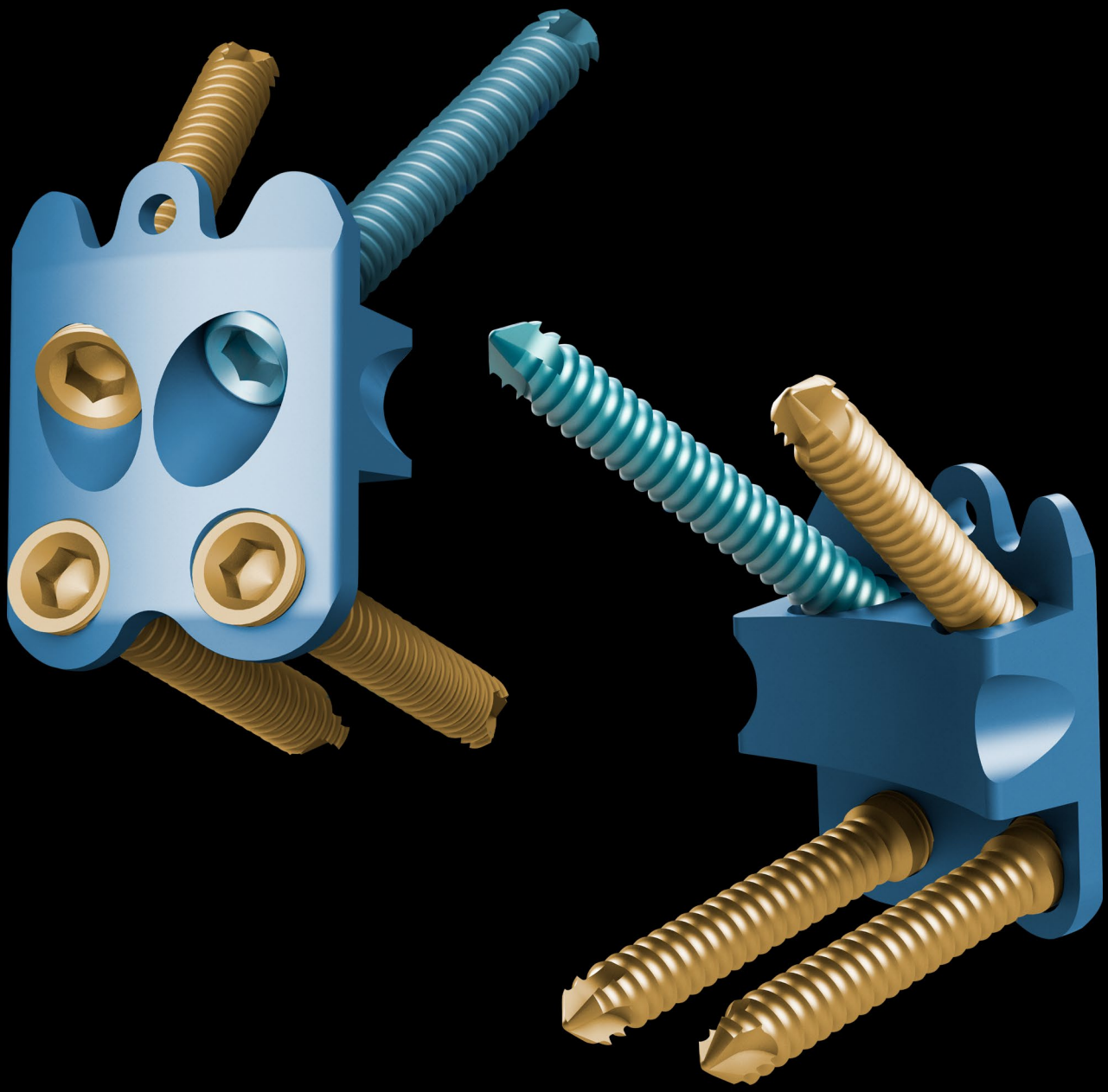
SURGICAL TECHNIQUE

Proximal tibial valgus osteotomy with medial opening wedge and *SPIDER HTO* MR plate fixation.



TRAUFIX
READY TO RUN

INTRODUCTION

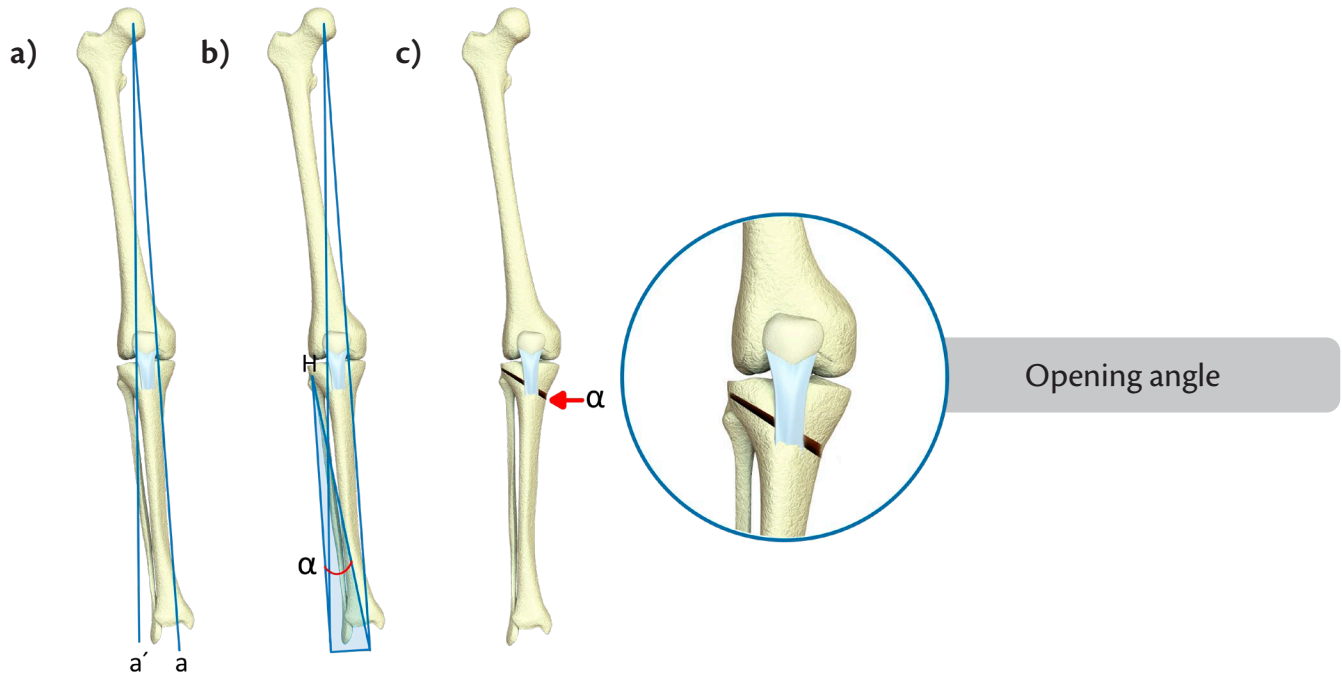
The present surgical technique provides a guide for the placement of the ***SPIDER HTO***[MR] plate using the specialized instruments contained in the kit at the time of selection.

CONTENTS

SURGICAL TECHNIQUE

Preoperative Planning

An accurate preoperative plan is essential for the success of this procedure. It is recommended to use the Miniaci planning method, which should be performed on a radiograph of the loaded entire lower extremity in AP projection, either on paper or digital.



a) Determine the mechanical axis of the lower extremity: draw a straight line from the center of the femoral head to the center of the ankle joint (a).

Draw the new load line from the center of the femoral head and passing through the knee at the desired position (a'). It is recommended that this passes between 60 and 70% of the tibial surface from medial to lateral.

b) Determine a hinge point (H). Generally, the hinge point should be located on the lateral cortex of the tibia at the level of the superior border of the proximal tibioperoneal joint. At least 1.5 cm below the knee joint.

Connect the hinge point (H) to the new center (a') and to the old center (a) of the ankle joint; measuring the resulting angle (**α**)

c) This angle (**α**) should correspond to the opening angle in the medial cortex of the proximal tibia that we will perform in the osteotomy, this may vary according to the dimensions of the diameter of the patient's tibia; for which it should be determined with the help of the trigonometric conversion table of *Hernigou et al (see Table 1).*

Conversion Table 1. Medio-lateral diameter of the proximal part of the patient's tibia at the level of the osteotomy.

