SURGICAL TECHNIQUE
RETROGRADE TIBIOTALOCALCANEAL ARTHRODESIS NAIL

MEDIN®

## Medical device description

The implant system of the retrograde tibiotalocalcaneal nail consists of the nail and locking screws.

The nails are available in three lengths of 180; 220 a 250 mm and four diameters – 8; 10; 12 a 14 mm. A distal 50 mm part of the nail size of 8 and 10 mm reinforced to 12 mm. The nail is of the same diameter along the entire length for the size of 12 a 14 mm. All nails are anatomically shaped - 8° ventrally and 10° laterally double bending. The nails are cannulated except of the 8mm diameter nail which is full. The nails are provided with two types of screw holes. The most distal hole of the nail has a diameter of 6.5 mm and is intended solely for the locking screw of a diameter of 6.5 mm. The other holes are of 5 mm diameter and are intended for the locking screws of 5 mm diameter. Use the locking screws of 3.5 mm diameter only for the nail of 8 mm diameter in its proximal part. A standard circle hole is in the proximal part of the nail and also an oval hole for a dynamization possibility. The nail has its version for the right or left extremities. The end of the nail is closed with the end cap.

The list of all implants can be found at the end of this surgical technique.

## The medical device indication

Arthrodesis using the retrograde tibiotalocalcaneal nails is indicated at:

- the treatment of the severe foot/ankle deformities
- the arthrosis of the ankle
- the instability and bone defects after resection of tumours in the ankle area
- the talus necrosis
- the failure of the ankle joint replacement
- the failed fusion of the distal tibia fracture

## 1. The patient's position

Patient lies on his/her back with the supported lower extremity (Fig. 1).

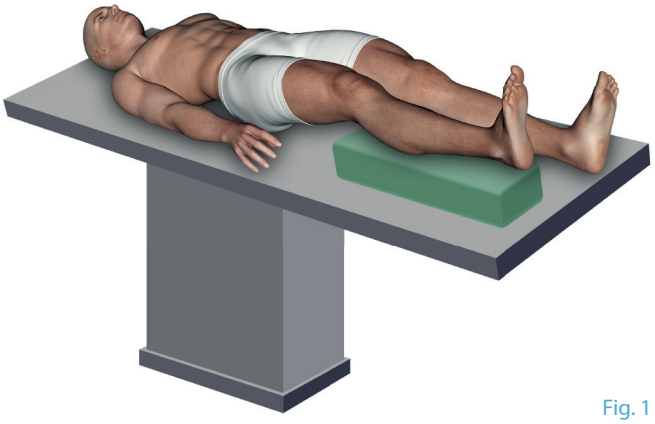


Fig. 1

## 2. Incision

The surgical approach is chosen according to the deviation of the ankle and leg. The transfibular approach is the most commonly used method (Fig. 2). It is appropriate to use the original anterior approach in cases where the arthrodesis is performed after a failed ankle replacement.

Use the medial approach for the large deviations, when it is necessary to perform resection of the medial malleolus as well.

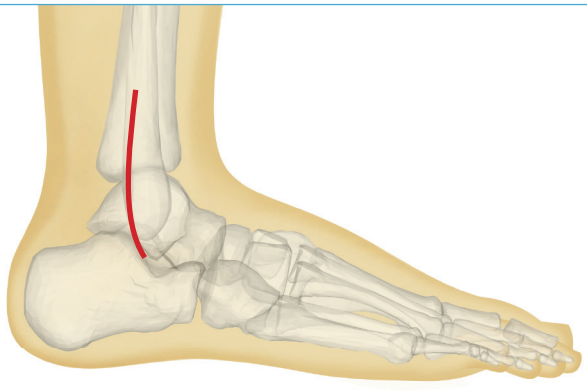


Fig. 2

## 3. Preparation of the joint surfaces

Perform an osteotomy of fibula and resection of the joint surfaces of tibia, talus, and calcaneus using a saw (Fig. 3).

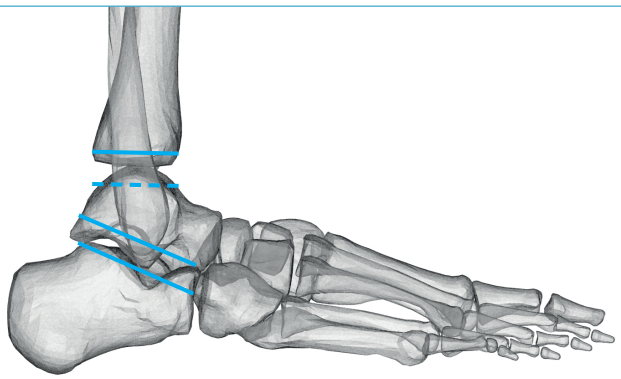


Fig. 3

## 4. Entry Point

The nail is inserted through the calcaneus. Perform an incision about 2 cm from the top of the calcaneus and slightly laterally from the leg axis (Fig. 5) to avoid damage of the structures in the sole of the foot (especially a. plantaris lateralis and n. plantaris lateralis) (Fig. 4).

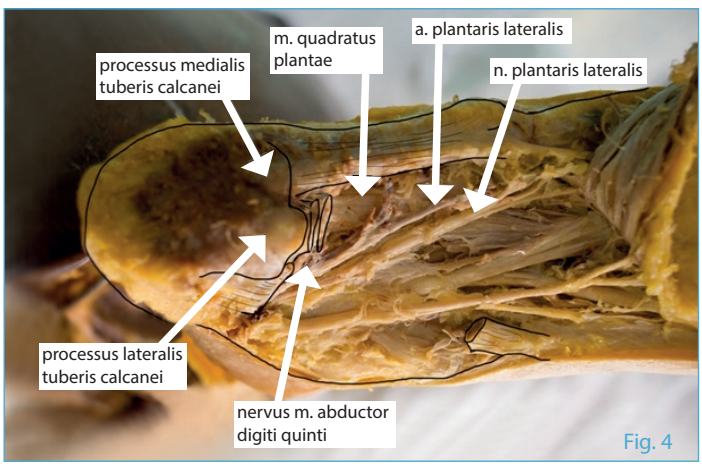



Fig. 4

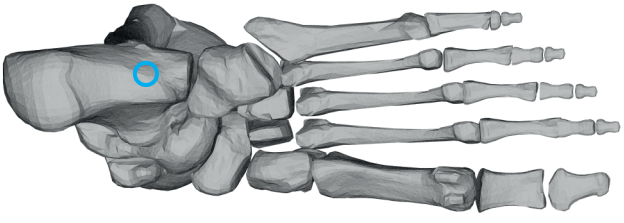


Fig. 5

## 5. Cavity pre-drilling

It is very important to monitor the leg position when pre-drilling to ensure its correct position. It is recommended to use a protective sleeve to avoid damage of the soft tissues when cutting the hole. Perform pre-drilling starting with the smallest diameter of the flexible reamer, i.e. from the diameter of 8 mm, gradually increasing by 0.5 mm. Slide the flexible reamer gradually without a big force in and out using small movements. Pre-drill the cavity for the nail 0.5 to 1 mm larger than the nail to be used (8, 10, 12 or 14 mm nail diameter). For more information on using and treatment of flexible reamers, see flexible reamers at the end of this surgical technique manual.

