the reaming technique makes it necessary to harvest a cylindrical bone plug that will fit snugly in a classic bone tunnel (Fig. 4).

When we view the grafts in cross section, we find that there is no significant difference in the thickness of round and rectangular grafts (Table 1).

These considerations led us to develop a technique for creating rectangular bone tunnels that conform to graft shape. We also wanted to simplify the technique for harvesting the QT graft and reduce donor-site morbidity, particularly from a cosmetic standpoint.

Figs. 3 Biomechanics of a flat QT graft in a model. In extension (a) and in 90° of flexion (b).

Figs. 4 Classic cylindrical bone plug (a). Rectangular bone plug conforms to the graft cross section (b).

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Cross Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 mm</td>
<td>8 x 5 mm</td>
</tr>
<tr>
<td>8 mm</td>
<td>9 x 5 mm</td>
</tr>
<tr>
<td>9 mm</td>
<td>10 x 5 mm</td>
</tr>
<tr>
<td>12 mm</td>
<td>12 x 5 mm</td>
</tr>
</tbody>
</table>

Table 1 Comparison of graft cross sections.
2 Operating Technique

2.1 Harvesting the Graft with a Bone Plug

A transverse skin incision approximately 2–3 cm long (or a longitudinal incision of equal length) is made over the superior border of the patella (Fig. 5). The bursal layer are then dissected aside to expose the QT, and a long LANGENBECK retractor is introduced. Next a tendon knife with two parallel blades (Fig. 6) is advanced to the 6-cm mark (measured from the superior patellar border) to define the width of the graft (9, 10, or 12 mm). The thickness of the graft is then defined with the tendon separator, which is set to a depth of 5 mm (Fig. 7) and is also advanced to the 6-cm mark. Finally, graft length is determined with the quadriceps tendon cutter, a punch-action instrument that is introduced 1–2 cm proximal to the superior patellar border. It is advanced to the desired length (6 cm) and activated to free the proximal end of the graft (Fig. 8). The graft is now reflected distally, and the distal end of the graft is outlined with a scalpel, cutting down to the patella. Next an oscillating saw with a narrow blade (0.5–0.7 cm) and a chisel are used to harvest a bone plug 1.5 cm long with a width and thickness conforming to graft geometry. To avoid patellar fractures, it is advisable (as in the conventional harvesting technique) to finish by sawing parallel to the anterior patellar surface in a proximal-to-distal direction with the narrow saw blade (Fig. 9). At that point the bone plug is easily mobilized with a chisel. The free end of the tendon is whipstitched with two nonabsorbable No. 2 lead sutures. The bone plug is tailored to form a rectangle of the desired size. Rounding the proximal corners of the bone plug will facilitate later graft passage into the joint. Two 1.5-mm holes are drilled in the bone plug, which is then tied to a FLIPPTACK® fixation button (KARL STORZ, Germany) with a nonabsorbable suture (28729 FC, Catgut Polyester-S, KARL STORZ, Germany) (Fig. 10).

Fig. 5 Transverse skin incision 2–3.5 cm long (alternative: longitudinal incision).

Fig. 6 Subcutaneous advancement of the tendon knife. The cutting edges are spaced at the desired graft width.
Fig. 7 Insertion and advancement of the 5-mm tendon separator.

Fig. 8 Subcutaneous advancement of the quadriceps tendon cutter.

Fig. 9 Harvesting the bone plug with the oscillating saw. The last cut is made in a proximal-to-distal direction, tailoring the thickness of the bone plug to the graft thickness.

Fig. 10 Rectangular QT graft with a bone plug.
2.2 Harvesting the Graft without a Bone Plug

Another option is to use the QT without a bone plug. The initial steps are the same as for a QT-bone graft. If the graft is freed directly at the superior patellar border, it should be harvested in a length of 7 cm. As an alternative to the bone plug, a periosteal strip equal to the graft width and 1.5–2 cm thick can be dissected from the anterior patellar surface (Fig. 11). The strip is then folded over and whipstitched with two nonabsorbable No. 2 sutures. This yields a rounded end that will facilitate later graft passage. Double lead sutures are placed in the distal end of the graft as in the bone plug technique (Fig. 12).

