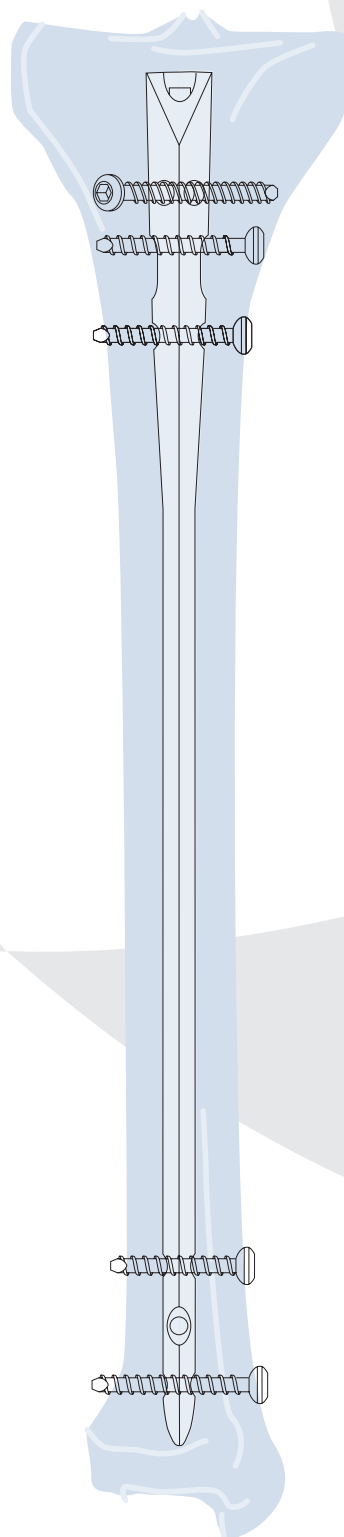





































# UTN/CTN Solid/Cannulated Tibial Nail

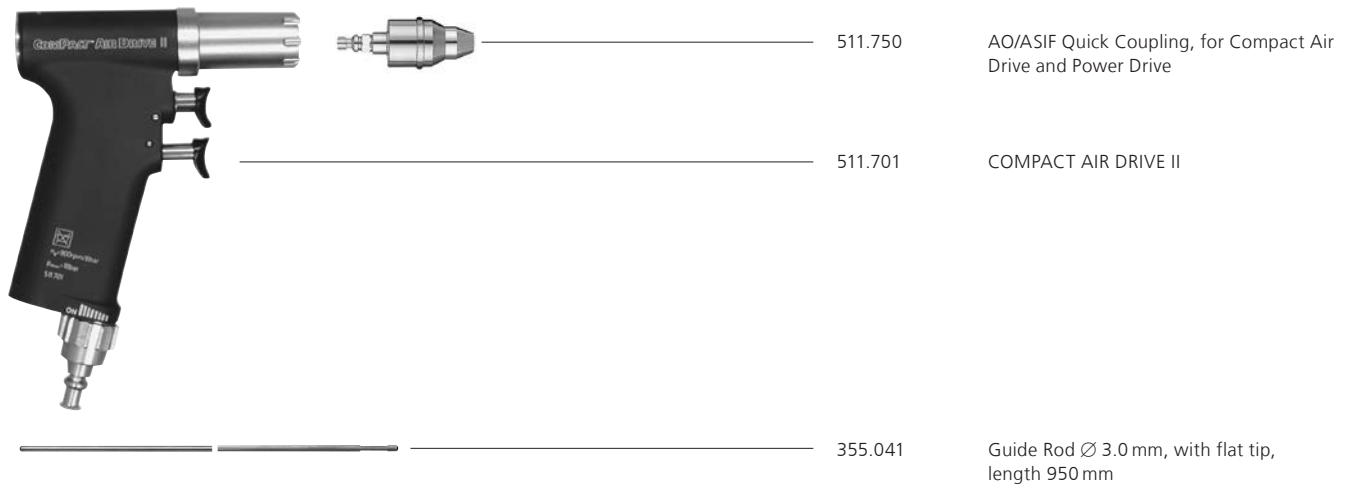
Surgical Technique



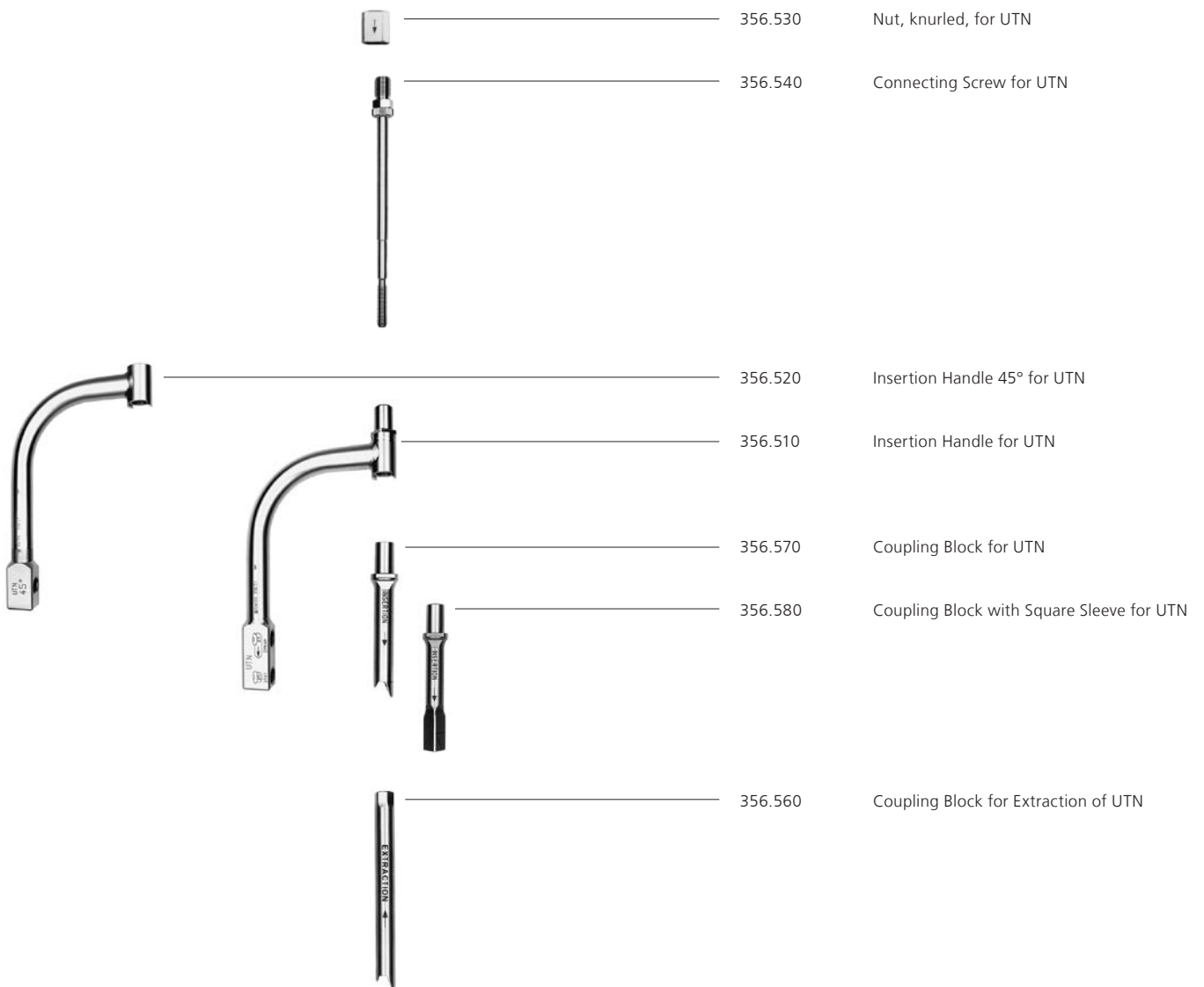
	356.590	Radiographic Ruler for UTN/CTN, length 430 mm
	351.060	Centering Pin Ø4.0mm, length 400 mm, for No. 351.240
	393.100	Universal Chuck with T-Handle
	351.240	Cutter for UTN/CTN and Universal Medullary Nail
	351.260	Protecting Sleeve, for No. 351.240
	356.490	Insertor/Extractor for UTN/CTN and UHN
	332.200	Slotted Hammer
	321.160	Combination Wrench Ø 11.0 mm
	356.542	Connecting Screw for UTN, for No. 356.511
	356.544	Connecting Screw for CTN, for No. 356.511
	356.543	Extraction Screw for UTN/CTN
	356.511	Insertion Handle for UTN/CTN
	356.521	Aiming Arm for UTN/CTN
	458.XXX	Locking Bolt Ø 3.9 mm, self-tapping, TAN
	459.XXX	Locking Bolt Ø 4.9 mm, self-tapping, TAN
	258.XXX	Locking Bolt Ø 3.9 mm, self-tapping, Stainless Steel
	458.110*	End Cap for UTN, extension 15 mm, TAN
	258.110	End Cap for UTN, extension 15 mm, Stainless Steel
	458.100	End Cap for UTN Ø 8.0, 9.0 and 10.0 mm, TAN
	258.100	End Cap for UTN Ø 8.0, 9.0 and 10.0 mm, Stainless Steel
	458.120	End Cap for CTN, Titanium Alloy (TAN), green
	47X.XXX	UTN-Solid Tibial Nail, complete, with End Cap, TAN
	27X.XXX	UTN-Solid Tibial Nail, complete, with End Cap, Stainless Steel
	485.XXX	CTN-Cannulated Tibial Nail, TAN
	355.700	Protection Sleeve 11.0/8.0
	355.750	Trocar Ø 8.0 mm
	355.722	Drill Sleeve 8.0/3.2, dark blue
