

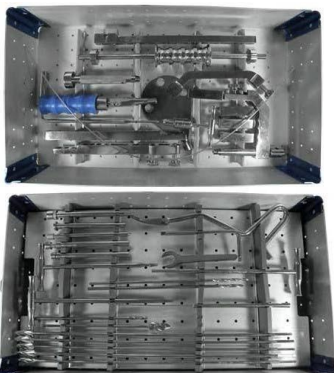
Cannulated/Solid Retrograde **FEMORAL NAIL**



Surgical Technique



Femoral Retrograde Nail
Self-tapping Bolt
Plug with diameter



Approved by



Intramedullary Nail System
Cannulated Retrograde Femur Nail Kit
Code 08360001



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Introduction

The general concepts of osteosynthesis have evolved from open reduction and plate fixation to the preservation of the fracture hematoma and periosteal circulation, a situation obtained through intramedullary nailing (1).

There are currently two fundamental kinds of locking nails: the cannulated nail inserted through drilling of the medullar cavity, and a second kind that is completely solid. The solid nail has biological advantages, having evinced a much lower rate of infection than found with cannulated nails with an open interior space, mainly useful in open fractures. Meanwhile, cannulated nails have been developed to the placement of larger diameter nails, and to facilitate the insertion technique, allowing for the insertion of a guide rod following the drilling, which improves stability, particularly in cases of non-union (2). The locked nails considerably increase resistance capacity with respect to torsional and shearing forces, and offer a low rigidity with a high capacity for fatigue (3-4).

An additional advantage offered by the use of solid nails is in cases of patients with high-energy traumas in long bones, or with open fractures where the drilling of the intramedullary cavity would potentially increase the risk of fat embolization (5, 6).

Surgical objectives (2):

To promote early mobility of the knee, which allows for the restoration of its functionality.

To maintain an adequate length and alignment of the extremity.

To preserve the viability of the soft tissues.

Bone consolidation.

To reduce the fat embolization index in polytraumatized patients in the case of solid nails (5, 6).

Indications

Ins Hilden Arzzt Nail Systems, consisting of intramedullary solid and cannulated nails, end cap and locking screws, are intended for fixation of fractures of different types: of the shaft, open and closed shaft fractures; and malunion and non-unions of the Femur, Tibia, and Humerus.

The indications are basically similar for both types of nails, with a possible preference for the solid nail in cases of polytraumatized patients (2-7).

Fracture types 33-A1 to A-3

Fracture types 33-C1 to C3.1

Fracture types 33-C1 to C3.1



Indications

Periprosthetic fractures of the hip and knee: In this type of fracture, the indication requires that it be a fracture at the supracondylar line or a distal third fracture of the femoral diaphysis with prior total arthroplasty of the knee, with a central notch able to accommodate the intramedullary nail within the femoral component of the knee prosthesis, the fracture line must be found with at least six centimeters of separation between the prosthetic implant and the fracture (8).

Supracondylar fractures and distal third fractures of the femur that are pathological: The requirements for this type of lesion are not different from non-pathologic fractures, with the exception of fracture lines that involve the joint, as the reduction may not be stable. Depending on the specific needs of the individual patient, this is an excellent option when the pathology is found at a supracondylar or diaphyseal level of the femur (9).

Supracondylar fractures and distal third fractures of the femur: In cases where there is a hip implant with a fracture line distal, the retrograde nail can be placed without requiring the additional removal of the previous system so long as there are 6 centimeters separating the tip of the hip implant and the fracture line. In situations that do not meet this requirement, be it in the hip or distal femur, it is necessary to remove the existing osteosynthesis prior to the placement of the nail (10).

Femoral fractures associated with fractures of the patella or ipsilateral tibia (floating knee): This is an absolute indication in this type of association of injuries, offering the same surgical approach for the placement of two osteosynthesis systems in a single surgical session and through a single surgical approach (11).

Diaphyseal fractures of the femur with concomitant fractures of the pelvis or ipsilateral acetabulum, or patients with poly-fractures: The antegrade implant can compromise the approach site for the management of fractures of the pelvis or ipsilateral acetabulum. Meanwhile, by not requiring a fracture table with traction, there is a diminished risk of fracture displacement with added complications for poly-fracture patients.

Open fractures: It is recommended that the cannulated nail be used in open femoral fracture types I, II, and IIIA (Gustilo). The solid nail is recommended for open femoral fracture types I, II, IIIA, IIIB, and IIIC (Gustilo) (6).

Non-union or pseudoarthrosis: This is an indication for the cannulated nail in cases where it is necessary to perform additional technical aspects, including: the opening of the fracture site to remove fibrosis and the placement of a bone graft (11). No literature was found to conclusively endorse the use of the solid nail, as several authors prefer the reaming of the intramedullary canal in these patients.



Contraindications

Fracture types 33-B, 33-C3.2, and 33-C3.3.

Proximal femur fractures

Type-B lesions situated on the posterior part of the femoral condyles, distant from the nail's entry site, in which case it is not viable to utilize any kind of intramedullary nailing.

Fracture lines with multiples fragments involving the knee articulation of the require an open and anatomical reduction, for which reason one must select a different system.

In proximal femur fractures, one must use a system that stabilizes the femoral neck and head, a situation that the retrograde nail does not offer.

The ARZZT solid and cannulated retrograde femoral nails offer excellent options in the treatment of patients because:

- a) They can be used without the need for a special surgical table or fluoroscopy because of their particular proximal blocking design, minimizing the patient's and medical personnel's exposure to radiation.
- b) Their placements and assemblies are not complex.
- c) Their extraction does not require a special additional instrument.
- d) The nail offers the option of three distal orifices. In the case of supracondylar fractures, the latter two can be blocked in the event that the most proximal orifice goes past the fracture line.

Cannulated/Solid Retrograde FEMORAL NAIL



Implant Design

Cannulated nail:

Made of TITANIUM 6Al4V, with 5.0 mm orifices

Available in the following measurements:

- Ø 9 mm / longitude of 160 to 420 mm
- Ø 10 mm / longitude of 160 to 420 mm
- Ø 11 mm / longitude of 160 to 420 mm
- Ø 12 mm / longitude of 160 to 440 mm
- Ø 13 mm / longitude of 160 to 440 mm
- There is a 20 mm increment between each nail measurement



Diameter of cannulated orifice: 3.7 mm

Diameter of guide rod: 2.5 mm; longitude of 950 mm

Titanium blocking screws: diameter of 5.0 mm, measurements of 20 to 100 mm with increments of 5 mm



Cannulated/Solid Retrograde FEMORAL NAIL



Implant Design

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- Ø 12 mm / longitude of 160 to 440 mm
- Ø 13 mm / longitude of 160 to 440 mm

There are 20 mm increments in nail longitude available between the minimum and maximum nail longitude.
Titanium blocking screws: diameter of 5.0 mm, longitude of 20 to 100 mm in 5 mm increments .



Both systems are divided into short and long nails:



Cannulated/Solid Retrograde
FEMORAL NAIL



Set of Instruments



Femoral Nail Adapter

Code 07120101



Ø2.5mm guide wire/rod for femur/tibia

Code 01014105



4.0 mm X 25 cm drill bit

Code 07013107



5.2 mm X 25 cm drill bit

Code 07013110



5.2 mm T-handled drill bit

Code 07120116

Cannulated/Solid Retrograde FEMORAL NAIL



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Set of Instruments



Nail Aligner

Code 07120104



Exterior sheath for femur

Code 07120118



Interior sheath for femur

Code 07120125



Primer punch for sheath

Code 07300110



Screwdriver for 5.0 femoral blocking screws

Code 07120206

Cannulated/Solid Retrograde
FEMORAL NAIL



Set of Instruments



Impactor extension

Code 07120142



13/64" L-handle hexagon key (Allen)

Code 07120149



15/32" fork wrench

Code 07120151



Awl for femur/tibia equipment

Code 07120166



Insertion Handle

Code 07120155

Cannulated/Solid Retrograde FEMORAL NAIL



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Set of Instruments



Nail Connector

Code 07120181



Aiming Arm for the Short Femoral Nail
(beginning from 160 – 220 mm)

Code 07120204



Proximal arm for long nails (beginning
from 240 – 420 mm)

Code 07120202



Aiming Arm for the Long Retrograde
Femoral Nail
(beginning from 240 – 420 mm)

Code 07120203



Distal Arm for Femur

Code 07120106

Cannulated/Solid Retrograde FEMORAL NAIL



Set of Instruments



Spacers for femur

9 mm Code 07120133
10 mm Code 07120134
11 mm Code 07120135
12 mm Code 07120136



Fastenings Screws for Femur

32.5 mm Code 07120184
41.0 mm Code 07120185
45.0 mm Code 07120186



Rigid intramedullary reamer diameter Ø9, 10, 11, 12, 13, 13.5 mm

9 mm Code 07061105
10 mm Code 07061106
11 mm Code 07061107
12 mm Code 07061108
13 mm Code 07061109
13.5 mm Code 07061110



