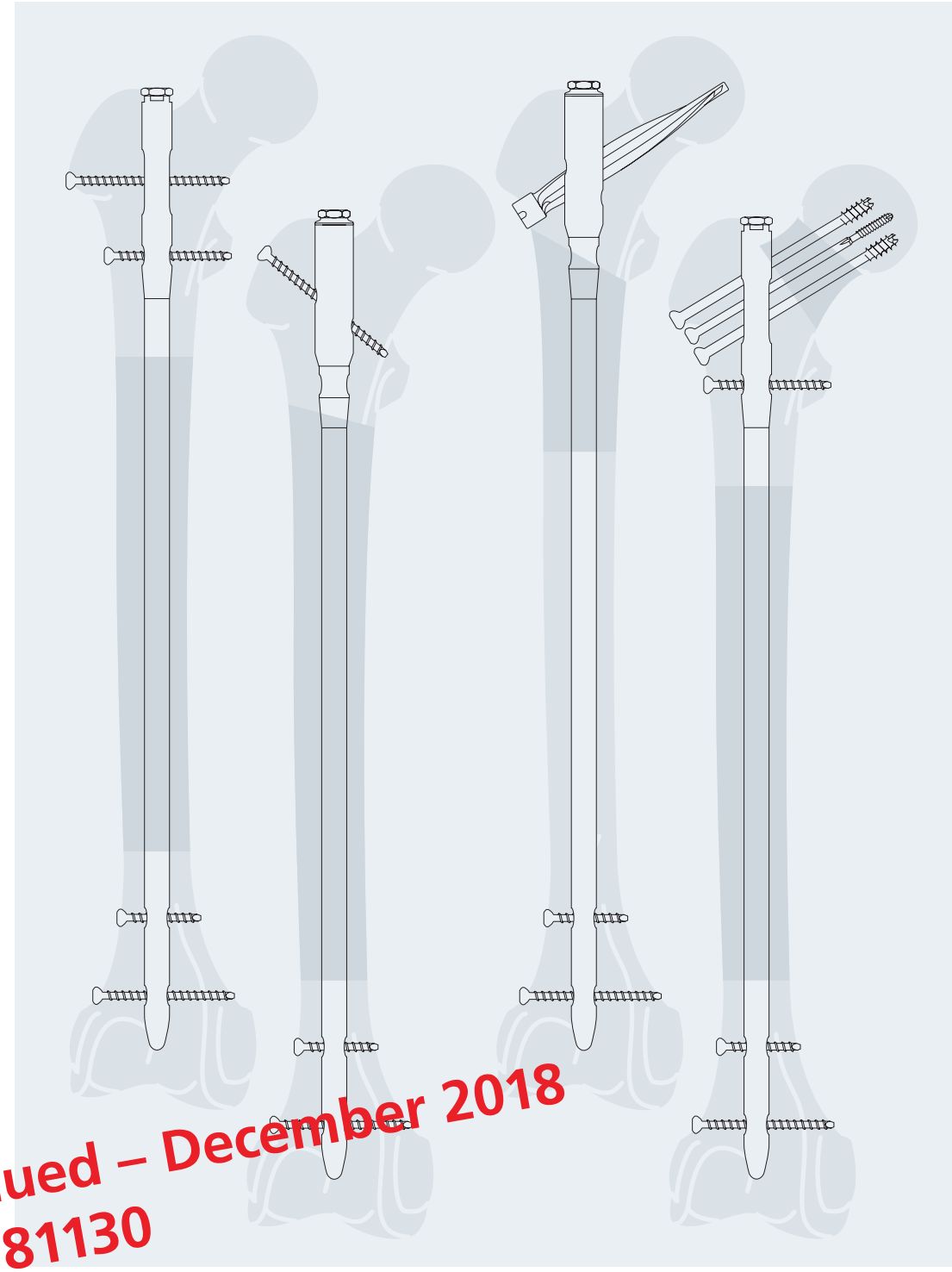
UFN Unreamed Femoral Nail
CFN Cannulated Femoral Nail

Surgical Technique



Discontinued – December 2018
103403-181130

Instruments and implants approved by the AO Foundation.

DePuy Synthes
PART OF THE Johnson&Johnson FAMILY OF COMPANIES

Image intensifier control

This description alone does not provide sufficient background for direct use of DePuy Synthes products. Instruction by a surgeon experienced in handling these products is highly recommended.

Processing, Reprocessing, Care and Maintenance
For general guidelines, function control and dismantling of multi-part instruments, as well as processing guidelines for implants, please contact your local sales representative or refer to:
http://emea.depuysynthes.com/hcp/reprocessing-care-maintenance
For general information about reprocessing, care and maintenance of Synthes reusable devices, instrument trays and cases, as well as processing of Synthes non-sterile implants, please consult the Important Information leaflet (SE_023827) or refer to:
http://emea.depuysynthes.com/hcp/reprocessing-care-maintenance

Table of Contents

Indications for femoral nailing			2
Indications for UFN/CFN			6
Implants			10
Preoperative planning			14
Instruments for opening the femur			15
Open the femur (all locking procedures)			16
Proximal locking	Standard locking	A	24
	Spiral blade locking	B	32
	Miss-A-Nail-Technique	C	43
	130° Antegrade locking	D	56
Implants and instruments for distal locking			63
Distal locking (all locking procedures)			64
Instruments for implant removal			67
Implant removal (all locking procedures)			68
Bibliography			70
MRI Information			71

Indications for Femoral Nailing

The range of implants available for intramedullary fixation of the femur has grown over the years. They differ in design (slotted/unslotted, unreamed/cannulated, small/large diameter, static/dynamic locking), materials (steel/titanium) and technical application (with/without reaming). Considerable overlap exists for the indications.

The following table prepared by the Long Bone Expert Group (LBEG) of the AO/ASIF provides an overview of the indications for Synthes femoral nails. The details concerning the classification of fractures are based on the AO fracture classification.

Implants
All intramedullary implants for the femur
CFN Cannulated Femoral Nail – Standard Locking TAN (Titanium-Aluminium-Niobium alloy), cannulated, for procedures with or without reaming
UFN Unreamed Femoral Nail – Standard Locking TAN, unreamed, for procedures without reaming
UFN/CFN – Proximal Spiral Blade Locking TAN
UFN – Miss-A-Nail Technique TAN
UFN/CFN – 130° Antegrade Locking TAN

Indications	Indication restrictions
– Shaft fractures – Metaphyseal fractures that allow the placement of locking bolts and thus stable fixation	– Serious contamination – Presence of an acute infection – Metaphyseal fractures that do not allow adequate placement of locking bolts (location, bone too weak) – Risk of unstable or displaced fixation
– All shaft fractures (32-A1–C3) and all open and closed fractures – Cases in which the use of a guide wire is considered beneficial – Pseudoarthrosis, non-union	– Reaming should be avoided in patients with lung injuries, major head injuries, haemodynamic instability, coagulopathy or hypothermia – Multiple trauma patients*
– All shaft fractures (AO 32-A1–C3) and all open and closed fractures – Cases in which the avoidance of reaming is considered beneficial – Modification of external fixator treatment	– Subtrochanteric fractures – Pseudoarthrosis, non-union – Multiple trauma patients*
– As for UFN/CFN standard locking, but with subtrochanteric fractures with an intact lesser trochanter	– Fractures with fractured lesser trochanter – Pseudoarthrosis, non-union of the femoral shaft – Multiple trauma patients*
– As for UFN standard locking, but with ipsilateral femoral neck fracture	– Fractures with fractured lesser trochanter – Pseudoarthrosis, non-union of the femoral shaft – Multiple trauma patients*
– As for UFN/CFN standard locking, but with subtrochanteric fractures with intact lesser trochanter	– Fractures with fractured lesser trochanter – Pseudoarthrosis, non-union of the femoral shaft – Multiple trauma patients*

* Multiple trauma patients with a serious lung injury, major head injury, haemodynamic instability, coagulopathy or hypothermia should be stabilized according to the principles of damage control

Implants

PFN Proximal Femoral Nail, standard
TAN, unreamed, for procedures with or without reaming

PFN Proximal Femoral Nail, long
TAN, cannulated, for procedures with or without reaming

DFN Distal Femoral Nail
TAN, unreamed, for procedures with or without reaming

Indications	Indication restrictions
– Inter- and high subtrochanteric fractures, incl. unstable fractures – Pertrochanteric fractures	– Long subtrochanteric or shaft fractures – Pseudoarthrosis, non-union of the femoral shaft – Femoral neck fractures (isolated or combined) – Multiple trauma patients*
– Long subtrochanteric fractures – Pertrochanteric fractures – Combined inter-, subtrochanteric and ipsilateral shaft fractures – (Impending) pathological fractures	– Femoral neck fractures (isolated or combined) – Multiple trauma patients*
– Fractures 33-A1–3 – Fractures 33-C1–2 – Femoral shaft fractures of the distal third 32-A1–C3	– Fractures AO 33-C3 – Fractures AO 33-B1–3 – Proximal shaft- and subtrochanteric fractures

* Multiple trauma patients with a serious lung injury, major head injury, haemodynamic instability, coagulopathy or hypothermia should be stabilized according to the principles of damage control

Indications for UFN/CFN

The unreamed femoral nail (UFN) and the cannulated femoral nail (CFN) are used to stabilize diaphyseal and metaphyseal fractures of the femur. The UFN is preferably used with the unreamed technique while, since it is cannulated, the CFN is primarily used with the reamed technique using a guide wire.

Locking

The nail must be inserted carefully so as to limit the distraction on the fractured side (healing promotion).

The distal end should be locked first. Before locking the proximal end, ensure that the fracture is not distracted. To close any fracture gap in a simple fracture, knock back the distally locked bone fragment with the slotted hammer. Placing screws in both distal locking holes minimizes screw deformation.

In general, the femoral nails must be locked both proximally and distally.

Axially stable and rotationally unstable fractures can be locked dynamically in the long slot (primary dynamization).

Axially and rotationally unstable fractures should be locked statically both proximally and distally.

In cases where stability cannot be assessed, or can only be assessed with difficulty, the more restrictive form of locking should always be selected.

Dynamization

In the nailing of femoral fractures, secondary dynamization (removal of the static proximal locking bolt) does not play an important role and should not be performed as a matter of routine. Dynamization is possible however if significant distraction is present. If no callus has formed in a later treatment phase (after 3 or more months), dynamization alone is not normally beneficial.

Weight-bearing

The fracture type, fracture site, soft tissue situation and bone quality should be taken into account when deciding on weight-bearing.

Partial weight-bearing (contact with the sole of the foot or 15 kg) is the initial situation for weight-bearing on the broken leg. Full weight-bearing should be avoided.

The increase in weight-bearing is determined by the fracture type, fracture site, soft tissue situation and bone quality and also by the presence or absence of pain on weight-bearing.

A Standard locking

Two standard locking configurations are possible: static transverse and dynamic transverse locking.

Indications: femoral shaft fractures

B Spiral blade locking

The spiral blade provides secure fixation of the proximal fragment and good stability for pathological or impending pathological subtrochanteric fractures. A static locking bolt may be used in conjunction with the spiral blade locking technique.

Indications: Subtrochanteric fractures

Contraindications: inter- and pertrochanteric fractures

C Miss-A-Nail technique

The Miss-A-Nail technique permits insertion of cannulated screws into the femoral head prior to or after intramedullary fixation of the shaft fracture. In cases of occult fractures of the femoral neck, it also permits screw insertion into the femoral head after nail insertion.

Indications: Ipsilateral femoral neck or shaft fractures

Contraindications: fractures with a detached lesser trochanter

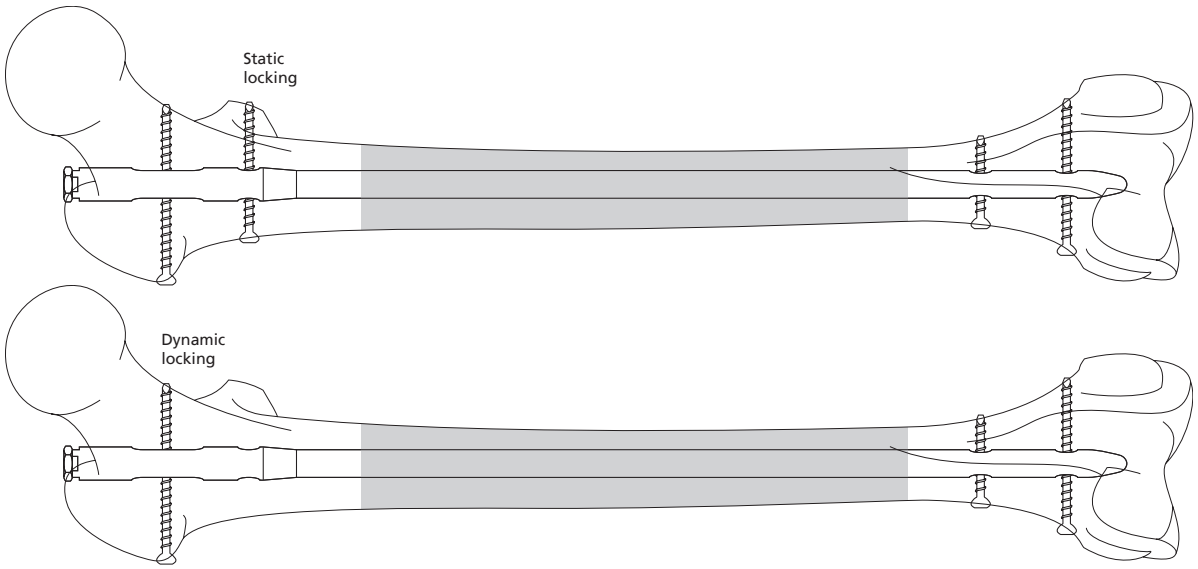
D 130° Antegrade locking

In 130° antegrade locking, a static locking bolt may be optionally used in addition.

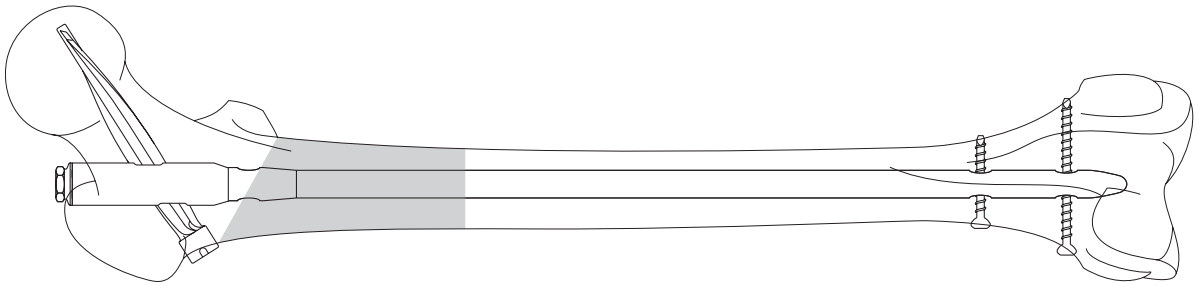
Indications: femoral shaft fractures or stable subtrochanteric fractures