A cutter can be used as an alternative to creating an entry point. Introduce a 3 mm diameter guide wire with an olive into the specified point. Use the protective sleeves to protect soft tissues. Introduce the wire up to the olive in the bone. Check the introduction of the guide wire in two projections using an X-ray device. Remove the sleeve for wire and leave only the outer sleeve for the cutter. Apply the cutter to the guide wire and pre-drill a hole for the distal end of the nail (Figure 6). Meanwhile push up the protective guide sleeve to the bone, thus ensuring the soft tissue protection, and at the same time you can monitor the depth of drilling that can be read from the scale directly on the reamer. The correct drilling direction is very important for the correct introduction of the nail. Then remove the cutter and guide wire. Bone material that remains after cutting inside the cutter can be removed by forcing out with the olive or it is possible to use side grooves on the cutter to remove it.

A perforator can also be used to form the entry point for the nail, which is introduced along the wire of the 3 mm diameter.

The selection of the nail has been done during pre-surgery preparation or can be done right now. It is advisable to use a scale that helps to correctly determine the diameter and length of the nail to be used. The diameter of the nail has already been chosen according to the size of the cavity when pre-drilling the bone. The length of the nail can also be determined by measuring the protruding end of the guide for pre-drilling.

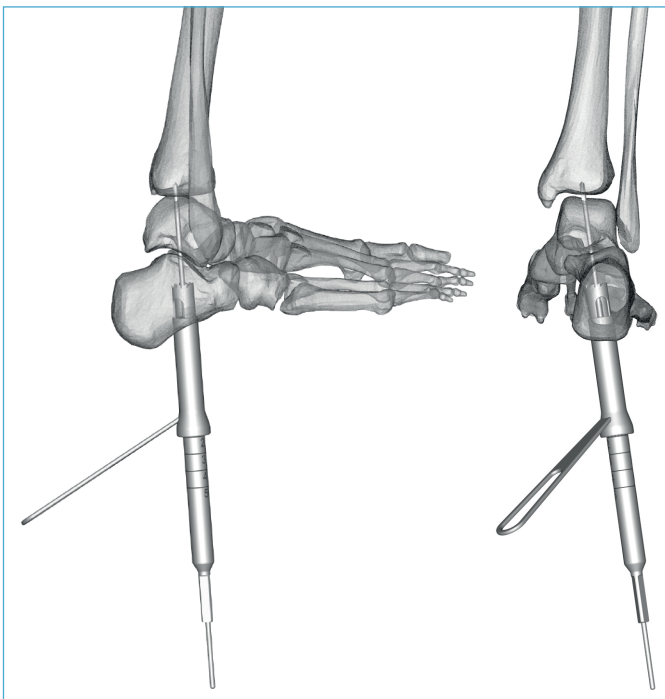


Fig. 6

## 6. How to assemble the aiming device and fasten the nail

### Assemble the aiming device

When assembling, proceed starting from the clamping pin. Parts belonging to each other are marked with the same number of dots.
An arm with one dot belongs onto the groove of the clamping pin with one dot (Fig. 7). A crossbeam with one dot belongs onto the arm with one dot (Fig. 8).

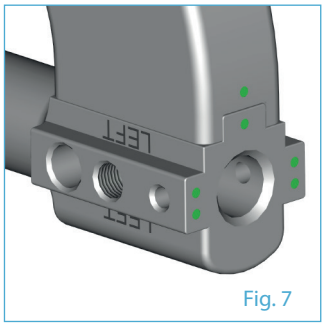



Fig. 7

Fig. 8

Attach the arms to the clamping pin. The lower part of the aiming device (i.e. the clamping pin and the arms) is marked with a green colour (1 or 2 dots) and the clamping pin is provided with a description of how to assemble the aiming device for the right or left legs (Fig. 9).

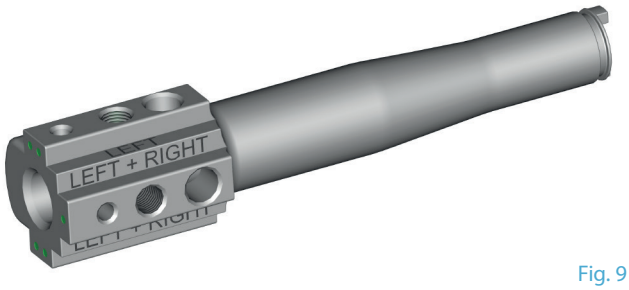



Fig. 9

The posterior arm marked by one dot is universal (i.e. common for the right and left sides). The lateral arm marked by two dots is intended for use on the lateral side (Fig. 10).

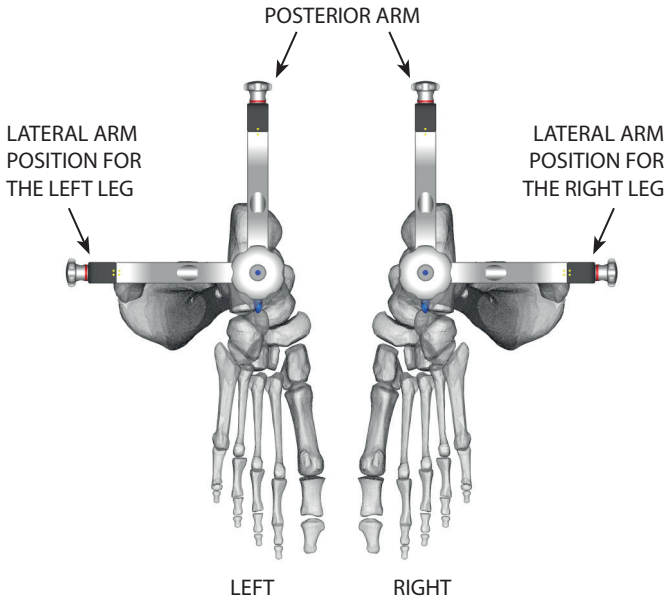


Fig. 10

Attach the arms to the clamping pin using the screws. Tighten the screws adequately with a 5 mm screwdriver with a hexagon end piece. Place crossbeams on the upper part of the arms. The upper part (i.e. arms and crossbeams) is marked with a yellow colour (1 or 2 dots). Attach the crossbeams using special screws (Fig. 11). The crossbeams must be freely attachable when attaching, do not use levering. The crossbeam with the arm must be well seated together before screwing. The wrench rod can be used for tightening.