	357.711	Drill Sleeve 8.0/4.0, green
	355.720	Drill Sleeve 8.0/3.2
	315.330	Drill Bit Ø 3.2 mm, calibrated
	356.982	Drill Bit Ø 4.0 mm, calibrated
	355.790	Depth Gauge for Locking Bolts, measuring range up to 90 mm
	314.240	Screwdriver, hexagonal, small, Ø 2.5 mm, with Groove, length 250 mm
	314.750	Screwdriver, hexagonal, large, Ø 3.5 mm, with Groove
	314.280	Holding Sleeve, large

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

\*Also available in TAV.



### Only for UTN



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 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.depuyshes.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.depuyshes.com/hcp/reprocessing-care-maintenance>

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# AO Principles

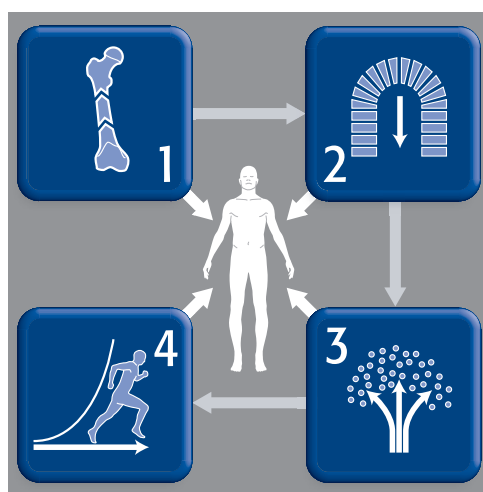
In 1958, the AO formulated four basic principles, which have become the guidelines for internal fixation<sup>1,2</sup>.

## **Anatomic reduction**

Fracture reduction and fixation to restore anatomical relationships.

## **Early, active mobilization**

Early and safe mobilization and rehabilitation of the injured part and the patient as a whole.



## **Stable fixation**

Fracture fixation providing absolute or relative stability, as required by the patient, the injury, and the personality of the fracture.

## **Preservation of blood supply**

Preservation of the blood supply to soft tissues and bone by gentle reduction techniques and careful handling.