	Angulation to be corrected according to the Miniaci Method												
	4°	**5°**	**6°**	**7°**	**8°**	**9°**	**10°**	**11°**	**12°**	**13°**	**14°**	**15°**	**16°**
50mm	3	4	5	6	7	8	9	10	10	11	12	13	14
55mm	4	5	6	7	8	9	10	10	11	12	13	14	15
60mm	4	5	6	7	8	9	10	11	12	14	15	16	17
65mm	5	6	7	8	9	10	11	12	14	15	16	17	18
70mm	5	6	7	8	10	11	12	13	15	16	17	18	20
75mm	5	6	8	9	10	12	13	14	16	17	18	20	21
80mm	6	7	8	10	11	13	14	15	17	18	19	21	22

Trigonometric conversion table to determine the height of the opening wedge in millimeters of the osteotomy, taking into consideration the degrees of correction planned by the Miniaci method and the mean - lateral trans-surgical diameter in millimeters of the proximal part of the tibia at the osteotomy site (modified from the publication of Hernigou et al 1987)

Practical example: We have a patient with a diagnosis of GIII Gonarthrosis of Kellgren & Lawrence secondary to genu varum of 6 degrees, with an angle (α) of Miniaci of 8° and whose measurement of the proximal mediolateral diameter of the tibia at the level of the osteotomy in the radiographic projection A.P; considering theradiographic magnification is 75 mm (to be verified in the trans- operatory with the osteotomy guide pin); therefore, it corresponds to an osteotomy opening and a ***SPIDER HTO*** [MR] plate size of 10 mm (see figure 1). It is recommended in case of a non number to choose the ***SPIDER HTO*** [MR] plate size from the next higher numberto avoid undercorrection, since the plate size is available in an even number.

Medio-lateral diameter of the proximal part of the patient's tibia at the level of the osteotomy

	Angulation to be corrected												
	4°	**5°**	**6°**	**7°**	**8°**	**9°**	**10°**	**11°**	**12°**	**13°**	**14°**	**15°**	**16°**
50mm	3	4	5	6	7	8	9	10	10	11	12	13	14
55mm	4	5	6	7	8	9	10	10	11	12	13	14	15
60mm	4	5	6	7	8	9	10	11	12	14	15	16	17
65mm	5	6	7	8	9	10	11	12	14	15	16	17	18
70mm	5	6	7	8	10	11	12	13	15	16	17	18	20
75mm	5	6	8	9	10	12	13	14	16	17	18	20	21
80mm	6	7	8	10	11	13	14	15	17	18	19	21	22

Figure 1. Practical example to determine the size of the wedge in millimeters for the opening osteotomy, which also corresponds to the size of the ***SPIDER HTO*** [MR] *plate.*

Surgical indications

Ideal candidate:

- Between 40 and 60 years old
- Medial gonarthrosis (Grade I-III).
- Varus deformity less than 15 degrees
- Full range of motion
- Normal ligament balance
- Good patellar alignment.
- Healthy lateral knee compartment
- Non-smoking.
- Good bone quality.
- Good pain tolerance

Possible candidate:
The indication is extended to those under 40 years of age and up to 70 years of age, allows flexion contracture of up to 15 degrees and in those who wish to continue doing sports.

Contraindications:

- Global joint destruction.
- Flexion contracture of more than 25 degrees.
- Pagoda type proximal tibial deformity (inverted V).
- Previous meniscectomy of the lateral compartment
- Grade III or morbid obesity.

Patient preparation and surgical access

The patient is placed in the supine decubitus position, under regional or general anesthesia, prior surgical protocol and with controlled ischemia.

Place a small textile bundle under the popliteal fossa to give discrete flexion to the knee and avoid strain on neurovascular structures.

Make a 4-5 cm longitudinal incision to the axis of the limb (*see figure2*), located medially at the level of the anterior tuberosity of the tibia (half towards proximal and half towards distal) of the limb to be operated on, dissect subcutaneous cellular tissue at your discretion, cauterize with electrocautery the periosteal veins in a meticulous way.

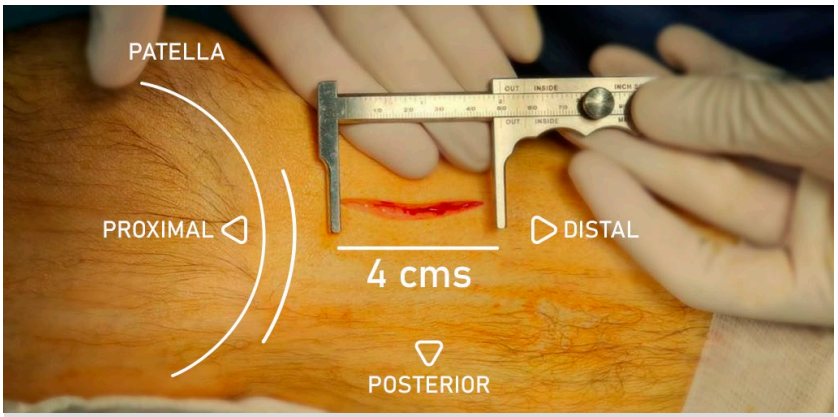


Figure 2. Cutaneous incision and initial approach.

Identify the insertion of the goose foot tendons, this is a key step of the technique to correctly place your osteotomy, with a fine curved Metzenbaum scissors free the fascia proximally and detach them from the deep plane (periosteal) respecting their distal insertion (*see Figure 3*), just enough to place a small Hohmman retractor type "shovel" in order to horizontalize the path of the tendons in their last 4 cms (*see Figure 4*).

Figure 3. Distal dissection towards the gracilis.

Figure 4. Placement of Hohmman separator, for horizontalization of the final path.

Supratuberosity Osteotomy

For the supratuberosity osteotomy, mark with electrocautery the vertical arm of the osteotomy 1 cm from the ventral border of the tibial tuberosity and with an angulation of approximately 110º to protect the insertion of the patellar tendon, mark now the second horizontal or main arm of the osteotomy in an anteroposterior direction perpendicular to the vertical axis of the tibia, to allow an oblique cut in the coronal plane and transverse in the sagittal plane (*see figure 5*).

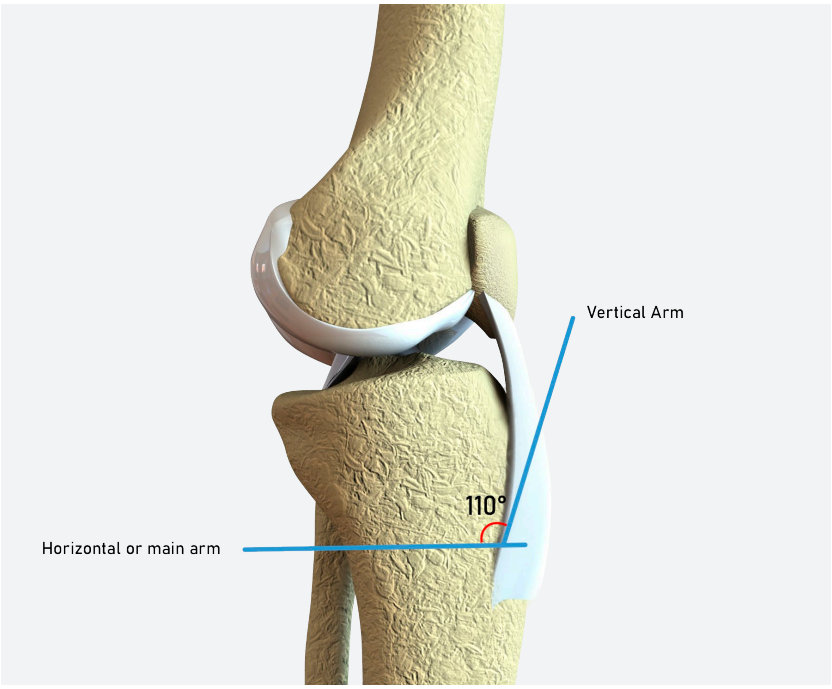


Figure 5. Cut marking of both Osteotomy arms.

Take off periosteum, with sharp osteotome 3 or 4 mm more distally on the horizontal or main arm of the osteotomy in order to descend a little more the level of the osteotomy, this step is essential, because if your osteotomy is well placed, the ***SPIDER HTO*** [MR] plate will direct the proximal screws towards the tibial spines (hard core) automatically and you will get a good hold and stability.

For a better location of the osteotomy site, the instruments have two cutting guides (left and right sides) with two holes to position short 1.8mm Kirschner pins with threaded tip, so as not to interfere with the saw cut. The first 1.8 mm Kirschner Pin (anterior position) is inserted in a point of attack, located on the horizontal or main arm approximately 3 mm from the apex of the two arms of the osteotomy (*See figure 6*).