Contraindications: fractures with a detached lesser trochanter

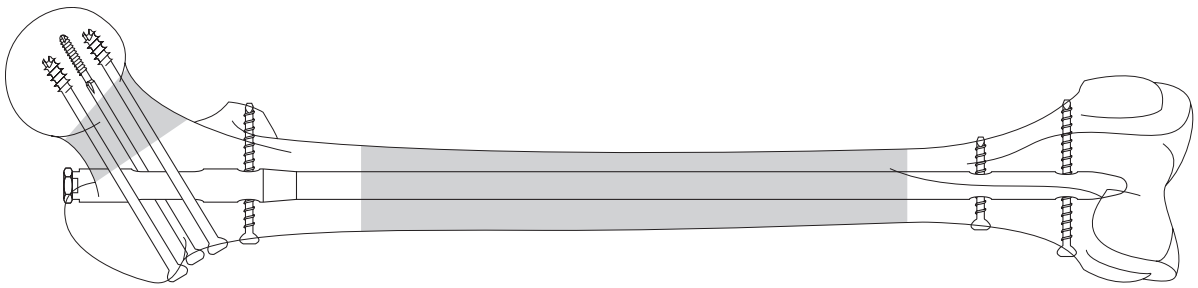
A



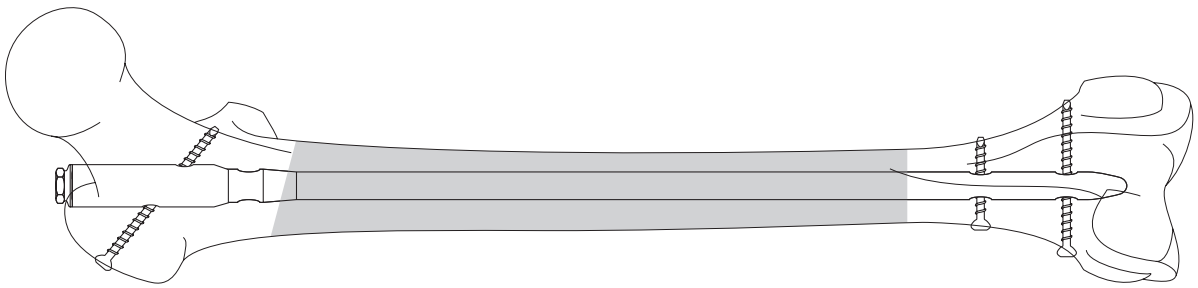
B



C

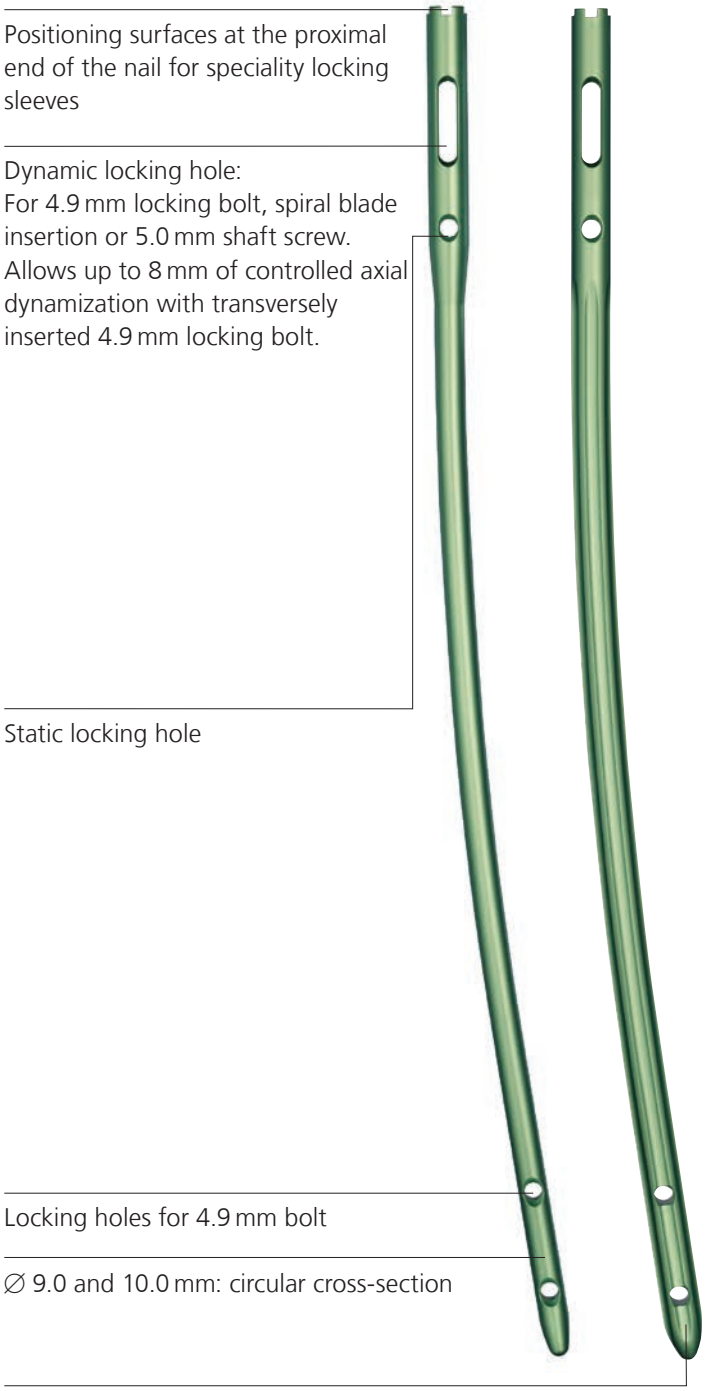


D



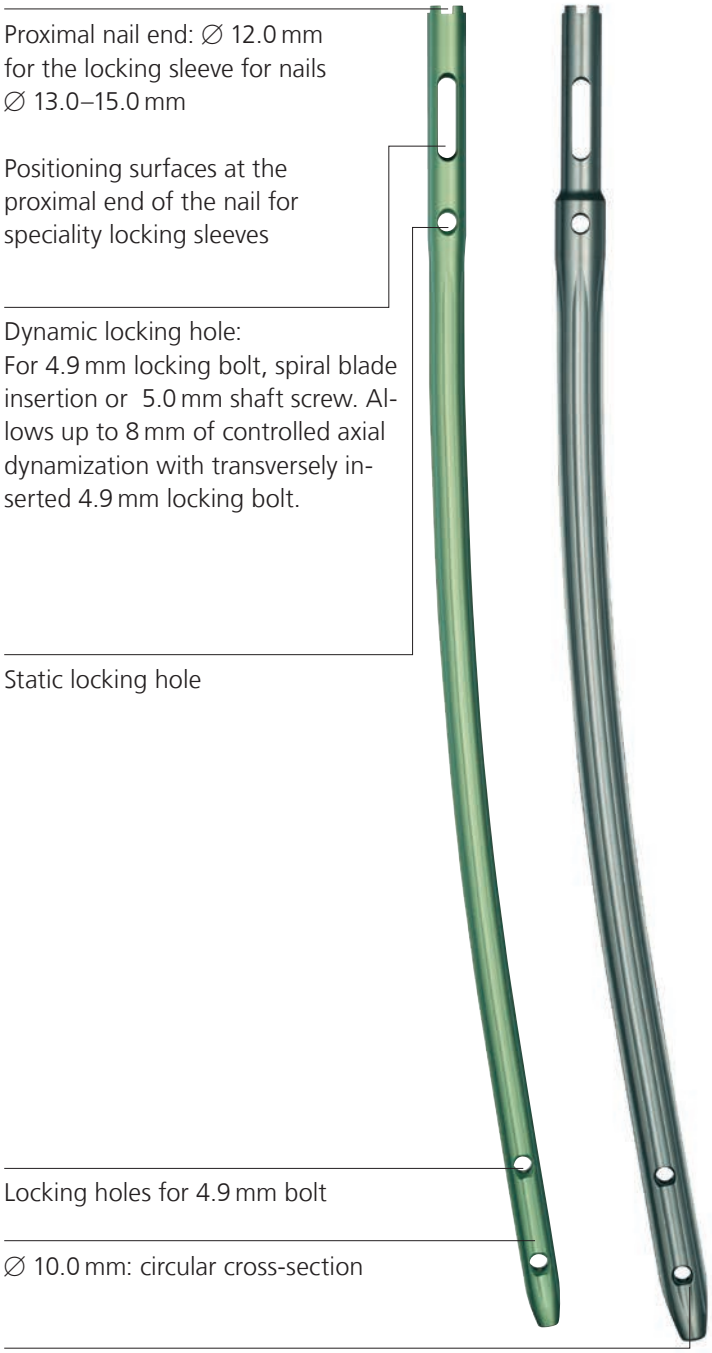
UFN Unreamed Femoral Nail (green)

- Universal design: for left or right femur
- Material: implant material: TAN (Ti-6Al-7Nb)
- Diameter: 9.0 and 10.0 mm: circular cross-section 11.0 and 12.0 mm: grooved cross-section
- Proximal nail end: 12.0 mm
- Lengths: 300–480 mm, in 20 mm increments
- Radius of curvature of the nail: 1.5 m



CFN Cannulated Femoral Nail (green)

- Universal design: for left or right femur
- Material: implant material: TAN (Ti-6Al-7Nb)
- Diameter: 10.0 mm: circular cross-section
  11.0–15.0 mm: grooved cross-section
- Proximal nail end: 12.0 mm
- Lengths: 300–480 mm, in 20 mm increments
- Radius of curvature of the nail: 1.5 m



Implant for distal locking
(for all locking procedures)

Locking bolts ∅ 4.9 mm
- TAN (Ti-6Al-7Nb)
- Lengths: 26–100 mm, in 2 or 5 mm increments
- Core diameter: 4.3 mm
- Self-tapping trocar tip

Implants for Proximal Locking

A Standard locking

End caps

- TAN (Ti-6Al-7Nb)
- Protect the proximal nail thread against tissue ingrowth
- Extensions of 10 and 20 mm: extend the proximal nail end to the level of the greater trochanter

– ∅ 12.0 mm (prox. ∅) – for UFN de ∅ 9.0–12.0 mm and CFN ∅ 10.0–12.0 mm	– ∅ 15.0 mm (prox. ∅) – for CFN ∅ 13.0–15.0 mm – Secures the locking sleeve statically to the nail

Locking sleeves TAN

- TAN (Ti-6Al-7Nb)
- ∅ 15.0 mm
- Positioning surfaces at the upper end correspond to those of the proximal nail end and engage in 2 positions, for left or right femur. Marking helps identify the lateral side

Not required	Shape of the sleeve matches the proximal profile of the 13.0–15.0 mm nails, providing a smooth transition to the nail

Locking

Locking bolts ∅ 4.9 mm

- TAN (Ti-6Al-7Nb)
- Lengths: 26–100 mm, in 2–5 mm increments
- Core diameter ∅ 4.3 mm
- Self-tapping trocar tip

B Spiral blade locking	C Miss-A-Nail technique		D 130° locking
– ∅ 15.0 mm (prox. ∅) – Secures the locking sleeve statically to the nail – Tip made of UHMWPE (Ultra High Molecular Weight Polyethylene implant material): Deforms over the spiral blade to secure the blade during the postoperative period.	– ∅ 12.0 mm (prox. ∅) – for UFN ∅ 9.0–12.0 mm and CFN ∅ 10.0–12.0 mm	– for CFN ∅ 13.0–15.0 mm – not recommended	– ∅ 15.0 mm (prox. ∅) – Secures the locking sleeve statically to the nail
100°, 110°, 120° angles: For adapting the dynamic locking hole to receive the spiral blade			The dynamic locking hole becomes a 130° antegrade locking hole
Spiral blade – TAN (Ti-6Al-7Nb) – Lengths: 70–120 mm, in 5 mm increments – Cannulated: For insertion over a guide wire ∅ 3.2 mm with calibrations – Self-tapping tip – Winding of the spiral: 104–122.5° from the head attachment to the tip – Width: 12–12.5 mm	**Screws** – TAN (Ti-6Al-7Nb) – 16 mm long cancellous thread: for interfragmental compression – Lengths: 70–125 mm, in 5 mm increments **Cannulated screws ∅ 7.3 mm** – Self-drilling/self-tapping – Reverse-cutting flute **Shaft screws ∅ 5.0 mm** – ∅ 5.0 mm: For insertion through the dynamic locking hole, as a third fixation point for the femoral neck fracture – Self-tapping **Washers (optional)** – ∅ 13.0 mm – Pure titanium		**Locking bolts ∅ 4.9 mm** – TAN (Ti-6Al-7Nb) – Lengths: 26–100 mm, in 2–5 mm increments – Core diameter ∅ 4.3 mm – Self-tapping trocar tip

The UFN/CFN rulers are used to determine the following measurements during the preoperative planning:

– Nail length
– Nail diameter
– Angle for spiral blade insertion (if indicated)
– Position of the locking holes.

When selecting the nail size, consider the anatomical medullary canal diameter, fracture pattern, and postoperative protocol/expectations.

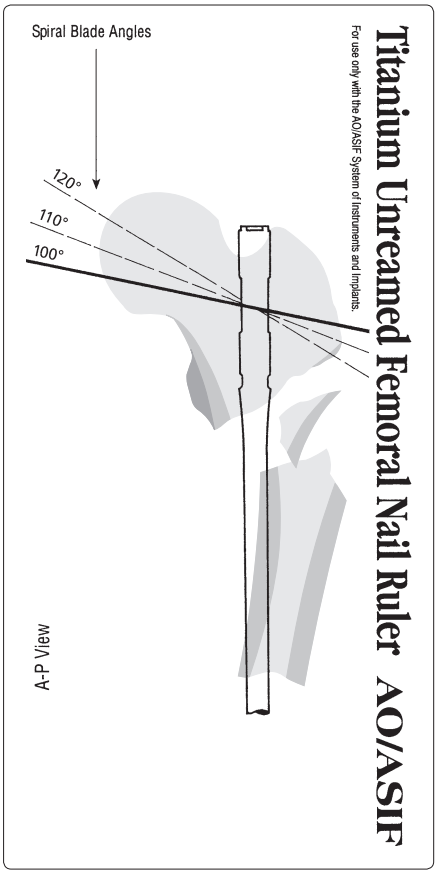
Note: For all locking procedures note that all ruler images are enlarged 15% to account for average radiograph magnification. However, deviations in magnification levels are common.

Spiral blade locking

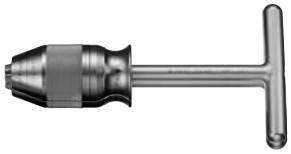
The spiral blade should be in the proximal fragment and should not cross the fracture line. The angle for spiral blade insertion is determined by the anatomical situation and the position of the fracture. Consequently, the spiral blade is often inserted at a narrower angle (e.g. 100°) in high subtrochanteric fractures.

To determine the spiral blade angle, place the radiographic ruler (357.590) over the preoperative x-ray. The blade tip should lie just inferior to the intersection of the compression and tension trabeculae in the AP view of the femoral head, and the midsection of the blade should lie in the inferior aspect of the femoral neck. Since the trabecular intersection is the densest area of bone in the femoral head, this blade placement maximizes purchase and cutout resistance.

In the example shown opposite, the measured 100° angle will place the spiral blade inferior to the trabecular intersection and fully in the proximal fragment.



Instruments for opening the femur

Instruments for opening the femur		Escala	
357.630	Guide Wire ∅ 3.2 mm, calibrated, length 300 mm	25%	
357.531	Drill Sleeve 15.0/3.2, for 357.530	30%	
357.530	Protection Sleeve 17.0/15.0mm, for 357.531	20%	
351.270	Drill Bit ∅ 13.0 mm, cannulated, length 290 mm, 3-flute, for quick coupling No. 511.760	20%	
393.100	Universal Chuck with T-handle	25%	
351.110	Reverse Awl for UFN/CFN ∅ 13 mm	20%	
351.890	Broach ∅ 16.0 mm, for UFN and CFN	20%	
357.590	Radiographic Ruler for Femoral Nails	31%	
511.701	Compact Air Drive II		
511.790	Quick Coupling for Kirschner Wires ∅ 0.6 to 3.2 mm, for Compact Air Drive and Power Drive		
511.760	Quick Coupling for DHS/DCS Triple Reamers, for Compact Air Drive and Power Drive		
519.510	Double Air Hose, length 3 m, for System Synthes		

Open the femur (all locking procedures)

1

Position patient

Position the patient in the supine or lateral decubitus posi
tion, if necessary on a fracture table. Position the image intensifier so that true AP and lateral views are possible.

2

Reduce fracture

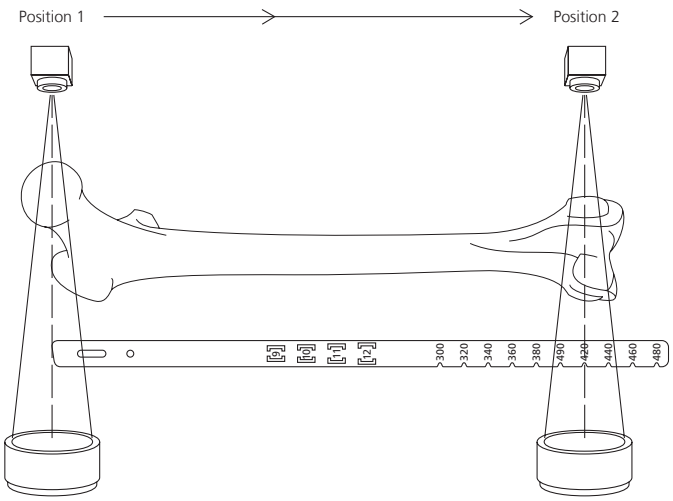
Reduce the fracture. The large distractor may be used if indicated.

3

Confirm nail length

Position the image intensifier for an AP view of the proximal femur. Using a long forceps, hold the radiographic ruler (357.590) alongside the lateral aspect of the thigh parallel to, and at the same level as, the femur. Adjust the image intensifier so that the beam is centred between the femur and radiographic ruler; this will prevent magnification errors. Adjust the ruler until the top is level with the tip of the greater trochanter. Mark the skin at the top of the radiographic ruler (position 1).

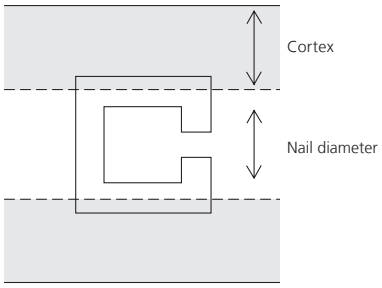
Position the image intensifier over the distal femur, place the proximal end of the radiographic ruler at the skin mark, and take an AP image of the distal femur (position 2). Verify fracture reduction. Read nail length directly from the ruler image, selecting the measurement that is at, or just proximal to, the physeal scar, or at the chosen insertion depth.



4

Confirm nail diameter

Position the radiographic ruler over the femur so that the square marking is over the isthmus. If the medullary canal/cortex transition is still visible on both sides of the marking, the corresponding nail diameter may be used.



5

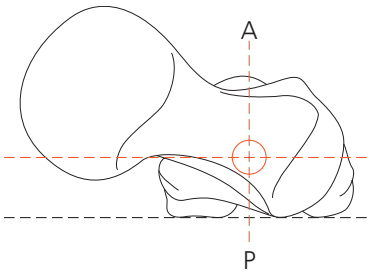
Skin incision and surgical approach

Make a stab incision about 3 cm long approximately 10–15 cm above the tip of the trochanter and towards the tip[1].

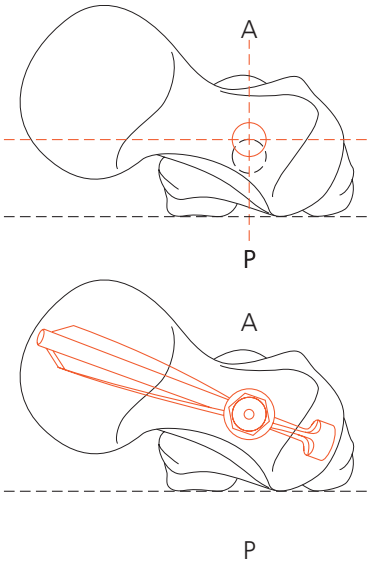
6

Identify nail entry point

For standard locking, antegrade locking, and Miss-A-Nail technique: The entry point of the nail is in line with the medullary canal in the AP and lateral views. This point is posterior in the proximal femur, in the piriformis fossa, but varies with patient anatomy.



For spiral blade locking: It may be advantageous to adjust the nail insertion site slightly towards the anterior for spiral blade locking. Estimate the insertion path of the spiral blade. The spiral blade should pass through the centre of the femoral neck; significant misdirection could cause the blade to cut out of the neck.

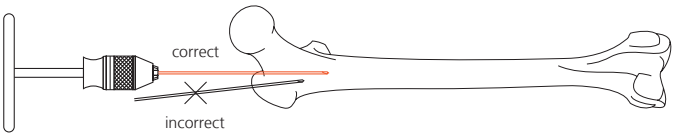


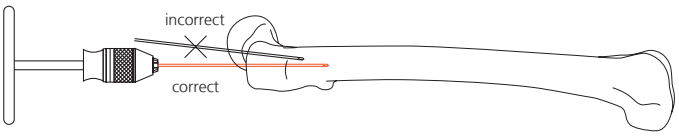
[1] Krettek C, Schulte-Eistrup S, Schandelmaier P, Rudolf J, Tscherne H (1994) Osteosynthese von Femurschaftfrakturen mit dem unaufgebohrten AO-Femurnagel (UFN) – Operative Technik und erste klinische Ergebnisse mit Standardverriegelung.Unfallchirurg 97: 549–567

7

Open the medullary canal

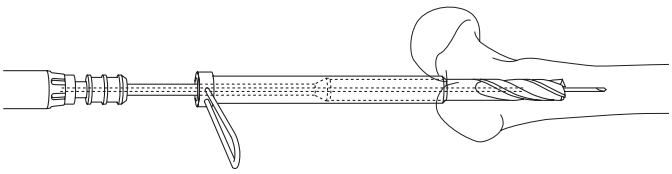
Make a longitudinal incision proximal to the greater trochanter, through the gluteus medius. Using the universal chuck (393.100) insert the ∅ 3.2 mm calibrated guide wire (357.630) through the incision into the medullary canal to a depth of 10 cm. Confirm the direction and depth with AP and lateral image intensification views.