Fig. 11 Harvesting a QT graft with a 2-cm-long periosteal strip conforming to the graft width.

Fig. 12 Rectangular QT graft with a folded-over periosteal strip instead of a bone plug.

Figs. 13 Donor defect in the quadriceps tendon after graft removal (a). The tendon defect is closed superficially (b).

In both techniques the donor defect in the tendon is closed superficially with sutures (Fig. 13). We do not recommend definitive wound closure at this time. Packing the donor site with a subcutaneous gauze sponge (Fig. 14) can provide good hemostasis and reduce any extravasation that may occur (from opening the suprapatellar pouch).

Fig. 14 The donor site is packed with a subcutaneous gauze sponge.
2.3 Femoral Bone Tunnel

A standard arthroscope portal is placed just lateral to the patellar tendon at the level of the patellar apex. A low medial portal is then placed under vision, using a trial needle to determine the portal site. The cruciate ligament remnants are resected, leaving a tibial stump. Generally it is unnecessary to perform a notchplasty. With the knee flexed 90°, the anatomic femoral insertion site of the ACL is marked with a microfracture awl (Fig. 15a). The position of this point can be checked by viewing through the medial arthroscope portal (Fig. 15b). Another option is to place a second medial viewing portal. Then the knee is flexed at least 115°. A 2.4-mm guide wire is now introduced through the medial arthroscope portal using a femoral drill guide. The guide wire is drilled out the lateral side of the femur until just 1 cm protrudes into the joint (laser mark on the guide wire should be flush with the medial femoral cortex; (Figs. 16a, b). Now the length of the bone tunnel can be accurately measured with an external depth gauge advanced to the cortex over the guide wire (Fig. 16c).

Drilling the guide wire out the lateral side of the femur ensures that:

- the position of the wire (at the center of the proposed femoral bone tunnel) can be checked again through the medial arthroscope portal (Fig. 17) and
- the cannulated drill bit can be threaded over the intra-articular wire to avoid cartilage damage on the medial femoral condyle (Fig. 18).

**Figs. 15** The femoral insertion site of the ACL is marked with an awl (a). Its position is checked through the medial arthroscope portal (b).

**Fig. 17** The position of the guide pin can be checked again through the medial arthroscope portal.

**Figs. 16** The guide wire is predrilled exactly to the laser mark (a). External view of the 2.4-mm guide wire drilled out to the laser mark (b). A small stab incision is made at the visible base of the guide wire, and the depth gauge is slid against the femoral cortex to obtain an accurate reading of the femoral tunnel length.

**Figs. 18** Direct overdrilling of the guide wire could potentially damage the cartilage on the medial femoral condyle (a). Cartilage damage can be prevented by threading the cannulated drill bit over the guide pin inside the joint (b).
When the correct position of the guide wire has been confirmed, it is overdrilled with a 4.5-mm drill bit. Then a rasp (8 mm for an 8- or 9-mm tendon graft or 10 mm for a 10- or 12-mm graft) is passed through the medial portal. A Half Pipe® can be used to facilitate rasp insertion. With the knee flexed 115°, the rasp should be aligned parallel to the tibial plateau (Fig. 19). The smooth surface of the rasp should face the posterior cruciate ligament to protect that structure from injury. A socket is formed by driving the rasp in slowly to a depth of approximately 25–30 mm (1 cm longer than the bone plug). The rasp is then tapped back out, and if necessary a dilator of the same dimensions is inserted using the same technique (Fig. 20). The finished femoral bone tunnel is shown in Fig. 21.

![Fig. 19](image1) The rasp (8 or 10 x 5 mm) is driven into the bone tunnel with the knee flexed approximately 110°. The instrument should be parallel to the tibial plateau, and its smooth surface should face the posterior cruciate ligament.

![Fig. 20](image2) A dilator matching the graft dimensions is driven into the bone tunnel.