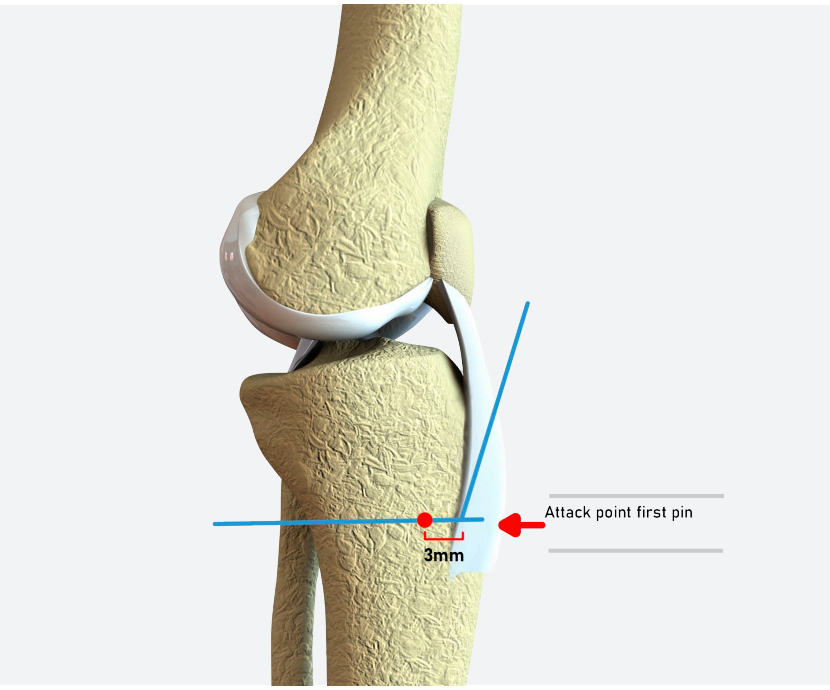


Figure 6. The point of attack or insertion of the first guide pin is shown.

The direction of this first pin under fluoroscopic control should be directed towards the tip of the fibular head (*see figure 7*), and within the recommended safety zone (*see figure 8*).

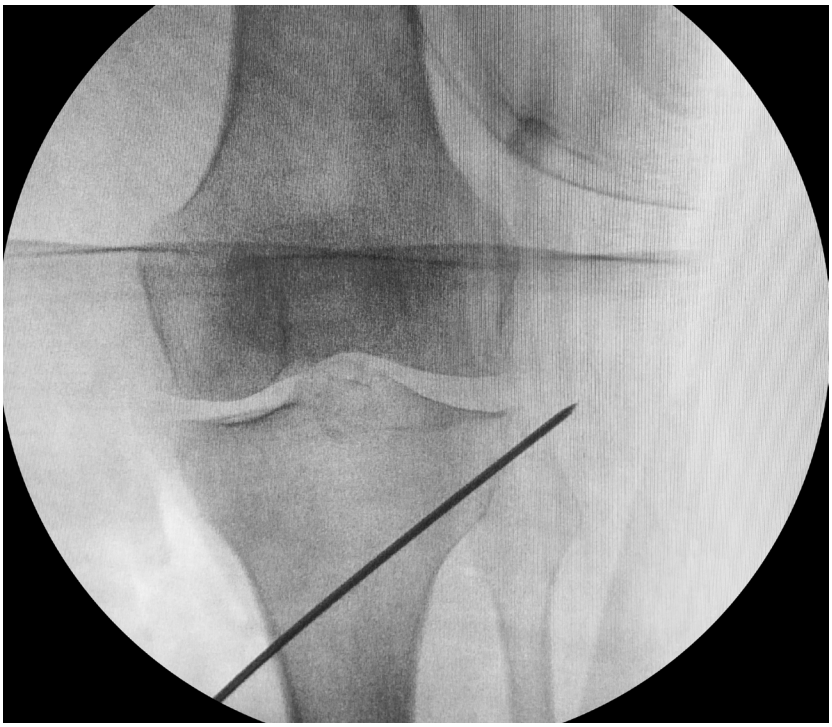


Figure 7. Guide pin routing at the safety zone level

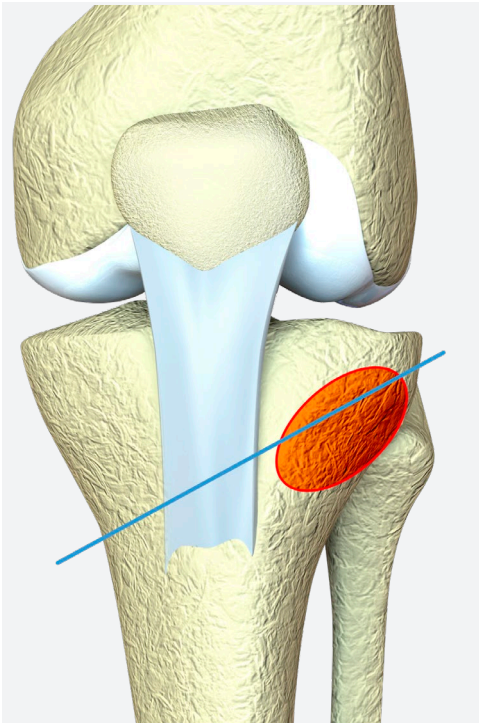
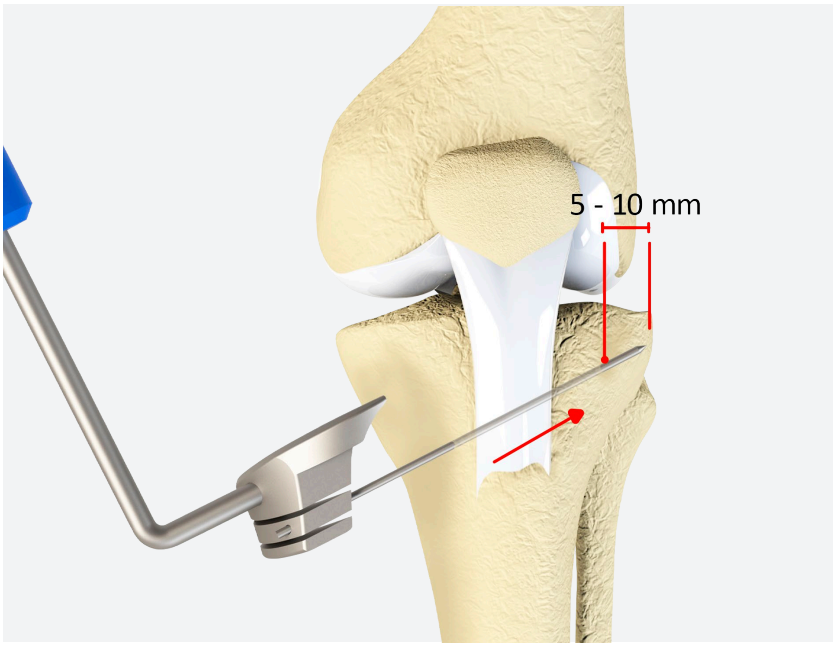


Figure 8. Upper tibial safety zone, circled in the form of an orange shaded oval.

Slide the cutting guide over this pin and fixate it as well as possible to the bone. Pass a second guide pin in the posterior part to avoid rotations of the guide, keeping the perpendicularity of the tibia axis (*see figure 9*).



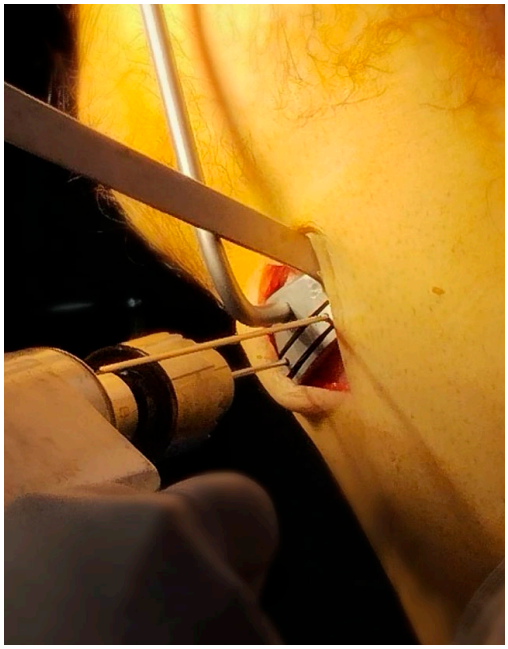


Figure 9. a) Placement of guide pins *b) Clinical photography reference*

The cutting guides have two slots for saw cutting which will be according to your choice, privilege the more distal slot, the thickness of the saw blade should not exceed 1.10mm, in order to avoid debris between the cutting slot and the saw. Perform the osteotomy through the cutting guide using a power saw at the site chosen for the horizontal or main arm penetrating up to 70% of the bone diameter and under fluoroscopic control, respecting at all times the insertion of the patellar tendon and avoiding areas at risk of neurovascular injury (*see figure 10*).