<sup>1</sup> Müller ME, Allgöwer M, Schneider R, Willenegger H. Manual of Internal Fixation. 3<sup>rd</sup> ed. Berlin, Heidelberg, New York: Springer. 1991.

<sup>2</sup> Rüedi TP, Buckley RE, Moran CG. AO Principles of Fracture Management. 2<sup>nd</sup> ed. Stuttgart, New York: Thieme. 2007.

# Indications/Contraindications

The Solid Tibial Nail (UTN) and Cannulated Tibial Nail (CTN) are used for the fixation of tibial shaft fractures. Because of its anatomical cross-section, the UTN is more suited to the unreamed technique, while the CTN, with its round cross-section, is more suited to the reamed technique.

## Indications for UTN

- Fractures, types 42-A to 42-C
- Closed fractures, types 0 to 3 (Tscherne classification)
- Open fractures, types I to IIIA, IIIB and IIIC (Gustilo classification)

## Contraindications for UTN

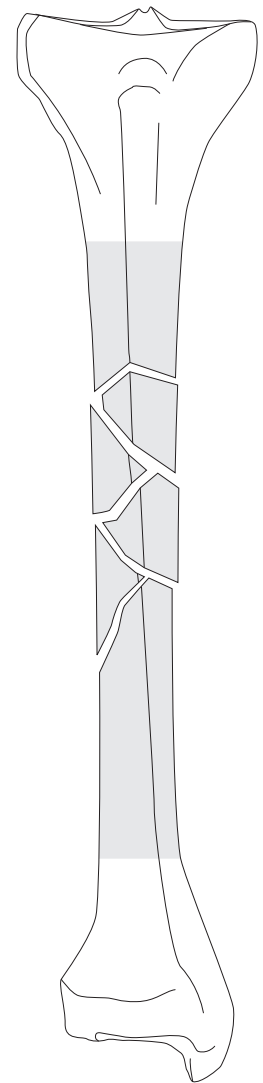
- Infections
- Pseudoarthroses
- Nonunions

## Indications for CTN

- Fractures, types 42-A to 42-C
- Closed fractures, types 0 to 2 (Tscherne classification)
- Open fractures, types I to IIIA (Gustilo classification)
- Pseudoarthroses
- Nonunions

## Contraindications for CTN

- Infections
- Closed fractures, type 3 (Tscherne classification)
- Open fractures, types IIIB and IIIC (Gustilo classification)



# Indications for Tibial Nailing<sup>3</sup>

The number of different implants available for intramedullary fixation of the tibia has grown over the years. The implants differ in their design (slotted/unslotted, solid/cannulated, small diameter/large diameter, static locking/dynamic locking), materials (steel/titanium), technical application (with/without/single reaming) and price. Considerable overlap exists for the indications.

The following table prepared by the Long Bone Expert Group (LBEG) of the Technical Committee of the AO/ASIF provides an overview of the indications for Synthes tibial nails.

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## Implants

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### All intramedullary implants for the tibia

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#### AO Universal Tibial Nail

unlocked, reamed application

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#### AO Universal Tibial Nail

locked, reamed application

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#### UTN Solid Tibial Nail, Stainless Steel

locked, unreamed application

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#### UTN Solid Tibial Nail, Titanium Alloy (TAN)

locked, unreamed application

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#### CTN Cannulated Tibial Nail, Titanium Alloy (TAN)

locked, reamed application

<sup>3</sup> Krettek C et al. "Nailing Indications." In: AO/ASIF Principles of Fracture Management, edited by C Colton, A Fernández, U Holz, J Kellam, WM Murphy, P Ochsner. Stuttgart, New York: Thieme. 2000.



Indications	Limitations
<ul style="list-style-type: none"> <li>• Diaphyseal fractures</li> <li>• Metaphyseal fractures where locking bolts can still be placed and will result in stable aligned fracture fixation</li> </ul>	<ul style="list-style-type: none"> <li>• Severe contamination</li> <li>• Presence of acute infection</li> <li>• Metaphyseal fractures where locking bolts cannot be placed adequately (poor bone stock) or when fixation is expected to be unstable</li> </ul>
<ul style="list-style-type: none"> <li>• Axially and rotationally stable fracture patterns (AO classification 42-A1 to 42-A2) in the middle third of the tibia</li> <li>• Pseudoarthroses/nonunions if axially and rotationally stable</li> </ul>	<ul style="list-style-type: none"> <li>• Axially and rotationally unstable fractures (42-A3 to 42-C)</li> <li>• Fractures in the proximal and distal third of the tibia</li> <li>• Closed fractures grade 3 (Tscherne)</li> <li>• Open fractures grade IIIB and IIIC (Gustilo)</li> <li>• Cases with increased risk of septic complications</li> </ul>
<ul style="list-style-type: none"> <li>• All 42-A to 42-C fractures (AO classification) in the middle three fifth of the tibia</li> <li>• Closed fractures grade 0 to 2 (Tscherne)</li> <li>• Open fractures grade I to IIIA (Gustilo)</li> <li>• Pseudoarthroses / nonunions</li> </ul>	<ul style="list-style-type: none"> <li>• Closed fractures grade 3 (Tscherne)</li> <li>• Open fractures grade IIIB and IIIC (Gustilo)</li> <li>• Cases with increased risk of septic complications</li> </ul>
<ul style="list-style-type: none"> <li>• Closed and open fractures of types 42-A to 42-C</li> <li>• Closed fractures grade 0 to 3 (Tscherne)</li> <li>• Open fractures grade I to IIIC (Gustilo)</li> <li>• Change of treatment from external fixator</li> </ul>	<ul style="list-style-type: none"> <li>• Pseudoarthroses</li> <li>• Nonunions</li> </ul>
<ul style="list-style-type: none"> <li>• Same indications as for UTN Stainless Steel</li> <li>• Compared to UTN Stainless Steel, UTN TAN <ul style="list-style-type: none"> <li>• might be beneficial in cases with increased risk of septic complications</li> <li>• is more resistant to fatigue</li> <li>• has higher elasticity</li> <li>• has better biocompatibility</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Pseudoarthroses</li> <li>• Nonunions</li> </ul>
<ul style="list-style-type: none"> <li>• Same indications as for locked Universal Tibial Nail (see above)</li> <li>• Cases where the use of a guide rod and an implant in titanium alloy might be beneficial</li> </ul>	<ul style="list-style-type: none"> <li>• Closed fractures grade 3 (Tscherne)</li> <li>• Open fractures grade IIIB and IIIC (Gustilo)</li> <li>• Cases with increased risk of septic complications</li> </ul>

### Locking

Distal locking should be performed first. Before proximal locking, care should be taken that the fracture is not distracted. This is best achieved by striking back the distally locked bone-implant construct with the slotted hammer in order to close the fracture gap in simple fractures. The use of all three distal locking options minimizes screw deformation.