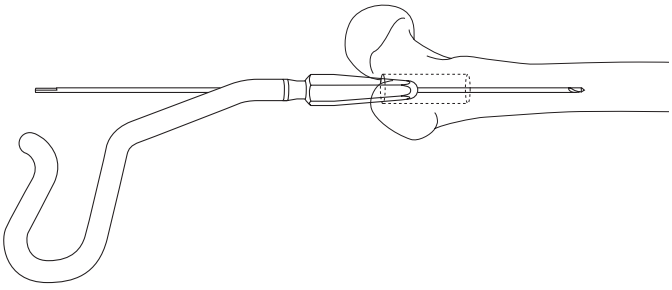


Introduce the protection sleeve 17.0/15.0 (357.530) together with the drill sleeve 15.0/3.2 (357.531) and remove the drill sleeve.

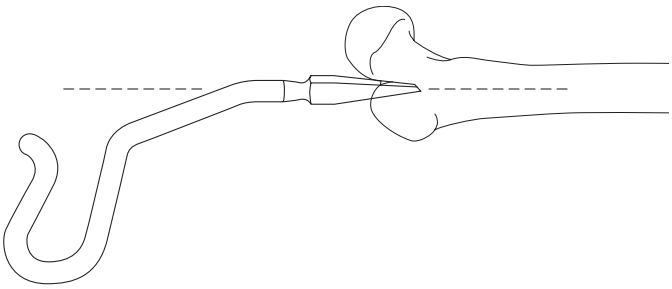
Push the cannulated drill bit ∅ 13.0 mm (351.270) over the guide wire, and drill the medullary canal to a depth of 10 cm, approximately to the level of the lesser trochanter. This opening will accommodate the proximal end of 9.0 to 12.0 mm diameter nails for a length of approximately 90 mm. Remove the drill bit, sleeve, and wire.



For speciality locking procedures and for 13.0–15.0 mm diameter nails, use the Broach ∅ 16.0 mm (351.890) to enlarge the medullary canal accordingly. Introduce the broach fully into the canal with a twisting hand motion and remove the guide wire.



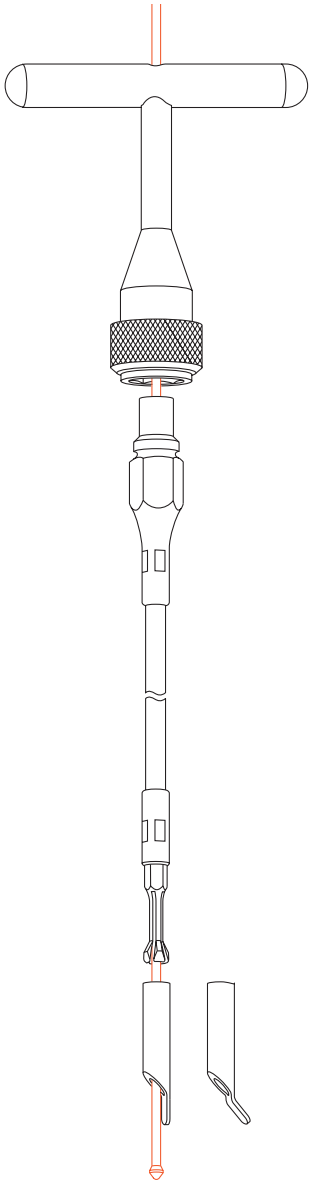
Alternative: The reverse awl for UFN/CFN (351.110) may also be used for identifying the nail entry point and for opening the medullary canal, particularly in obese patients.



8

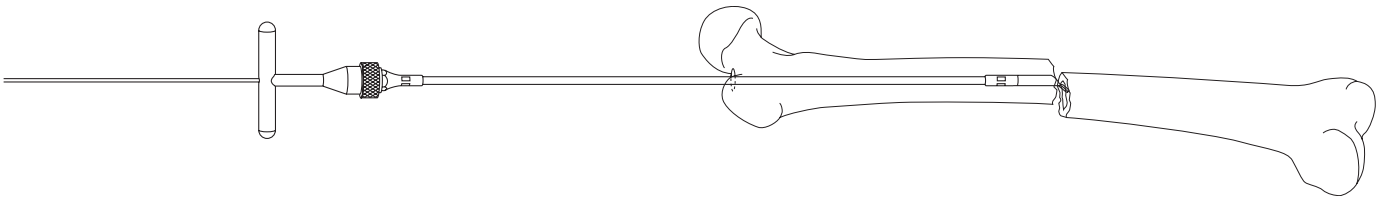
Ream medullary canal with SynReam (optional)

1 Assemble reduction system
Assemble the reduction system of the SynReam Intramedullary Reaming System (189.060): attach the T-Handle (351.150) at the rear of the SynReam Flexible Shaft (352.040) and a Reduction Head (352.050 or 352.055) at the front.

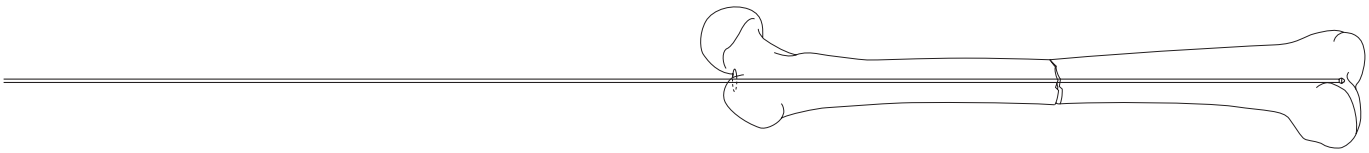


2 Reduce fracture
To secure the reduction head, insert the SynReam Reaming Rod ∅ 2.5 mm (352.032, length 950 mm or 352.033, length 1150 mm) in a retrograde direction up to the olive, ensuring that the olive is located in the reduction head. Insert the assembled reduction system over the SynReam reaming rod into the medullary canal and reduce the distal fragments under image intensifier control.

Note: Always reduce over the reaming rod, since secure fixation can only be ensured if the reduction system is used in conjunction with the reaming rod. Using the reduction system without the reaming rod entails the risk of losing the reduction head in the medullary canal.

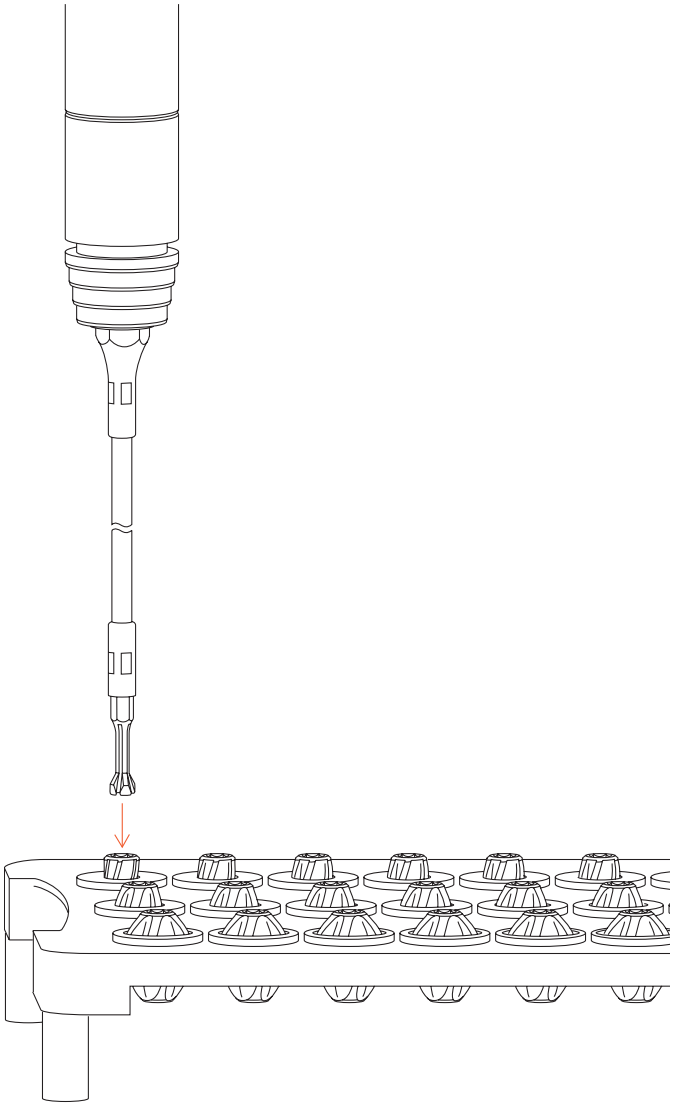


3 Remove reduction instruments
After completing the reduction, remove the reduction instruments with the exception of the reaming rod, which must remain in the medullary canal.

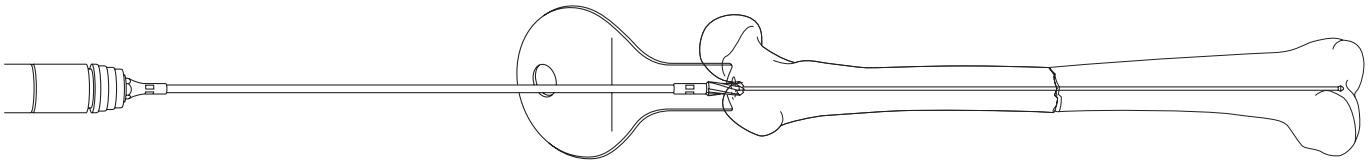


4 Assemble the reaming system
Connect the SynReam Flexible Shaft (352.040) to the drill and insert the first SynReam Medullary Reamer (352.085) into the shaft. The reamers can be picked up directly, without hand contact, from the insert for medullary reamers using the SynReam flexible shaft.

Start with the smallest reamer (∅ 8.5 mm, 352.085) and then increase in 0.5 mm increments using the larger reamers (352.090–190). The reaming depth should be identical to the chosen nail length.

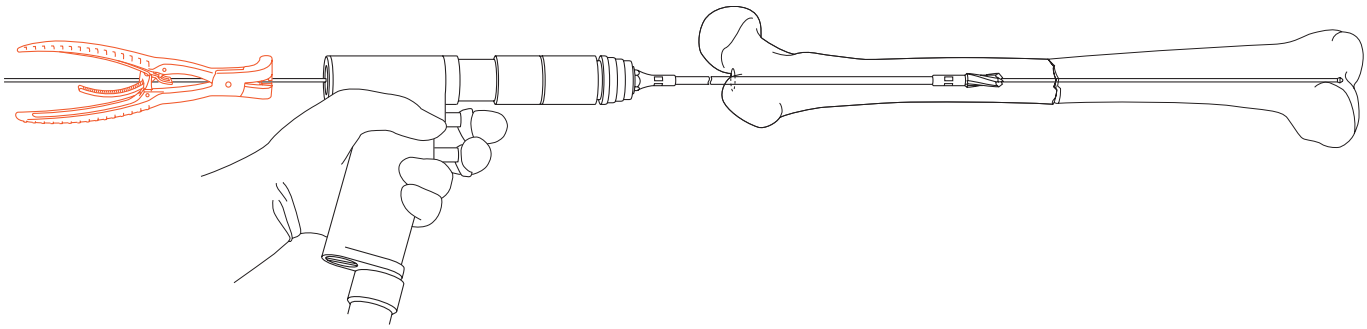


5 Insert reaming system
Insert the assembled reaming system, without rotating it, over the SynReam reaming rod into the medullary canal. Use the Tissue Protector (351.050) to spare the soft tissues.



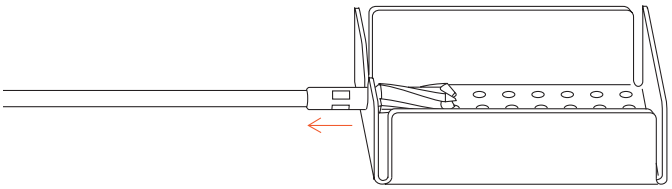
6 Ream medullary canal
Ream the medullary canal according to the standard procedure. Advance the reamer slowly and steadily at maximum drill speed. Secure the SynReam Reaming Rod with the Holding Forceps for SynReam Reaming Rod (351.782) to prevent it from rotating.

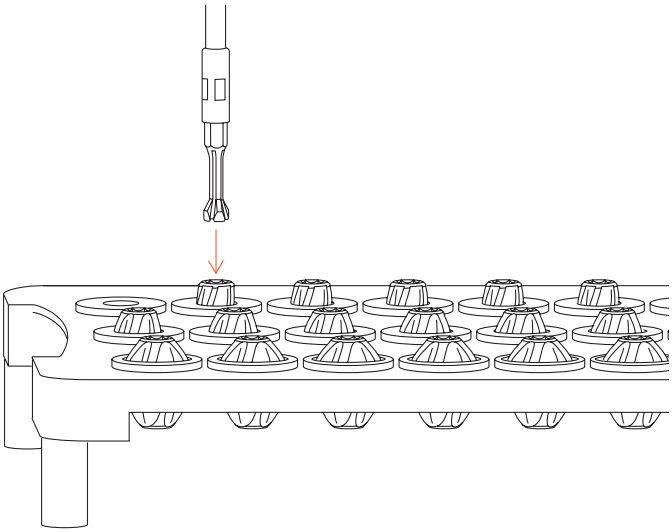
Note: Only ream over the SynReam Reaming Rod ∅ 2.5 mm (352.032, length 950 mm or 352.033, length 1150 mm), since the rod ensures that a secure connection is maintained between the reamer and the flexible shaft.



7 Change reamer
Having reamed the medullary canal along its full length, retract the SynReam flexible shaft with the first reamer until the whole reamer is visible. Grasp the reaming rod with the Holding Forceps for SynReam Reaming Rod (351.782) immediately above the bone insertion point and hold in situ to avoid loss of reduction. Draw the SynReam flexible shaft through the slot on the Push-off Instrument for SynReam Medullary Reamers (689.063) so as to remove the reamer without touching the used reamer.

The reamer of the next size up can be picked up directly, without hand contact, from the insert for medullary reamers using the SynReam flexible shaft.

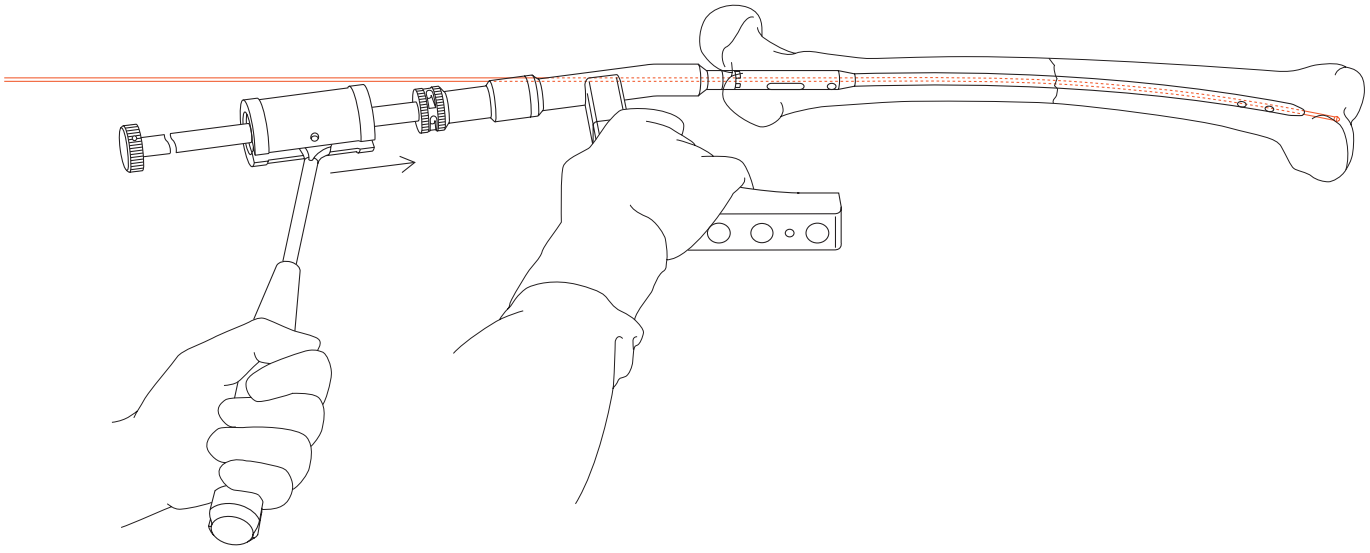




8 Complete medullary reaming
Repeat steps 5 to 7 for each additional reamer (352.090–190) until the medullary canal is reamed to the desired diameter. Reaming is usually performed with increments of 0.5 mm.

Notes:
- Only ream over the SynReam Reaming Rod ∅ 2.5 mm (352.032 or 352.033), since the rod ensures that a secure connection is maintained between the reamer and the flexible shaft.
- Loosen blocked medullary reamers with left-right turns or with gentle hammer taps to the Holding Forceps for SynReam Reaming Rod (351.782) fastened to the SynReam Reaming Rod ∅ 2.5 mm (352.032 or 352.033).

9 Insert nail
Introduce the nail directly over the SynReam Reaming Rod ∅ 2.5 mm (352.032 or 352.033). The SynReam reaming rod does not need to be replaced by the guide wire for nails, although the speciality Connecting screw for CFN/ AFN for SynReam (398.335) must be used for this technique.



Implants and Instruments for Standard Locking A

Available non-sterile or sterile packed.
Add "S" to the catalogue number to order sterile products.

Instruments and Implants for standard locking A		Escala	
459.01x	End Cap for Standard Locking UFN ∅ 12.0 mm, TAN, green	35%	
464.xxx	UFN – Solid Femoral Nail ∅ 10–12 mm, length 300–320 mm, Titanium Alloy (TAN), green, 465.300–465.480, 466.320–466.480, 467.300–467.480	25%	
474.920– 474.922	End Cap for Standard Locking CFN ∅ 15.0 mm, TAN, green	35%	
474.900– 474.912	Locking Sleeve for CFN 13.0–15.0 mm, TAN, green	35%	
474.028	CFN – Cannulated Femoral Nail, length 300–480 mm, Titanium Alloy (TAN), green, 474.031–048, 474.131–148, 474.231–248, 474.331–348, 474.431–448, 474.531–548	25%	
474.928– 474.942	CFN Cannulated Femoral Nail, length xxx mm, TAV, green CFN Cannulated Femoral Nail, length xxx mm, TAN, green		
459.260– 459.960	Locking Bolt ∅ 4.9 mm, self-tapping, length 26 mm, Titanium Alloy (TAN), green	35%	
314.750	Screwdriver, hexagonal, large, ∅ 3.5 mm, with Groove	20%	
511.701	Compact Air Drive II		
511.750	AO/ASIF Quick Coupling, for Compact Air Drive and Power Drive		
519.510	Double Air Hose, length 3 m, for System Synthes		
357.521	Insertion Handle for UFN/CFN	15%	
398.335	Connecting Screw for CFN/AFN for SynReam	35%	
357.515	Screwdriver, hexagonal, with spherical head ∅ 8.0 mm	20%	
357.180	Driving Cap for UFN/CFN	25%	
357.220 357.250	Hammer Guide, for No. 357.250 Slide Hammer, for Nos. 357.220 and 357.221	15%	
399.430	Hammer 700 g	15%	

321.160	Combination Wren ∅ 11.0 mm	25%	
321.210	Socket, hexagonal ∅ 11.0 mm	30%	
321.170	Pin Wrench ∅ 4.5 mm, length 120 mm	25%	
357.570	Standard Aiming Arm for UFN/CFN	20%	
357.710	Drill Sleeve 8.0/4.0, for No. 357.760, green	30%	
357.760	Protection Sleeve 11.0/8.0, for UFN/CFN, green	30%	
357.750	Trocar ∅ 4.0 mm, for no. 357.710, green	30%	
357.630	Guide Wire ∅ 3.2 mm, calibrated, length 300 mm	25%	
356.980	Drill Bit ∅ 4.0 mm, calibrated, length 270/245 mm, 3-flute, for Quick Coupling	25%	

Optional instruments		Percentage of actual size	
357.790	Depth Gauge for Locking Bolts, measuring range from 26 to 100 mm	20%	
321.200	Ratchet Wrench for Nut, hexagonal, 11.0 mm	25%	
357.181	Driving Cap for UFN/CFN, with Quick Coupling Connection	20%	
357.221	Hammer Guide with Quick Coupling, for No. 357.250	20%	
357.222	Cap Nut for Hammer Guide with Quick Coupling	30%	
357.540	Connecting Screw for UFN (cannot be used for CFN)	25%	
357.516	Coupling Shaft, cannulated, ∅ 8.0 mm, for No. 398.335	20%	
352.032/ 352.033	SynReam Reaming Rod ∅ 2.5 mm	20%	

Standard Locking A

The UFN/CFN allows two proximal standard locking configurations for the fixation of femoral shaft fractures: static transverse and dynamic transverse locking.