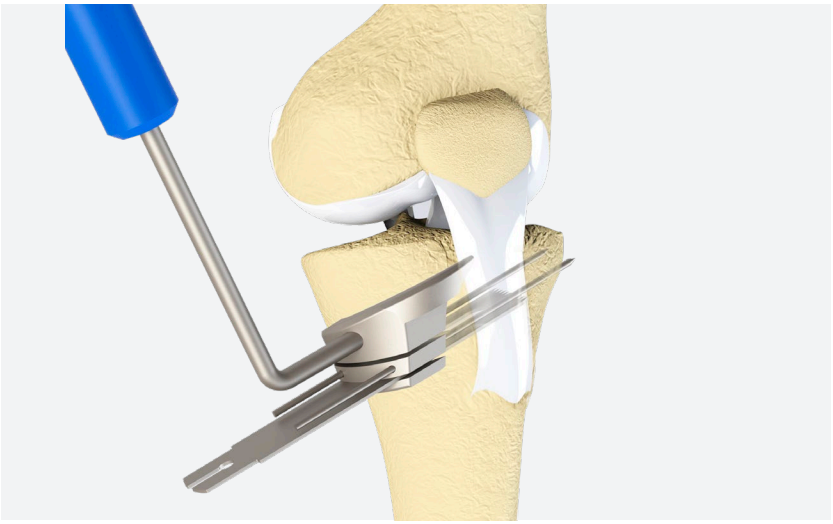


Figure 10. Cutting slots with the use of a power saw

Remove the cutting guide and with 2mm thick sharp osteotomes complete your cuts, work first the vertical arm of the osteotomy, to protect the insertion of the patellar tendon, then move to the horizontal or main osteotomy (anteroposterior in the sagittal plane) taking as reference and palpating at all times the superior pole of the fibula; leave 5 mm uncut, as a hinge on the opposite side (*see figure 11*).

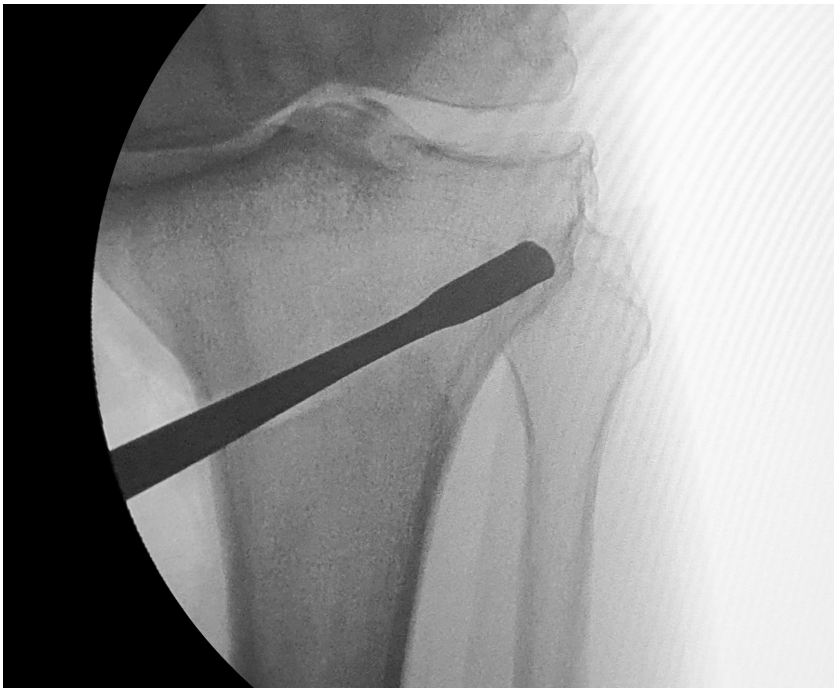


Figure 11. Reference radiographic image for correct osteotome placement at 5mm from the lateral cortex.

For posterior cortex osteotomy be especially careful to avoid neurovascular injury, advance with small cuts from medial to lateral, use your ear and pay attention to identify the change in sound when tapping until the cortex yields.

The osteotomy is considered complete when, when applying pressure from the ankle, a slight medial opening of the osteotomy is perceived. To avoid jamming of the osteotome, the system allows backward impact (*see figure 12*).

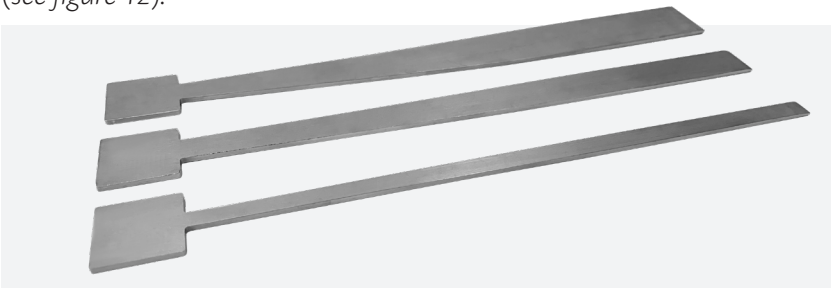


Figure 12. Set of 3 osteotomes to complete your cuts to allow backward impact if necessary.

Open of the osteotomy

Insert manually a few millimeters the bone distractor in closed form (*see figure 13*), then impact with a striker in the site marked with the letter B of the guide to the desired depth at approximately 90% of the length of the osteotomy (*see figure 14*).

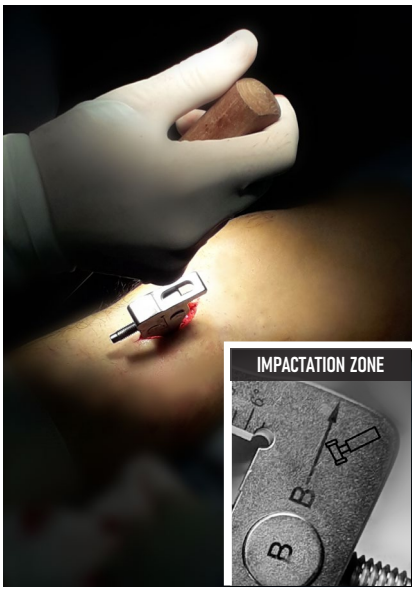


Figure 13. Insertion of the bone distractor in the osteotomy.

Figure 14. Correct placement of the bone distractor

Gradually open the bone distractor using a screwdriver to the desired size according to your individualized preoperative planning, considering the size defined by Table 1 (*see Figure 15a*).

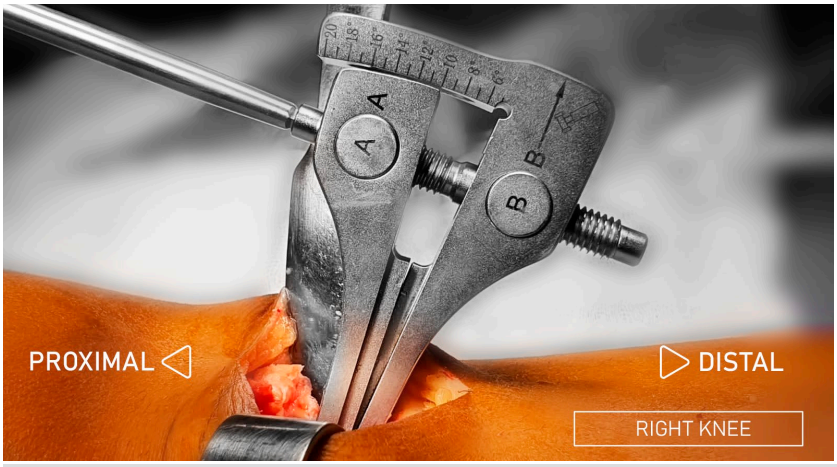


Figure 15. a) Opening of the bone distractor by means of a screwdriver in accordance with preoperative planning.

b) Radiographic image

Bone distractor replacement

To keep the osteotomy open you can place an opening FORCEPS (*see figure 16 a*) with a zipper included in the kit as posterior as possible resting on cortical bone or using the osteotomy wedge (*see figure 16 b*) to allow free access to your osteotomy.