![Fig. 21](image3) Final appearance of the rectangular femoral bone tunnel.
Anatomic Reconstruction of the Anterior Cruciate Ligament – Quadriceps Tendon and Rectangular Bone Tunnels

2.4 Tibial Bone Tunnel

The tibial drill guide is introduced through the medial arthroscope portal. Then a vertical or horizontal skin incision approximately 1.5 cm long is made medial to the tibial tuberosity. The first guide wire is now drilled in through the center of the drill sleeve, and its relation to the roof of the intercondylar notch is evaluated by extending the knee (Fig. 22a). If the wire is correctly placed, the guide sleeve is removed and a cannulated 10-mm (or 12-mm) drill bit is advanced over the wire. It is predrilled to a depth of 0.5–1 cm to create a countersunk bed for the later placement of an ENDOTACK® (KARL STORZ, Germany; Fig. 22b). Now the drill sleeve is reintroduced and fixed securely in the predrilled hole (Fig. 23a). Depending on the position of the first guide wire in relation to the notch roof, a second guide wire is drilled in parallel to the first at a slightly more anterior or posterior site (Fig. 23b).

Figs. 22 Placement of the tibial bone tunnel. A central guide pin is drilled into the tibial stump of the ACL using the tibial drill guide (a). The guide sleeve is removed, and the guide pin is overdrilled to a depth of 0.5–1 cm with a 10-mm (or 12-mm) drill bit (b).

Figs. 23 Placement of the tibial bone tunnel. A second, parallel guide wire is introduced through the guide sleeve, emerging anterior or posterior to the first wire (check for free extension) (b).
Next, each wire is overdrilled with a 5-mm drill bit (for a planned 5.5 x 9.5-mm tibial tunnel) or a 5.5-mm drill bit (for a 5.5 x 10.5-mm or 12.5-mm tibial tunnel; (Fig. 24a). Both wires are removed, and any bony bridges that remain between the drill holes are disrupted with a shaver (Fig. 24b). Now a guide wire is inserted for orientation purposes, and a rasp of the correct width (8 or 10 mm) is carefully driven into the tunnel. Finally a tibial dilator of the appropriate size is carefully tapped into place to complete the tibial tunnel (Figs. 25, 26).

Caution: Both the rasp and dilator should be checked for correct rotation. If the instrument is driven in too forcibly or is improperly rotated, it may cause a fracture in the area of the intercondylar eminence.

Since the placement of a rectangular tibial bone tunnel is more technically demanding, a conventional round tunnel may also be created. We generally recommend the placement of a conventional round tibial tunnel, especially in revisions. It is often difficult to produce a second flat bone plug due to the curved anterior surface of the tibial tuberosity when a patellar tendon graft is used. In this case, therefore, we recommend using a rectangular bone plug from the patella with a rectangular femoral tunnel, plus a cylindrical bone plug from the tibial tuberosity with a round tibial tunnel.

Figs. 24 Placement of the tibial bone tunnel. Each wire is overdrilled with a 5-mm (or 5.5-mm) drill (a). Any bony bridges between the drilled holes are removed with a shaver (b).

Figs. 25 Placement of the tibial bone tunnel. A tibial dilator of the appropriate size is carefully driven into place.
Anatomic Reconstruction of the Anterior Cruciate Ligament – Quadriceps Tendon and Rectangular Bone Tunnels

Figs. 26 View into the finished tibial bone tunnel in a model. The round socket 1–2 cm deep opens into the rectangular bone tunnel (b). Intraoperative view with the arthroscope (b).

2.5 Graft Passage

The suture loop (28729 FC, Catgut Polyester-S, KARL STORZ, Germany) from the bone plug or the free suture ends from the tendon end of the graft (= end without bone) to the FLIPPTACK® are now tied off to equal the measured length of the femoral tunnel (Fig. 27). When a bone plug is used, its distal end should fit flush with the intra-articular cortex.