Open the femur

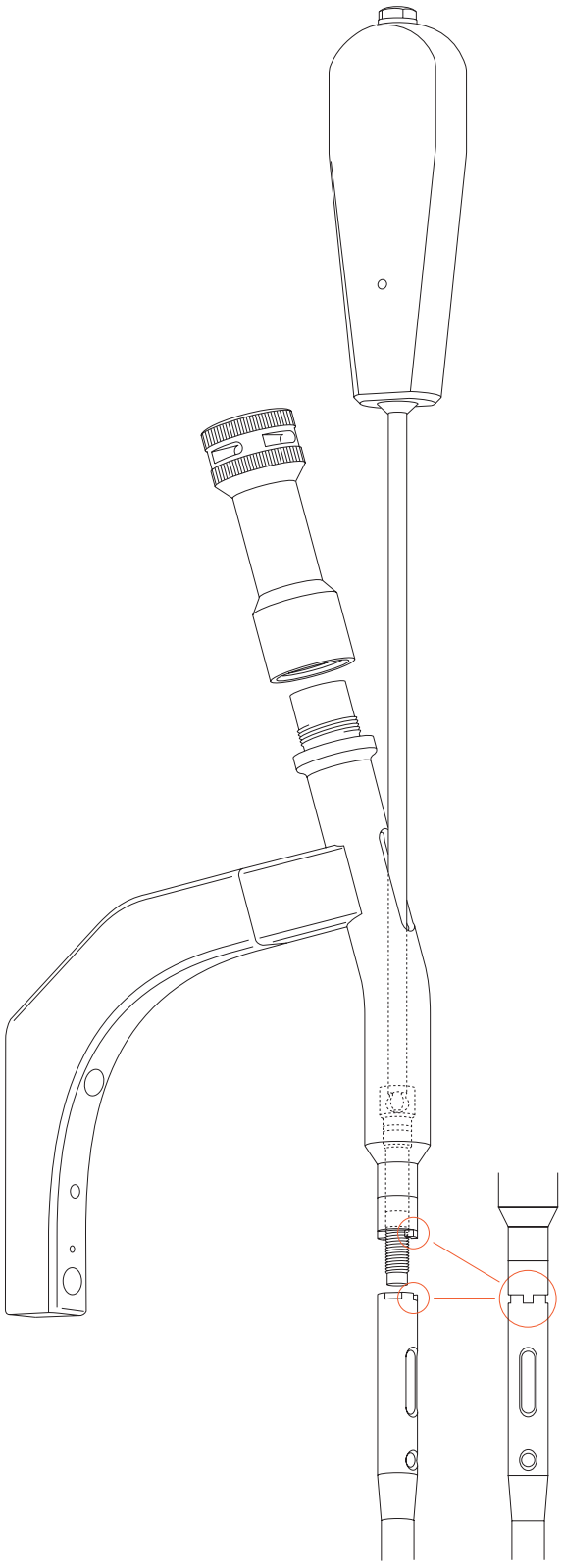
Follow the procedure described in steps 1 to 8 on pages 16 to 23.

9 Standard locking A

Assemble the insertion instruments

If a 13.0–15.0 mm diameter nail is to be used, push the Locking Sleeve for CFN (474.900) over the proximal end of the nail before assembling the instruments.

Insert the cannulated Connecting Screw for CFN/AFN for SynReam (398.335) into the Insertion Handle (357.521). Connect the insertion handle to the nail so the handle orients laterally (convex side of the nail bow faces anteriorly). Use the Hexagonal Screwdriver with Spherical head ∅ 8.0 mm (357.515) to secure the connecting screw to the nail. Thread the Driving Cap (357.180) onto the insertion handle.



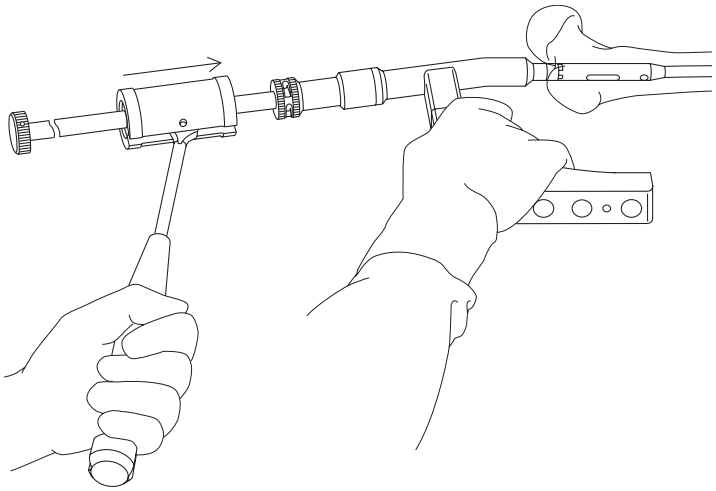
Alternative for UFN: Use the Unreamed Connecting Screw for UFN (357.540) and tighten with the Combination Wrench ∅ 11.0 mm (321.160).

Note: Do not attach the aiming arm to the handle until the nail is fully inserted in the medullary canal, since the arm can loosen during nail insertion.

10 Standard locking A

Insert nail

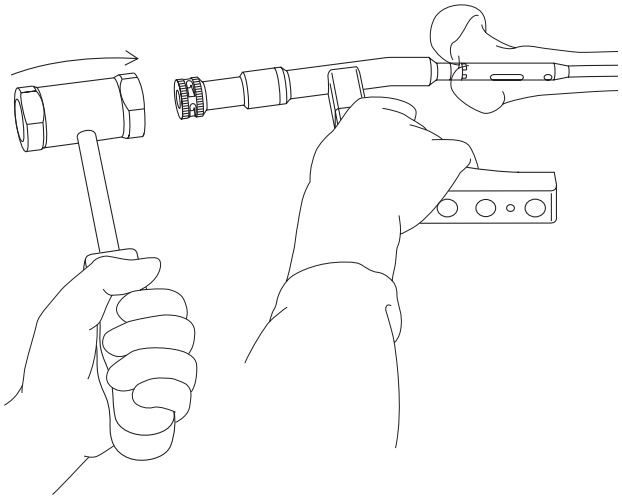
Insert the nail into the medullary canal with gentle twisting hand motion, using a CFN over the SynReam Reaming Rod ∅ 2.5 mm (352.032 or 352.033). The reaming rod passes through the opening on the side of the insertion handle. The insertion handle is oriented laterally. Verify fracture reduction, and insert the nail as far as possible by hand. Monitor nail passage across the fracture under image intensification. Use the insertion assembly to manipulate the nail across the fracture.



Note: If using the SynReam reaming rod, use the Connecting Screw CFN/AFN for SynReam (398.335).

If necessary use light blows of the hammer to advance the nail into the distal metaphysis, leaving the proximal nail end at or just below the level of the tip of the greater trochanter. You can use the Slide Hammer (357.250) and the Hammer Guide (357.220) for this operation, screwing the guide into the Driving Cap (357.180).

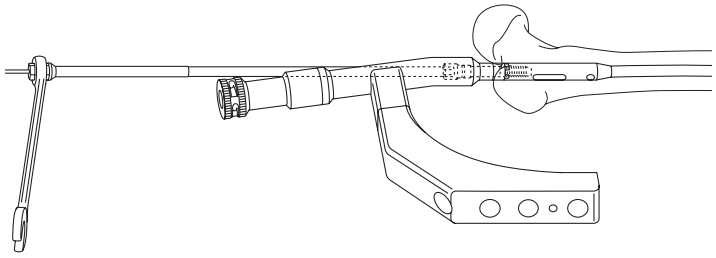
You may also use the Hammer 700 g (399.430) instead of the slide hammer and hammer guide. In this case, the proximal end of the driving cap is the direct striking surface for the hammer.



When nail overinsertion is required, you may exchange the nail or extend nail length with a green end cap (see steps 16 and 17, "Determine length of end cap/Place green end cap", pages 30 and 31).

If the nail was inserted over a SynReam Reaming Rod ∅ 2.5 mm (352.032 or 352.033) or guide rod, remove these now.

Notes: If the connecting screw has loosened during insertion, the Cannulated Coupling Shaft (357.516) and Combination Wrench 11.0 mm (321.160) may be used to retighten the connecting screw.



During final seating of the nail, the fracture may distract. In standard locking situations, distal locking can be performed prior to proximal locking, and the fracture gap can be closed by gently hammering the nail backwards.

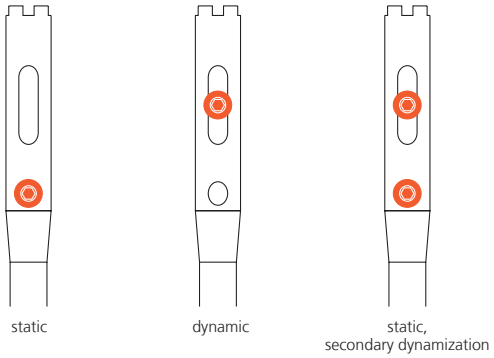
11 Standard locking A

Proximal locking

For static interlocking, insert a 4.9 mm locking bolt (459.xxx) through the round hole. For added rotational control, insert a second bolt through the dynamic slot. For subsequent, controlled axial dynamization of the fracture, the static locking bolt may be removed at a later date.

For immediate dynamization, insert a locking bolt only through the proximal slot in the nail.

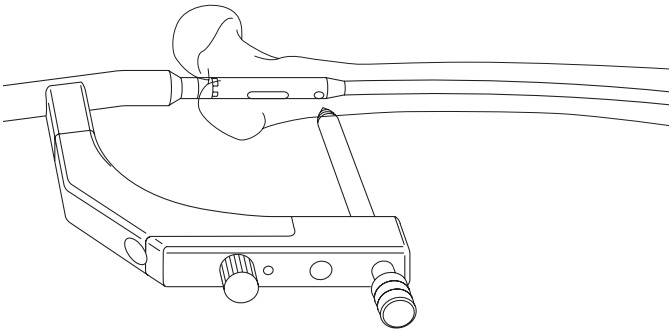
Before you start interlocking, make sure that the insertion handle is still tightly connected to the nail. You may need to retighten the connecting screw firmly in order to ensure exact placement of the locking bolt.



12 Standard locking A

Attach insertion handle and insert trocar combination

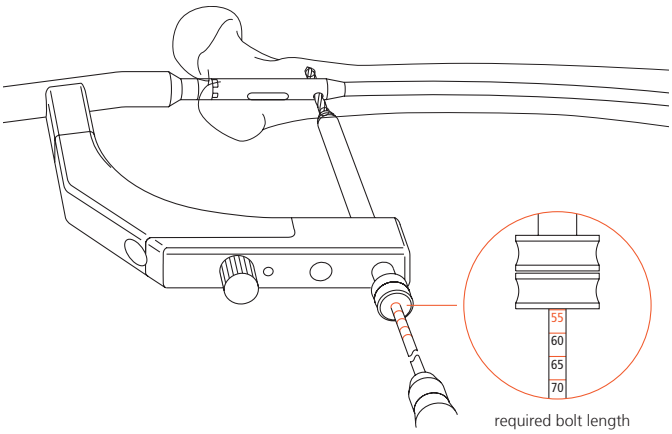
Attach the Standard Aiming Arm (357.570) to the insertion handle. Insert the green Drill Sleeve System (357.760/357.710/357.750) through the specially provided hole in the handle and advance through a stab incision down to the bone. Remove the trocar.



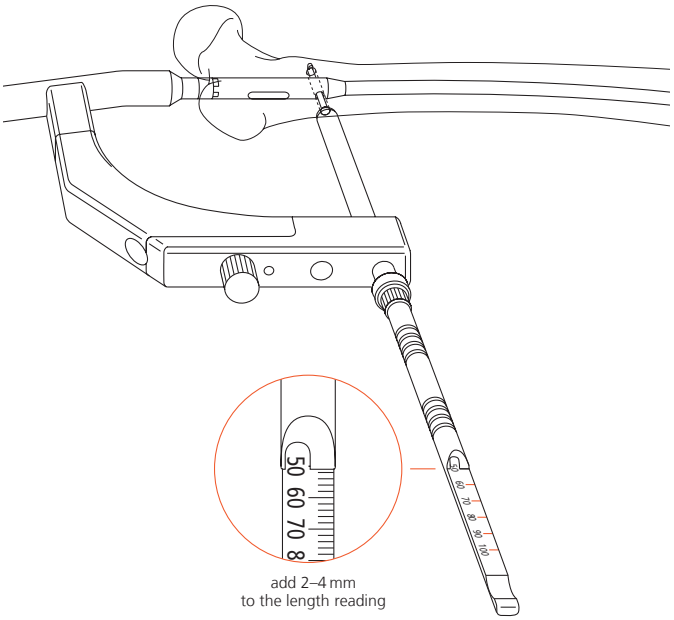
13 Standard locking A

Drill and determine length of the locking bolt

Drill through both cortices with the Calibrated Drill Bit ∅ 4.0 mm (356.980), stopping the drill immediately after penetrating the far cortex. Confirm drill bit position radiographically. Be sure the drill sleeve is pressed firmly to the cortex, and read locking bolt length directly from the calibrated drill bit on the back of the drill sleeve. Remove drill sleeve.



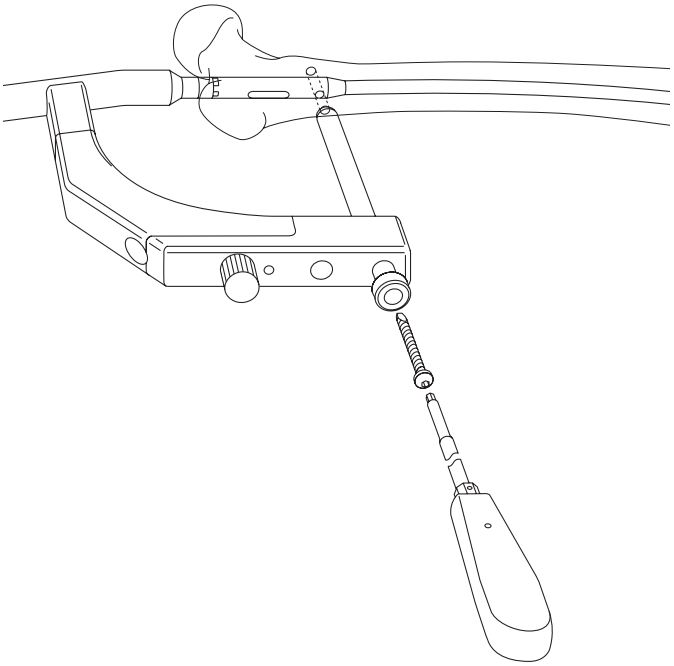
Alternative: With the drill sleeve removed, the Depth Gauge for Locking Bolts (357.790) may also be used to determine locking bolt length. Measure through the protection sleeve with the depth gauge, and add 2–4 mm to the reading to ensure thread engagement of the locking bolt in the far cortex.



14 Standard locking A

Insert locking bolt

Insert a Locking Bolt ∅ 4.9 mm (459.xxx) through the protection sleeve, using the large Hexagonal Screwdriver (314.750). Repeat the procedure for a second proximal locking bolt.



15 Standard locking A

Distal locking

The procedure is described in a separate section on pages 64 to 66.

16 Standard locking A

Determine length of end cap

With the insertion handle in place, take an AP image intensification view of the proximal femur. Note the position of the proximal nail end in relation to the tip of the greater trochanter. The nail end should be apparent due to a difference in nail and insertion handle diameters.

If the nail end is not visible, place a Calibrated Guide Wire ∅ 3.2 mm (357.630) through the corresponding hole in the aiming arm and insertion handle, and note wire position radiographically. This is the level of the proximal nail end. The notch on the insertion handle is likewise located at the level of the proximal nail end.

If the nail end is level with the tip of the greater trochanter, select the end cap without an extension.

If the proximal nail end is distal to the tip of the greater trochanter and the nail is to be lengthened, take into account the position of the insertion handle tube in relation to the tip of the greater trochanter on the image.

– If the indented calibration is at the tip of the greater trochanter, use the end cap with 10 mm extension.
– If the base of the flare is at the tip of the greater trochanter, use the end cap with 20 mm extension.

Note: For the standard and Miss-a-nail locking techniques, use the End Cap ∅ 12.0 mm (459.01x) of the corresponding length for all 9.0–12.0 mm diameter nails. For 13.0–15.0 mm diameter nails and standard locking, use the green End Cap ∅ 15.0 mm (474.92x) of the corresponding length to secure the green Locking Sleeve (474.900).

17 Standard locking A

Place green end cap

Remove the insertion instruments.

Using the large Hexagonal Screwdriver (314.750) or Hexagonal Socket (321.210) with Combination Wrench ∅ 11.0 mm (321.160), align the end cap with the nail axis to prevent cross-threading. Thread the end cap into the nail until it seats fully.