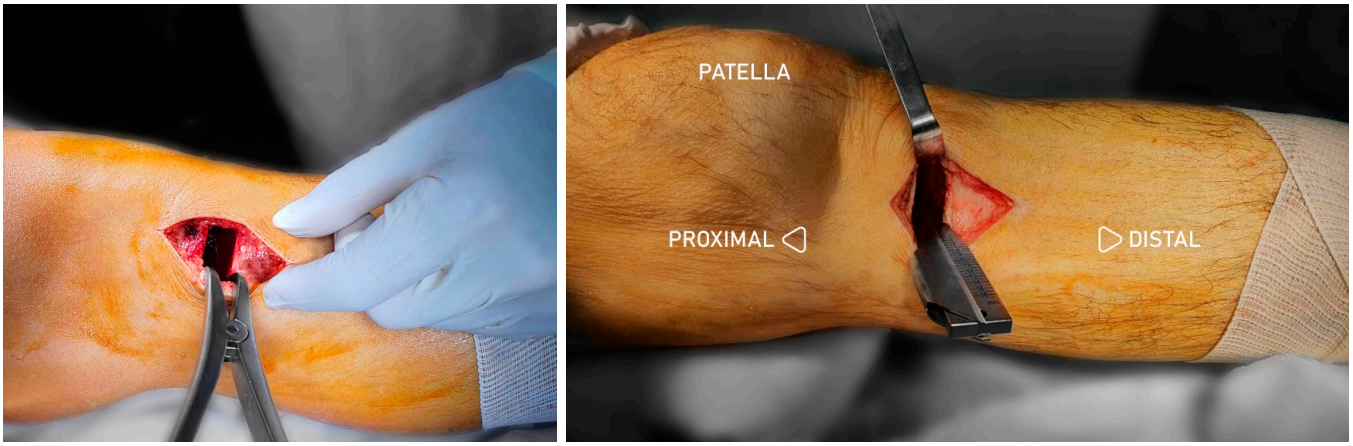


Figure 16. a) Lamellar opening forcepsb *b) Osteotomy wedge*

Bone graft placement

Apply cancellous graft to fill the cuneiform space (*see Figure 17 a*), especially dorsally, deeply and ventrally, gently compact it leaving space for the ***SPIDER HTO*** ^{MR} plate spacer block *(see Figure 17 b).*

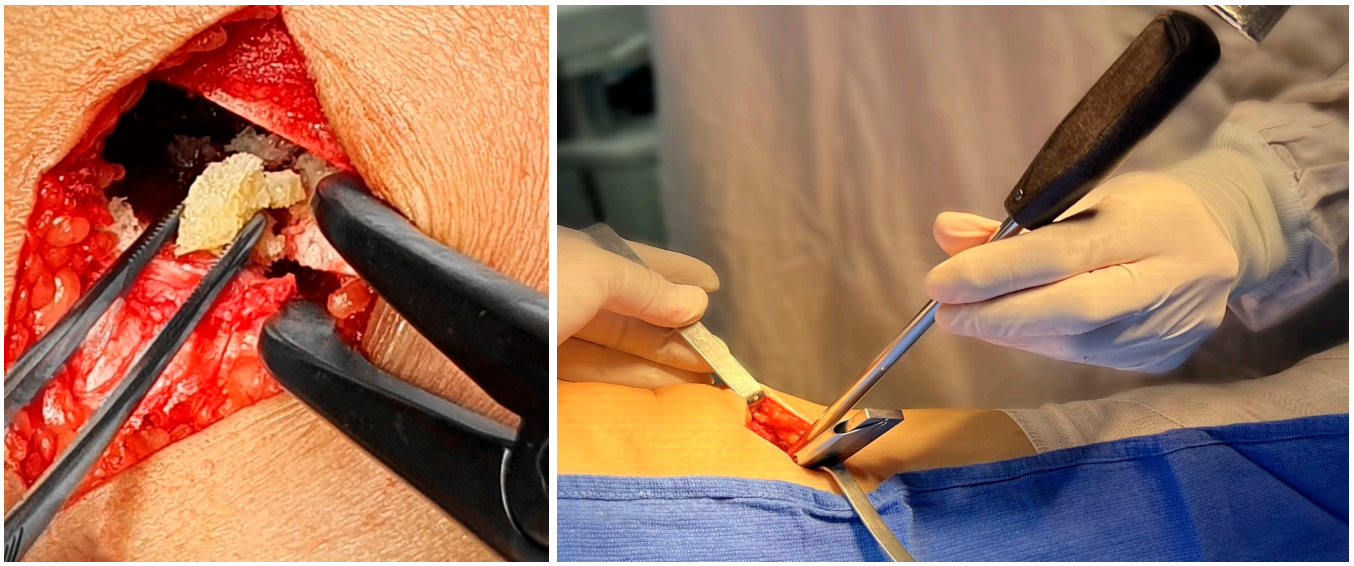


Figure 17. a) Placement of graft for space filling. *b) Impaction of the same.*

Installation of the ***SPIDER HTO*** [MR] plate

Manually place the ***SPIDER HTO*** [MR] plate of the previously planned size, position it as dorsal as possible and make sure that the block passes freely, being well positioned inside the osteotomy and that the implant body is well supported on the bone surface, in case of difficulty in seating the implant do not hesitate to open a little more your osteotomy instead of forcing its insertion (see figure 18).

Figure 18. Manual placement of ***SPIDER HTO*** [MR] *plate*

To avoid increasing the inclination of the tibial articular surface in the sagittal plane (thus avoiding low patella), the sterile textile bundle should be repositioned under the ankle (*see figure 19*), with the objective of obtaining full extension of the knee or even in recurvatum, as a bridge, also the spacer block of the ***SPIDER HTO*** [MR] plate is designed in a trapezoidal shape with its posterior end wider than the anterior end (identified in the implant with the letter A) (*see figures 20 and 21*).

Figure 19. Placement of sterile textile bundle

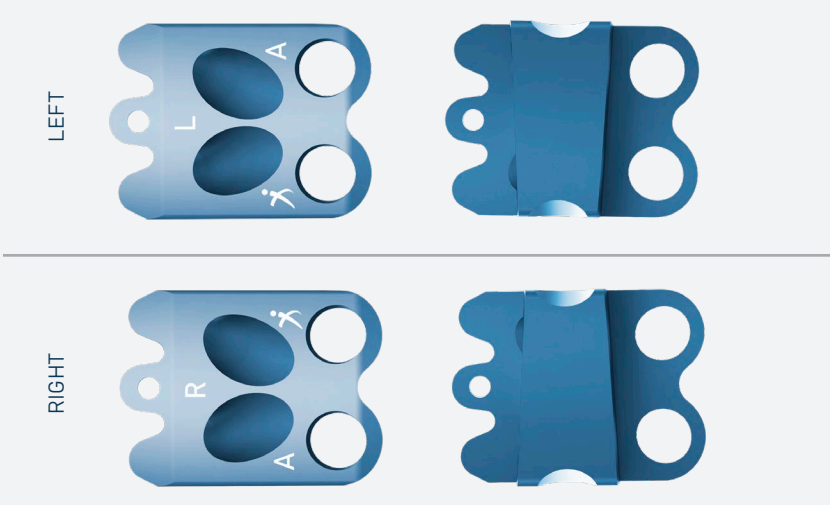


Figure 20. ***SPIDER HTO*** ^{MR} *Plate*

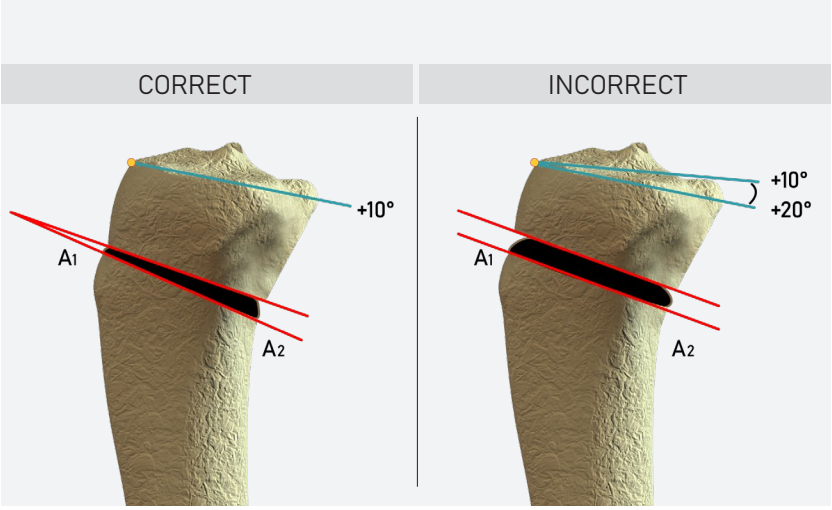


Figure 21. Correct opening of the osteotomy in the sagittal plane

Because of this asymmetry a double stock of implants is available, one for the right side and one for the left side, make sure you have the correct one by checking the marks printed on the laser.