6.5 mm T-handled tap for tibia/femur

Code 07043105



Feeler gauge for femur

Code 07120161

Cannulated/Solid Retrograde FEMORAL NAIL



Set of Instruments



Skin protector for femur

Code 07120164



Solid reamer handle with e-quick

Code 07061111



Interior sheath for diameter Ø5.2 mm drill bit

Code 07120123



Exterior sheath for diameter Ø5.2 mm drill bit

Code 07120117



Nail impactor/extractor

Code 07120146



Star screwdriver for diameter Ø5.0 mm screw

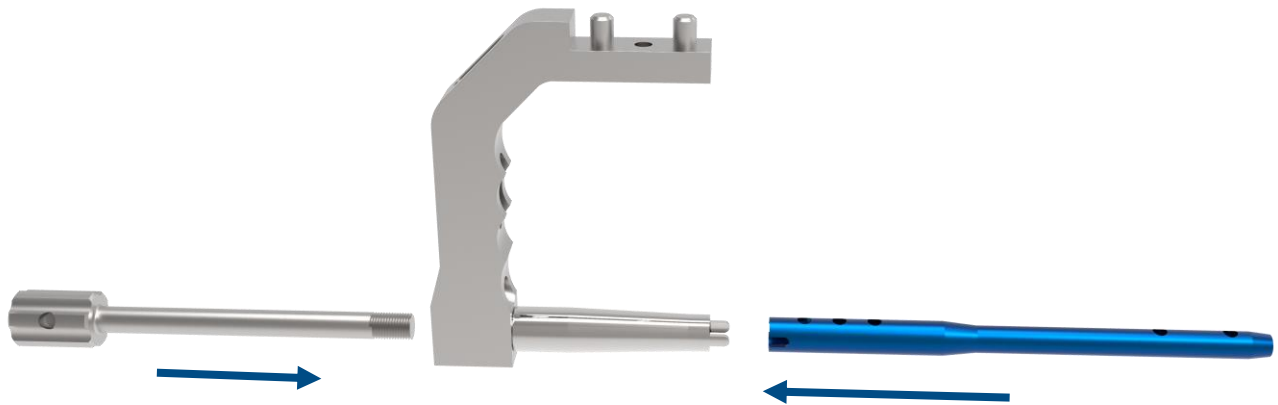
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System Assembly (Solid and Cannulated Nails)

Short nails (160–220 mm in longitude)

1. Introduce the nail connector to the handle, fixing the distal part of the nail, ensuring that the grooves align. Confirm the proper fastening of the nail for the appropriate orientation of the screws.



2. Couple the femoral module for short nails to the fastener handle using fastening screw no. 1 for the femoral module.

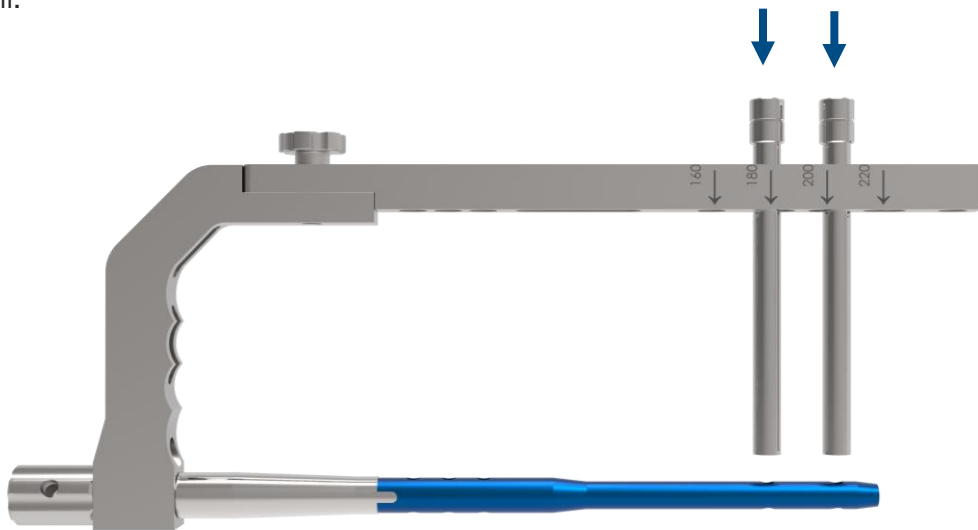




System Assembly (Solid and Cannulated Nails)

Short nails (160–220 mm in longitude)

3. Position the internal femoral sheath within the external femoral sheath and introduce both elements into the proximal and distal locking orifices of the femoral module that correspond to the longitude of the chosen nail.



4. Position the 5.0 mm drill bit and verify that it can easily penetrate through the nail's orifices.

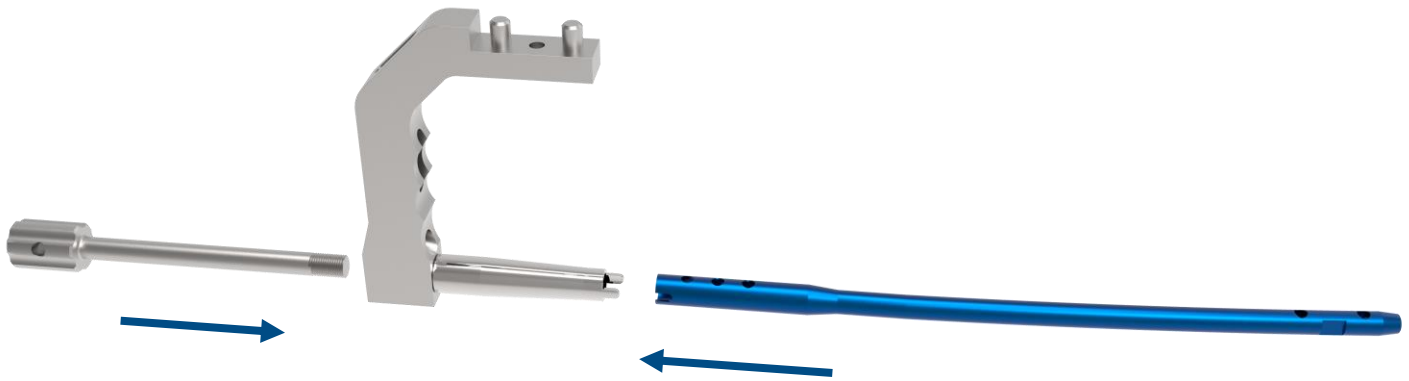




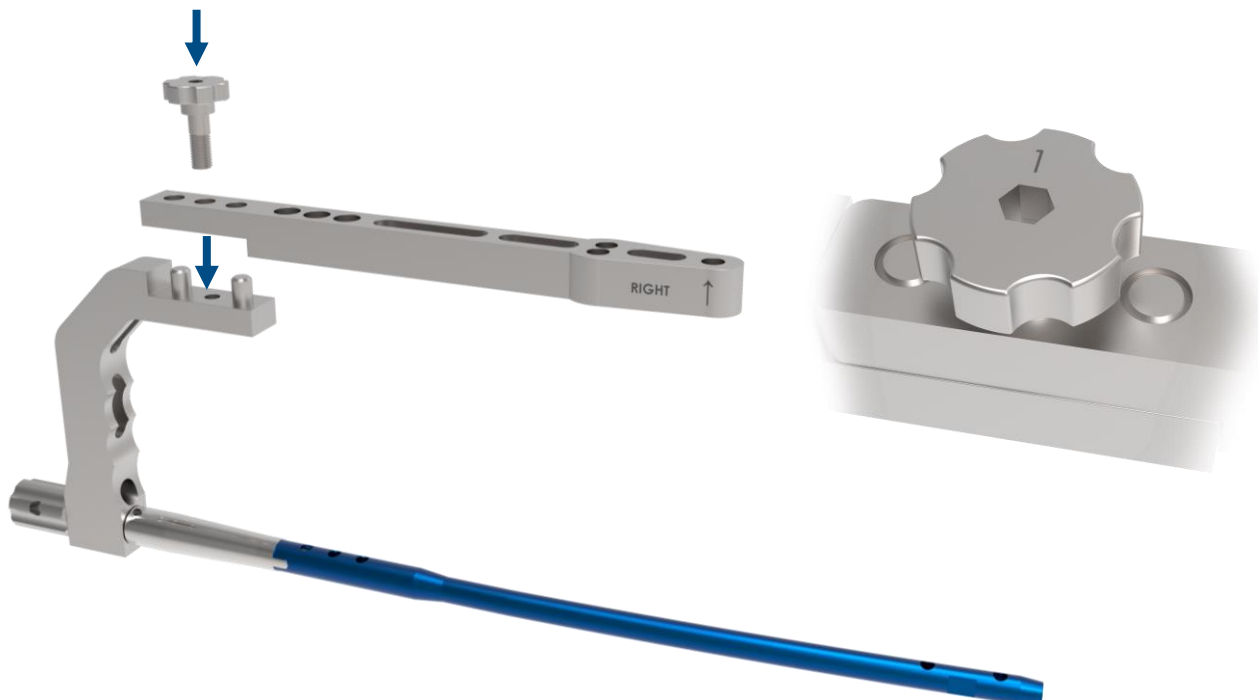
System Assembly (Solid and Cannulated Nails)

Long nails (240–400 mm in longitude)

1. Repeat step 1 as previously described.



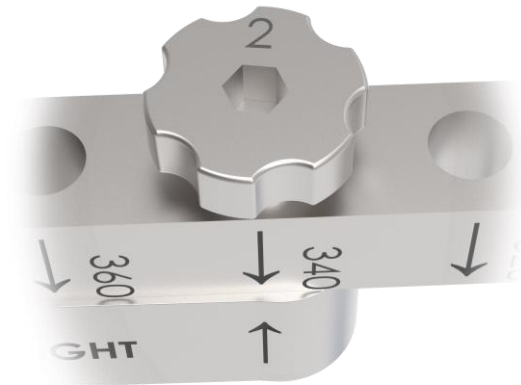
2. Couple the proximal arm for long nails with the insertion handle using fastening screw no. 1.