Fig. 11

## Attach the nail to the assembled aiming device

Hřeb nasaďte na upínací čep do drážek (obr. 12). Drážky na konci hřebu zajišťují správnou orientaci hřebu (hřeb nelze nasadit obráceně). Hřeb musí jít volně nasadit na drážky, aby se konec hřebu opíral o čelo upínacího čepu. Následně hřeb zajistěte přiměřeným dotažením upínacího šroubu (obr. 13). K utažení upínacího šroubu lze použít utahovací tyčinku vloženou do otvoru pod hlavou šroubu.

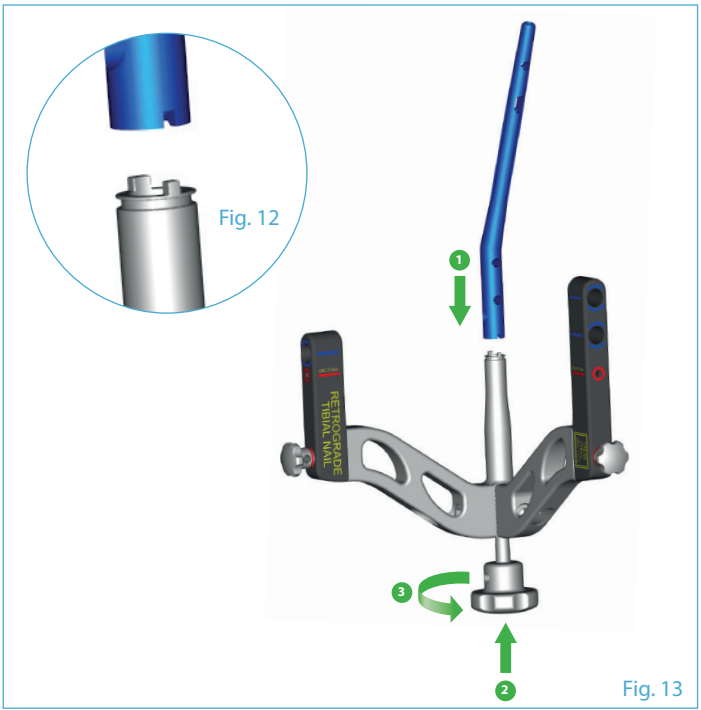


Fig. 13

## 7. The check of the function of the aiming device

It is necessary to check the correct function of the aiming device before the nail introduction. Use the sleeves and drills to verify the correct function of the aiming device (Fig. 14). All holes on the aiming device must correspond to the holes in the nail. You will prevent possible complications that may occur during the surgery by performing this check.

The aiming device cannot be used if the holes in the aiming device do not correspond with the holes in the nail. Check all parts of the aiming device (nail attachment to the aiming device, possible damage of the plastic arms, tightening of the clamping screw of the nail...) and verify the correct assembly of the aiming device in terms of the nail selection (left x right).

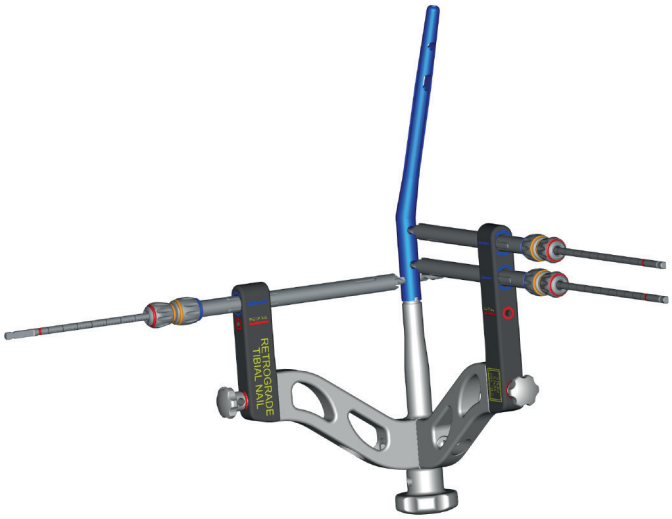



Fig. 14

The holes in the aiming device to be used can be provided with a plug to facilitate orientation during the surgery (Fig. 15). Just remove the plug and replace it with the outer sleeve during the surgery.

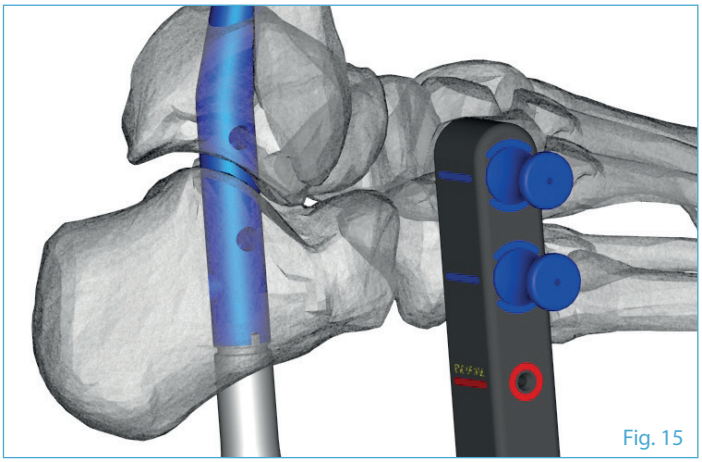


Fig. 15

## 8. Nail introduction

Avoid any blows of the mallet to the plastic parts of the aiming device or any other violent handling with them when introducing the nail (levering, bending...). There is a risk of the irreversible damage or destruction of the aiming device.

Introduce the nail with the aiming device into the bone cavity, at first using only hand (Fig. 16). If necessary, it is possible to add a mallet to the aiming device and introduce the nail into the correct position this way (Fig. 17). To add the mallet to the aiming device, proceed as follows: Screw the mallet rod onto the end of the clamping screw for the nail, then slide the mallet itself onto the rod and screw the handle onto the end of the mallet rod. The nail can be introduced deeper by adequate mallet blows or vice versa to be pulled back if the nail is too deep. Any other procedure or manipulation with the mallet is forbidden. If the mallet set is mounted onto the aiming device, it must be held all the time in order to avoid damage to the aiming device or loss of the correct position of the lower extremity.

It is advisable to perform a check of the introduction using X-ray device. The correct introduction depth must be checked primarily from the lateral projection. The final location of the nail must be checked from the AP and from the lateral projection.