Placement of ***SPIDER HTO*** [MR] plate screws and bolts

To avoid an asymmetric fit of the ***SPIDER HTO*** [MR] plate the order of placement of cortical and cancellous screws should be followed as shown in *Figure 22*.

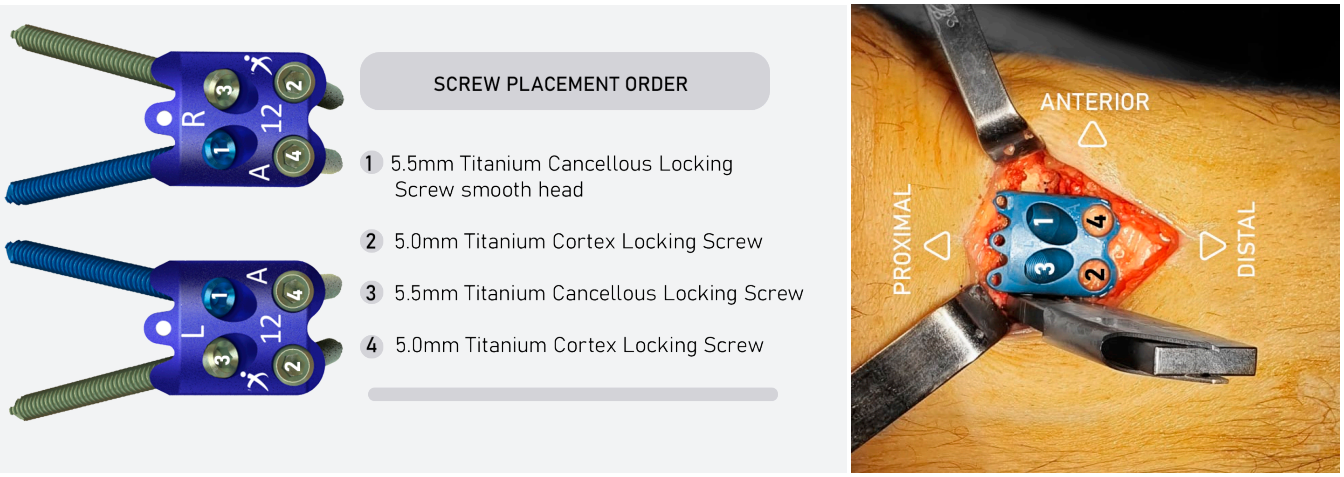


Figure 22. a) Diagram of the order in which screws and bolts are placed. for right (R) and left (L) plate

b) Numerical sequence of screw placement and bolts, clinical image

Place the guide sleeve for the first drilling, positioning it in the ventral proximal hole (No. 1), being flared as this hole has no string, use a 3.2mm drill bit avoiding penetrating the joint. The functionality of this smooth hole (without string) in conjunction with the smooth head screw is to allow a good attachment of the plate, thus providing a controlled flexibility to the system.

During the placement of the cancellous type fixation screw, be careful to avoid sweeping the bone fixation cord, it is recommended to use 40 or 45 mm long screws, depending on the size of the patient, you can support yourself by using the fluoroscope or X-rays that allow you to check that it has not come out intra-articularly (*see figure 23*).

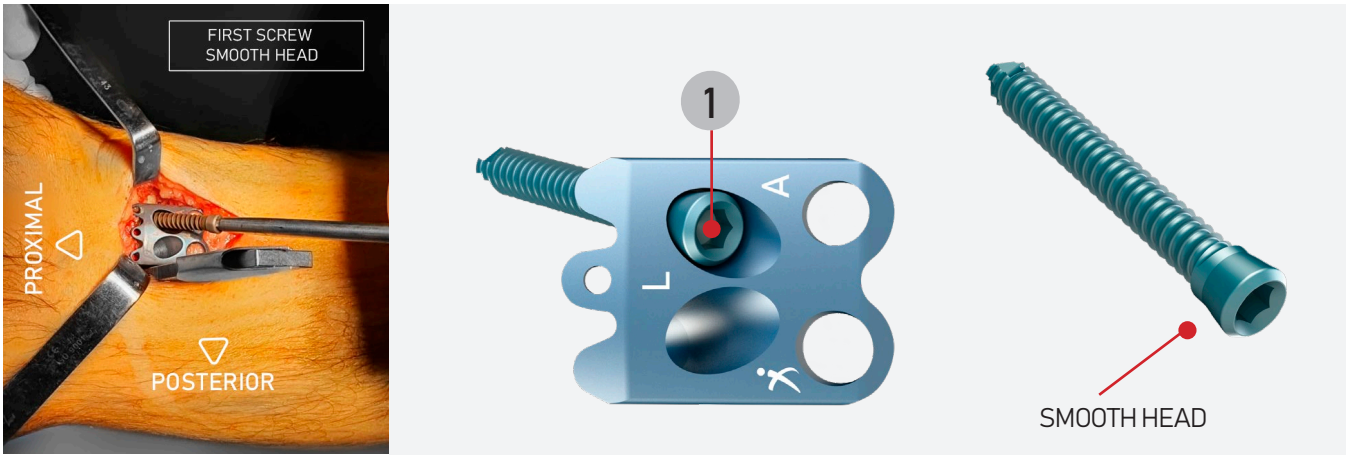


Figure 23. Placement of the first 5.5 mm nonlocking cancellous bone screw with smooth head.

Once the first screw has been placed, the opening forceps or the osteotomy wedge can be removed.

Place the threaded drill guide sleeve in the distal posterior hole (No. 2) and drill with a 3.2 mm drill bit, then proceed to take the reading for the screw measurement, then use the tap (*see figure 24*) to tap only the first cortex to facilitate the placement of the second 5.0mm screw manually locking to the plate (*see figure 25*).

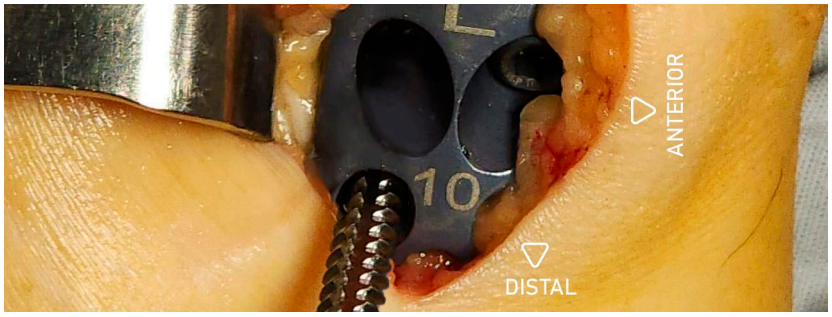


Figure 24. First cortical terracing

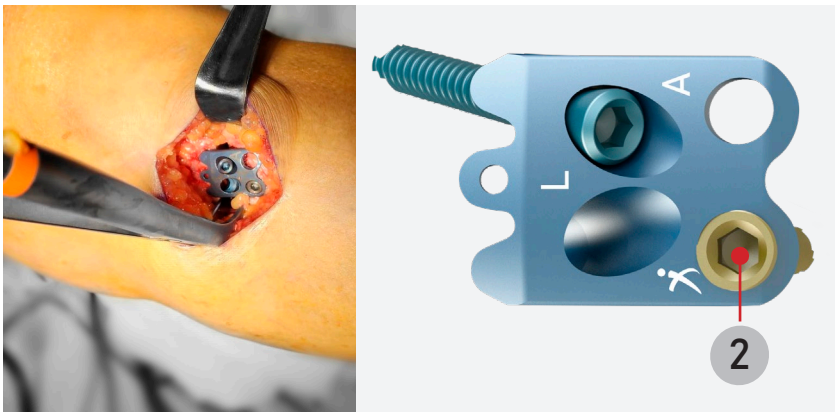


Figure 25. Drilling and placement of the second screw (5.0 mm cortex screw).

Place the threaded drill guide sleeve in proximal and posterior hole (No.3), use 3.2 mm drill bit and directly place a 5.5 mm cancellous type locking screw, locking the plate (usually 40 or 45 mm length is required) (*see figure 26*).

Figure 26. Drilling and placement of the third screw (5.5 mm cancellous bone screw).

Place the fourth 5.0mm cortical screw, distal-anterior (*see figure 27*). Drill with a 3.2mm drill bit, then proceed to take a reading for the screw measurement, then make use of the tap (*see figure 24*) to thread only in the first cortex to facilitate the placement of the fourth screw, we advise to follow the order noted in *figure 22* to avoid an uneven attachment of the system. Fully tighten the first screw placed (No.1).