Correct graft rotation is an important consideration during graft passage (Fig. 28). It is easier to achieve correct graft rotation with the knee slightly extended. Once the plug has been properly rotated, the knee is flexed and the graft is pulled completely into the joint. When it is confirmed that the fixation button has been flipped, the graft is pulled back through the tibial tunnel to seat the button securely against the femoral cortex. Now the knee joint is taken through 10

Figs. 27 The QT graft (with bone plug) is ready for passage. A FLIPPTACK® has been mounted at its proximal end and an ENDOTACK® at its distal end. The length (→) of the segment marked in panel (a) equals the measured length of the femoral bone tunnel.

Figs. 28 The femoral bone plug is rotated 90° with an arthroscopic probe.
cycles of flexion-extension while traction is maintained on the distal leads. Then, with the knee flexed approximately 20°, the tibial end of the graft is fixed with a 7 or 8 x 28-mm absorbable interference screw inserted on the lateral side of the graft (Fig. 29). Additionally, the sutures are tied over an ENDOTACK® (KARL STORZ, Germany).

Finally, the position of the graft is checked by arthroscopic inspection (Fig. 30).

**Note:** A QT graft without a bone plug is also suitable for ACL reconstruction in a patient with open growth plates. In this case we recommend drilling a conventional round tibial tunnel and using an ENDOTACK® alone (without an interference screw) for distal graft fixation.

![Figs. 29](image1.png) **Figs. 29** Tibial fixation of the graft with an interference screw. The guide wire is positioned so that the screw will be inserted along the lateral side of the graft.

![Figs. 30](image2.png) **Figs. 30** QT graft immediately after fixation (a). QT graft 6 months after implantation (b). Follow-up arthroscopy was performed to investigate persistent pain after a meniscal repair.
3 Postoperative Care

While still in the operating room, the knee is positioned in an extension brace following application of the wound dressing and CryoCuff.

If the patient is hospitalized, drains are removed and radiographs (Fig. 31) are obtained on the first postoperative day. A 0-0-90° knee brace is applied, and the patient is mobilized under the direction of a physical therapist.

Partial weight bearing at approximately 20–30 kg should be maintained for the first two postoperative weeks. The brace and crutches can be discontinued by the third postoperative week. In most cases the patient is discharged on the second or third postoperative day and continues outpatient physical therapy 2 or 3 times per week for at least 6 weeks.

In patients with associated injuries and/or concomitant procedures (torn medial collateral ligament, meniscus repairs, etc.), the rehabilitation protocol should be modified accordingly.

4 Summary

The quality of the QT is often underestimated in cruciate ligament surgery. The tendon is very flexible in its dimensions and can be used with or without a bone plug. It is superior to the patellar tendon in donor-site morbidity, especially with regard to kneeling.

Based on the results of clinical and biomechanical studies, the QT also appears to be a suitable graft for primary anatomic reconstructions of the anterior cruciate ligament.

To date, we feel that a major obstacle to the widespread use of the QT as a primary graft is the more technically demanding harvesting technique and the frequently poorer cosmetic result. These disadvantages can be significantly reduced, however, by the development of a standardized, minimally invasive technique for harvesting the graft (Fig. 32).
References


11. HERBORT M, ZANTOP T, TECKLENBURG K. Quadriceps and BPTB ACL reconstruction: rectangular bone tunnel restores the intact knee kinematics significantly better compared to conventional single bundle hamstring reconstruction. AGA Forschungsförderung. Arthroscopy. 2012; (in Revision).


Instrument Set for Anatomic Reconstruction of the Anterior Cruciate Ligament
Instruments for Quadriceps Tendon Harvesting for ACL Reconstruction

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

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

28185 FC Tendon Knife, for removal of the quadriceps tendon for cruciate ligament reconstruction, vertical parallel cutting, width 8 mm, height 6 mm, sterile, for use with Handle 28185 MH

28185 FD Same, width 9 mm
28185 FE Same, width 10 mm
28185 FF Same, width 12 mm

28185 EC Tendon Separator, for removal of the quadriceps tendon for cruciate ligament reconstruction, horizontal parallel cutting, height 5 mm, sterile, for use with Handle 28185

28185 MB Tendon Thickness Tester, for determining the thickness of the quadriceps tendon
Instruments for Tunnel Preparation