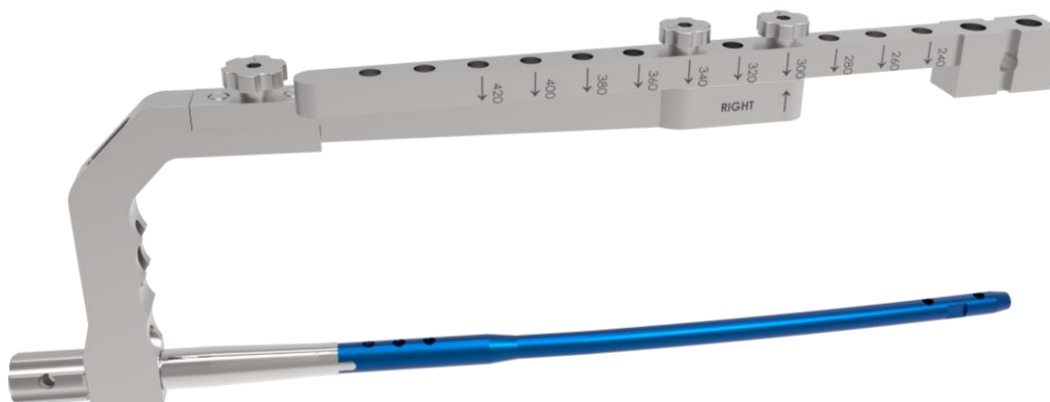
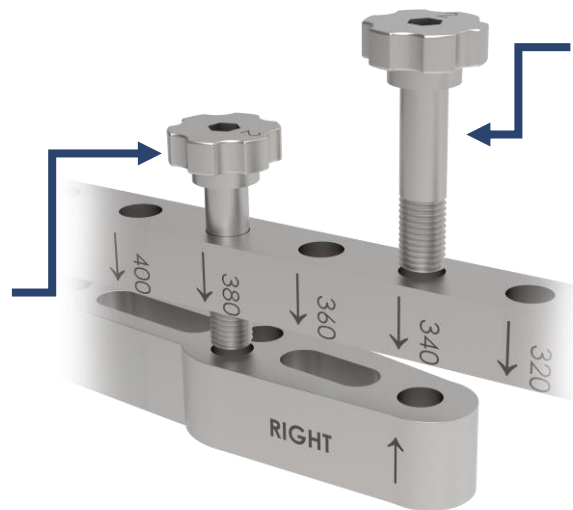
System Assembly (Solid and Cannulated Nails)

3. Adapt the aiming arm for the retrograde femoral nail using the no. 2 fastening screws.



Upon positioning the proximal fastening screw on the distal module for the retrograde femoral nail, it should coincide with the length of the nail.

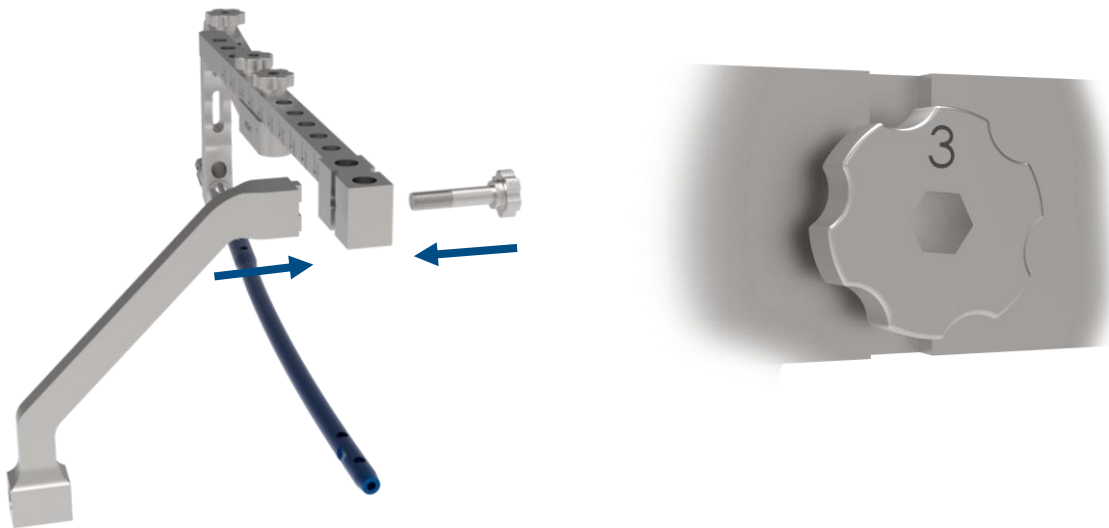
The distal fastening screw is to be placed in the corresponding hole next to the fracture, which is why the proximal arm is marked with the words "left" and "right" to avoid confusion.





System Assembly (Solid and Cannulated Nails)

4. Continue with the assembly of the distal arm, which should be on the same side as the fracture. The assembly is secured using fastening screw no. 3.



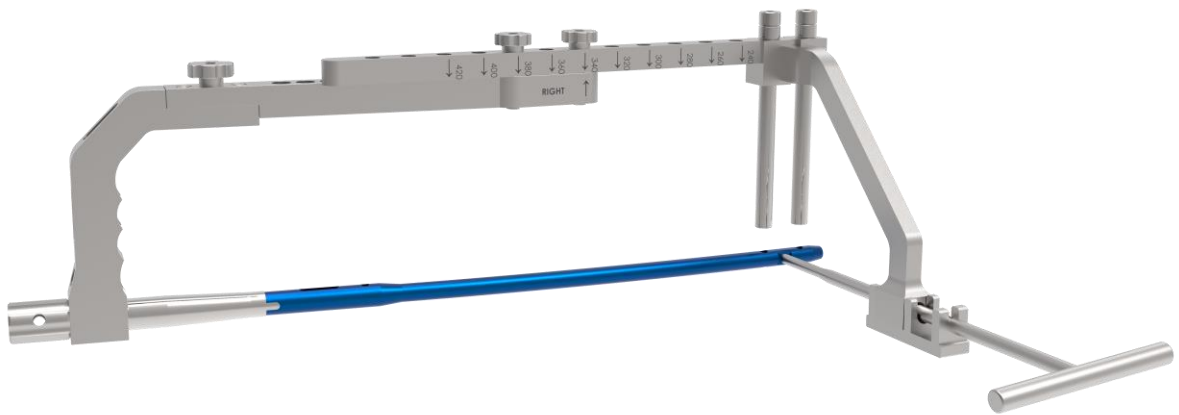
5. In accordance with the diameter of the nail, affix the spacer to the inferior part of the distal arm, along with the feeler gauge, making contact with the latter.





System Assembly (Solid and Cannulated Nails)

6. Fit the external femoral sheaths and the internal femoral sheaths in the corresponding orifices, ensuring that the drill bit passes through without any problem.



Cannulated/Solid Retrograde *FEMORAL NAIL*

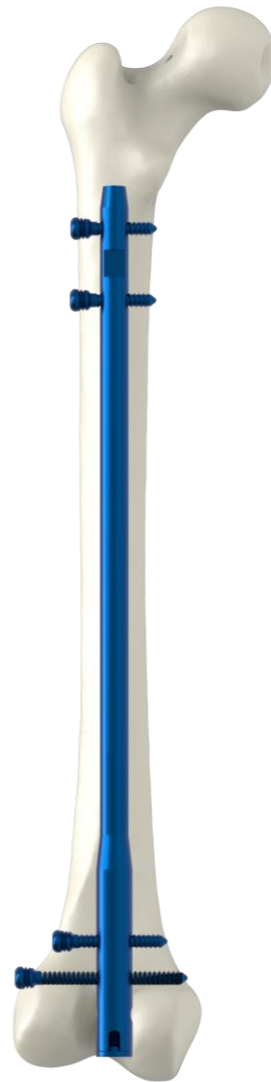


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Surgical Technique (NAILS, SOLID/CANNULATED):

The surgical technique described as follows is used for the placement of both implants (solid and cannulated nails), with the particular variants for the insertion of each kind of nail specified.