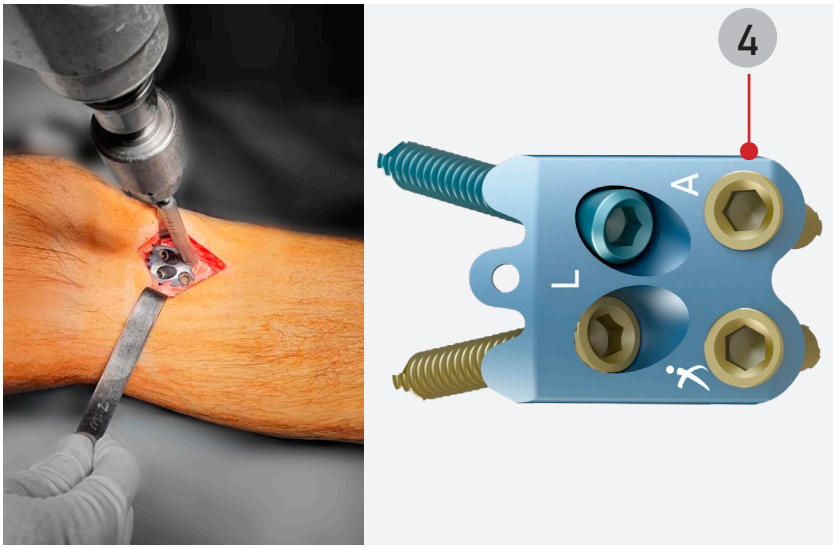


Figure 27. Placement of the fourth screw.

Check the stability of the system, flexing and extending the knee; pay special attention to a possible penetration of any screw inside the joint. If a fluoroscope is available, check the length of the screws in the two main projections, in the AP it is suggested to direct the X-rays with a cephalocaudal inclination of 5-10 degrees (*see figure 28*).

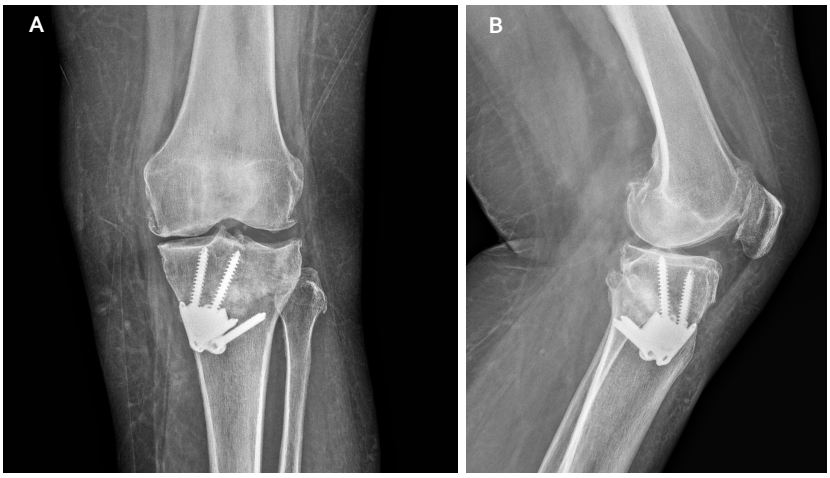


Figure 28. Fluoroscopic or radiographic projections.
a) AP projection b) Lateral projection

Apply additional bone graft in the missing empty spaces after fixation (*see figure 29*).

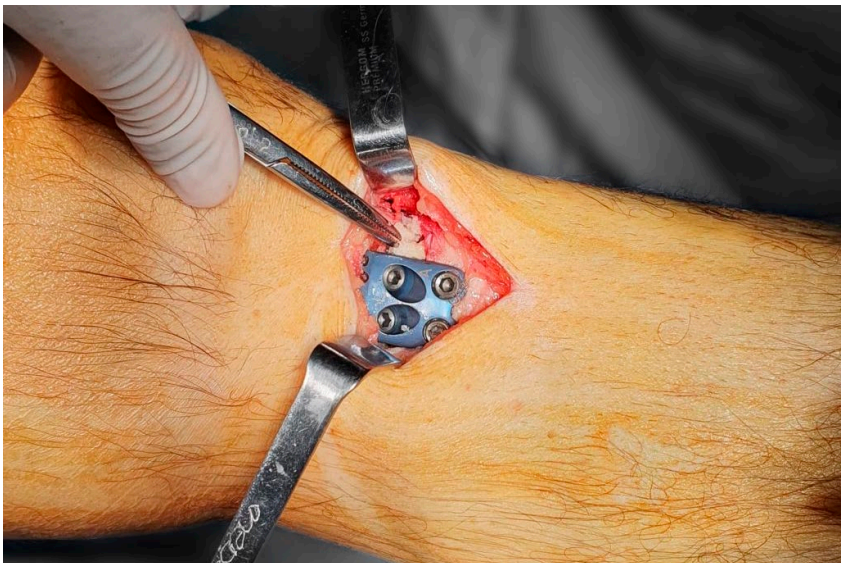


Figure 29. Bone graft application.

Intravenous or oral tranexamic acid is suggested to limit bleeding from the osteotomy bone surfaces.

Wash and close the wound in two planes (*see figure 30*).

Figure 30. Surgical wound closure

Place a sterile compress over the surgical wound and an elastic bandage from the base of the fingers to the middle third of the thigh.

Release the ischemia from the pneumatic handle and verify capillary filling.

Postoperative care

a. In the immediate post-surgical period it is suggested the use of analgesics and anti-inflammatory, prophylaxis for infection and thrombosis; gastric mucosa protector; hospital discharge can be generated at 24 hrs with indication to perform active mobility to tolerance of all joints of the operated limb, especially insist on completing the extension of the operated knee from the first postoperative day, from week 4 is recommended partial and progressive support of the operated limb with the use of crutches and full support until obtaining radiographic consolidation GIII of Montoya.

b. It is recommended to start physical therapy and rehabilitation from the first 3 days postoperatively for edema management and unsupported exercise of the operated limb, as well as activation of the rest of the limbs and respiratory therapy in order to avoid vascular, metabolic and respiratory complications.

c. The patient's integration to his activities will depend on his general-conditions and the specific type of tasks in which he performs, usually around the twelfth week.

SPIDER HTO ^{MR} PLATE INSTRUMENTATION

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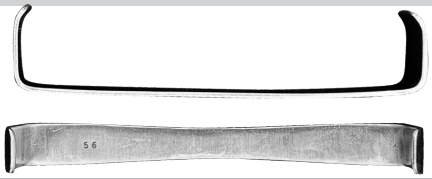
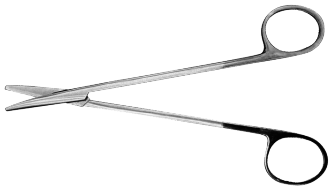
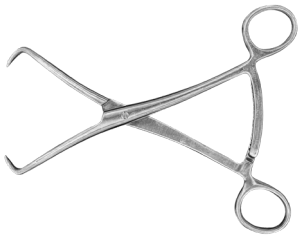
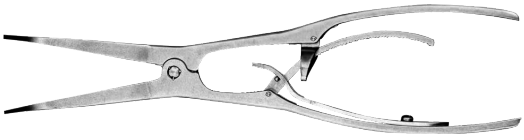
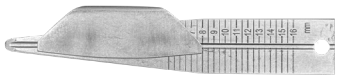
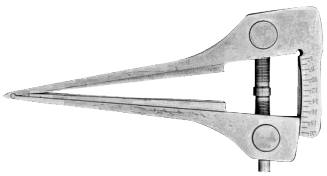
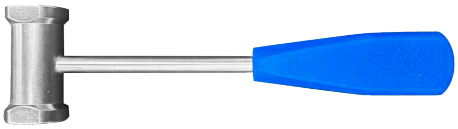
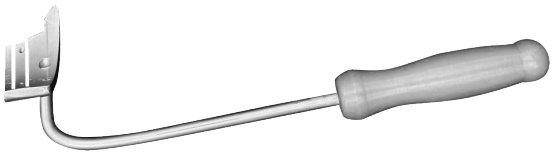
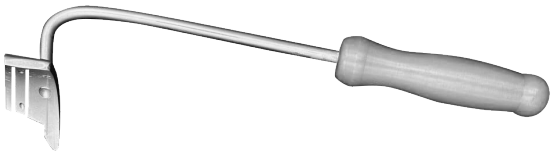
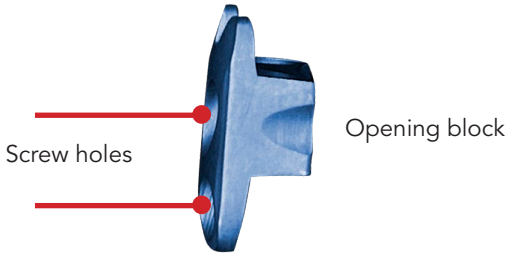
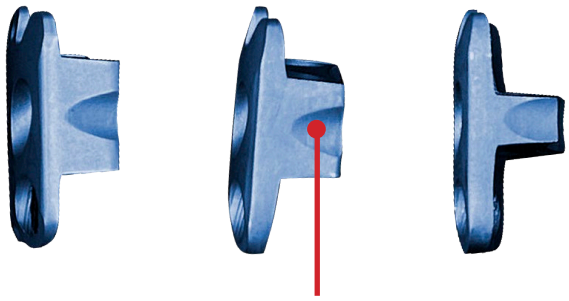
100204	Farabeuf Separator (PAIR) 200X40X20mm	1	
500079	Dissecting Forceps 180 mm	1	
05-231-20-B	Metzenbaum scissors	1	
100005	205 mm reduction clamps	1	
16.01.90	Depth gauge 0-90 mm	1	
13.02.35	Drill bit with quick coupling Φ 3.2 mm	1	
11.05.35	Screwdriver with hexagonal tip for screws 4.5/6.5 with 3.5 mm screw holder	1	
11.04.35	Hexagon screwdriver tip with AO anchor 3.5 mm	1	
12.01.40	Handle with torque wrench anchor AO 4.0 NM	1	
001.004- A	Opening forceps, opens from 6 to 16 mm and approximately 30 mm in length. +/- 10 mm	1	