Implants and Instruments for Spiral Blade Locking B

Implants and instruments for spiral blade locking B

457.01x	End Cap for Spiral Blade, ∅ 15.0 mm, TAN, light blue	
456.070–456.120	Spiral Blade for UFN/CFN, TAN, light blue	
456.01x	Locking Sleeve for Spiral Blade, TAN, light blue	
464.xxx	UFN Unreamed Femoral Nail, Length xxx mm, TAN, green	
456.91x	Locking Sleeve for CFN ∅ 13.0–15.0 mm, TAN, green	
474.xxx	CFN Cannulated Femoral Nail, length xxx mm, TAN, green	
459.xxx	Locking Bolt ∅ 4.9 mm, self-trapping TAN, green	
314.750	Screwdriver, hexagonal, large, ∅ 3.5 mm, with Groove	
511.701	Compact Air Drive II	
511.750	AO/ASIF Quick Coupling, for Compact Air Drive and Power Drive	
511.790	Quick Coupling for Kirschner Wires ∅ 0.6 to 3.2 mm, for Compact Air Drive and Power Drive	
511.760	Quick Coupling for DHS/DCS Triple Reamers, for Compact Air Drive and Power Drive	
519.510	Double Air Hose, length 3 m, for System Synthes	
351.890	Broach ∅ 16.0 mm, for UFN and CFN	
357.521	Insertion Handle for UFN/CFN	
398.335	Connecting Screw for CFN/AFN for SynReam	
357.515	Screwdriver, hexagonal, with spherical head ∅ 8.0 mm	

357.180	Driving Cap for UFN/CFN	
357.220 357.250	Hammer Guide, for No. 357.250 Slide Hammer, for Nos. 357.220 and 357.221	
357.580	Special Aiming Arm for UFN/CFN	
357.820	Drill Sleeve 8.0/3.2 for No. 357.580, light blue	
357.960	Trocar ∅ 3.2 mm, for No. 357.820, light blue	
357.630	Guide Wire ∅ 3.2 mm, calibrated, length 300 mm	
351.230	Drill sleeve 13.0/3.2, for No. 351.280, light blue	
351.280	Protection Sleeve 15.0/13.0, for Nos. 357.270 and 357.310, light blue	
351.270	Drill Bit ∅ 13.0 mm, cannulated, length 290 mm, 3-flute, for quick coupling No. 511.760	
357.310	Impactor for Spiral Blade, for Nos. 357.340 and 357.341	
357.340	Connecting Screw for Spiral Blade for UFN/CFN, for No. 357.310	
321.170	Pin Wrench ∅ 4.5 mm, length 120 mm	
399.430	Hammer 700 g	
321.160	Combination Wrench ∅ 11 mm	
321.210	Socket, hexagonal ∅ 11.0 mm	

Optional instruments		Percentage of actual size	
357.341	Connecting Screw for Spiral Blade for UFN/CFN, with Quick Coupling Connection, for No. 357.310	20%	
357.181	Driving Cap for UFN/CFN, with Quick Coupling Connection	20%	
357.221	Hammer Guide with Quick Coupling, for No. 357.250	20%	
357.222	Cap Nut for Hammer Guide with Quick Coupling	30%	
357.601	Protective Cap for Quick Coupling Connection	25%	
357.570	Standard Aiming Arm for UFN/CFN	20%	
357.710	Drill Sleeve 8.0/4.0, for No. 357.760, green	30%	
357.760	Protection Sleeve 11.0/8.0, for UFN/CFN, green	30%	
357.750	Trocar ∅ 4.0 mm, for No. 357.710, green	30%	
357.790	Depth Gauge for Locking Bolts, measuring range from 26 to 100 mm	20%	
357.516	Coupling Shaft, cannulated, ∅ 8.0 mm, for No. 398.335	20%	
356.980	Drill Bit ∅ 4.0 mm, calibrated, length 270/245 mm, 3-flute, for Quick Coupling	20%	
352.032/ 352.033	SynReam Reaming Rod ∅ 2.5 mm		

Spiral Blade Locking B

The spiral blade provides secure fixation of the proximal fragment in subtrochanteric fractures, except for cases involving a detached lesser trochanter.

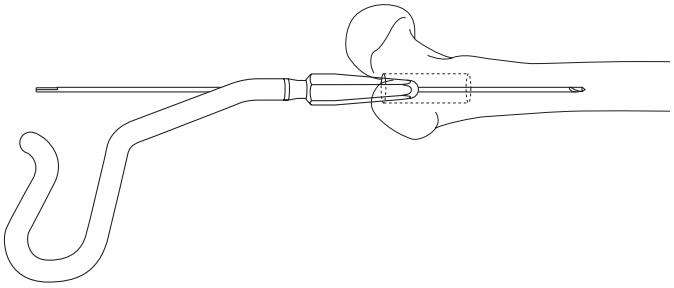
Open the femur

Follow the procedure described in steps 1 to 8, pages 16 to 23.

9 Spiral blade locking B

Enlarge the femoral opening

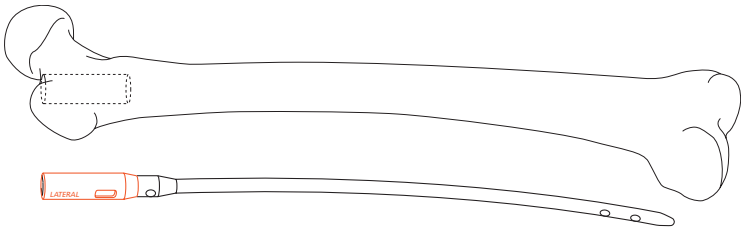
Fully insert the Broach (351.890) in the femoral opening using a twisting hand motion. The opening must be large enough to accommodate the locking sleeve for spiral blade.



10 Spiral blade locking B

Assemble implants

Select the correct spiral blade locking sleeve angle, as determined preoperatively (see page 12). Orient the blue Spiral Blade Locking Sleeve (456.01x/474.91x) to the nail so that the word "LATERAL" faces laterally (convex side of the nail bow faces anteriorly). Seat the locking sleeve onto the proximal nail end.



11 Spiral blade locking B

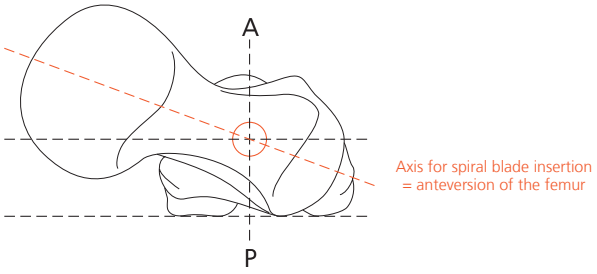
Assemble the insertion instrumentation

See step 9, Standard locking A, page 26.

12 Spiral blade locking B

Estimate insertion path of the spiral blade

Prior to nail insertion, estimate the insertion path of the spiral blade by considering both femoral anteversion and the nail insertion site. The spiral blade should pass through the centre of the femoral neck; significant misdirection could cause the blade to cut out of the neck.

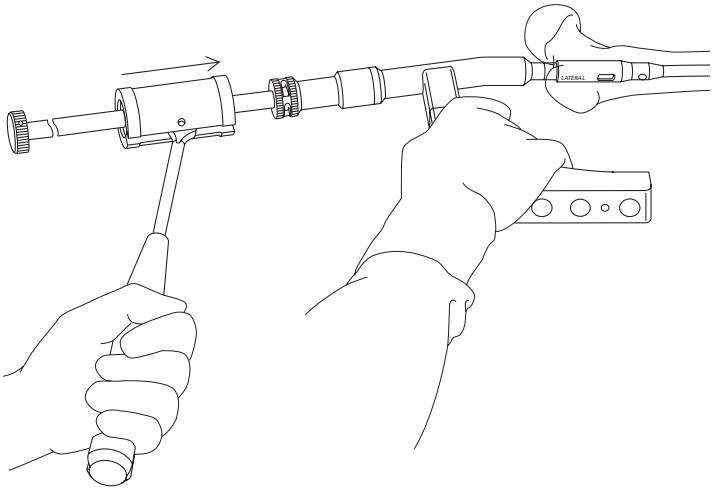


13 Spiral blade locking B

Insert nail

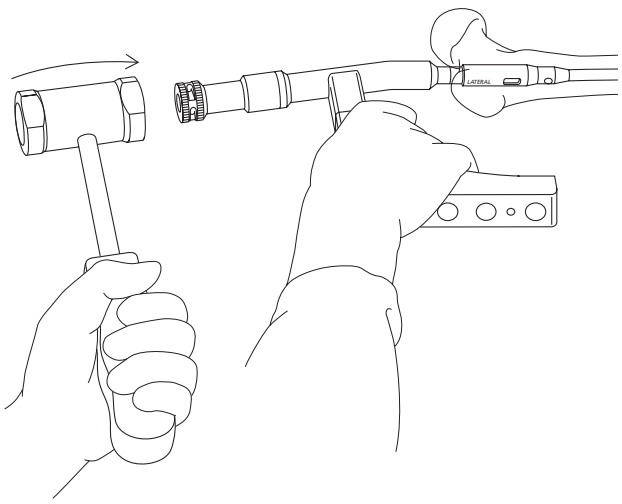
Manually insert the nail into the femoral opening. If a CFN is used, advance the nail over the SynReam Reaming rod ∅ 2.5 mm (352.032 or 352.033). The guide rod passes through the opening on the medial side of the insertion handle.

Verify fracture reduction, and insert the nail as far as possible into the medullary canal by hand with the insertion handle in this position. Monitor nail passage across the fracture under image intensification. The insertion handle is oriented to the lateral side.



Note: It is important that femoral neck anteversion is kept in mind during insertion of the nail into the distal fragment. If this is not done, secondary rotational correction, due to the curvature of the nail, may lead to malalignment in the frontal (and also in the sagittal) plane.

If necessary, use light blows of the hammer to seat the nail into the distal metaphysis, leaving the proximal nail end at or just below the level of the tip of the greater trochanter. When nail overinsertion is required, the surgeon may exchange the nail or extend nail length with a light blue end cap (457.0xx) (see steps 16 and 17 „Determine length of end cap / Place green end cap“, pages 30 and 31).



Note: During insertion of a cannulated nail, the Cannulated Shaft may be used to retighten the connecting screw, as needed.

If the nail was inserted over a reaming rod remove this now.

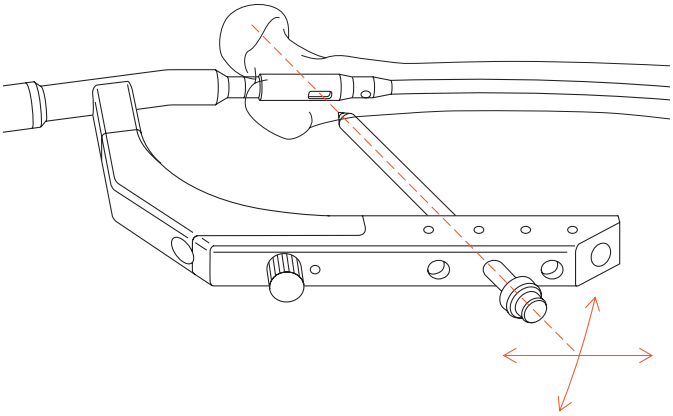
14 Spiral blade locking B

Verify nail position (insertion depth and rotation)

Turn the insertion handle until the long slot and the desired insertion path are aligned in the lateral view.

Note: The nail insertion depth dictates the spiral blade position in the coronal plane.

Securely screw the Special Aiming Arm (357.580) onto the insertion handle. Insert the light blue drill sleeve 8.0/3.2 (357.820) through the hole in the aiming arm that corresponds to the preoperatively chosen spiral blade angle and the selected locking sleeve.

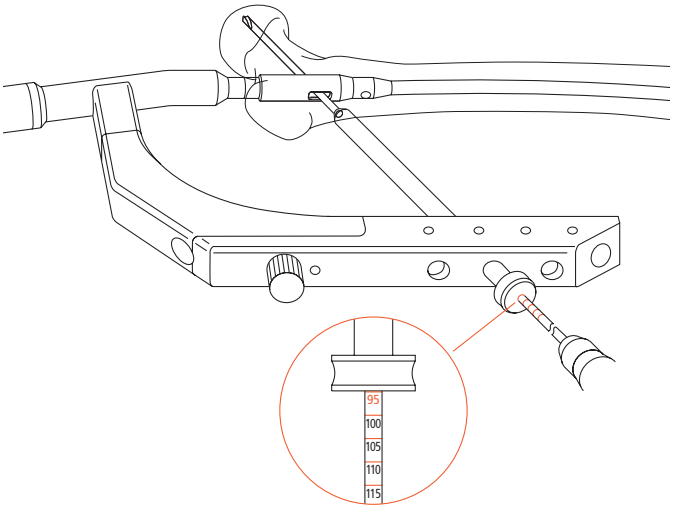


15 Spiral blade locking B

Insert guide wire for spiral blade

Make a short incision under the drill sleeve. Insert the light blue Trocar ∅ 3.2 mm (357.960) into the drill sleeve to bone. Remove the trocar, and advance the Calibrated Guide Wire ∅ 3.2 mm (357.630) into the femoral head until the tip is 5–10 mm short of subchondral bone.

- Monitor guide wire placement with image intensification in the AP and lateral views.



required spiral blade length

16 Spiral blade locking B

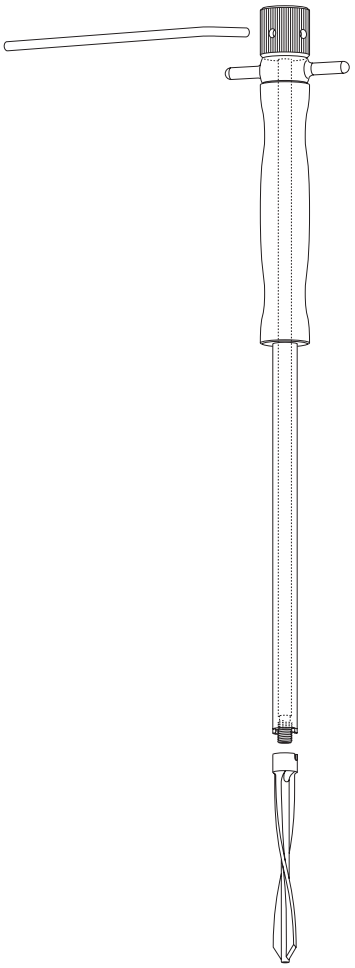
Determine spiral blade length

Press the drill sleeve against the bone, and read direct spiral blade length on the back of the sleeve. Remove the drill sleeve and speciality aiming arm.

17 Spiral blade locking B

Attach spiral blade

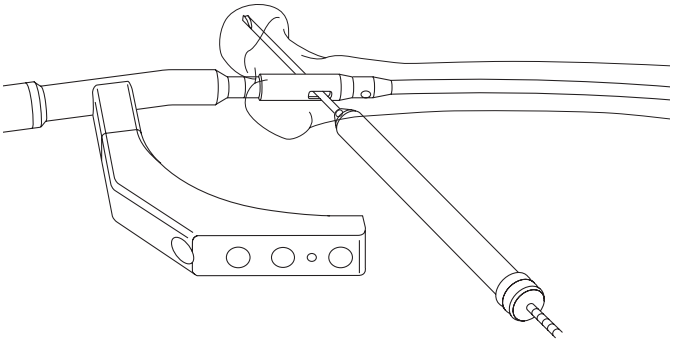
Insert the Spiral Blade Connecting Screw (357.340) into the Spiral Blade Inserter (357.310). Thread the connecting screw into the spiral blade and tighten the assembly with the Pin Wrench (321.170).



18 Spiral blade locking B

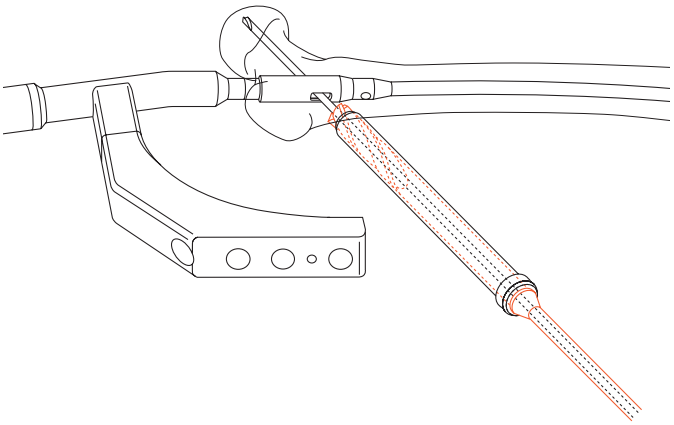
Drill cortex

Insert the light blue Drill Sleeve 13.0/3.2 (351.230) in the light blue Protection Sleeve 15.0/13.0 (351.280), and advance this assembly over the guide wire and through the incision down to the bone. Press the protection sleeve firmly to bone, and remove the drill sleeve.



Pass the Cannulated Drill Bit ∅ 13.0 mm (351.270) over the guide wire and open the lateral cortex. The shoulder of the drill bit prevents overpenetration of the bit.

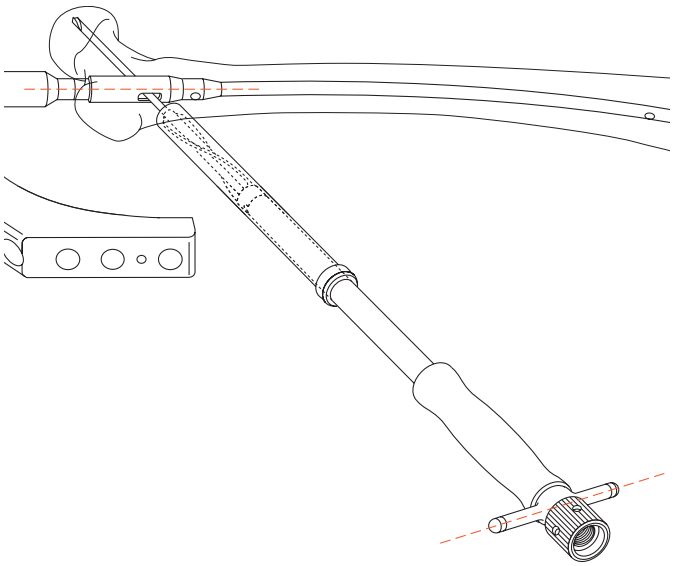
Under image intensification, ensure that the bit has fully penetrated the lateral cortex. If a complete circle of cortex is not removed, remove the protection sleeve and continue drilling. Closely monitor drilling depth under image intensification until the cortical circle is removed.