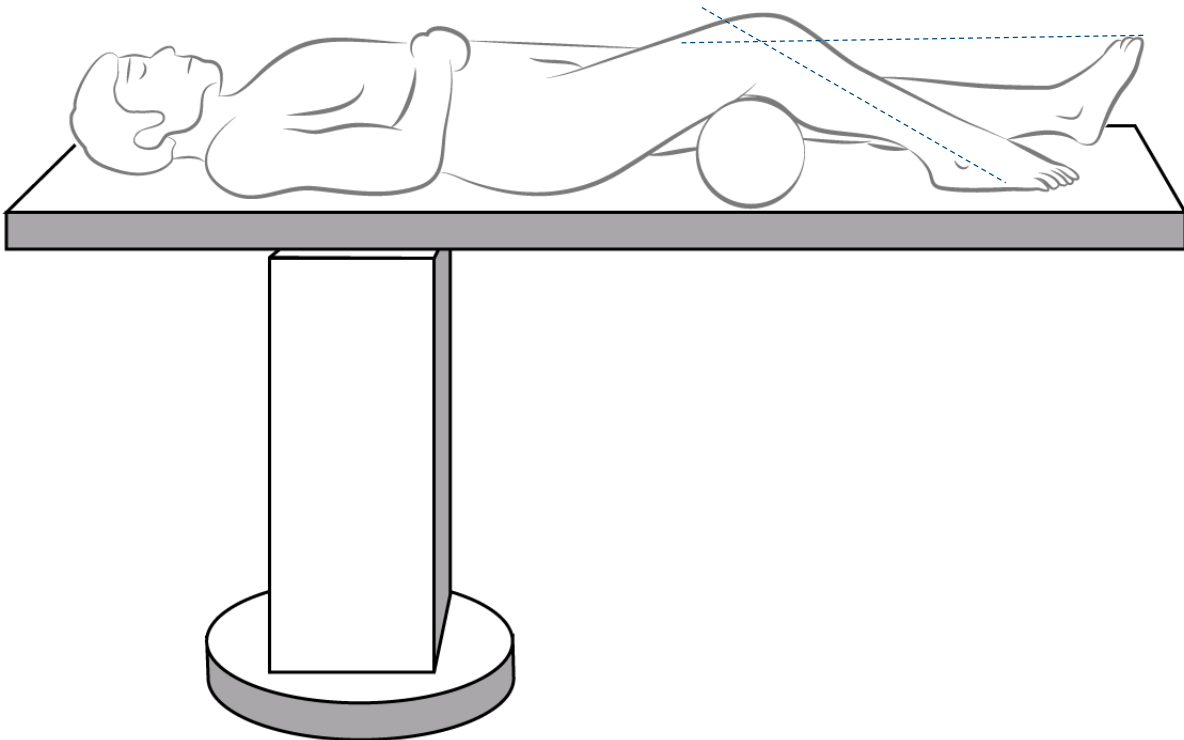


Implant Placement

Surgical Technique (NAILS, SOLID/CANNULATED):

Patient positioning (both implants)

The patient is placed in a supine position with the relevant knee flexed at 30 degrees by placing a pad underneath the leg to facilitate reduction..



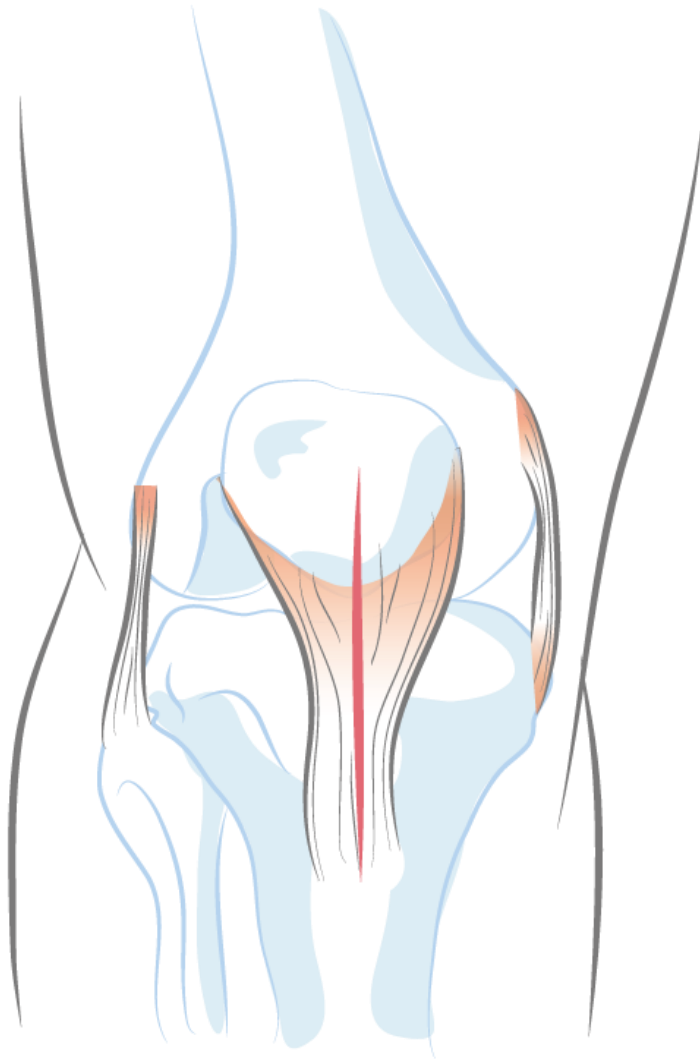


Implant Placement

Surgical Technique (NAILS, SOLID/CANNULATED):

Incision (both implants)

Over the medial line of the patellar tendon, make a 2-centimeter straight-line incision just beneath the inferior pole of the patella, toward the tibial tubercle.

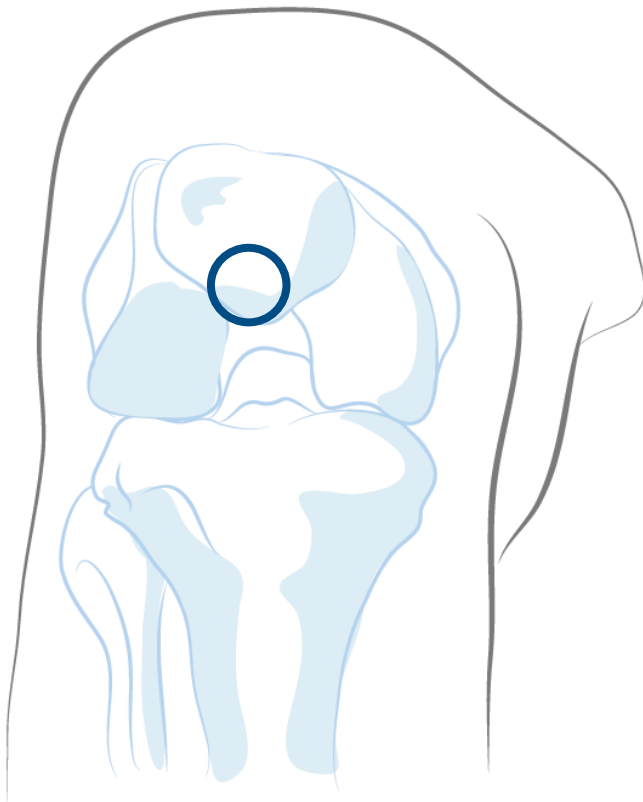




Implant Placement

Surgical Technique (NAILS, SOLID/CANNULATED):

It is fundamental to select the entry site for the implant in order to avoid damaging the posterior cruciate ligament and the weightbearing portion of the articular cartilage. The anatomical point to choose is just above the intercondylar notch and laterally in front of the Blumensaat line, thus avoiding the insertion area of the posterior cruciate ligament.