CODE	DESCRIPTION	QTY.	
217001	Aperture Gauge 130 mm	1	
217011	Aperture Gauge 120 mm	1	
25.03.45	Tap tip 4.5 mm	1	
26.027	Bone Impactor Φ 8.0 mm	1	
32.03.30	Solid hammer 300 gr	1	
437R	Cutting guide for right osteotomy	1	
437L	Cutting guide for left osteotomy	1	
438.08	Osteotome Φ 08 mm * 250 mm	1	
438.16	Osteotome Φ 16 mm * 250 mm	1	
438.25	Osteotome Φ 25 mm * 250 mm	1	
128.32	Guide for 3.2 mm drill bit	1	

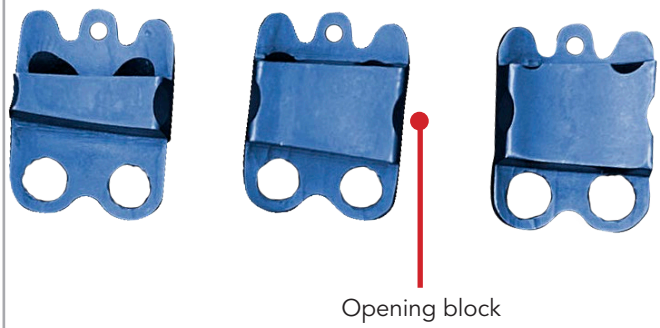
SPIDER HTO ^{MR} profile



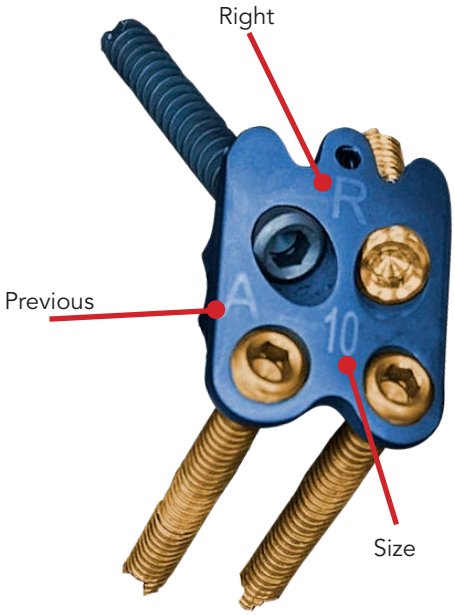
SPIDER HTO ^{MR} slots for bone graft application



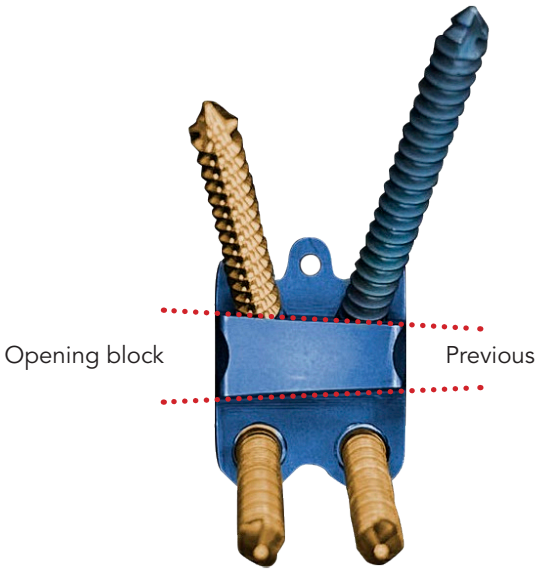
SPIDER HTO ^{MR} blocks of different thicknesses



SPIDER HTO ^{MR} lasser brands



SPIDER HTO ^{MR} Screw orientation



SPIDER HTO MR Implants

HTO Spider plate right

252.06 HTO Spider Plate 6mm
252.08 HTO Spider Plate 8mm
252.10 HTO Spider Plate 10mm
252.12 HTO Spider Plate 12mm
252.14 HTO Spider Plate 14mm
252.16 HTO Spider Plate 16mm

HTO Spider plate left

253.06 HTO Spider Plate 6mm
253.08 HTO Spider Plate 8mm
253.10 HTO Spider Plate 10mm
253.12 HTO Spider Plate 12mm
253.14 HTO Spider Plate 14mm
253.16 HTO Spider Plate 16mm

Screws

ALP Cancellous Bone Screw Titanium Plain Head 5.5 mm

263.25 5.5mm titanium cancellous locking screw smooth head 25 mm
263.30 5.5mm titanium cancellous locking screw smooth head 30 mm
263.35 5.5mm titanium cancellous locking screw smooth head 35 mm
263.40 5.5mm titanium cancellous locking screw smooth head 40 mm
263.45 5.5mm titanium cancellous locking screw smooth head 45 mm
263.50 5.5mm titanium cancellous locking screw smooth head 50 mm

ALP Titanium Cancellous Bone Screw 5.5 mm

109.40 5.5mm titanium cancellous locking screw 40 mm
109.45 5.5mm titanium cancellous locking screw 45 mm
109.50 5.5mm titanium cancellous locking screw 50 mm
109.55 5.5mm titanium cancellous locking screw 55 mm
109.60 5.5mm titanium cancellous locking screw 60 mm
109.65 5.5mm titanium cancellous locking screw 65 mm
109.70 5.5mm titanium cancellous locking screw 70 mm
109.75 5.5mm titanium cancellous locking screw 75 mm
109.80 5.5mm titanium cancellous locking screw 80 mm
109.85 5.5mm titanium cancellous locking screw 85 mm
109.90 5.5mm titanium cancellous locking screw 90 mm

ALP Cortex Screw Titanium 5.0 mm

108.20 5.0mm titanium cortex locking screw 20 mm
108.22 5.0mm titanium cortex locking screw 22 mm
108.24 5.0mm titanium cortex locking screw 24 mm
108.26 5.0mm titanium cortex locking screw 26 mm
108.28 5.0mm titanium cortex locking screw 28 mm
108.30 5.0mm titanium cortex locking screw 30 mm
108.32 5.0mm titanium cortex locking screw 32 mm
108.34 5.0mm titanium cortex locking screw 34 mm
108.36 5.0mm titanium cortex locking screw 36 mm
108.38 5.0mm titanium cortex locking screw 38 mm
108.40 5.0mm titanium cortex locking screw 40 mm
108.42 5.0mm titanium cortex locking screw 42 mm
108.44 5.0mm titanium cortex locking screw 44 mm
108.46 5.0mm titanium cortex locking screw 46 mm
108.48 5.0mm titanium cortex locking screw 48 mm
108.50 5.0mm titanium cortex locking screw 50 mm
108.55 5.0mm titanium cortex locking screw 55 mm
108.60 5.0mm titanium cortex locking screw 60 mm
108.65 5.0mm titanium cortex locking screw 65 mm
108.70 5.0mm titanium cortex locking screw 70 mm

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