Femoral Target Guide

28729 ZG  **Handle**, with ratchet, for use with Inserts 28729 ZM-ZQ, WZ, VX-VZ, WU-WW, WA-WD, WX, WY

28729 WY  Femoral Target Guide Attachment, for ACL reconstruction via a medial port, with 5 mm offset, for use with Handle 28729 ZG

28729 WX  **Same**, with 6 mm offset
28729 WZ  **Same**, with 7 mm offset
28729 VX  **Same**, with 8 mm offset
28729 VY  **Same**, with 9 mm offset
28729 VZ  **Same**, with 10 mm offset

28729 TL  Depth Gauge, long, for use with larding wire, pyramidal tip, diameter 2.4 mm
28729 E   Larding Wire, pyramidal tip, diameter 2.4 mm, length 32 cm, package of 10

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>28729 BH</td>
<td>Bone Drill, cannulated, diameter 4.5 mm, for use with Drilling Wire 28729 D and Larding Wire 28729 E</td>
</tr>
<tr>
<td>28729 BA</td>
<td>Same, diameter 5 mm</td>
</tr>
<tr>
<td>28729 BI</td>
<td>Same, diameter 5.5 mm</td>
</tr>
<tr>
<td>28729 BC</td>
<td>Same, diameter 6 mm</td>
</tr>
<tr>
<td>28729 BK</td>
<td>Same, diameter 6.5 mm</td>
</tr>
<tr>
<td>28729 BD</td>
<td>Same, diameter 7 mm</td>
</tr>
<tr>
<td>28729 BL</td>
<td>Same, diameter 7.5 mm</td>
</tr>
<tr>
<td>28729 BE</td>
<td>Same, diameter 8 mm</td>
</tr>
<tr>
<td>28729 BM</td>
<td>Same, diameter 8.5 mm</td>
</tr>
<tr>
<td>28729 BF</td>
<td>Same, diameter 9 mm</td>
</tr>
<tr>
<td>28729 BN</td>
<td>Same, diameter 9.5 mm</td>
</tr>
<tr>
<td>28729 BG</td>
<td>Same, diameter 10 mm</td>
</tr>
<tr>
<td>28729 BO</td>
<td>Same, diameter 10.5 mm</td>
</tr>
<tr>
<td>28729 BH</td>
<td>Same, diameter 11 mm</td>
</tr>
</tbody>
</table>

28179 GH | Half Pipe® long, working length 95 mm
Instruments for Tunnel Preparation
Femoral Rasps and Rectangular Femoral Dilators for the Anterior Cruciate Ligament

28185 GA
- **Rasp**, femoral, cannulated, straight, coarse, one side plain, width 8 mm, height 5 mm, working length 15 cm
- **28185 GB** Same, width 10 mm

28185 HA
- **Dilator**, rectangular, femoral, width 8 mm, height 5 mm, working length 15 cm
- **28185 HB** Same, width 9 mm
- **28185 HC** Same, width 10 mm
- **28185 HD** Same, width 12 mm

Tibial Target Guide and Rectangular Tibial Dilators

28729 CF
- **Tibial Target Guide**, for the placement of a maximum of 3 parallel drilling wires

28185 IA
- **Dilator**, rectangular, tibial, width 8.5 mm, height 5.5 mm, working length 15 cm
- **28185 IB** Same, width 9.5 mm
- **28185 IC** Same, width 10.5 mm
- **28185 ID** Same, width 12.5 mm
Instruments for Tendon Preparation

28729 SB  **Tendon Board**, including FLIPPTACK® Retainer 28729 SC

28729 SA  **Tendon Thickness Tester**, for determination of tendon thickness size 6 – 10.5 mm at intervals of 0.5 mm

28729 SC  **FLIPPTACK® Retainer**

28729 FK  **Thread Clip**

28729 P  **Tissue Forceps**, 1 x 2 teeth, medium, distal curved to left, length 14.5 cm
Instruments for Graft Fixation

28729 TT  **ENDOTACK®,** tibial fixation button, 10 x 16 mm, sterile
28729 FT  **FLIPPTACK®,** extracortical fixation button, 4 x 12 mm, sterile
28729 FC  **Catgut Polyester-S white,** 3 x 75 cm, USP 7, sterile, package of 24, for use with FLIPPTACK®, extracortical fixation button