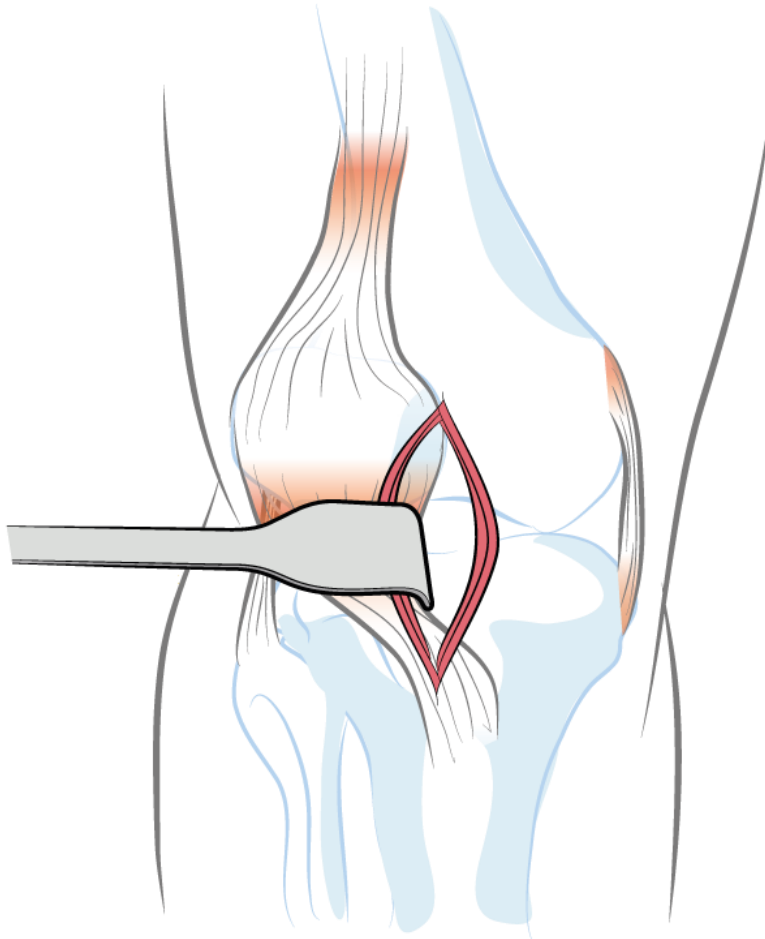




Implant Placement

Surgical Technique (NAILS, SOLID/CANNULATED):

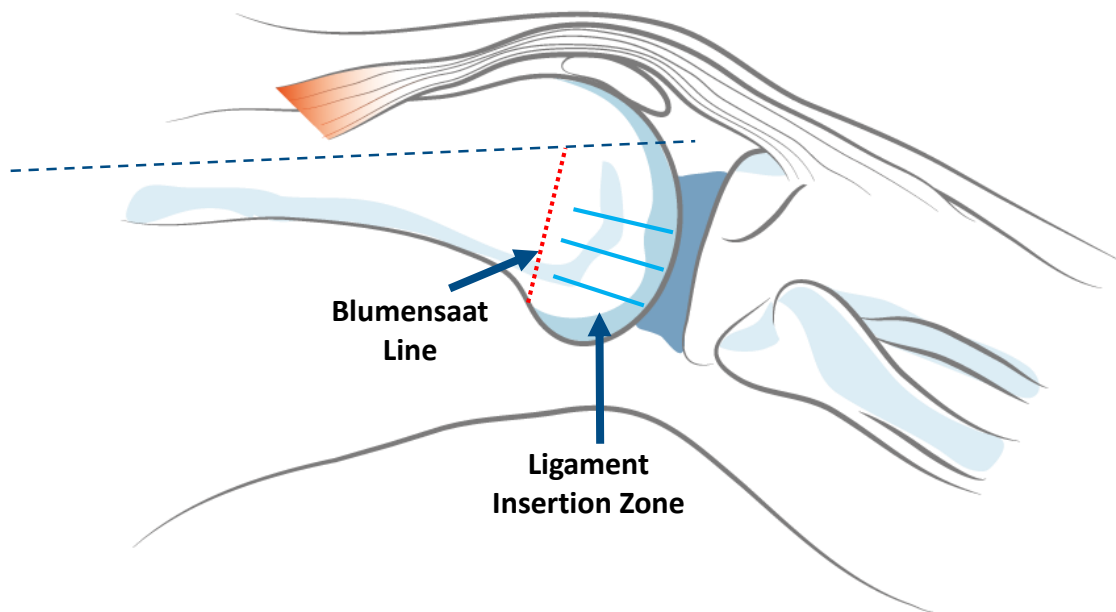
Locate and dissect the medial parapatellar tissue, and laterally displace the patellar tendon (do not penetrate through the tendon) until the articular surface of the femur is exposed.





Opening the canal (both implants)

Place one external sheath. Insert the guide wire/rod, directed toward the center of the medullary canal, just in front of the Blumensaat line. Insert the guide wire/rod approximately 12–14 centimeters to the fracture zone.



Begin the drilling sequentially without removing the guide pin. The drill must penetrate the medullary cavity by approximately 30 millimeters. The reaming must be performed in one to two millimeters above the diameter of the nail to be used, allowing for the smooth insertion of the nail. Always protect the soft tissues with the skin protector for the femur. Optionally, you may use the primer punch for the opening of the canal.

Important:

FOR THIS TECHNIQUE, YOU MUST USE A FLEXIBLE REAMER OF THE SAME DIAMETER AS THE RIGID REAMER. THIS REAMER IS SOLD SEPARATELY FROM THE RETROGRADE FEMORAL NAIL KIT.



Cannulated/Solid Retrograde FEMORAL NAIL

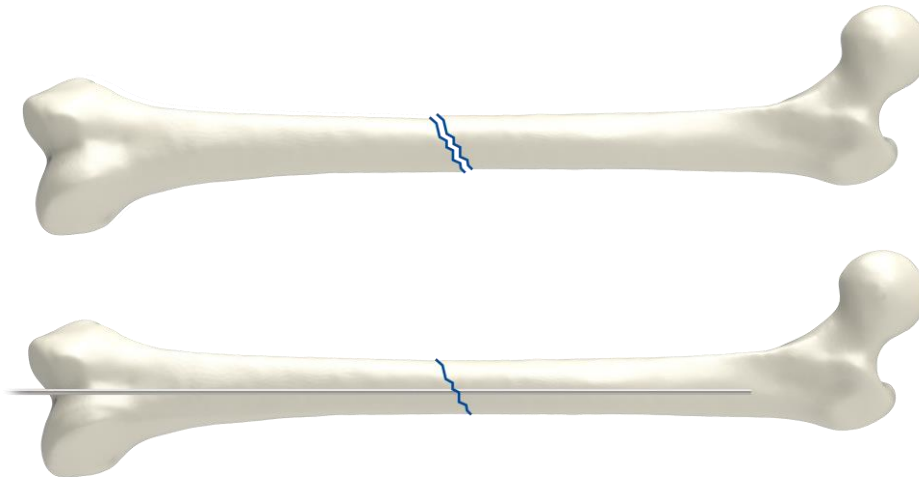


Solid nail: If you are using a solid nail, you must follow this procedure. Remove the reamer or punch, as well as the guide wire. Take the femoral nail—previously fastened to the handle as described in the assembly section—and introduce the implant into the femoral canal opening in the intercondylar notch. Control the entry of the nail through the fracture site with the image intensifier. Introduce the implant by hand as deep as possible, with light rotational movements. Ensure that the distal end of the nail does not stick out beyond the cartilaginous border in order to avoid future chondral lesions.



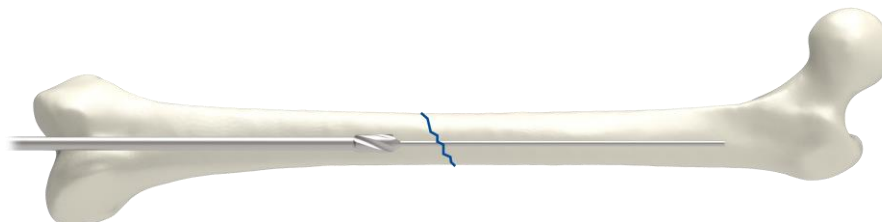


Cannulated nail: If you are using a cannulated nail, adhere to the following steps. Remove the reamer or punch. Introduce the guide wire/rod (2.5 mm/length of 950 mm) into the orifice of the intercondylar notch.



Guide wire/rod (2.5mm/longitude of 950mm)

Begin the drilling process with the reamer (diameter of 8.0 mm). Proceed to drill the medullary cavity in increments of 0.5 mm. Use the fastening pliers to control the rotation of the guide wire/rod. Advance the head of the reamer with light movements forward and back without using force. Continue reaming until the diameter of the cavity is 0.5–1.5 mm greater than the diameter of the nail to be used.