19 Spiral blade locking B

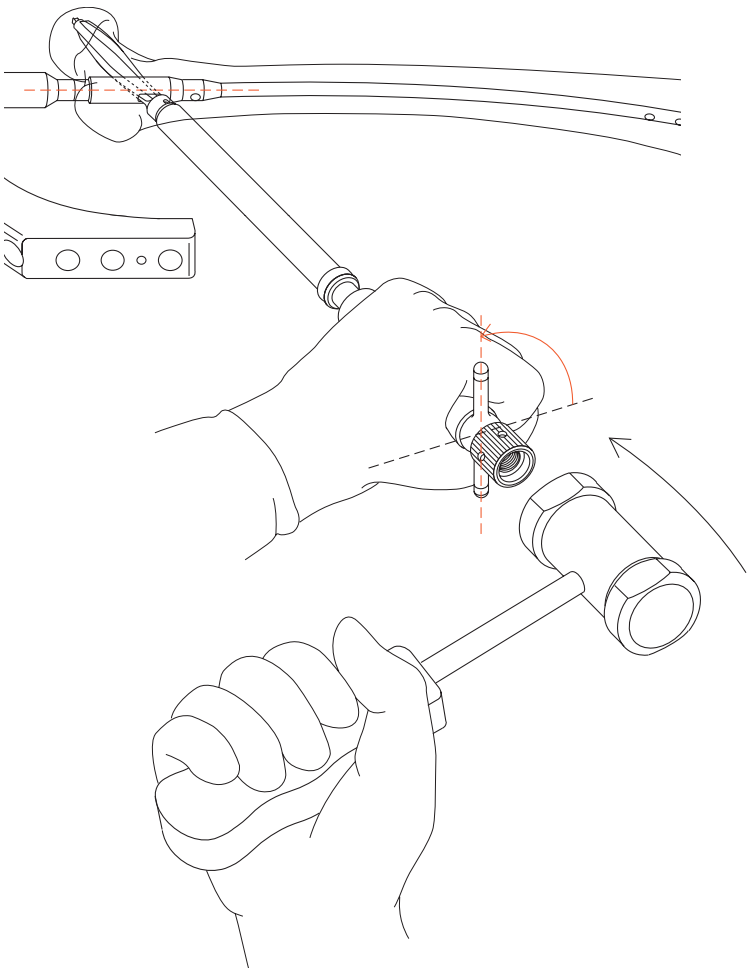
Insert spiral blade

Align the T-handle of the inserter parallel to the femoral axis. Push the spiral blade over the guide wire, through the cortical opening, and into the dynamic locking slot by hand, holding the T-handle. As the blade engages the nail slot, the T-handle starts to turn by itself and indicates the position of the blade.



Grip the blue handle of the inserter with one hand, and gently hammer on the end of the Connecting Screw (357.340) with the Hammer 700 g (399.430) to fully insert the spiral blade. The blade should advance with each hammer blow. Monitor blade insertion radiographically.

The blade is fully inserted when its hub is flush with the lateral cortex. Disconnect the insertion assembly, and remove the guide wire. Use bone wax to protect the threads of the spiral blade, if desired.

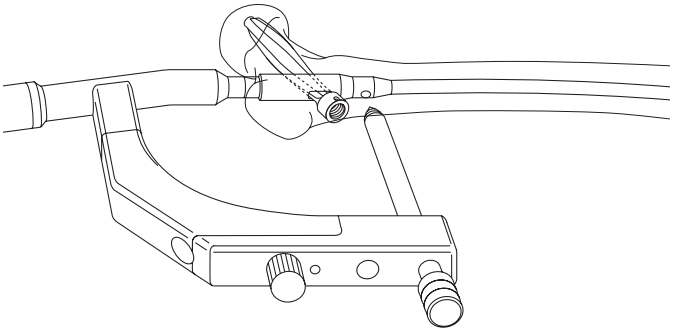


20 Spiral blade locking B

Insert the proximal transverse locking bolt (optional)

Connect the Standard Aiming Arm (357.570) to the insertion handle.

Use the inferior (static) aiming hole to insert the green Locking Bolt ∅ 4.9 mm (459.xxx) into the static locking hole of the nail, as described in standard interlocking technique A on pages 26 and 27.



21 Spiral blade locking B

Distal locking

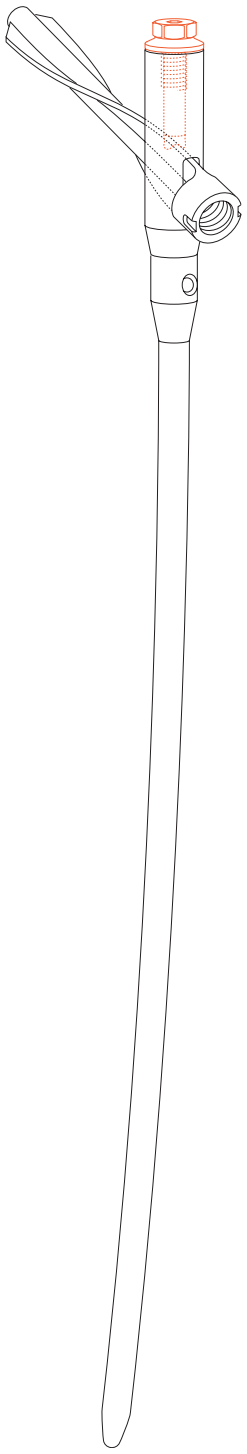
The procedure is described in a separate section on pages 64 to 66.

22 Spiral blade locking B

Place the light blue end cap

Place the end cap as described in step 16, Standard locking A and 17 Standard locking A, pages 30 and 31, but using the light blue End Cap for Spiral Blade (457.01x).

The light blue end cap for spiral blade statically locks the light blue Locking Sleeve (456.01x) to the nail and must be inserted in every case. Upon final seating of the end cap, the UHMWPE (Ultra High Molecular Weight Polyethylene Implant Material) tip deforms around the blade edge, further securing the spiral blade against cut out.



Implants and Instruments for Miss-A-Nail Technique C

Implants and instruments for Miss-A-Nail technique C		Percentage of actual size	
459.01x	End Cap for Standard Locking UFN ∅ 12.0 mm, TAN, green	30%	
464.xxx	UFN – Solid Femoral Nail, length xxx mm, Titanium Alloy (TAN), green	25%	
474.0xx– 474.2xx	CFN – Cannulated Femoral Nail, ∅ 10–12 mm length 300–480 mm, Titanium Alloy (TAN), green		
459.xxx	Locking Bolt ∅ 4.9 mm, self-tapping, length 26 mm, Titanium Alloy (TAN), green	35%	
408.xxx	Cannulated Screws ∅ 7.3 mm, self-tapping, TAN, golden	35%	
457.070– 457.125	Shaft Screws ∅ 5.0 mm, self-tapping, TAN, gold	35%	
357.630	Guide Wire ∅ 3.2 mm, calibrated, length 300 mm	25%	
314.050	Screwdriver, hexagonal, cannulated, for Cannulated Screws ∅ 6.5 and 7.3 mm	20%	
314.750	Screwdriver, hexagonal, large, ∅ 3.5 mm, with Groove	20%	
511.701	Compact Air Drive II		
511.750	AO/ASIF Quick Coupling, for Compact Air Drive and Power Drive		
511.790	Quick Coupling for Kirschner Wires ∅ 0.6 to 3.2 mm, for Compact Air Drive and Power Drive		
511.760	Quick Coupling for DHS/DCS Triple Reamers, for Compact Air Drive and Power Drive		
519.510	Double Air Hose, length 3 m, for System Synthes		
357.521	Insertion Handle for UFN/CFN	15%	
398.335	Connecting Screw for CFN/AFN for SynReam	35%	
357.515	Screwdriver, hexagonal, with spherical head ∅ 8.0 mm	20%	

357.180	Driving Cap for UFN/CFN	20%	
357.220 357.250	Hammer Guide, for No. 357.250 Slide Hammer, for Nos. 357.220 and 357.221	15%	
321.170	Pin Wrench ∅ 4.5 mm, length 120 mm	25%	
399.430	Hammer 700 g	15%	
357.580	Special Aiming Arm for UFN/CFN	20%	
357.880	Aiming Jig for Miss-A-Nail Technique, for 357.580	20%	
357.970	Dummy Nail for Miss-A-Nail Technique	25%	
321.160	Combination Wrench ∅ 11 mm	15%	
321.210	Socket, hexagonal ∅ 11.0 mm	30%	
357.840	Protection Sleeve 11.0/8.0, for 130° Retrograde Technique, gold	30%	
357.850	Drill Sleeve 8.0/3.2, for Retrograde Technique, gold	30%	
357.860	Trocar ∅ 3.2 mm, for Nos. 357.850 and 357.940, gold	30%	
357.900	Drill Sleeve 5.6/2.8, for No. 357.880, gold	30%	
357.910	Trocar ∅ 2.8, for No. 357.900, gold		
292.670	Guide Wire ∅ 2.0 mm with threaded tip with trocar, length 300 mm, for Miss-A-Nail Technique, Stainless Steel	25%	

Optional instruments

Percentage of actual size

312.080	Drill Sleeve 8.5/2.8	25%
312.050	Protection Sleeve 12.0/8.5	25%
319.700	Direct Measuring Device for Guide Wires ∅ 2.0 and 2.8 mm, length 300 mm	25%
310.630	Drill Bit ∅ 5.0 mm, cannulated, length 300/250 mm, 3-flute, for Quick Coupling	
311.690	Tap, cannulated, calibrated, length 230 mm, for Cannulated Screws ∅ 7.0 mm	15%
311.680	Tap, cannulated, for Cannulated Screws ∅ 7.3 mm	15%
292.680	Guide Wire ∅ 2.8 mm, with threaded tip with trocar, length 300 mm, for Cannulated Screws ∅ 6.5 and 7.3 mm, Stainless Steel	20%
357.950	Trocar ∅ 2.0 mm, for No. 357.930, gold	20%
357.940	Drill Sleeve 5.6/3.2, for No. 357.880, gold	20%
315.470	Drill Bit ∅ 4.5/2.1 mm, cannulated, length 300/285 mm, 3-flute, for Quick Coupling	20%
357.181	Driving Cap for UFN/CFN, with Quick Coupling Connection	20%
357.221	Hammer Guide with Quick Coupling, for No. 357.250	20%
357.222	Cap Nut for Hammer Guide with Quick Coupling	30%
357.601	Protective Cap for Quick Coupling Connection	25%
357.540	Connecting Screw for UFN (cannot be used for CFN)	25%
357.790	Depth Gauge for Locking Bolts, measuring range from 26 to 100 mm	25%
419.990	Washer ∅ 13.0/6.6 mm, for Screws ∅ 4.5 to 7.3 mm, Pure Titanium	
352.032/ 352.033	SynReam Reaming Rod ∅ 2.5 mm	

Miss-A-Nail Technique C

The Miss-A-Nail device allows screw fixation of the neck fracture before or after nail fixation of the shaft fracture with a medullary nail. In cases of occult fractures of the femoral neck, it also permits screw insertion into the femoral head after nail insertion.

9 Miss-A-Nail technique C

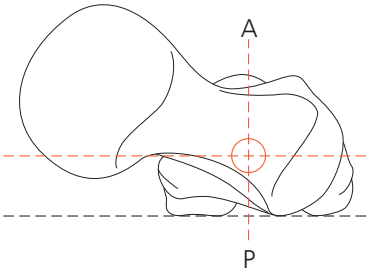
Reduce neck fracture

If the femoral neck fracture is displaced, perform meticulous reduction and temporarily stabilize the fracture. Open reduction may be necessary. When using Kirschner wires, place them anteriorly and/or posteriorly to the anticipated path of the nail.

10 Miss-A-Nail technique C

Identify dummy nail entry point

Since the correct standard nail entry point is often posterior to the femoral neck axis, it will usually allow room for the Cannulated Screws ∅ 7.3 mm (408.9xx) placed anteriorly to the nail in the Miss-A-Nail technique. However, consider each case individually and move the nail insertion point slightly posteriorly if needed to accommodate the screws.



11 Miss-A-Nail technique C

Open the femur

Follow the procedure described in steps 1 to 8, pages 16 to 23.

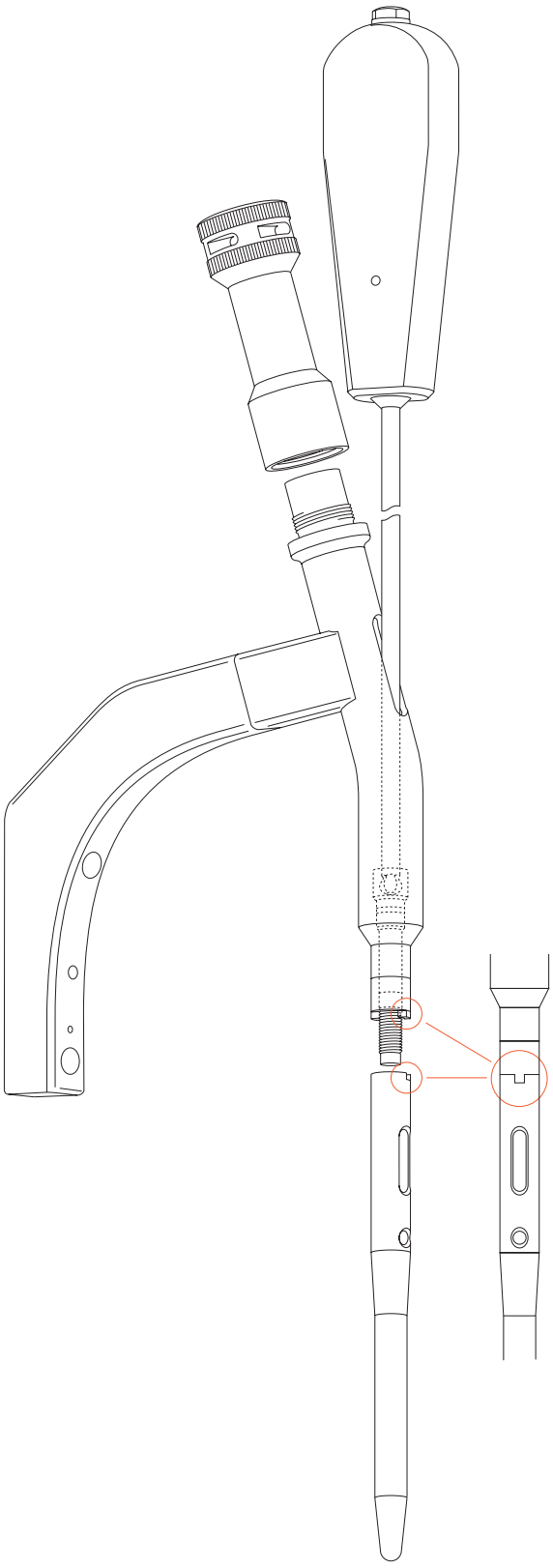
When opening the femur, take great care to prevent displacement or distraction of the femoral neck fracture.

Note: The use of 13–15 mm diameter nails is not recommended for the Miss-A-Nail technique, since the larger opening into the medullary canal required for accommodating the proximal nail end can impair the stability in the femoral neck and trochanter regions.

12 Miss-A-Nail technique C

Assemble the insertion instrumentation

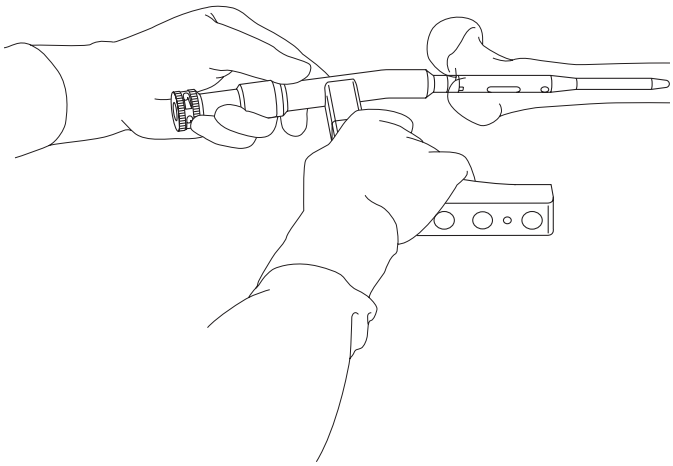
Insert the cannulated Connecting Screw for CFN/AFN for SynReam (398.335) into the Insertion handle (357.512). Connect the handle to the Dummy Nail for Miss-A-Nail Technique (357.970). Use the Combination Wrench ∅ 11.0 mm (321.160) to secure the connecting screw to the dummy nail.



13 Miss-A-Nail technique C

Insert the dummy nail

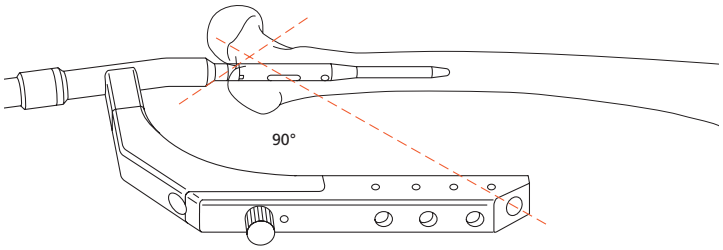
Manually insert the dummy nail into the femoral opening. Do not use the hammer or the slide hammer with hammer guide. If you feel resistance, remove the dummy nail, re-drill the entry site, and manually reinsert the dummy nail.



14 Miss-A-Nail technique C

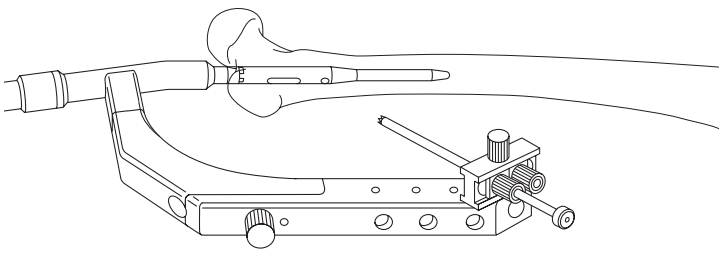
Select screw insertion angle

Attach the Special Aiming Arm (357.580) securely to the insertion handle. Under AP image intensification, lay a calibrated Guide Wire ∅ 3.2 mm (357.630) on the anterior thigh along the femoral neck axis. Adjust the angle of the guide wire until it is perpendicular to the fracture. This will allow you to place the screws perpendicularly to the fracture, for fracture compression. Hold the wire in this position.



Move the instrument assembly distally and proximally until the guide wire corresponds to one of the four Miss-A-Nail angles on the insertion handle.

Securely fasten the Aiming Jig for Miss-A-Nail Technique (357.880) to the speciality aiming arm at the relevant angle. Insert the gold Drill Sleeve 5.6/2.8 (357.900) into the superior bushing of the speciality aiming arm and use it as a pointer to verify the angle and dummy nail insertion depth under image intensification.

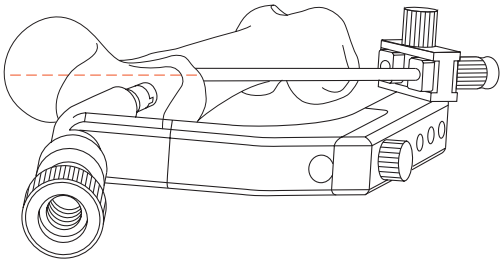


Note: If the drill sleeve does not reach the bone, turn the Miss-A-Nail jig 180° in order to reduce the distance to the bone.

15 Miss-A-Nail technique C

Adjust for anteversion

If necessary, readjust the image intensifier for an axial view of the proximal femur. Rotate the insertion handle around the dummy nail until the drill sleeve is directed safely through the centre of the femoral neck and into the femoral head.