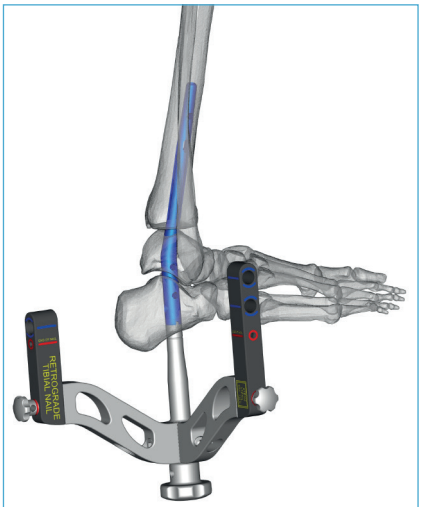


Fig. 16

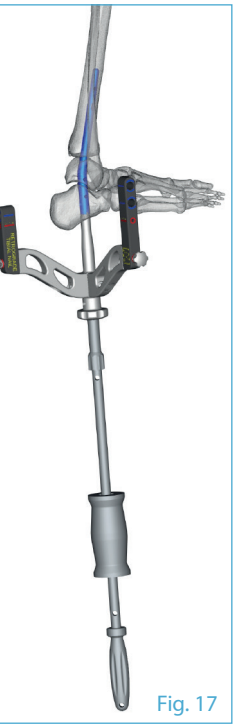


Fig. 17

## 9. Distal locking

The distal locking can be performed in the frontal or sagittal plane through the calcaneus. Three holes are provided to lock the nail in the distal part. The first (most distal) hole is intended for a 6.5 mm locking screw, the remaining holes are intended for 5 mm locking screws.

Table of the recommended drill bit dimensions for the individual screws.

| | **Locking screw Ø 3,5 mm** *(grey colour)* | **Locking screw Ø 5 mm** *(grey colour)* | **Locking screw Ø 6,5 mm** *(grey colour)* |
|---|---|---|---|
| Healthy bone | **Drill Ø 2,9 mm** *(Green colour)* | **Drill Ø 4,4 mm** *(Red colour)* | **Drill Ø 5,5 mm** *(Black colour)* |
| Porous bone | **Drill Ø 2,9 mm** *(Green colour)* | **Drill Ø 3,5 mm** *(Yellow colour)* | **Drill Ø 4,4 mm** *(Red colour)* |

Insert the outer sleeve together with the trocar (Fig. 18) into the holes of the aiming device (marked with blue strips). Make an incision at the skin contact site. Push the sleeve with trocar gradually up to the bone. This procedure minimizes the possibility of the soft tissue damage. It is possible to pre-mark a drilled hole with a trocar at the same time.

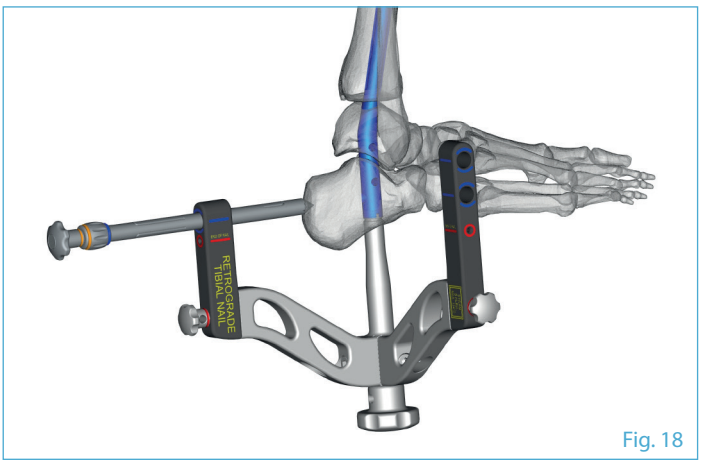


Fig. 18

Remove the trocar from the outer sleeve and replace it with the inner sleeve for the drill. Select the size of the drill and the relevant sleeve according to the screw you want to use and according to the bone condition (see table above). The sleeves are specially designed to not fall out when handling the aiming device. Then pre-drill the screw hole using a drill (drill through both cortical bones) (Fig. 19). The depth of drilling can be read directly on the drill scale. Remove the drill and inner sleeve after pre-drilling the hole.

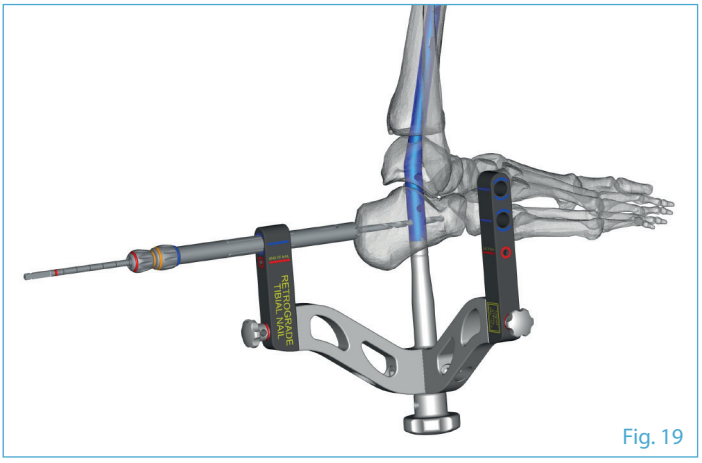


Fig. 19

You can also use the depth gauge to measure the depth of the hole. Insert the depth gauge into the remaining outer sleeve (Fig. 20). Pull the hook through the drilled hole, hook it by the second corticalis, and read the depth of the hole from the scale on the depth gauge handle. Read the value at the top of the outer sleeve. The outer sleeve must be pushed up to the bone for the proper depth measurement using a drill or depth gauge, otherwise the measured values will not be correct. Select the appropriate screw length depending on the measured value.

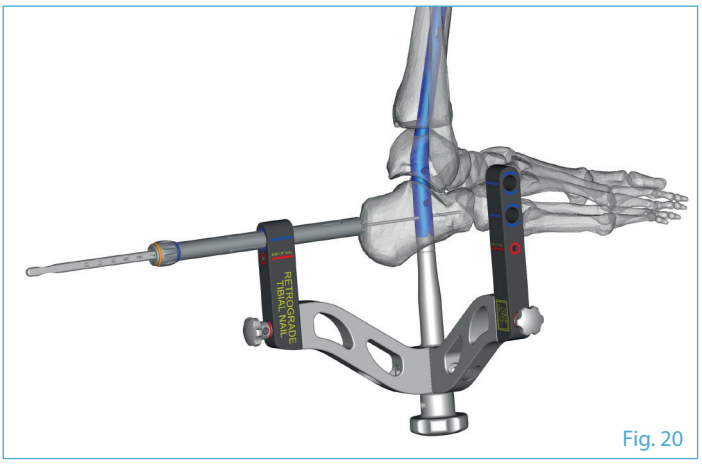


Fig. 20

Put the required screw length onto the 5 mm screwdriver with a hexagon end piece directly in the stand. The end piece of the screwdriver will hold the screw to facilitate its introduction. Insert the screw through the outer sleeve in the aiming device (Fig. 21). Scale on the screwdriver indicates the remaining distance to the bone. As soon as the upper end of the outer sleeve corresponds to line 0 on the screwdriver, the screw head is screwed up to the bone. Again, for the correct operation of the scale on a screwdriver it is necessary to push the outer sleeve up to the bone.