As a rule, tibial nails are to be locked proximally as well as distally.

**Axially and rotationally stable:** In fracture patterns where the main fragments are axially and rotationally stable, either proximal or distal locking can be performed when AO Universal nails are used (primary dynamization).

**Axially stable, rotationally unstable:** The dynamic locking option (slot) can be used in axially stable but rotationally unstable fracture patterns (primary dynamization).

**Axially and rotationally unstable:** In axially and rotationally unstable fracture patterns, proximal and distal static locking should be performed.

In cases where judgement of stability is difficult or impossible, the more restrictive form of locking should be chosen.

### Weight-bearing

When deciding on weight-bearing, fracture pattern, fracture localisation, conditions of soft tissues and quality of bone stock should be taken into account.

Partial weight bearing (sole contact or 15 kg) is the basic form of loading the fractured leg. Complete non-weight-bearing should be avoided.

Increase in load is determined according to fracture pattern and localisation, conditions of soft tissues and quality of bone as well as absence or presence of load induced pain.

### Locking protocol<sup>4</sup>

Fracture type in segment 42	Site (fifths, from proximal to distal)
All A3, stable B2–3, C2	3–5
All A1–2, B1, unstable B2–3, C2, all C1 and C3	3–5
All A–C	2

### Weight-bearing protocol<sup>2</sup>

Fracture type in segment 42	Site (fifths, from proximal to distal)
A3, C2 stable B2–3	2–4
	2 or 5
A1–2, B1 unstable B2–3	3
C1, C3	2–5

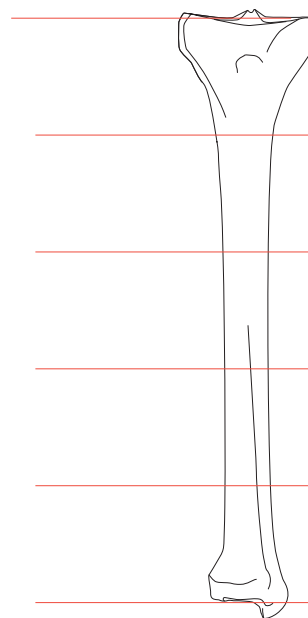
<sup>4</sup> Krettek C, Schandelmaier P, Rudolf J, Tschorne H. Current status of surgical technique for unreamed nailing of tibial shaft fractures with the UTN (unreamed tibia nail) (in German). Unfallchirurg 1994;97: 575–599.

**Proximal locking pattern**

Dynamic

Dynamic + static

Dynamic + static + oblique



Weight-bearing pain	Initial weight-bearing	Increase in weight-bearing
Yes	15–20 kg	If pain-free or evidence of callus formation, at the latest after 6 weeks
None	1/2 body weight	Increasing to full weight-bearing if pain-free
In part	15–20 kg	If evidence of callus formation, not before 12 weeks
Yes	15–20 kg	If pain-free
None	1/2 body weight	Increasing to full weight-bearing if pain-free and no dislocation (regular x-ray checks)
	15–20 kg	According to x-rays and clinical progress (not before 12 weeks)

**Dynamisation/Use of bone graft**

In nailing of tibia fractures, secondary dynamisation (removal of the static proximal locking bolts) during the healing process might be important.

Dynamisation should be considered, if a fracture gap could not be avoided during primary surgery and in cases of radiographic absence of callus.

In defect situations, cancellous bone grafting should be considered.

Decision making for dynamisation or bone grafting should be considered within 6–8 weeks after nailing.

**Dynamic locking protocol<sup>5</sup>**

<b>Fracture type in segment 42</b>	<b>Site (fifths, from proximal to distal)</b>
A3	3–4
Stable B2–3 or C2	5
A1–2	2
B1	3–5
Unstable B2–3 or C2	2
C1, C3	3–5
	2

<sup>5</sup> Krettek C, Schandelmaier P, Rudolf J, Tschorne H. Current status of surgical technique for unreamed nailing of tibial shaft fractures with the UTN (unreamed tibia nail) (in German). Unfallchirurg 1994;97: 575–599.

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<b>Site of dynamic locking</b>	<b>Time of dynamic locking</b>
Proximal	Primary
Distal	Primary
Dynamic + static	6 weeks
	6–8 weeks
	6–8 weeks
Dynamic + static + oblique	Depends on x-ray findings
	Depends on x-ray findings

# Implants

	<b>Solid Tibial Nail UTN TAN*</b>		<b>Cannulated Tibial Nail CTN TAN*</b>
<b>End Caps</b>	<b>blue</b>	<b>blue</b>	<b>green</b>
Material	TAN	TAN	TAN
Article number (without extension)	458.100	458.100	458.120
Article number (with 15 mm extension)	458.110	458.110	–
<b>Nails</b>	<b>blue</b>	<b>green</b>	<b>green</b>
Diameter	8.0, 9.0 mm	10.0 mm	10.0, 11.0, 12.0, 13.0 mm
Lengths	255, 270, 285, 300, 315, 330, 345, 360, 380, 400, 420 mm		(see UTN)
Locking options	Proximal <ul style="list-style-type: none"> <li>• Static 45° to AP plane</li> <li>• Dynamic in ML plane</li> <li>• Static in ML plane in the dynamic longitudinal hole</li> <li>• Static in ML plane</li> </ul> Distal <ul style="list-style-type: none"> <li>• Static in ML plane</li> <li>• Static in AP plane</li> <li>• Static in ML plane</li> </ul>		(see UTN)
Curvature	9°; $\frac{1}{3}$ from the proximal end		(see UTN)
Cross-section	Anatomical		Round (∅ 11.0, 12.0 und 13.0 mm with longitudinal grooves)
<b>Locking Bolts</b>	<b>blue</b>	<b>green</b>	<b>green</b>
Material	TAN	TAN	TAN
Diameter	3.9 mm	4.9 mm	4.9 mm
Lengths	20–80 mm	26–100 mm	26–100 mm
Article numbers	458.200– 458.800	459.260– 459.960	459.260– 459.960