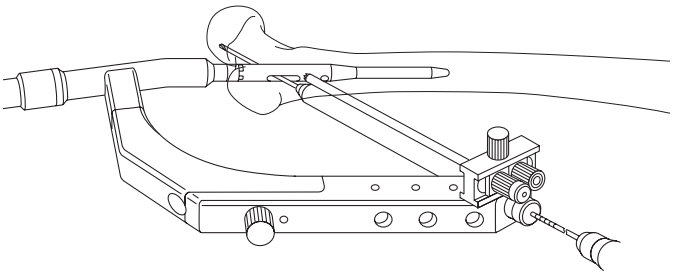


16 Miss-A-Nail technique C

Insert the stabilization wire

While holding the insertion assembly in the precise axial position, insert the gold Drill Sleeve 8.0/3.2 (357.850) through the speciality aiming arm at the same angle as the Miss-A-Nail jig. (When using the 130° angle, use the gold Protection Sleeve 11.0/8.0 [357.840] and the gold Drill Sleeve 8.0/3.2 [357.850]).

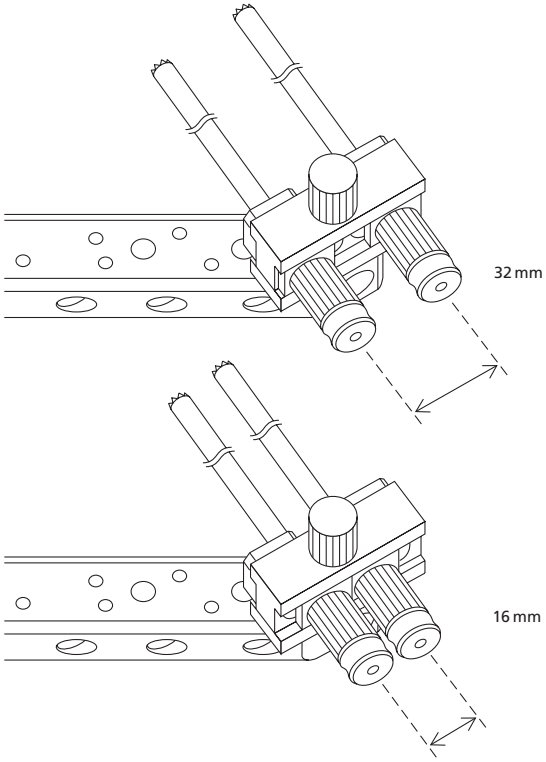
Make a stab incision and insert a calibrated Guide Wire ∅ 3.2 mm (357.630) through the slot of the dummy nail and into the femoral head. This will temporarily hold the instrument assembly in the correct position and further stabilize the neck fracture.



17 Miss-A-Nail technique C

Adjust sleeves for screw insertion

Insert the second gold Drill Sleeve 5.6/2.8 (357.900) into the inferior bushing of the Miss-A-Nail jig. Reposition the image intensifier for an AP image of the proximal femur. Independently adjust the two bushings of the Miss-A-Nail jig to maximize distance between the screws while remaining within the femoral neck. Secure the bushings to the jig by hand.



Notes:

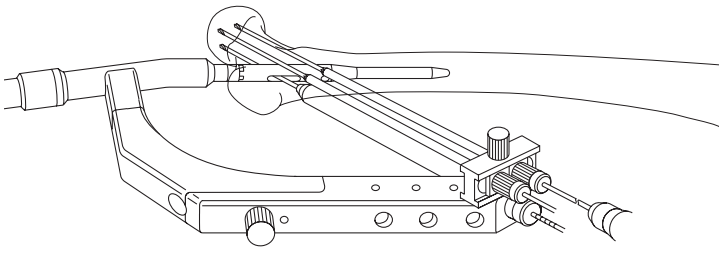
– If the patient is small statured, it may be acceptable to place only one screw through the jig and subsequently place a second screw (5.0 mm shaft screw) through the nail.

– If the entry point is anterior to the nail, you may place one or two screws posteriorly to the dummy nail by attaching the Miss-A-Nail jig to the posterior side of the aiming arm.

18 Miss-A-Nail technique C

Insert guide wires

Make a stab incision and advance the drill sleeve and gold Trocar ∅ 2.8 mm (357.910) down to the bone. Remove the trocar.



Insert the Guide Wire ∅ 2.8 mm (292.680) through the sleeve and into the femoral head. Excessive axial force can cause wire misdirection.

Insert the second guide wire using the same technique.

19 Miss-A-Nail technique C

Remove dummy nail and stabilization wire

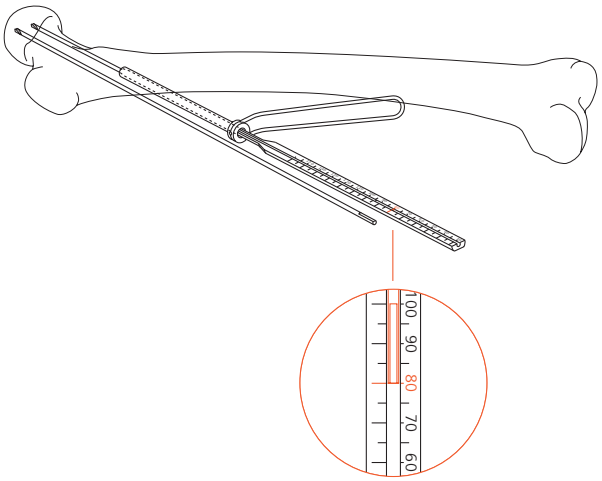
Remove all instrumentation, including the dummy nail, and the stabilization wire, leaving only the guide wires in place.

20 Miss-A-Nail technique C

Determine screw length

Slide the Drill Sleeve 8.5/2.8 (312.080) and the Protection Sleeve 12.0/8.5 (312.050) of the instrumentation for percutaneous insertion over one of the guide wires.

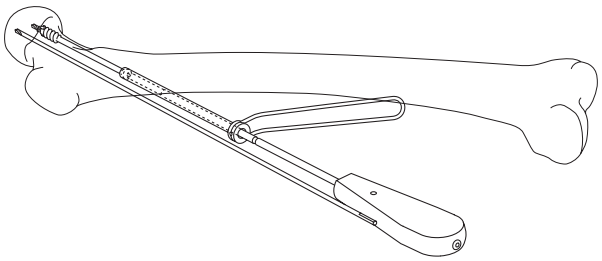
Remove the drill sleeve. Slide the Direct Measuring Device for Guide Wires (319.700) over one guide wire down to bone, and measure for direct screw length. (This device measures to the tip of the guide wire). Remove the direct measuring device.



21 Miss-A-Nail technique C

Insert screws

Insert a self-drilling Cannulated Screw ∅ 7.3 mm (408.9xx) into the femoral head through the protection sleeve, using the cannulated Hexagonal Screwdriver (314.050). Remove and dispose of the guide wire.



Note: In very dense bone, the near cortex may be pre-drilled and tapped through the protection sleeve with the cannulated Drill Bit ∅ 5.0 mm (310.630) and the cannulated Tap (311.680).

Insert the second screw using the same technique.

Alternative I:
Use of cancellous bone screws ∅ 6.5 mm

If the use of Cancellous Bone Screws ∅ 6.5 mm (416.xxx / 216.xxx) is preferred, use the gold Drill Sleeve 5.6/3.2 (357.940) and the gold Trocar ∅ 3.2 mm (357.860) through the Aiming Jig for Miss-A-Nail Technique (357.880), and drill and measure for the screws using the Calibrated Guide Wire ∅ 3.2 mm (357.630). In this measurement the screw comes to rest 5 mm in front of the tip of the guide wire. Remove the guide wire and tap with the Tap for Cancellous Bone Screws ∅ 6.5 mm (311.660).

Alternative II:
Use of Cannulated Screws ∅ 7.0 mm

For Cannulated Screws ∅ 7.0 mm (208.xxx) use the gold Drill Sleeve 5.6/2.0 (357.930) and the gold Trocar (357.950). Pass these through the Aiming Jig for Miss-A-Nail Technique (357.880). Remove the trocar and insert the 300 mm long Threaded Guide Wire ∅ 2.0 mm (292.670) through the gold drill sleeve. Drill with the Cannulated Drill Bit ∅ 4.5/2.1 mm (315.470) and measure the screw length with the Direct Measuring Device for Guide Wires (319.700). Tap with the Cannulated Tap (311.690).

22 Miss-A-Nail technique C

Insert the nail

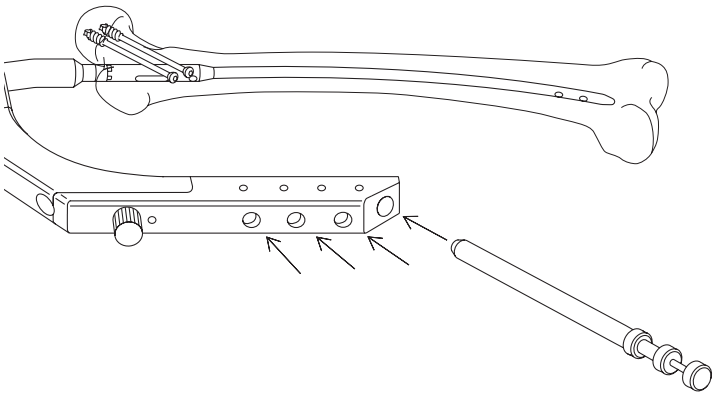
Follow the procedure described in step 10 Standard locking A, page 27.

23 Miss-A-Nail technique C

Insert the shaft screw

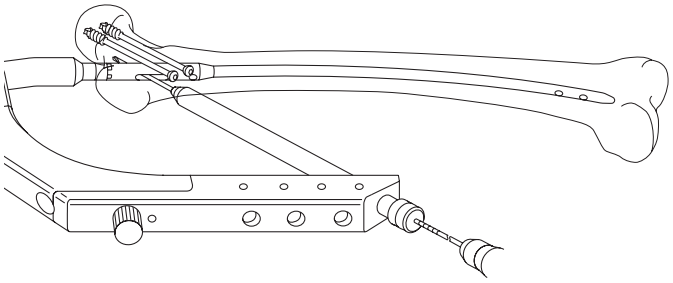
A Shaft Screw ∅ 5.0 mm (457.xxx) may be inserted through the dynamic slot for an additional point of femoral neck fracture fixation.

To insert the shaft screw, attach the Special Aiming Arm (357.580) to the insertion handle. Insert the gold Drill Sleeve 8.0/3.2 (357.850) and the Trocar ∅ 3.2 mm (357.860) through the aiming arm bushing at the same angle as the screws placed in the Miss-A-Nail technique.

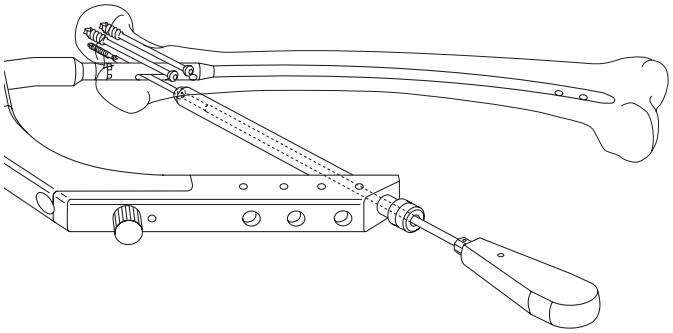


Note: When using the 130° angle, use the gold Protection Sleeve 11.0/8.0 (357.840) with the gold drill sleeve 8.0/3.2.

Insert the Calibrated Guide Wire ∅ 3.2 mm (357.630) through the sleeve and into the femoral head until it is just short of subchondral bone. Press the drill sleeve against the lateral cortex, and read the shaft screw length directly from the guide wire at the back of the sleeve. In this measurement the screw comes to rest 5 mm in front of the tip of the guide wire.



Remove the guide wire and insert the shaft screw using the large Hexagonal Screwdriver (314.750).



24 Miss-A-Nail technique C

Proximal locking

Statically lock the shaft fracture by inserting a green Locking Bolt ∅ 4.9 mm (459.xxx) through the inferior, proximal hole of the nail.

Follow the procedure described in steps 11 Standard Locking A to 14 Standard Locking A, pages 28 to 29.

25 Miss-A-Nail technique C

Distal locking

The procedure is described in a separate section on pages 62 to 65.

26 Miss-A-Nail technique C

Place the green end cap

Follow the procedure described in steps 16 Standard locking A and 17 Standard locking A, pages 30 to 31.

Implants and Instruments for 130° Antegrade Locking D

Implants and instruments for 130° antegrade locking		Percentage of actual size	
457.21x	End Caps for 130° Locking Sleeves, TAN, pink	30%	
464.xxx	UFN – Solid Femoral Nail ∅ 10–12 mm, length xxx mm, Titanium Alloy (TAN), green	25%	
456.013	Locking Sleeve 130°, ∅ 15.0 mm, for UFN, Titanium Alloy (TAN), pink	35%	
474.xxx	CFN – Cannulated Femoral Nail, length xxx mm, Titanium Alloy (TAN), green	25%	
474.913	Locking Sleeve 130°, for CFN ∅ 13.0 to 15.0 mm, Titanium Alloy (TAN), pink	35%	
459.xxx	Locking Bolt ∅ 4.9 mm, self-tapping, length 26 mm, Titanium Alloy (TAN), green	35%	
314.750	Screwdriver, hexagonal, large, ∅ 3.5 mm, with Groove	20%	
511.701	Compact Air Drive II		
511.750	AO/ASIF Quick Coupling, for Compact Air Drive and Power Drive		
519.510	Double Air Hose, length 3 m, for System Synthes		
356.980	Drill Bit ∅ 4.0 mm, calibrated, length 270/245 mm, 3-flute, for Quick Coupling	20%	
357.521	Insertion Handle for UFN/CFN	15%	
398.335	Connecting Screw for CFN/AFN for SynReam	35%	
357.515	Screwdriver, hexagonal, with spherical head ∅ 8.0 mm	20%	
357.220 357.250	Hammer Guide, for No. 357.250 Slide Hammer, for Nos. 357.220 and 357.221	15%	

357.180	Driving Cap for UFN/CFN	25%	
321.170	Pin Wrench ∅ 4.5 mm, length 120 mm	25%	
399.430	Hammer 700 g	15%	
321.160	Combination Wrench ∅ 11 mm	15%	
321.210	Socket, hexagonal ∅ 11.0 mm	30%	
357.710	Drill Sleeve 8.0/4.0, for No. 357.760, green	30%	
357.760	Protection Sleeve 11.0/8.0, for UFN/CFN, green	30%	
357.750	Trocar ∅ 4.0 mm, for No. 357.710, green	30%	

Optional instruments		Percentage of actual size	
357.181	Driving Cap for UFN/CFN, with Quick Coupling Connection	20%	
357.221	Hammer Guide with Quick Coupling, for No. 357.250	20%	
357.222	Cap Nut for Hammer Guide with Quick Coupling	30%	
357.601	Protective Cap for Quick Coupling Connection	25%	
357.540	Connecting screw for UFN (cannot be used for CFN)	25%	
357.790	Depth Gauge for Locking Bolts, measuring range from 26 to 100 mm	20%	
352.032/ 352.033	SynReam Reaming Rod ∅ 2.5 mm		
357.516	Coupling Shaft, cannulated, ∅ 8.0 mm, for No. 398.335	20%	

130° Antegrade Locking D

The 130° locking sleeve is used for the fixation of femoral shaft fractures or stable subtrochanteric fractures (with lesser trochanter intact and attached to the proximal fragment).

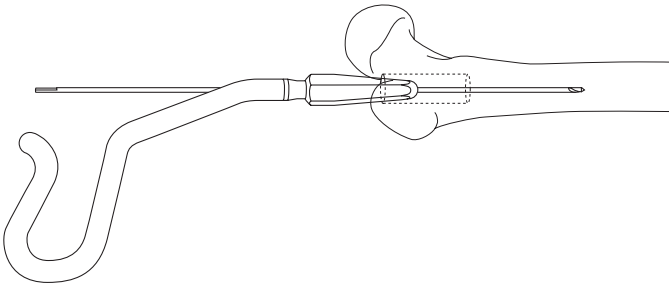
Open the femur

Follow the procedure described in steps 1 to 8, pages 16 to 23.

9 130° Antegrade locking D

Enlarge the femoral opening

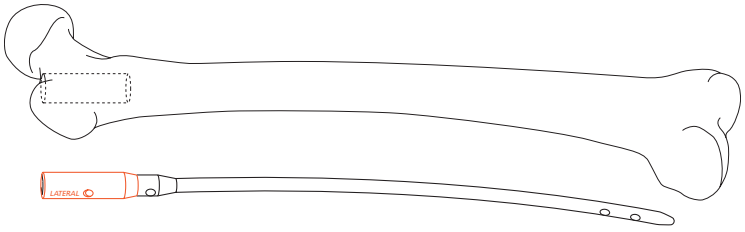
Fully insert the Broach ∅ 16.0 mm (351.890) into the femoral opening using a twisting hand motion. The opening must be large enough to accommodate the pink 130° Locking Sleeve (456.013 / 474.913).



10 130° Antegrade locking D

Assemble the implants

Orient the corresponding 130° Locking Sleeve to the nail so that the word "LATERAL" faces laterally (convex side of the nail faces anteriorly). Seat the pink sleeve on the proximal nail end.



11 130° Antegrade locking D

Assemble the insertion instrumentation

See step 9 Standard locking A, page 26.

Note: No aiming arm is needed for the 130° locking procedure

12 130° Antegrade locking D

Insert the nail

See step 10 Standard locking A, page 27.

13 130° Antegrade locking D

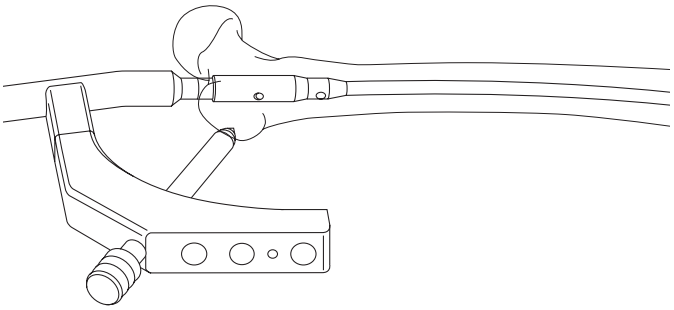
Verify nail insertion depth

Insert the green Protection Sleeve 11.0/8.0 (357.760) into the 130° hole of the insertion handle. The sleeve will act as a pointer: under image intensification, further insert or withdraw the nail until a line drawn through the sleeve corresponds to the desired locking bolt position.