The screwdriver with a hexagon end piece of 5 mm provided with AO coupling can also be used to insert the screw. Use a manual screwdriver to tighten the screw only!

Introduce also the other locking screws in the distal part in the same way. The thread in the bone must not be damaged when introducing the screw.

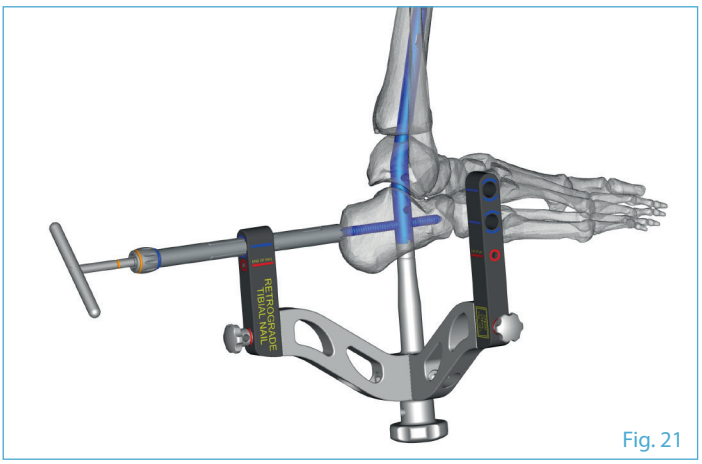


Fig. 21

## 10. Proximal locking

If necessary, lock the nail also in the proximal part (into the tibia) (Fig. 22). The proximal nail locking is recommended when primary fixation of the nail in the tibia is not strong enough (especially its rotational stability). There is a classic circular hole for static locking and an oval hole for dynamic locking in the proximal part.

Use locking screws of 3.5 mm diameter for 8 mm diameter nail in the proximal part. Use a screwdriver or a bit with 3.5mm hexagonal end piece to introduce these screws.

The proximal locking is performed freely from the hand.

Perform a control using an X-ray amplifier if all screws are in the correct positions and check if all screws are tightened when the distal and proximal nail locking are completed.

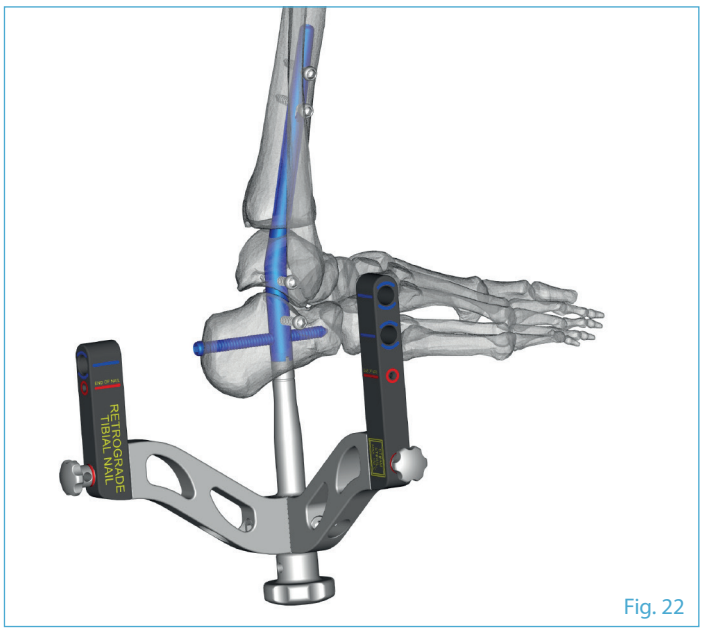


Fig. 22

## 11. Closure of the nail with the end cap

Remove the clamping screw of the aiming device. An auxiliary rod that is included in the instrumentation set can be used if the screw cannot be loosened by hand. Keep the aiming device attached to the nail for an easier introduction of the end cap (the aiming device must be held when removing the clamping screw for the nail). Attach the end cap to the T--screwdriver with the 5mm hexagonal end piece and introduce it through the hole of the aiming device into the nail (Figure 23). Tightening the end cap locks the most distal screw against the axial movement. Finally, remove the screwdriver and remove the entire aiming device.

Fix the resected part of the fibula with one screw to the tibia (this screw is not a part of the set).

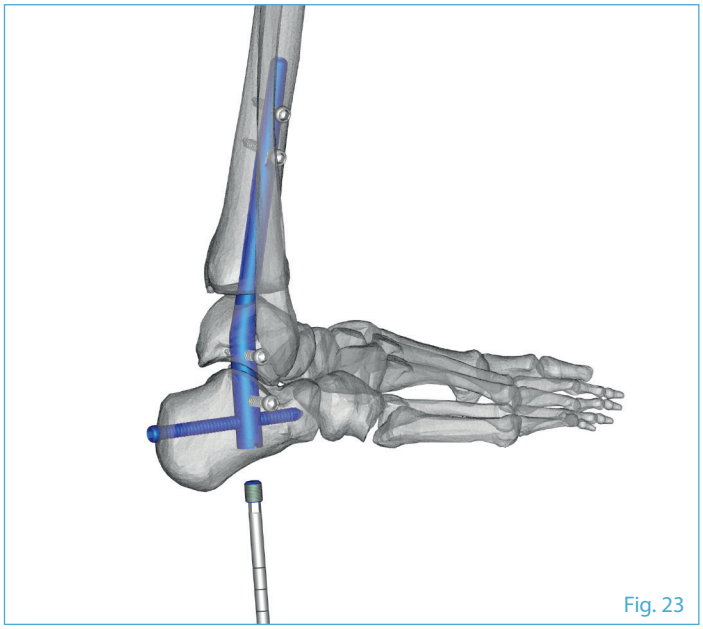


Fig. 23

## 12. Closure of the operation

Perform sutures of all wounds after irrigation. Apply the sucking drain to the place of the nail introduction; it must not suck blood directly from the cavity. Cover the wound with a soft bandage and perform an X-ray documentation (Fig. 24).