\* TAN: Ti Al6 Nb7

**Solid Tibial Nail  
UTN Stainless Steel**

**UTN TAN**

**CTN TAN**

**UTN Stainless Steel**

Stainless Steel

258.100

258.110

8.0, 9.0 mm

(see UTN)

(see UTN)

(see UTN)

Anatomical

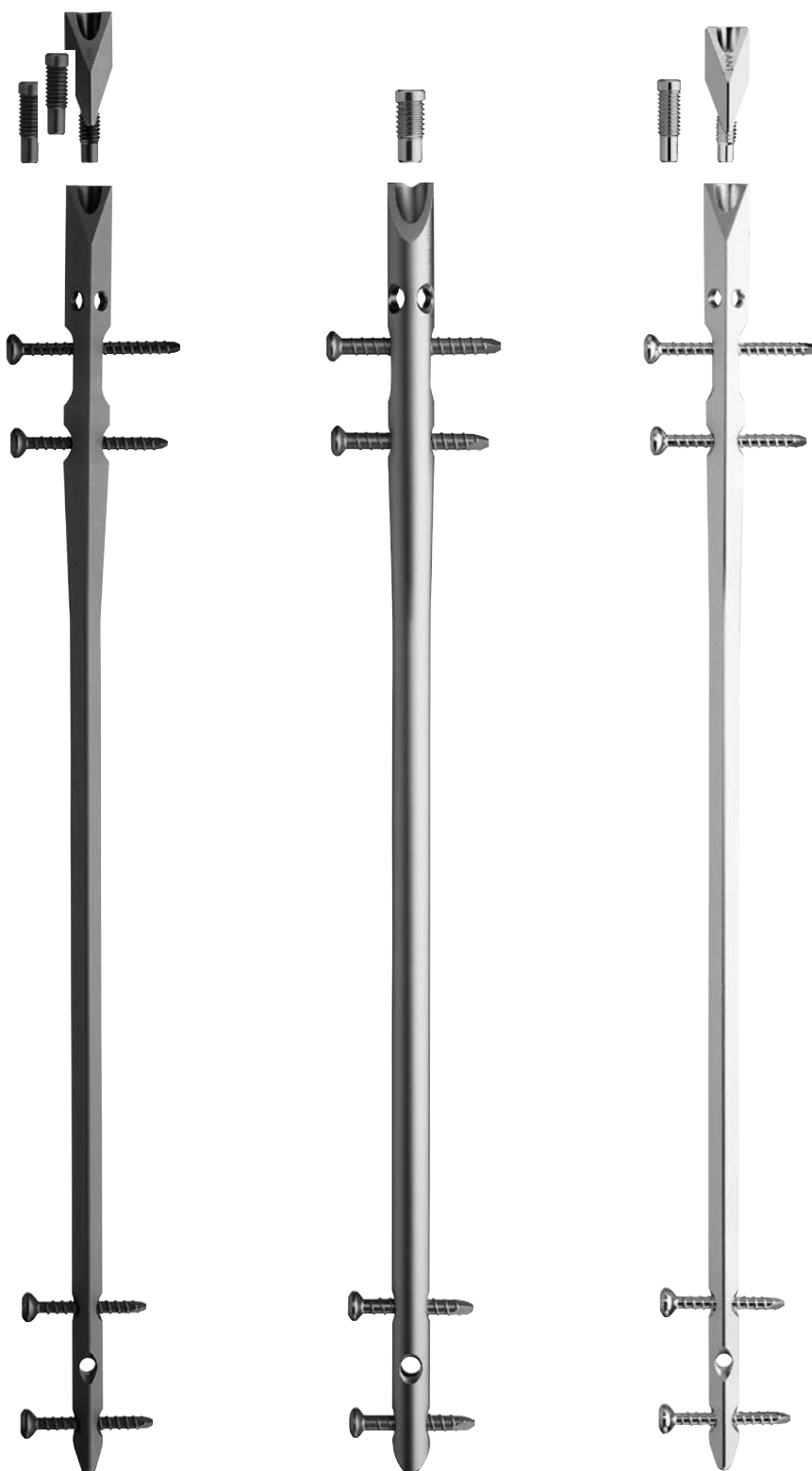
Stainless Steel

3.9 mm

20–80 mm

258.200–

258.800



# Surgical Technique

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Meticulous preoperative planning with clear fracture classification and the right choice of implants is essential for a good surgical result.

Whether a UTN or CTN should be used will depend primarily on the indications for the two nails (see pages 3 to 9). Where the indications overlap for the UTN and CTN (closed fractures and minor open fractures), the stability of the fracture and the corresponding stability required for the internal fixation are crucial. The UTN  $\varnothing$  10.0 mm or a CTN should be selected for unstable fractures requiring highly stable fixation. These nails are locked with 4.9 mm bolts for enhanced stability. The UTN  $\varnothing$  8.0 mm and  $\varnothing$  9.0 mm versions are locked with 3.9 mm bolts.

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## 1. Position patient

Lay the patient in a supine position with the knee of the injured leg flexed at an angle of 70–90°. A knee support can be used to facilitate reduction and subsequent stabilisation of the reduced fracture. Position the image intensifier to allow AP and lateral x-rays to be taken along the full length of the tibia.