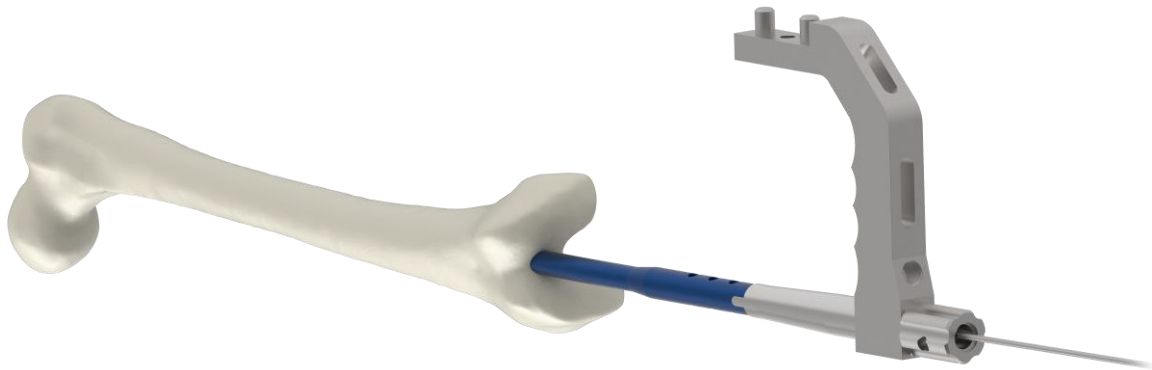


Medullar Drilling

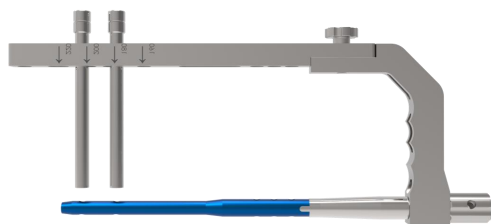
Cannulated/Solid Retrograde **FEMORAL NAIL**



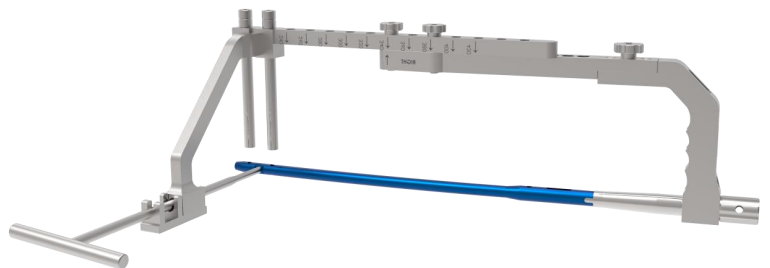
Remove the reamer and introduce the retrograde femoral nail above the guide wire/rod used for the drilling. The tip of the guide wire/rod must be situated at the exact center of the medullary cavity, as this will determine the definitive proximal position of the nail.



Prior to the previous step, you must assemble the nail's fastener handle as described in the assembly section. Introduce the implant by hand as deep as is possible with light rotational movements, following the direction of the guide wire/rod. Ensure that the distal end of the nail is inserted 2 and 5 mm below the cartilaginous border to avoid future chondral lesions. Finally, extract the guide wire/rod.



Short Nail



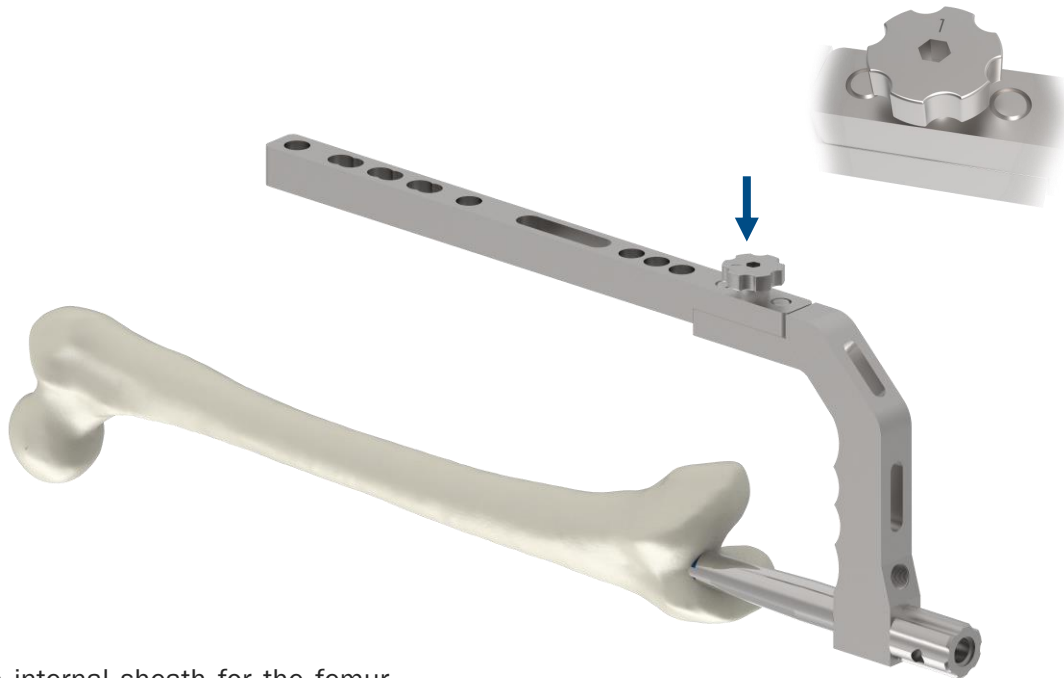
Long Nail

Assemble the proximal arm, the distal arm, and the distal module (long nail) or retrograde femoral module (short nail) in accordance with the length of the nail described in the assembly section (both implants).



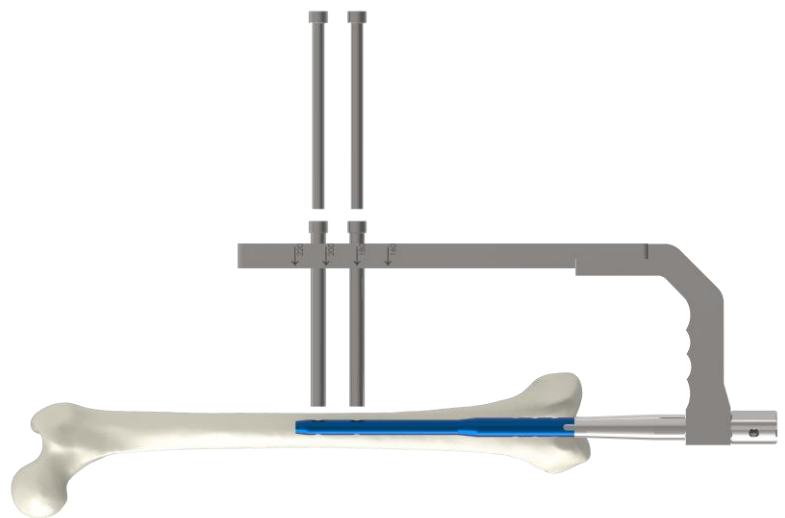
Distal blocking (both implants)

Short nails: Connect the retrograde femoral module for short nails to the fastening handle using fastening screw no. 1 for the femoral module.



Place the internal sheath for the femur inside the external sheath for the femur and introduce both elements into the distal locking orifices of the femoral module corresponding to the length of the chosen nail. Incise the skin and dissect the soft tissues until you make contact with the femoral cortex.

Perform the locking of the screws by placing, in order, the exterior sheath for the femur, the internal sheath for the femur, and the primer punch for the external sheath for the 5.0 mm bit. Finally, remove the primer punch and introduce the 5.0 mm bit. Using the depth gauge, determine the appropriate screw longitude.



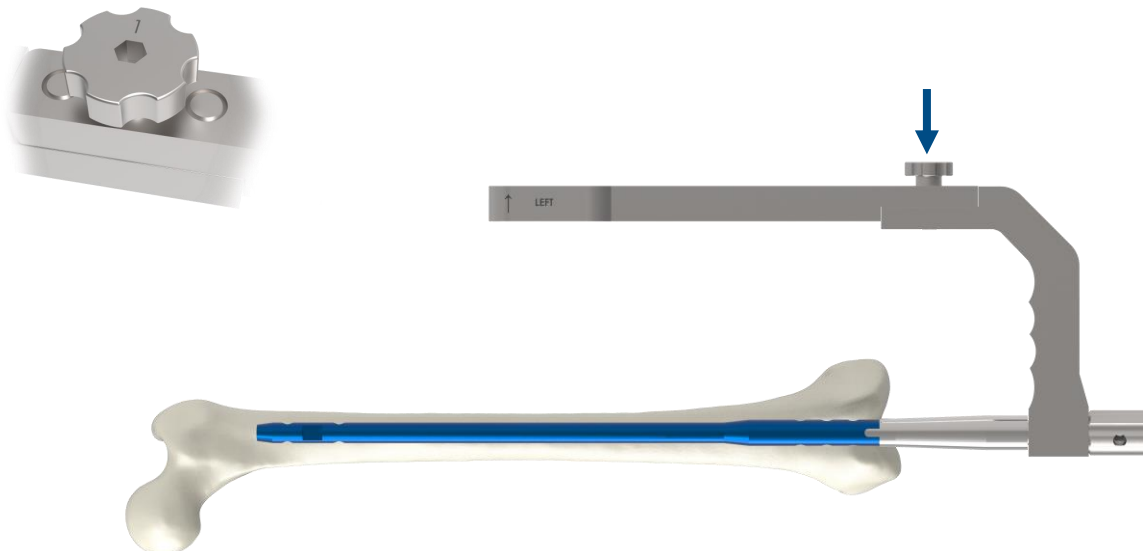
Cannulated/Solid Retrograde FEMORAL NAIL



