System for Anterior Cruciate Ligament Reconstruction
with rectangular bone tunnels
using the quadriceps tendon
The Quadriceps Tendon

The quadriceps tendon is used in cruciate ligament revision surgery and, more and more frequently, for the primary reconstruction of the anterior (ACL) and posterior (PCL) cruciate ligaments.\textsuperscript{1}

The quadriceps tendon has also emerged as an ideal graft source for the reconstruction of the medial patellofemoral ligament (MPFL).\textsuperscript{2}

This is mainly due to the following properties of the quadriceps tendon:

### Benefits of the quadriceps tendon:

- Lower harvest site morbidity in comparison to the patellar tendon
- Harvesting with or without a bone block possible
- Good biomechanical properties

A special tendon harvesting system was designed to provide fast, safe and atraumatic tendon harvesting, featuring the following properties:

- Reproducible technique
- Safe subcutaneous tendon harvesting
- Defined harvesting depth
- Attractive cosmetic results

### Studies on the Quadriceps Tendon

\textsuperscript{1} Fink C, Herber M, Abermann E, Hoser C. Minimally invasive harvest of a quadriceps tendon graft with or without a bone block. Arthros Tech 2014


\textsuperscript{2} Fink C, Veselko M, Herbert M, Hoser C, 2014. Minimal invasive reconstruction of the MPFL using the quadriceps tendon. Arthros Tech 2014, 3(3) e325 - e329 [Epub ahead of print]

Note
ENDOWORLD® “Quadriceps Tendon Harvesting System” (96152047) is available on request.
A special harvesting system for the quadriceps tendon allows subcutaneous tendon removal via a minimal skin incision. Knives in different sizes are used to determine graft width and thickness.

For cruciate ligament reconstruction, an oscillating saw can be used to harvest a bone block from the proximal patella in the appropriate width and thickness. Alternatively, the graft can be detached from the patellar margin without a bone block and used as a soft-tissue graft.

The quality of the quadriceps tendon (QT) as a graft is often underestimated in knee ligament surgery. Its dimensions are very flexible and the tendon can be used with or without a bone block.

Cruciate ligament reconstruction techniques using the semitendinosus and/or gracilis tendon have gained increasing attention in recent years. However, there has been little focus on the quadriceps tendon.

Today many knee surgeons value the quadriceps tendon not only as a revision graft, but also use the quadriceps tendon more and more frequently for primary reconstruction of the anterior (ACL) and posterior (PCL) cruciate ligaments.
System for ACL Reconstruction with Rectangular Bone Tunnels using the Quadriceps Tendon

The actual anatomy of the anterior cruciate ligament insertion site gave rise to the idea of a system that would best match the insertion-site anatomy.

In co-operation with Prof. Christian Fink, Sportsclinic Austria (Innsbruck, Austria), a compact system was developed for creating rectangular femoral and tibial bone tunnels.
Creating Anatomical Bone Tunnels

Anatomical femoral insertion of ACL

At 115° flexion, the opening of the rectangular bone tunnel is approximately horizontal.

The rectangular bone tunnel corresponds very well to the anatomical femoral insertion of the ACL. Right: Pulling in the graft
Application Description

1. Measuring the graft diameter with the tendon thickness tester

QR code for the femoral tunnel

2. Creation of the femoral bone tunnel
Overdrilling using the 4.5 mm drill bit for FLIPPTACK fixation and subsequent measurement of the tunnel length.

A rasp matching the graft diameter (8 mm for 8 and 9 mm grafts or 10 mm for 10 and 12 mm grafts) is selected.

The femoral tunnel is created using the “Medial Portal Aimers”. It is important to center the tunnel in the insertion area of the native ACL.

The rasp is inserted vertically via the K-wire (to protect the condyles from iatrogenic damage). In the joint, the rasp is then horizontally aligned at 115° knee flexion with the smooth side facing the PCL. The rasp features an attachable 4.5 mm pin that allows exact centering in the 4.5 mm tunnel.
The tunnel is rasped for the full length of the bone block. The K-wire remains in the tunnel.

To avoid ligament abrasion, it is important that the flat side of the rasp faces the PCL in the final position at the tunnel entrance.

Then a dilator of the same size as the graft is selected and inserted in the tunnel to the desired depth.

In extracortical fixation, both the rasp and the dilator are inserted 1.0 cm deeper so that the FLIPPTACK can flip extracortically. In that case, the blind hole is typically approx. 30 mm.
3. Creating the tibial tunnel

The tibial aimer features a unique tip design. This allows the placement of two K-wires to align the tunnel on the tibial plateau.