### **Alternative**

Lay the patient on an extension table. However, only limited treatment of soft tissue injuries is possible with this option.

### **Precautions:**

- **Instruments and screws may have sharp edges or moving joints that may pinch or tear user's glove or skin.**
- **Handle devices with care and dispose worn bone cutting instruments in an approved sharps container.**



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## 2. Reduce fracture

- If possible reduce the fracture while closed under the image intensifier. The use of the Large Distractor (394.350) or Pinless Fixator (186.310) may be appropriate in certain circumstances.

### 3. Determine nail length

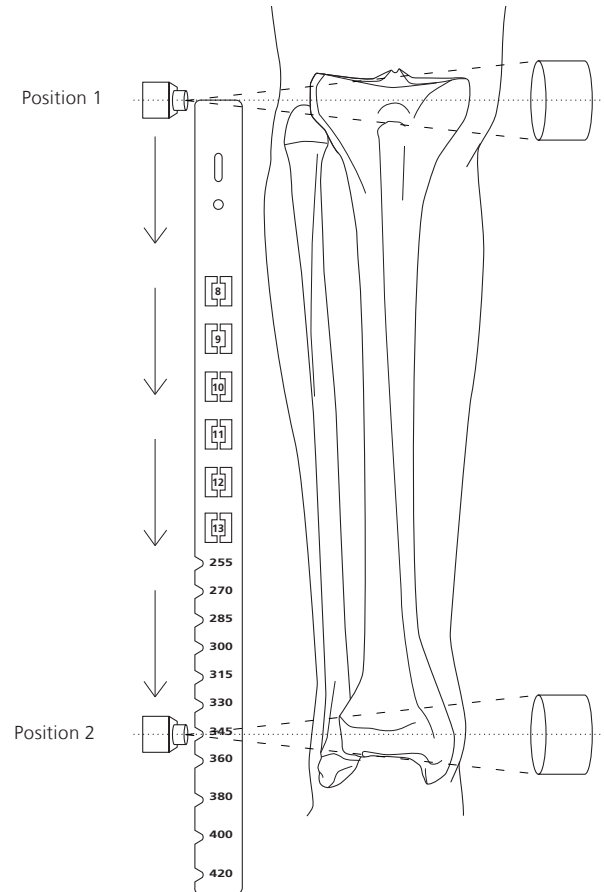
The required nail length may be determined either before or after disinfection of the injured leg.

- 1 Position the image intensifier as for an AP x-ray of the proximal tibia (position 1). Using long forceps, hold the Radiographic Ruler for UTN/CTN (356.590) parallel to the tibia on the lateral side of the lower leg. Position the ruler such that the proximal end is located at the level of the desired nail insertion point. Mark the skin on the lateral side.
- 2 Move the image intensifier toward the distal end of the tibia (position 2), align the proximal end of the radiographic ruler with the skin marking and record an AP x-ray of the distal tibia. Check the reduction and read off the required nail length on the ruler as it appears in the x-ray.

The possibility of immediate or subsequent dynamisation must be taken into account when determining nail length and a correspondingly shorter nail chosen. The locking bolt in the dynamic hole is allowed to move by up to 8 mm distally.

#### Alternative

- Determine the nail length by the above procedure on the uninjured leg or before draping (unsterile).
- Use a planning template and x-ray.

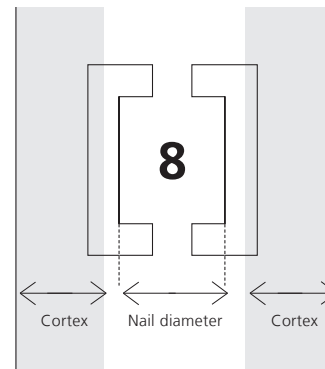


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## 4. Determine nail diameter

- Place the radiographic ruler over the tibia so that the measuring edge is located over the isthmus. Select the nail diameter (8 mm in this example) shown when the medullary canal/cortex transition is still visible on both sides of the marking.

If the reamed technique is used, the diameter of the largest medullary reamer applied must be 1 mm larger than the nail diameter.



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## 5. Make incision

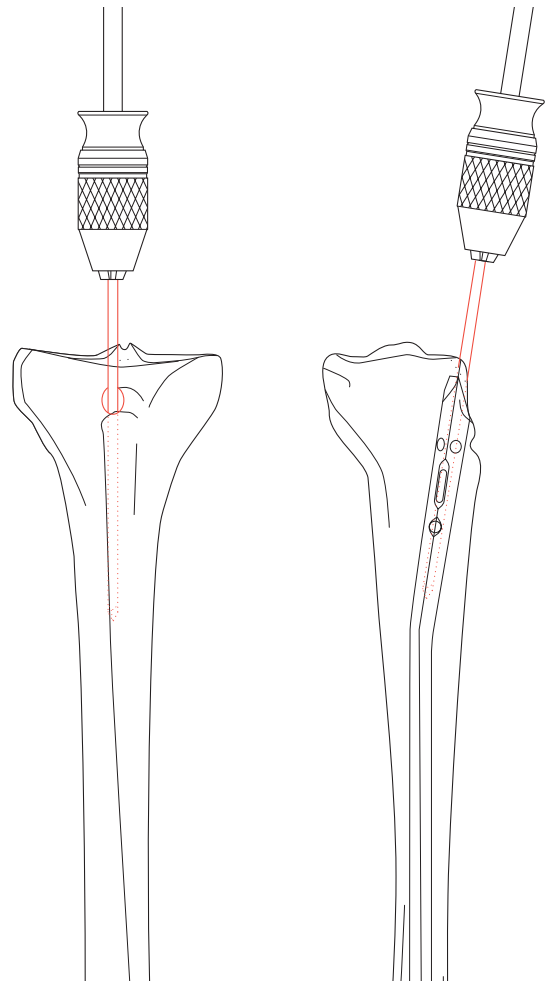
Make a parapatellar medial or transligamentous incision (via the patellar ligament).