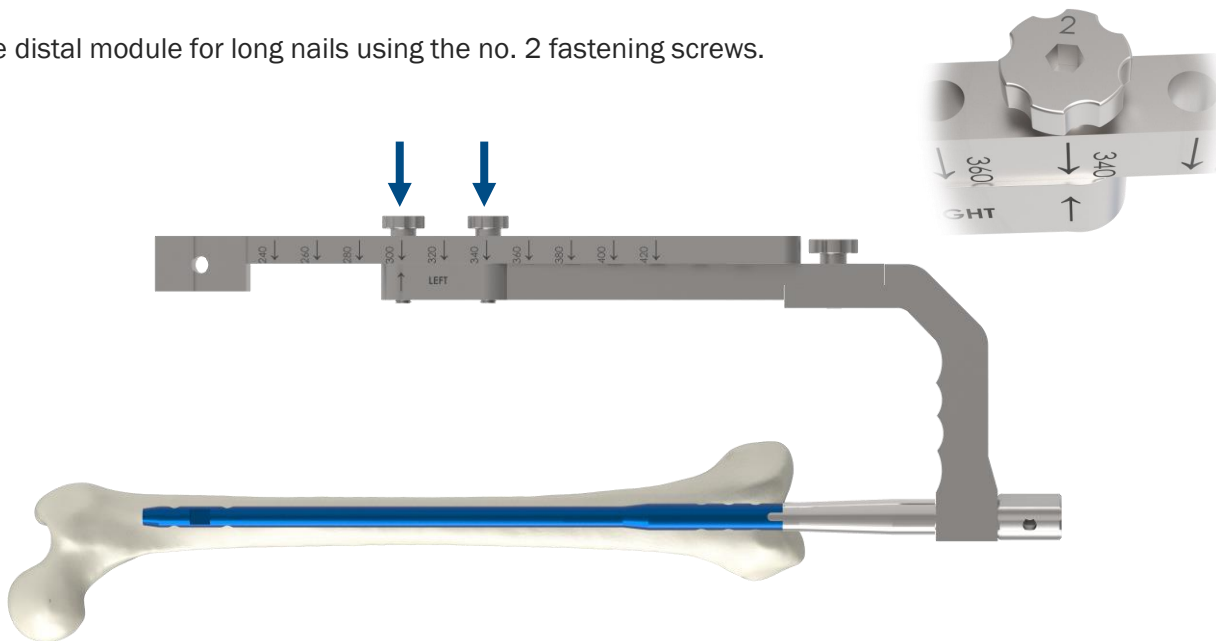
ARZZT
ALWAYS ONE STEP AHEAD

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Long nails: Couple the proximal arm for long nails with the insertion handle using fastening screw no. 1.



Adapt the distal module for long nails using the no. 2 fastening screws.



Place the fastening screw on the distal module coinciding with the longitude of the nail. Meanwhile, the distal fastening screw will be placed in the hole corresponding to the side of the fracture, which is why the proximal module has the words “left” and “right” on it to avoid confusion. Remember that the long nails must be selected in relation to the side the fracture is on, be it right or left.

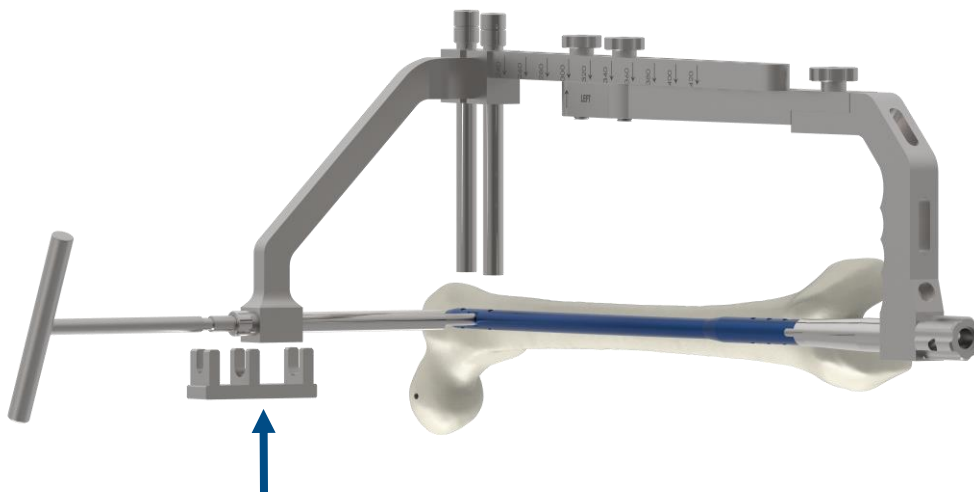
Cannulated/Solid Retrograde FEMORAL NAIL



Continue with the assembly of the aiming arm, which must be on the same side as the fracture. This assembly is secured using fastening screw no. 3.



Affix the spacer that corresponds to the diameter of the nail to the inferior part of the aiming arm, along with the feeler gauge. Make a small incision with a scalpel on the anterior surface of the thigh, exactly at the place where the nail aligner makes contact with the skin. Deepen the wound until you locate the anterior cortex of the femur, and drill a orifice with the 5.0 mm bit through only the first cortex. Introduce the feeler gauge, making contact with the nail, and reposition the spacer with the feeler gauge maintaining the system's stability.



Perform the locking of the distal screws in the same way described in the preceding section on short nails.

Cannulated/Solid Retrograde FEMORAL NAIL



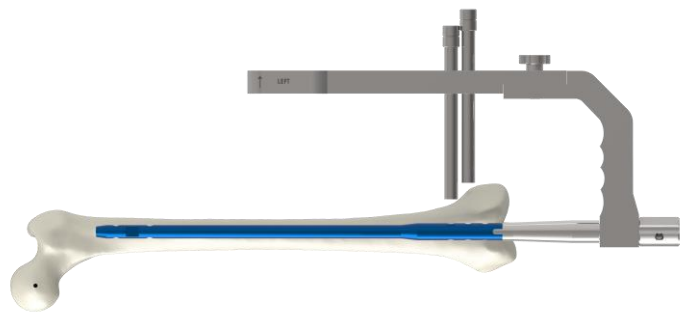
It is important to perform the distal locking screw first. Otherwise, if the proximal screws are locked first, the surgeon will not be able to make the final corrections regarding the I. You have the option of locking only two screws in the event that the most proximal orifice of the nail surpasses the fracture line.

Proximal blocking (both systems)

Place the internal femoral sheath within the external femoral sheath and introduce both elements in the proximal blocking hole of the directional arm corresponding to the length of the chosen nail. Incise the skin until contact is made with the femoral cortex.

Perform the locking of the screws, positioning (in order) the exterior sheath, the interior sheath, and the primer punch for the 5.0 mm external sheath. Finally, remove the primer punch and introduce the 5.0 mm bit.

Using the depth gauge, determine the size of the blocking screws.



Remove the system and position the sealing cap.

Closing the wound:

Before closing the wound, perform appropriate irrigation, removing the debris from the joint. Conclude the process with the repair of the patellar tendon (if necessary). Suture the deep soft tissues and the skin. You may drain the wound if recommended by the surgeon.





Implant Extraction

Extraction fo the Distal Nail From the femur (Both Implants)

Patient positioning:

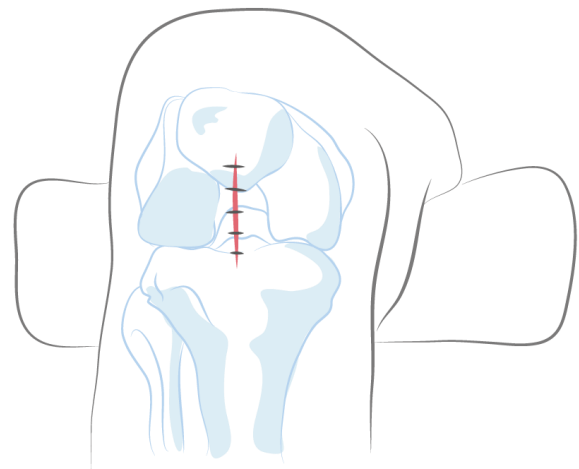
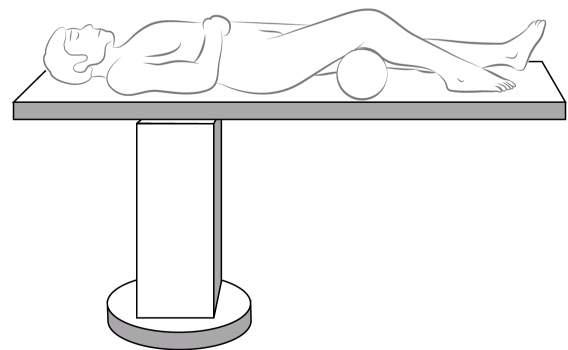
The extraction of the intramedullary nail requires that the patient be placed in a prone supine position (dorsal), which does not require a special surgical table.