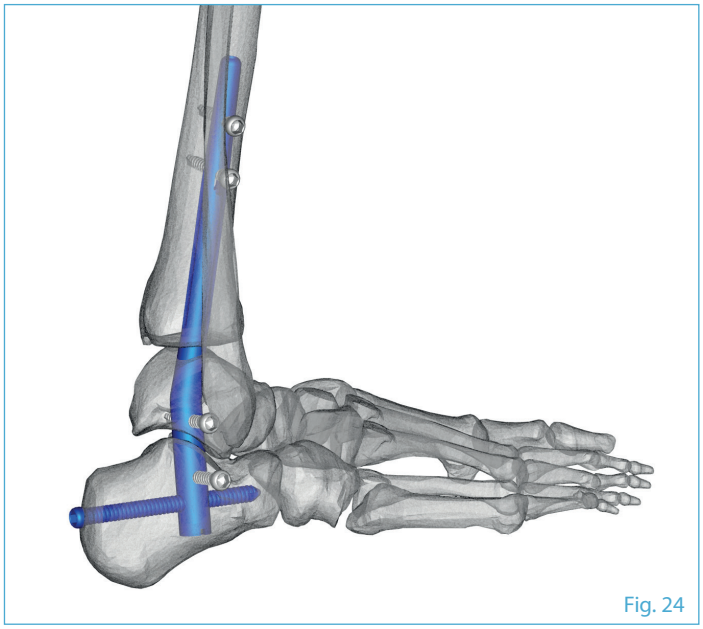


Fig. 24

## 13. Recommended procedure of implant removal

Implants are mostly retained permanently; gradually remove the screws from the distal and proximal part of the nail in the case when the extraction is necessary. It is necessary to remove the end cap before the locking screw if the end cap is firmly tightened. It is possible to attach the aiming device to the nail for easier localization and removal of the screws and remove the individual screws using the sleeves. Screw the extraction rod into the distal end of the nail as a next step. It is advisable to keep in the nail at least one screw to prevent a rotation of the nail and a possible damage to the bone. Slide the weights onto the pulling rod and screw the handle to its end. Extract the nail with blows of the weight against the handle. This part of the instrumentation has to be held constantly after the weight and handle attachment to avoid burden of the bone by a bending moment.

### Final notes

Never combine different materials in one patient.

Implants from different companies must never be combined.

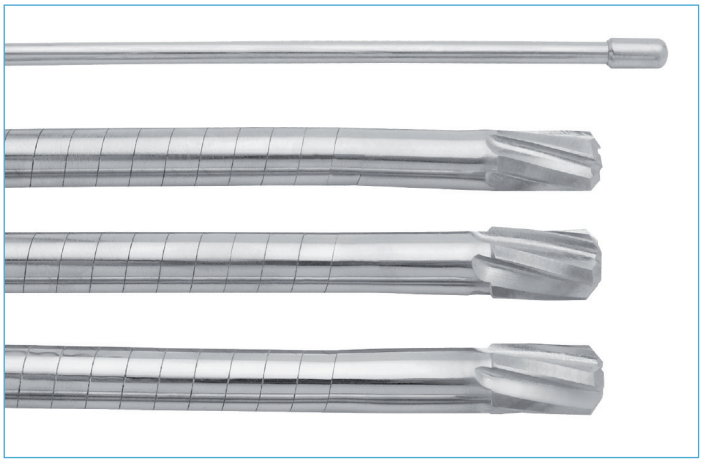
The patient must be warned that the implant does not bear the entire weight of the patient. The patient must use support when walking and burden implant progressively depending on how the callus is being created at the fracture site.

The implants are intended for single use, single patient and single damaged bone stabilization only. Repeated use is forbidden.

### Additional information

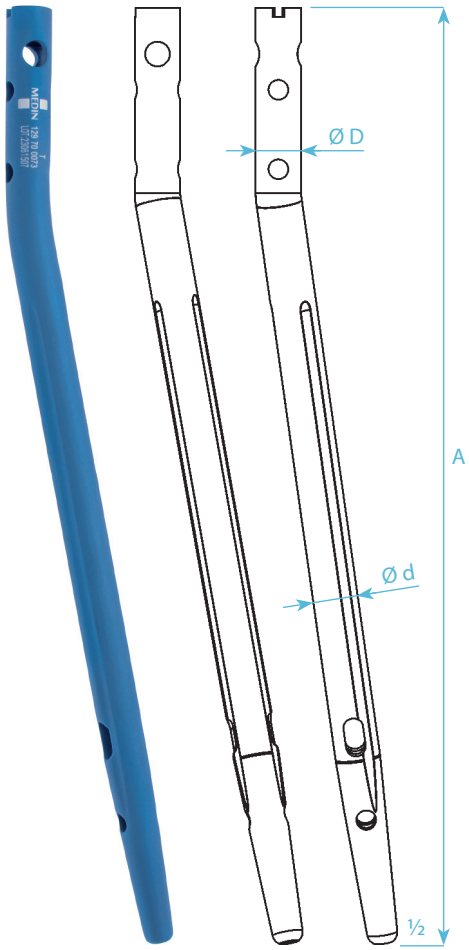
## Flexible reamers

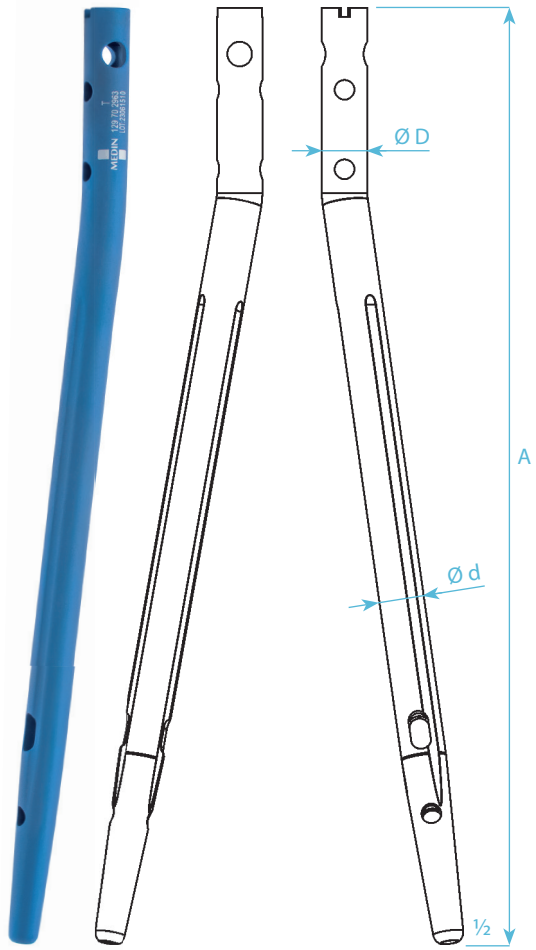
A line of flexible MEDIN reamers is available for pre-drilling of the medullary cavity. The complete line starts with an 8 mm diameter reamer and continues with increments of 0.5 mm. The quick coupler allows the connection of the reamers to the commonly used drive units. **Do not switch the backward running of the drill when used!** The flexible shaft can be „unfolded" at the slightest load of the reamer. The reamers have to be used only with the original MEDIN guides of 3 mm diameter, 950 a 1150 mm long, with the olive at the end. The use of these reamers is forbidden without guide wires. Milling must begin with a reamer of an 8 mm diameter, which is the only one specially designed for the front stroke. It is not recommended to skip some of the sizes of the reamers, i.e. it is necessary to use the reamers with the 0.5 mm increments.