## 6. Determine nail insertion point and insert guide wire

The nail insertion point is slightly distal to the tibial plateau, slightly laterally, below the lateral intercondylar tubercle and exactly in line with the proximal anterior tibial margin.

Secure the Centering Pin (351.060) in the Universal Chuck with T-Handle (393.100) and slightly punching mark the insertion point at a 9° angle to the shaft axis. Hold a sterile UTN or CTN on the lateral side of the lower leg so that its distal end is parallel to the tibial shaft. The angled proximal nail end determines the definitive angle of insertion for the centering pin.

- Screw in the centering pin for approx. 8–10 cm and check the position under the image intensifier via AP and lateral views.



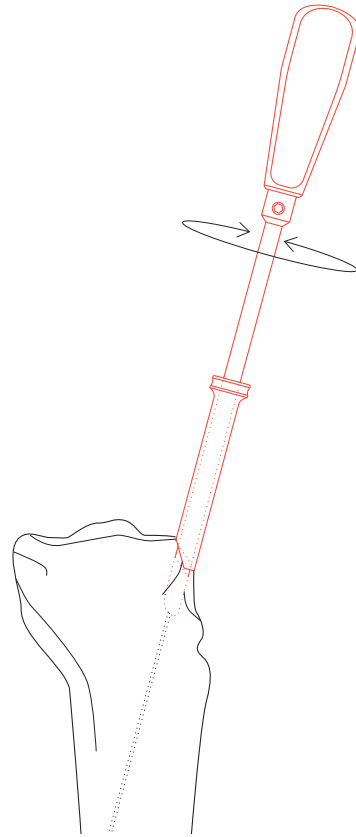
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## 7. Open medullary canal

Push the Protection Sleeve (351.260) and the Cutter for UTN/CTN and Universal Medullary Nail (351.240) over the centering pin and open the medullary canal over 8–10 cm. Remove the centering pin, cutter and protection sleeve.

Reaming may be indicated depending on the individual situation, otherwise proceed to step 9.

Since the medullary canal is circular in cross-section after reaming, a CTN is recommended for the reamed technique since this nail likewise has a round cross-section. Thanks to its anatomical cross-section, the UTN can generally be inserted without reaming.



## 8. Ream medullary canal (optional)

- Check fracture reduction under the image intensifier.

### A Inserting the reaming rod

Insert the Reaming Rod  $\varnothing$  3.0 mm (351.710) in the medullary canal.

### B Reaming

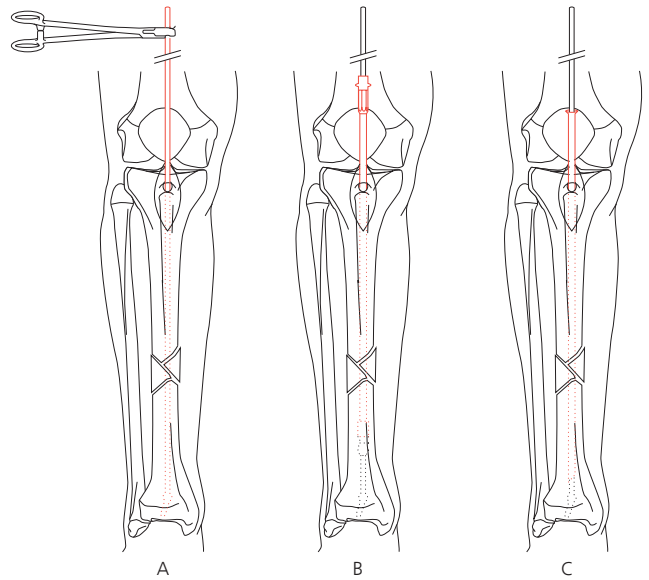
Starting with the smallest diameter (9.0 mm), ream the medullary canal in 0.5-mm increments. The Holding Forceps (351.780) are used to control the rotation of the flexed reaming rod. Advance the reamer head with slight forward and backward movements. Do not use force. Continue reaming until the diameter of the canal is 1.0 mm larger than the nail diameter.

If a solid nail is used, remove the reaming rod.

### C Replace reaming rod with the guide rod (for cannulated nails)

Remove the reaming instruments and push the Medullary Tube (355.010) over the reaming rod into the medullary canal. Remove the reaming rod and insert a Guide Rod  $\varnothing$  3.0 mm with flat tip (355.041) through the medullary tube. Withdraw the medullary tube. The guide rod remains in position for insertion of the cannulated nail.

The Guide Rod  $\varnothing$  3.0 mm (355.040) cannot be used, since the bilaterally thickened ends will not fit through the cannulated Connecting Screw for CTN (356.544).



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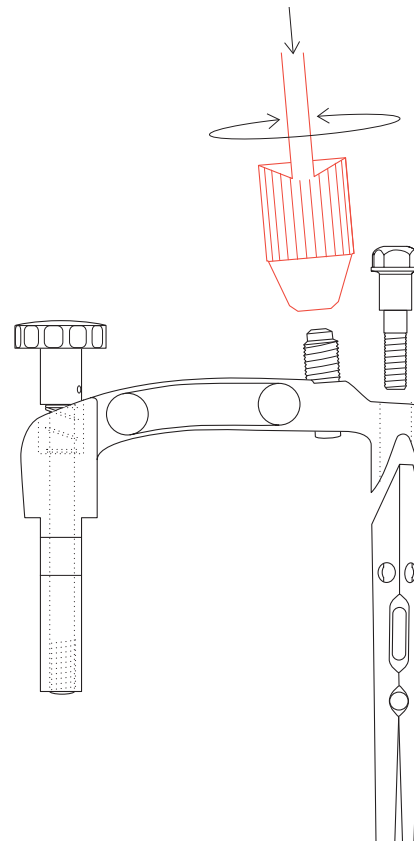
## 9. Mount insertion handle onto the nail

Anteriorly align the Insertion Handle for UTN/CTN (356.511). Accurately locate the flats of the insertion handle on the proximal end of the nail. Secure the UTN or CTN to the insertion handle with the Solid Connecting Screw for UTN (356.542) or the Cannulated Connecting Screw for CTN (356.544), respectively. Tighten the connecting screw with the 11.0 mm Combination Wrench (321.160) or the hexagonal Screwdriver (314.750). Do not overtighten.