Surgical technique:

1. Cover the knee with sterile drapes and maintain the flexion of the knee at 30 to 60 degrees in order to facilitate the extraction.

2. Use the same approach through the previous surgical scar via an incision of 2-3 cm underneath the patellar pole, in the direction of the tibial tubercle.

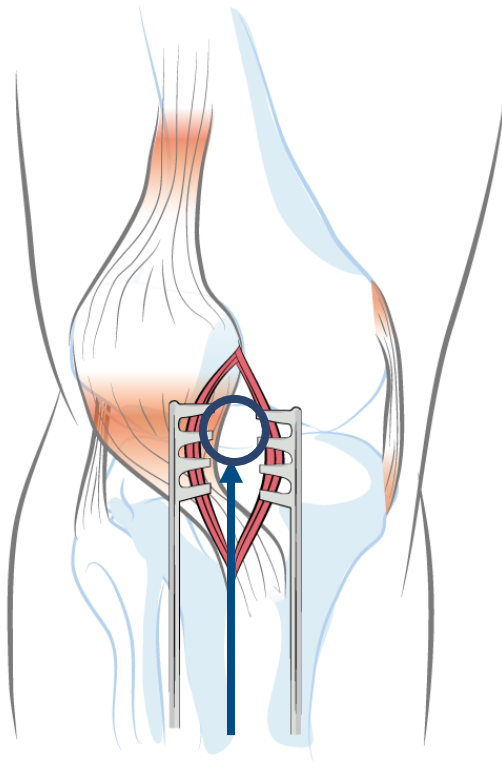
3. Separate the subcutaneous cellular tissue and locate the patellar tendon. Carefully displace the medial border of the tendon, removing the fibrous tissue formed by the previous surgery.



Cannulated/Solid Retrograde FEMORAL NAIL



4. Expose the articular cartilage of the femoral condyles, and feel for the nail's entry orifice. Occasionally it is possible to feel or see the nail's metallic extreme.



5. Remove the redundant tissue and extract the sealing cap.



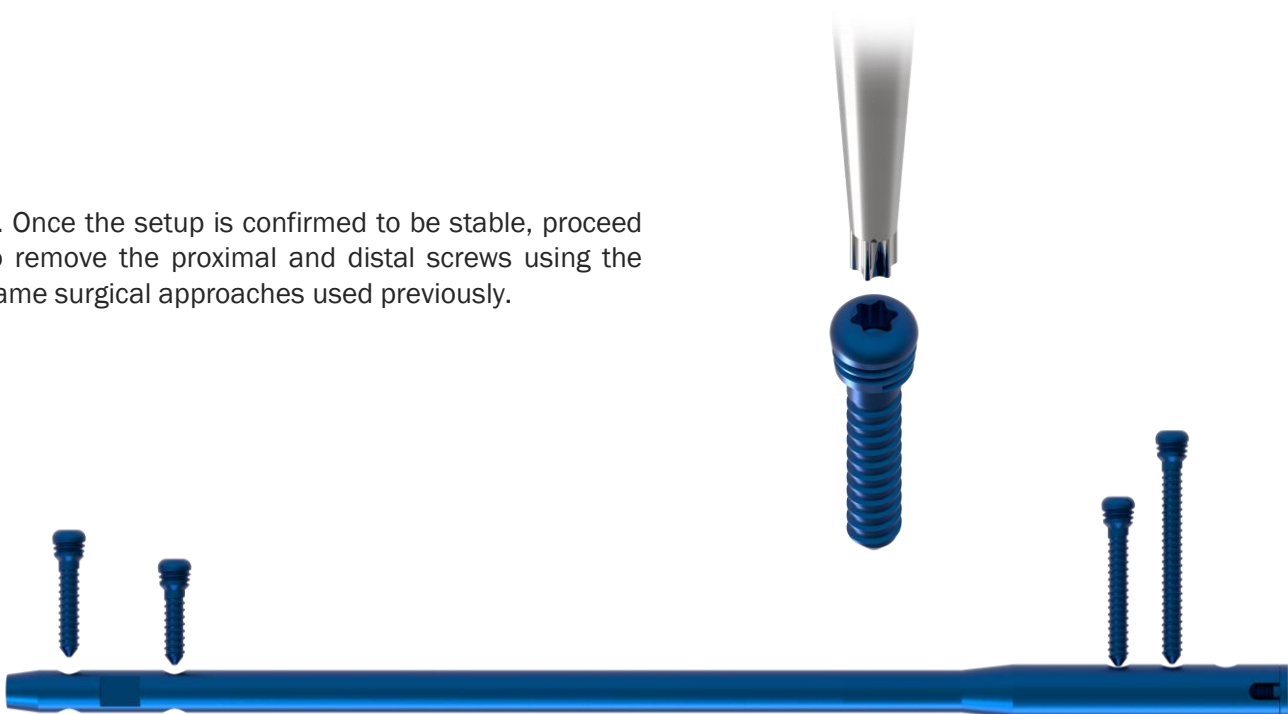
Cannulated/Solid Retrograde FEMORAL NAIL



6. Use the femoral impactor/extractor for the femoral nail, adequately fixating on the nail's entry point. Do not remove the screws yet in order to avoid the rotation of the nail, which will make its extraction more difficult.



7. Once the setup is confirmed to be stable, proceed to remove the proximal and distal screws using the same surgical approaches used previously.

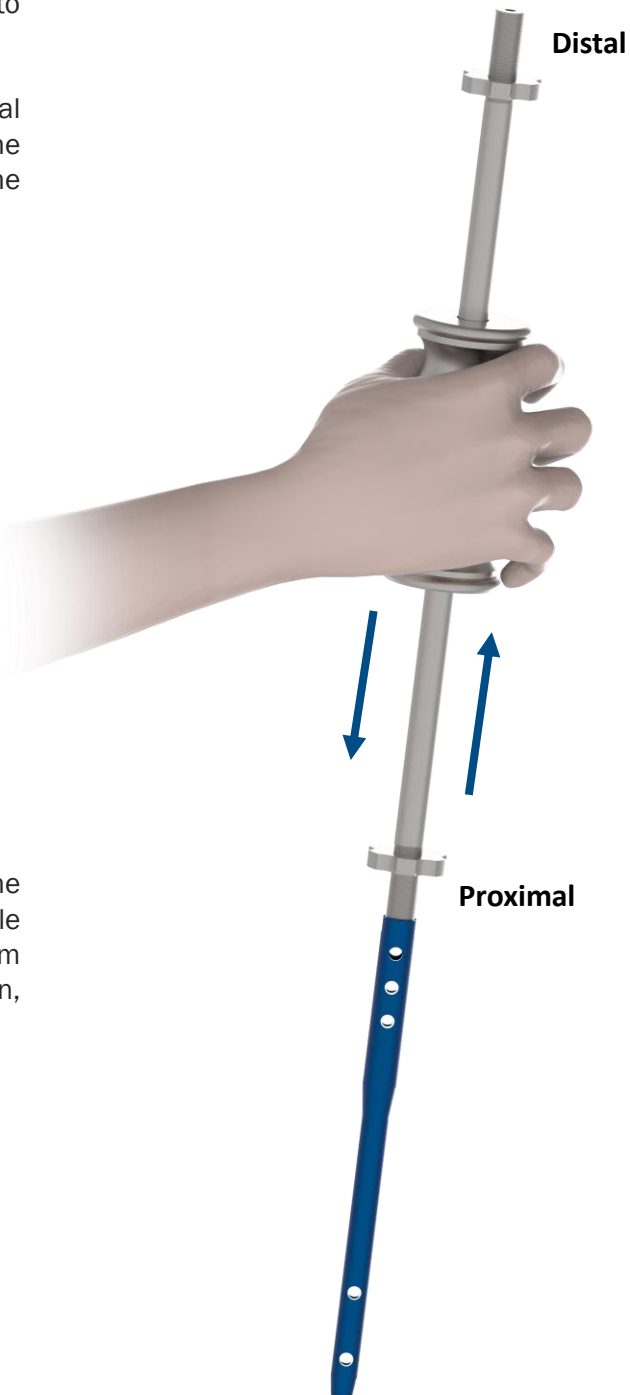


Cannulated/Solid Retrograde FEMORAL NAIL



8. Ensure the complete extraction of the screws.
If the extraction of a screw occurs unnoticed, it may cause a fracture upon attempting to remove the nail.

Softly slide the hammer handle in the proximal direction over the metallic column of the impactor, and then impact the handle over the distal extreme.



9. Once the nail is removed, carefully wash the femoral canal, removing the detritus while simultaneously removing loose fragments from the joint, suturing the soft tissues and skin, thereby completing the surgical procedure.



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