## IMPLANTS FOR THE RETROGRADE TIBIOTALOCALCANEAL ARTHRODESIS NAIL

**Retrograde tibiotalocalcaneal arthrodesis nail**



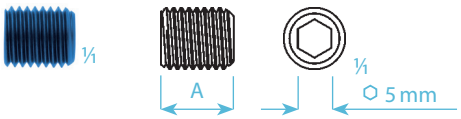




RIGHT

| Ti | A | Ø d | Ø D |
|---|---|---|---|
| **129 70 0013** | 180 mm | 8 mm | 12 mm |
| **129 70 0023** | 180 mm | 10 mm | 12 mm |
| **129 70 0033** | 220 mm | 10 mm | 12 mm |
| **129 70 0043** | 250 mm | 10 mm | 12 mm |
| **129 70 0053** | 180 mm | 12 mm | 12 mm |
| **129 70 0063** | 220 mm | 12 mm | 12 mm |
| **129 70 0073** | 250 mm | 12 mm | 12 mm |
| **129 70 0083** | 180 mm | 14 mm | 14 mm |
| **129 70 0093** | 220 mm | 14 mm | 14 mm |

LEFT

| Ti | A | Ø d | Ø D |
|---|---|---|---|
| **129 70 2903** | 180 mm | 8 mm | 12 mm |
| **129 70 2913** | 180 mm | 10 mm | 12 mm |
| **129 70 2923** | 220 mm | 10 mm | 12 mm |
| **129 70 2933** | 250 mm | 10 mm | 12 mm |
| **129 70 2943** | 180 mm | 12 mm | 12 mm |
| **129 70 2953** | 220 mm | 12 mm | 12 mm |
| **129 70 2963** | 250 mm | 12 mm | 12 mm |
| **129 70 2973** | 180 mm | 14 mm | 14 mm |
| **129 70 2983** | 220 mm | 14 mm | 14 mm |

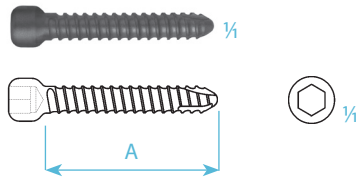



**End cap**

| Ti | A |
|---|---|
| **129 70 6753** | 10 mm |

NOTES: Ti – titanium version, material Ti6Al4V ELI according to ISO 5832-3

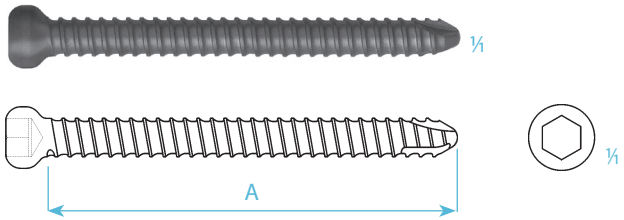
## IMPLANTS FOR THE RETROGRADE TIBIOTALOCALCANEAL ARTHRODESIS NAIL




| | |
|---|---|
| thread diameter | 3.5 mm |
| core diameter | 2.9 mm |
| head diameter | 5.6 mm |
| drill for thread | Ø 2.9 mm |
| screwdriver | ⬡ 3.5 mm |

### The strengthened locking screw 3.5 mm

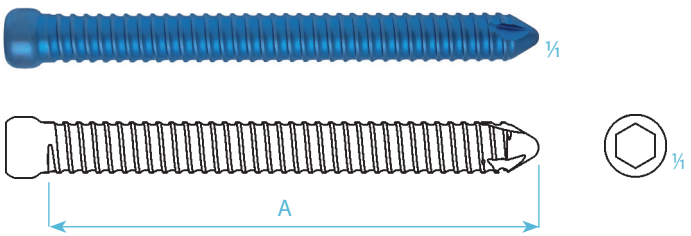
| Ti | A |
|---|---|
| **129 77 6554** | 20 mm |
| **129 77 6564** | 22 mm |
| **129 77 6574** | 24 mm |
| **129 77 6584** | 26 mm |
| **129 77 6594** | 28 mm |
| **129 77 6604** | 30 mm |
| **129 77 6614** | 32 mm |
| **129 77 6624** | 34 mm |
| **129 77 6634** | 36 mm |
| **129 77 6644** | 38 mm |
| **129 77 6654** | 40 mm |
| **129 77 6664** | 42 mm |
| **129 77 6674** | 44 mm |
| **129 77 6684** | 46 mm |
| **129 77 6694** | 48 mm |
| **129 77 6704** | 50 mm |
| **129 77 6714** | 55 mm |
| **129 77 6724** | 60 mm |
| **129 77 6734** | 65 mm |
| **129 77 6744** | 70 mm |




| | |
|---|---|
| thread diameter | 5.0 mm |
| core diameter | 4.4 mm |
| head diameter | 8.0 mm |
| drill for thread | Ø 4.4 mm |
| screwdriver | ⬡ 5 mm |

### The strengthened locking screw 5 mm

| Ti | A |
|---|---|
| **129 79 9634** | 25 mm |
| **129 79 9644** | 30 mm |
| **129 79 9654** | 35 mm |
| **129 79 9664** | 40 mm |
| **129 79 9674** | 45 mm |
| **129 79 9684** | 50 mm |
| **129 79 9694** | 55 mm |
| **129 79 9704** | 60 mm |
| **129 79 9714** | 65 mm |
| **129 79 9724** | 70 mm |
| **129 79 9734** | 75 mm |
| **129 79 9744** | 80 mm |
| **129 79 9754** | 85 mm |
| **129 79 9764** | 90 mm |

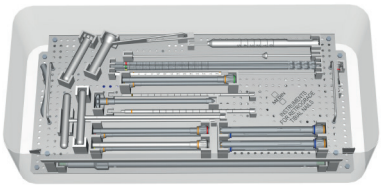



| | |
|---|---|
| thread diameter | 6.5 mm |
| core diameter | 5.9 mm |
| head diameter | 8.0 mm |
| drill for thread | Ø 4.4 mm |
| screwdriver | ⬡ 5 mm |