A conventional round or a rectangular tibial tunnel can be created.
The tibial aimer is inserted and placed with reference to the anterior horn of the lateral meniscus. The length of the tibial tunnel can be measured at the target sleeve. This measurement should later be taken into account for the insertion depth of the tibial dilator.

In the case of a planned rectangular bone tunnel, the first K-wire is drilled through the central target sleeve of the aimer.

This is always overdrilled using a cannulated drill bit in size 10 mm (for a graft width of 8/9 mm) or 12 mm (for a graft width of 10/12 mm) to a depth of 5-10 mm to open the cortical bone.

Then additional K-wires are drilled ventrally and/or dorsally, depending on the graft dimensions (2 wires for 8-10 mm, 3 wires for 12 mm), in addition to the placement of the first K-wire.
Any osseous bridge is broken with the aid of shaver and the K-wire is re-inserted.

To facilitate the distal to proximal insertion of the graft, the tibial dilator is used to dilate the complete tunnel into a rectangular shape that is 0.5 mm more than the thickness and width of the graft.

The graft, which has been prepared on the tendon board, can now be inserted into the tunnel. In this process, the bone block is intra-articularly guided and correctly rotated with the aid of a hypomochlion (palpation hook).
It is important that the graft is inserted under control to avoid avulsion of the bone block. This is a particular concern for users who are switching from hamstrings to bone blocks.

This is followed by tibial fixation with an interference screw and/or ENDOTACK®.
**Tips**

In revision surgery, it is often advantageous to reuse a previously placed round tibial tunnel and only create a rectangular femoral tunnel.

If a patellar tendon graft is used as a bone-ligament-bone graft, it is also recommended to create a femoral bone tunnel and a conventional round tibial tunnel.

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**Benefits of creating rectangular bone tunnels:**

- Enables the creation of both femoral and tibial rectangular tunnels
- Rasp with smooth side to protect the PCL
- Distal tip of the tibial aimer with target marks for additional K-wires to align the tunnel on the tibial plateau
- Anatomical insertion area for the graft used
- Compact instrument set
- Compatible with existing instruments for cruciate ligaments
- Ideal for primary and revision ACL
- Provides ideal anatomical and cosmetically attractive results for the patient in combination with minimally invasive harvesting system for the quadriceps tendon
System Components

- Tendon thickness tester
- Rasps and dilators for femoral rectangular bone tunnels
- Target aimer and dilators for tibial rectangular bone tunnels

Tendon thickness tester:
- For measuring the following bone blocks: 8.0 mm, 9.0 mm, 10.0 mm and 12.0 mm x 5.0 mm

Rasps:
- 8.0 and 10.0 mm widths
- Each with 11.0 mm rasp depth
- 3 sides with cutting teeth
- 1 smooth side
- Tip with 4.5 mm outer diameter to accommodate 2.4 mm K-wires
- Laser marked in 5.0 mm increments
- Removal aid at the handle

Dilator, femoral:
- 8.0, 9.0, 10.0 and 12.0 mm wide and 5.0 mm thick
- 20.0 mm at full dilation width
- Laser marked in 5.0 mm increments
- Removal aid at the handle
Aimer, tibial:
- 98° fixed bending angle
- Distal tip with target marking for additional K-wires to align tunnel on the tibial plateau
- Target sleeve with additional ventral and dorsal K-wire guide
- Target sleeve with measuring scale for tibial tunnel length

Dilator, tibial:
- 8.5, 9.5, 10.5 and 12.5 mm wide and 5.5 mm thick
- 55.0 mm at full dilation width
- Laser marked in 5.0 mm increments
- Removal aid at the handle

<table>
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<tr>
<th>Graft diameter</th>
<th>Rasp, femoral</th>
<th>Dilator, femoral</th>
<th>K-wires, tibial</th>
<th>Drill bit, tibial</th>
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<td>8.00 mm</td>
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<td>12.00 mm</td>
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<td>5.00 mm</td>
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</table>
Instruments

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

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

28185 MB  **Tendon Thickness Tester**, for determining the thickness of the quadriceps tendon

28185 GA  **Rasp**, femoral, cannulated, straight, coarse, one side smooth, 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

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
Knives for quadriceps tendon harvesting for cruciate ligament reconstruction

<table>
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<tr>
<th>Cutting</th>
<th>Dimensions (w x h)</th>
<th>Art. No.</th>
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<tr>
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<td>12 x 6 mm</td>
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<tr>
<td>Tendon Knife</td>
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<td>5 mm height</td>
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Knives for quadriceps tendon harvesting for MPFL reconstruction

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<th>Dimensions (w x h)</th>
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<td>Tendon Separator</td>
<td>Horizontal parallel</td>
<td>3 mm height</td>
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</table>
Notes

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