14 130° Antegrade locking D

Prepare proximal locking

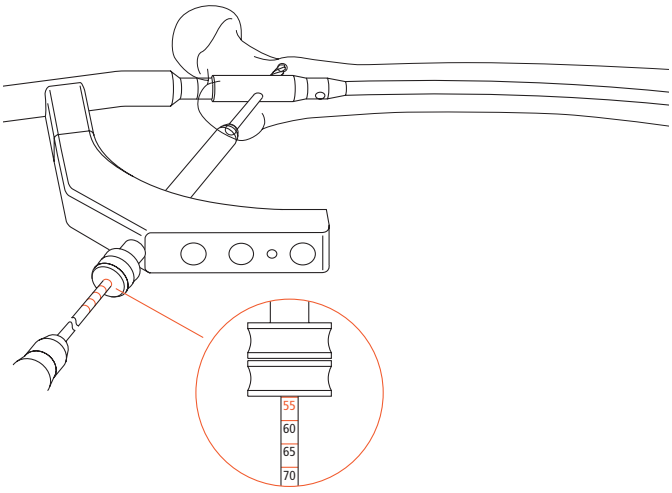
Make an incision under the green protection sleeve 11.0/8.0. Insert the green Drill Sleeve 8.0/4.0 (357.710) and the green Trocar ∅ 4.0 mm (357.750) down to the bone. Remove the trocar.



15 130° Antegrade locking D

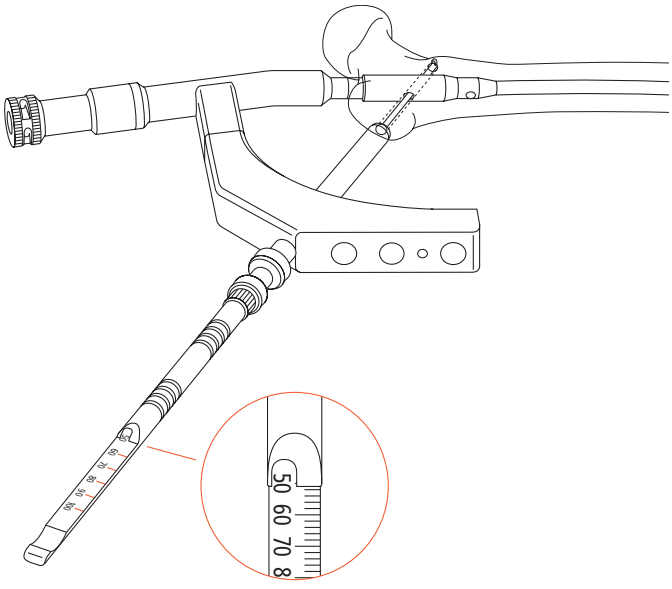
Drill and determine length of the locking bolt

Drill through both cortices with the Calibrated Drill Bit ∅ 4.0 mm (356.980), stopping the drill immediately after penetrating the far cortex. Confirm drill bit position radiographically. Be sure the drill sleeve is pressed firmly to the cortex, and read locking bolt length directly from the calibrated drill bit on the back of the drill sleeve. Remove drill bit and drill sleeve.



required bolt length

Alternative: With the drill sleeve removed, the Depth Gauge for Locking Bolts (357.760) may also be used to determine locking bolt length. Measure through the protection sleeve using the standard depth gauge technique, and add 2–4 mm to the reading to ensure thread engagement of the far cortex.

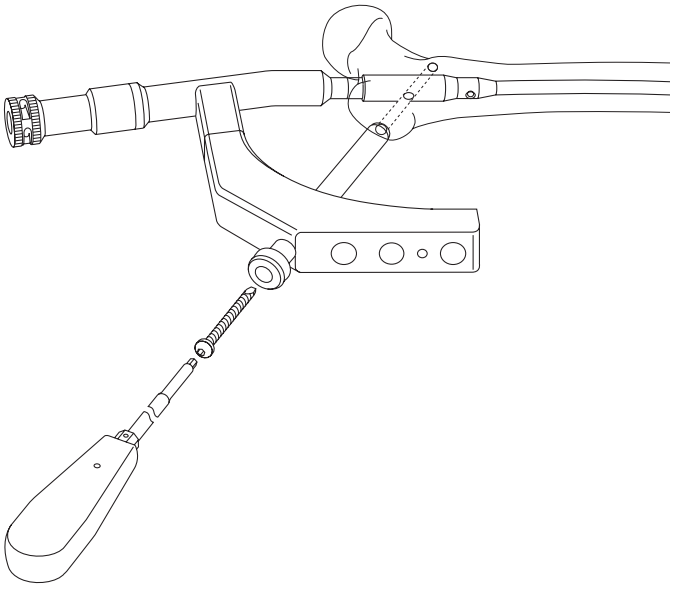


add 2–4 mm
to the length reading

16 130° Antegrade locking D

Insert locking bolt

Insert a Locking Bolt ∅ 4.9 mm (459.xxx) through the 11.0/8.0 mm protection sleeve, using the large Hexagonal Screwdriver (314.750).



17 130° Antegrade locking D

Distal locking

The procedure is described in a separate section on pages 64 to 66.

18 130° Antegrade locking D

Place pink end cap

Follow the procedure described in step 17 Standard locking A, page 31, but using the pink End Cap for 130° Locking Sleeve (457.21x).

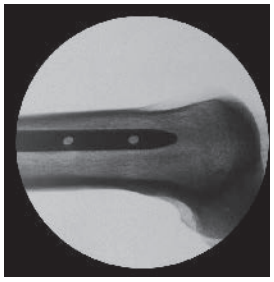
Implants and Instruments for Distal Locking

Implants and instruments for distal locking		Percentage of actual size	
511.701	Compact Air Drive II		
511.750	AO/ASIF Quick Coupling, for Compact Air Drive and Power Drive		
511.300	Radiolucent Drive		
511.417	Drill Bit ∅ 4.0 mm with centering tip, length 148/122 mm, 3-flute, with Coupling for RDL	30%	
357.790	Depth Gauge for Locking Bolts, measuring range from 26 to 100 mm	20%	
314.750	Screwdriver, hexagonal, large, ∅ 3.5 mm, with Groove	20%	
459.xxx	Locking Bolt ∅ 4.9 mm, self-tapping, length 26 mm, Titanium Alloy (TAN), green	35%	
314.280	Holding Sleeve, large, for Nos. 314.190, 314.240, 314.260, 314.270 and 314.750	25%	

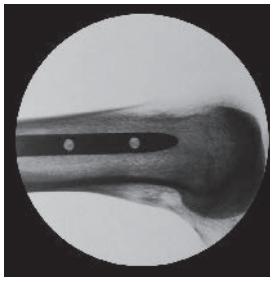
1

Confirm reduction

Reconfirm reduction/alignment of the distal fragment.



Oblique (incorrect)

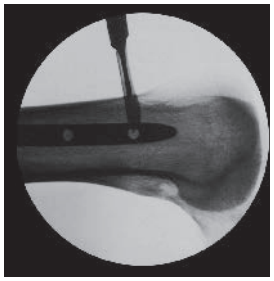


Round (correct)

2

Determine incision point and perform the incision

Use the Radiolucent Drive (511.300). Align the image in tensifier with the most distal hole in the nail until a perfect circle is visible in the centre of the screen. Ideally use the image intensifier's magnification mode. Determine the incision point, and make a stab incision.



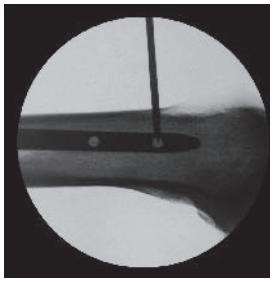
Determine incision point

3

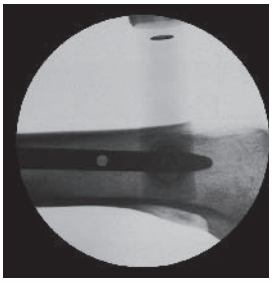
Drill

Under image intensification, insert the tip of the Drill Bit ∅ 4.0 mm with centering tip (511.417) into the incision and place the bit oblique to the X-ray beam until the tip is centred in the locking hole.

Tilt the drive upwards until the drill bit is in line with the beam and appears as a radiopaque solid circle in the centre of the outer ring. The drill bit will nearly fill in the locking hole image. Hold the drill in this position and drill through both cortices.



Centre drill bit in locking hole



Align drill bit

4

Determine length of the locking bolt

Determine the locking bolt length using the Depth Gauge for Locking Bolts (357.790). Add 2–4 mm to the reading to ensure thread engagement of the far cortex.

5

Insert locking bolt

Insert the Locking Bolt ∅ 4.9 mm (459.xxx) using the large Hexagonal Screwdriver (314.750), fitted with the large Holding Sleeve (314.280).

6

Freehand technique (optional)

Use the Drill Bit ∅ 4.0 mm (315.400) to perform the free-hand distal locking technique.

The Distal Aiming Device (355.600) with the Direction Finder (355.620) and the Femoral Fixation Bolt (355.660) from the Universal Nail System may also be used.

Instruments for Implant Removal

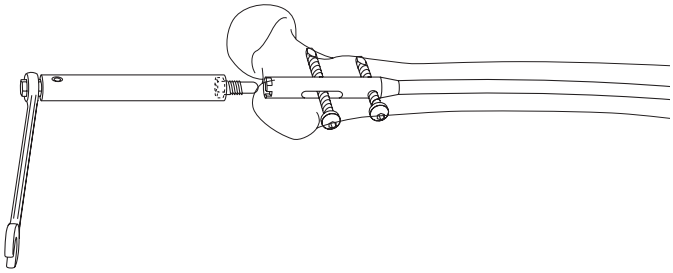
Instruments for implant removal		Percentage of actual size	
357.360	Extraction Screw for UFN/CFN and Spiral Blade	30%	
314.280	Holding Sleeve large, for Nos. 314.190, 314.240, 314.260, 314.270 and 314.750	25%	
321.160	Combination Wrench ∅ 11 mm	25%	
321.210	Socket, hexagonal ∅ 11.0 mm	30%	
321.170	Pin Wrench ∅ 4.5 mm, length 120 mm	25%	
314.750	Screwdriver, hexagonal, large, ∅ 3.5 mm, with Groove	20%	
357.220 357.250	Hammer Guide, for No. 357.250 Slide Hammer, for Nos. 357.220 and 357.221	15%	

Optional instruments		Percentage of actual size	
357.361	Extraction Screw for UFN/CFN and Spiral Blade, with Quick Coupling Connection	30%	
357.221	Hammer Guide with Quick Coupling, for No. 357.250	20%	

1

Remove the end cap

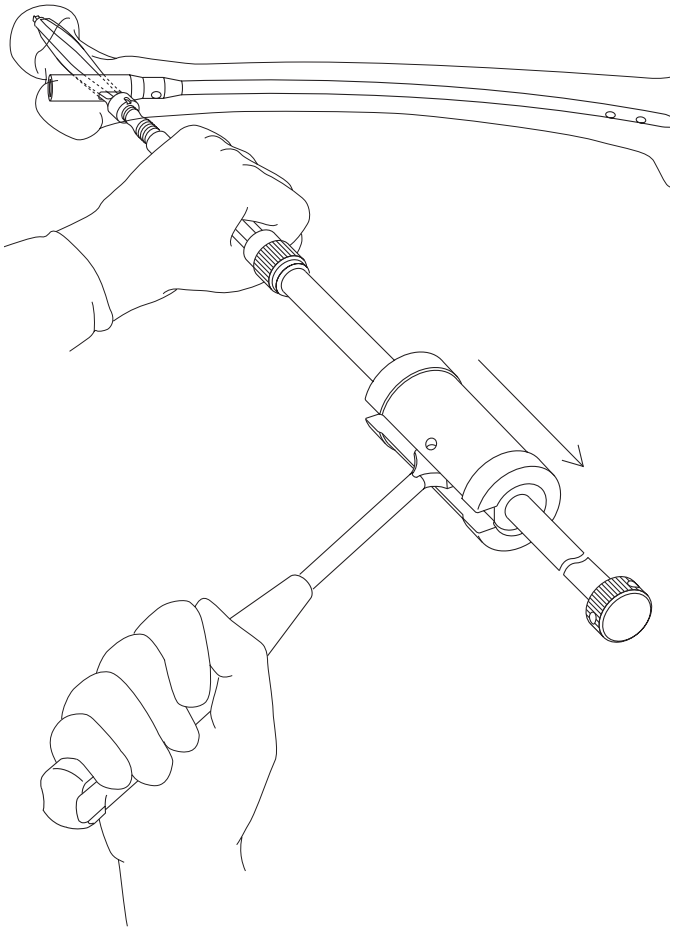
Use the Combination Wrench ∅ 11.0 mm (321.160) and Hexagonal Socket (321.210) or the large Hexagonal Screwdriver (314.750) to remove the end cap.



2

Remove the spiral blade

Manually thread the Extraction Screw (357.360) into the hub of the spiral blade, and secure the screw using the Pin Wrench ∅ 4.5 mm (321.170). Thread the Hammer Guide (357.220) and Slide Hammer (357.250) into the extraction screw. Extract the spiral blade. Maintain a loose grip on the extraction assembly so that it can rotate with the blade during extraction.

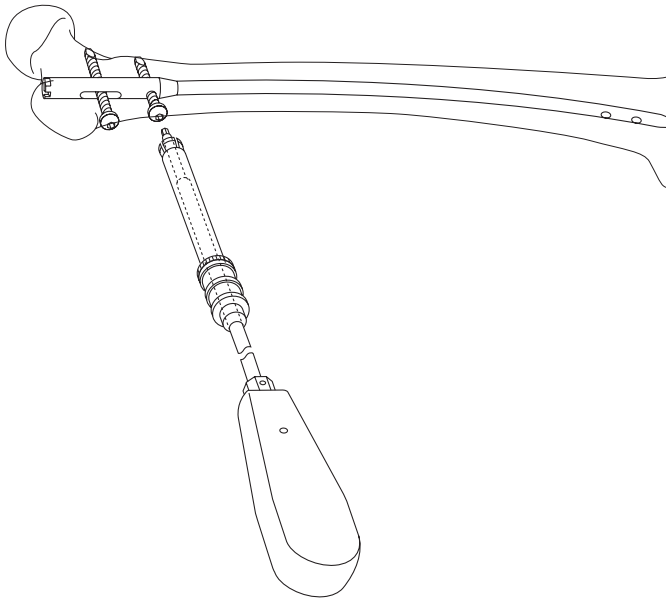


3

Remove the locking bolts

Remove the locking bolts using the large Hexagonal Screwdriver (314.750) and large Holding Sleeve (314.280).

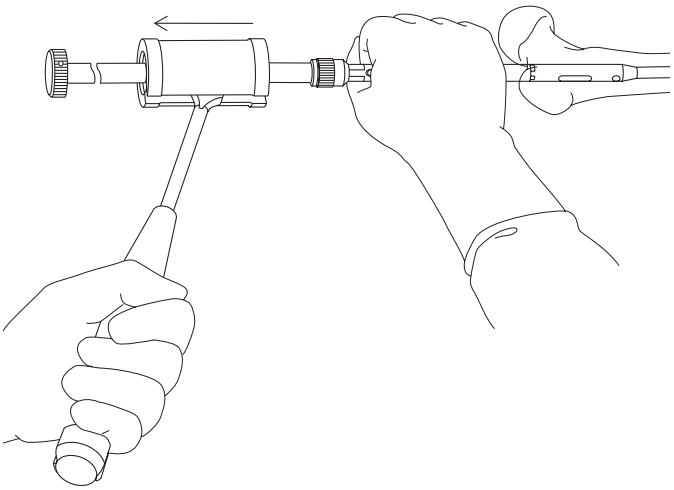
Note: Before removing the last locking bolt, thread the extraction screw into the proximal nail end. This will prevent the nail from sliding distally or rotating in the medullary canal.



4

Remove the nail

Thread the hammer guide and slide hammer into the extraction screw. Thread the extraction screw into the proximal nail end. Tighten the assembly using the pin wrench, and extract the nail.



Bibliography

Baumgärtel F, Dahlen C, Stiletto R, Gotzen L (1994) Technique of using the AO-Femoral Distractor for Femoral Intramedullary Nailing. J. Orthop Trauma 8: 315–321

Krettek C (2000) Intramedullary nailing. In: Colton C, Fernández A, Holz U, Kellam J, Murphy WM, Ochsner P, AO/ASIF Principles of Fracture Management. Thieme, Stuttgart, New York: Thieme: 195–218

Krettek C, Schulte S, Schandelmaier P, Rudolf J, Tscherne H (1994) Osteosynthese von Femurschaftfrakturen mit dem unaufgebohrten AO-Femurnagel (UFN) – Operative Technik und erste klinische Ergebnisse mit Standardverriegelung.
Unfallchirurg 97: 549–567

McFerran MA, Johnson KD (1992) Intramedullary nailing of acute femoral shaft fractures without a fracture table: Techniques of using a femoral distractor. J Orthop Trauma 6: 271–278

Müller ME, Allgöwer M, Schneider R, Willenegger H (1992) Manual der Osteosynthese. 3rd ed. Berlin: Springer

MRI Information

Torque, Displacement and Image Artifacts according to ASTM F 2213-06, ASTM F 2052-06e1 and ASTM F2119-07

Non-clinical testing of worst case scenario in a 3 T MRI system did not reveal any relevant torque or displacement of the construct for an experimentally measured local spatial gradient of the magnetic field of 3.69 T/m. The largest image artifact extended approximately 169 mm from the construct when scanned using the Gradient Echo (GE). Testing was conducted on a 3 T MRI system.

Radio-Frequency-(RF-)induced heating according to ASTM F2182-11a

Non-clinical electromagnetic and thermal testing of worst case scenario lead to peak temperature rise of 9.5 °C with an average temperature rise of 6.6 °C (1.5 T) and a peak temperature rise of 5.9 °C (3 T) under MRI Conditions using RF Coils (whole body averaged specific absorption rate [SAR] of 2 W/kg for 6 minutes [1.5 T] and for 15 minutes [3 T]).

Precautions: The above mentioned test relies on non-clinical testing. The actual temperature rise in the patient will depend on a variety of factors beyond the SAR and time of RF application. Thus, it is recommended to pay particular attention to the following points:

- It is recommended to thoroughly monitor patients undergoing MR scanning for perceived temperature and/or pain sensations.
- Patients with impaired thermoregulation or temperature sensation should be excluded from MR scanning procedures.
- Generally, it is recommended to use a MR system with low field strength in the presence of conductive implants. The employed specific absorption rate (SAR) should be reduced as far as possible.
- Using the ventilation system may further contribute to reduce temperature increase in the body.

DePuy Synthes
PART OF THE Johnson&Johnson FAMILY OF COMPANIES
People inspired™

Synthes GmbH
Eimattstrasse 3
4436 Oberdorf
Switzerland
Tel: +41 61 965 61 11
Fax: +41 61 965 66 00
www.depuysynthes.com

Not all products are currently available in all markets.

This publication is not intended for distribution in the USA.

All surgical techniques are available as PDF files at
www.depuysynthes.com/ifu

CE
0123

 036.000.382 DSEM/TRM/1214/0254(2) 09/16