28729 KK  **Knot Holder,** small, 1 x 1 mm, working length 14.5 cm

*The first knot is pressed onto the ENDOTACK® with the knot holder to keep the knot from loosening. Tie sutures of one tendon loop. Then tie sutures of other tendon loop.*
Instruments for Graft Fixation

28729 ST

- **Positioning Device**, for use with ENDOTACK® 28729 TT

28729 SM

- **Positioning Device**, for use with Mini ENDOTACK® 28729 MT, color code: red

28729 MS

- **Button Wrench**, for use with ENDOTACK® 28729 TT

28729 MM

- **Button Wrench**, for use with Mini ENDOTACK® 28729 MT, color code: red

28729 TM

- **Tensiometer**, for measuring and controlling the tension of the graft
Instruments for Graft Fixation

28789 SK  CrossDrive® Screwdriver, cannulated, size 8 – 11, for use with bioresorbable Mega Fix® screws diameter 8 – 11 mm and Nitinol Guide Wires 28789 GW/KW

28770 SK  CrossDrive® Screwdriver, cannulated, size 7, for use with bioresorbable Mega Fix® screws diameter 7 mm and Nitinol Guide Wires 28789 GW/KW

28760 SK  CrossDrive® Screwdriver, cannulated, size 6, for use with bioresorbable Mega Fix® screws diameter 6 mm and Nitinol Guide Wires 28789 GW/KW

28789 CD  CrossDrive® Plus Screwdriver, cannulated, for use with Mega Fix® titanium interference screws and Nitinol Guide Wire 28789 FW

28789 GW  Nitinol Guide Wire, diameter 1.1 mm, length 38.5 cm, package of 6, for use with CrossDrive® Screwdrivers 28789 SK, 28770 SK and 28760 SK

28789 KW  Nitinol Guide Wire, diameter 1.1 mm, length 25.5 cm, package of 6, for use with CrossDrive® Screwdrivers 28789 SK, 28770 SK and 28760 SK

28789 FW  Nitinol Guide Wire, diameter 2 mm, length 38.5 cm, package of 6, for use with CrossDrive® Plus Screwdriver 28789 CD
Instruments for Graft Fixation

Mega Fix® B

2870619 B  Mega Fix®, bioresorbable interference screw, diameter 6 mm, length 19 mm, sterile
2870623 B  Same, length 23 mm
2870719 B  Mega Fix®, 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®, 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®, bioresorbable interference screw, diameter 9 mm, length 23 mm, sterile
2870928 B  Same, length 28 mm

Mega Fix® P

2870823 P  Mega Fix®, bioresorbable interference screw, perforated, diameter 8 mm, length 23 mm, sterile
2870828 P  Same, length 28 mm
2870923 P  Mega Fix®, 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®, bioresorbable interference screw, perforated, diameter 10 mm, length 28 mm, sterile
2871035 P  Same, length 35 mm
2871135 P  Mega Fix®, bioresorbable interference screw, perforated, diameter 11 mm, length 35 mm, sterile
## Instruments for Graft Fixation

### 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
Overview of KARL STORZ Arthroscopy and Sports Medicine

- HOPKINS® Telescopes and Sheaths
- SILCUT® Punches
- SILCUT® Punches, Forceps and Scissors
- Joint and Bone Reconstruction
- Instruments for Meniscus and Patella Surgery
- Instruments for Cruciate Ligament Reconstruction
- Instruments for Hip Arthroscopy
- Instruments for Wrist Arthroscopy and for Treatment of the Carpal Tunnel Syndrome
- Instruments for Rheumatology
- Spine Surgery
- HD Imaging with Operating Microscopes
- VITOM® System – Visualization System for Open Surgery with Minimal Access
- Holding Systems
- Extracorporeal Shock Wave Therapy ESWT
- KARL STORZ OR1 NEO™, Telepresence, Hygiene, Endoprotect1