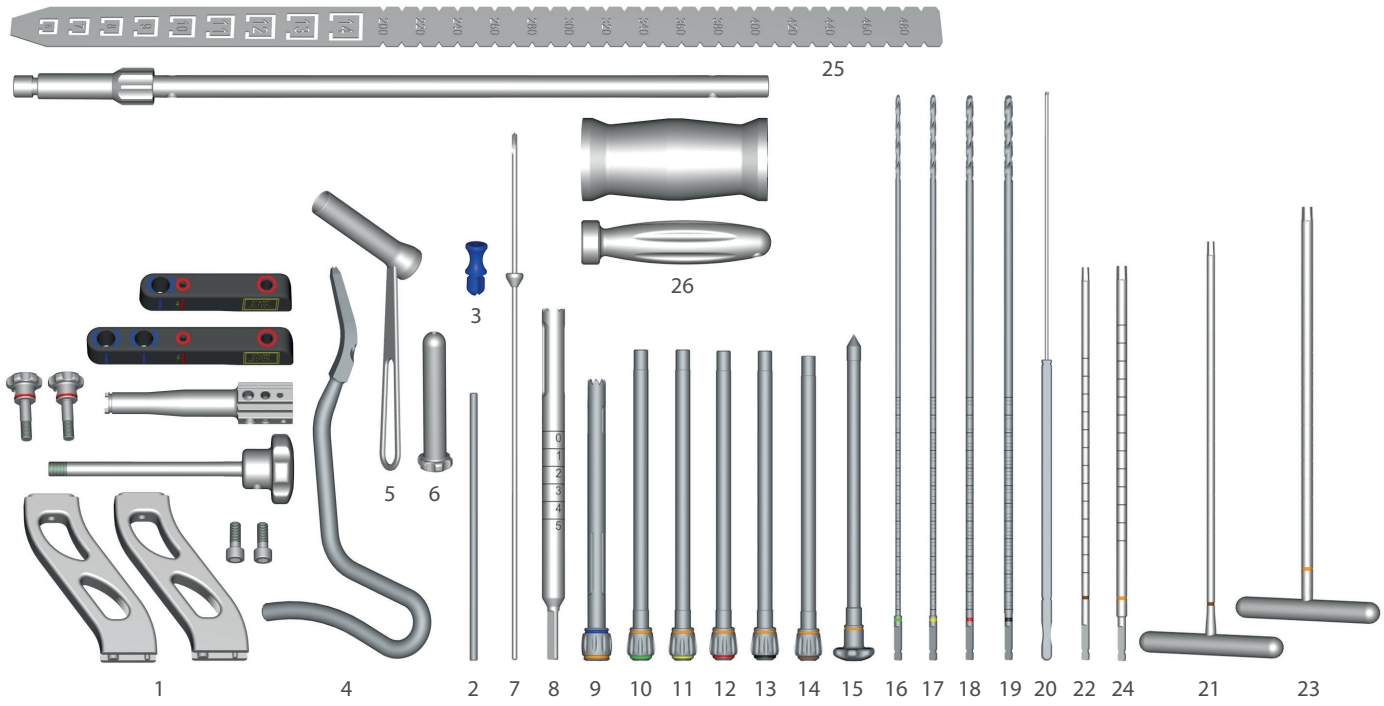
### The locking screw 6.5 mm

| Ti | A |
|---|---|
| **129 70 9274** | 40 mm |
| **129 70 9284** | 45 mm |
| **129 70 9294** | 50 mm |
| **129 70 9304** | 55 mm |
| **129 78 9154** | 60 mm |
| **129 78 9164** | 65 mm |
| **129 78 9174** | 70 mm |
| **129 78 9184** | 75 mm |
| **129 78 9194** | 80 mm |
| **129 78 9204** | 85 mm |
| **129 78 9214** | 90 mm |
| **129 78 9224** | 95 mm |
| **129 78 9234** | 100 mm |
| **129 78 9244** | 105 mm |
| **129 78 9254** | 110 mm |
| **129 78 9264** | 115 mm |
| **129 78 9274** | 120 mm |

## INSTRUMENTATION FOR THE RETROGRADE TIBIOTALOCALCANEAL ARTHRODESIS NAIL

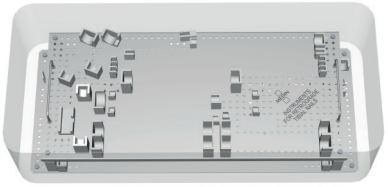


**139 09 0595** Instrumentation set for the retrograde tibiotalocalcaneal arthrodesis nails
540 × 240 × 130 mm
*with instruments*



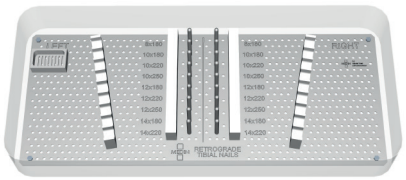

**139 09 0590** set

| | | | ks |
|---|---|---|---|
| 1 | **129 69 5760** | Aiming device for the retrograde tibiotalocalcaneal arthrodesis nails | 1 |
| 2 | **129 69 6100** | Wrench rod | 1 |
| 3 | **129 69 7210** | Plug | 4 |
| 4 | **129 09 0702** | Perforator | 1 |
| 5 | **129 69 7350** | Cutter sleeve Ø 13 mm | 1 |
| 6 | **129 69 7370** | Sleeve for wire Ø 13/Ø 3 mm | 1 |
| 7 | **129 69 7360** | K-wire with olive Ø 3×300 mm | 1 |
| 8 | **129 69 7340** | Cutter Ø 13/Ø 3 mm | 1 |
| 9 | **129 69 6400** | Sleeve Ø 10/Ø 8 mm | 4 |
| 10 | **129 69 6440** | Sleeve Ø 8/Ø 2.9 mm | 1 |
| 11 | **129 69 6420** | Sleeve Ø 8/Ø 3.5 mm | 1 |
| 12 | **129 69 6430** | Sleeve Ø 8/Ø4.4 mm | 2 |
| 13 | **129 69 9160** | Sleeve Ø 8/Ø 5.5 mm | 1 |
| 14 | **129 69 6450** | Sleeve of Ø 8/Ø 6 mm | 1 |
| 15 | **129 69 6470** | Trocar Ø 8 mm | 1 |
| 16 | **129 69 6621** | Drill Ø 2.9 mm | 1 |
| 17 | **129 69 6631** | Drill Ø 3.5 mm | 1 |
| 18 | **129 69 6641** | Drill Ø 4.4 mm | 2 |
| 19 | **129 69 9170** | Drill Ø 5.5 mm | 1 |
| 20 | **129 69 8040** | Depth gauge | 1 |
| 21 | **129 69 9310** | T- screwdriver; hexagon 3.5 mm | 1 |
| 22 | **129 69 9320** | Screwdriver; hexagon 3.5 mm | 1 |
| 23 | **129 69 7380** | T- screwdriver; hexagon 5 mm | 1 |
| 24 | **129 69 9060** | Screwdriver; hexagon 5 mm | 1 |
| 25 | **129 69 9190** | Depth gauge | 1 |
| 26 | **129 69 5670** | Mallet | 1 |

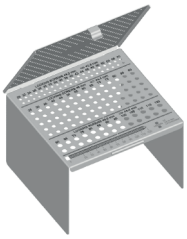


**129 69 7080** Sieve for instrumentation for the retrograde tibiotalocalcaneal arthrodesis nails
540 × 240 × 130 mm
*without instruments*

## INSTRUMENTATION FOR THE RETROGRADE TIBIOTALOCALCANEAL ARTHRODESIS NAIL



**129 69 7100** Sieve for the retrograde tibiotalocalcaneal arthrodesis nails
540 × 240 × 70 mm
*without the implants*



**129 69 8420** Stand for the locking screws for the retrograde tibiotalocalcaneal arthrodesis nails
180 × 176 × 136 mm
*without the implants*

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