Screw the Inserter/Extractor for UTN/CTN (356.490) onto the connecting screw.

**Note:** Do not attach the aiming arm for nail insertion.

See page 30 for mounting of the insertion instruments with the coupling block.



## 10. Insert nail

Insert the nail up to the bend with gentle rotary movements, insert further by hand but without rotating the nail. If a cannulated nail is used, insert it into the tibia over the guide rod. Under the image intensifier, check the passage of the nail tip through the fracture line.

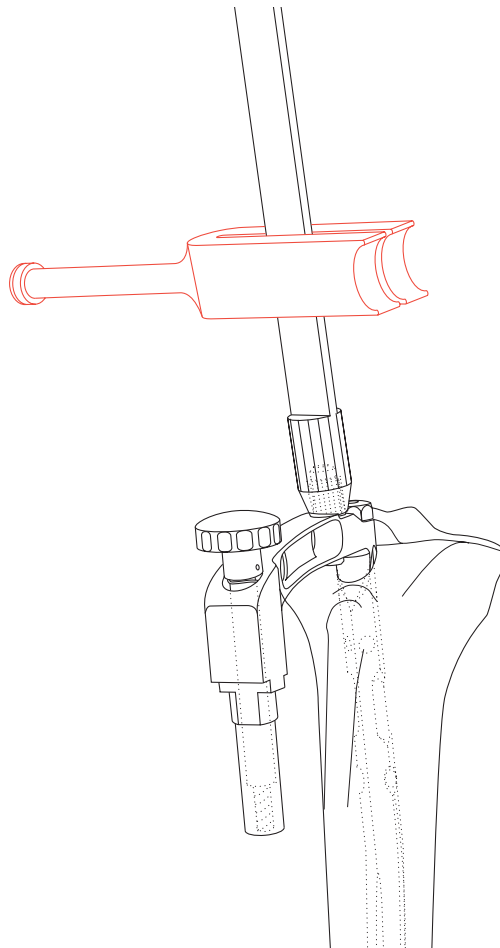


If necessary, use the Slotted Hammer (332.200) over the inserter/extractor to apply gentle hammer blows until the proximal end has sunk 1–5 mm into the bone. Do not strike the insertion handle! If the UTN cannot be inserted even with gentle hammer blows, it must be removed and either replaced by a thinner nail or else the reamed technique should be applied (see step 8).

**Note: The nail must be fully inserted in flexion.**

Remove the guide rod. Check whether the connecting screw is still sufficiently tight as it may have been loosened by the hammer blows.

For proximal locking mount the aiming arm for insertion handle only when the nail has been completely inserted, otherwise the aiming arm may loosen during nail insertion.





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## 11. Distal locking

Distal locking is preferably carried out first, enabling the use of the backstrike technique to prevent diastasis. The nail must have been inserted to the sufficient depth beforehand.

For distal locking, always use at least two locking bolts to ensure adequate stability.

Locking of the UTN/CTN is usually performed from the medial side, if possible with the leg extended. This position helps counteract the forces exerted by the quadriceps muscle that would tend to deform the proximal fragment and also facilitates rotational control of the tibial axis before locking.

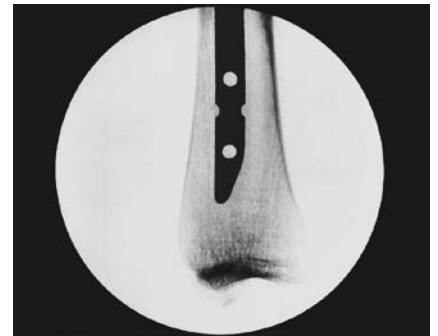
In most cases, the inserter/extractor for UTN/CTN must be unscrewed before the knee is extended. The insertion handle, however, should be left mounted on the nail.

Distal locking with the Radiolucent Drive (511.300) is illustrated below.

### **Align image intensifier**

Check the reduction, correct alignment of the fragments and leg length.

- ① Align the image intensifier until the most distal nail hole appears completely round.



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## 12. Make incision

Determine the point of skin incision and perform a stab incision with the scalpel.



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## 13. Drill

- Insert a Drill Bit ( $\varnothing$  3.2 mm [511.414] for 3.9-mm bolts or  $\varnothing$  4.0 mm [511.432] for 4.9-mm bolts) in the radiolucent drive and push through the incision down to the bone.

Incline the drive so that the tip of the drill bit is centred over the locking hole. The drill bit should almost completely fill the circle of the locking hole. Hold the bit in this position and drill through both cortices until the tip of the drill bit just breaks through the lateral cortex.



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## 14. Determine locking bolt length and insert bolt

Measure the locking bolt length using the Depth Gauge for Locking Bolts (355.790). Add 2 mm to the read-out to obtain the required bolt length.

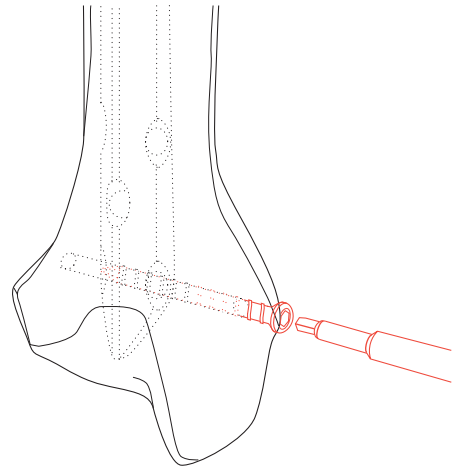
Insert the locking bolts using the corresponding hexagonal screwdriver.

In the event of diastasis, the rebound technique can be used after insertion of the second locking bolt.

### **Alternative**

The Distal Aiming Device (DAD) for UTN/CTN (185.115) can be used for distal locking.

If neither a DAD nor a radiolucent drive is available, locking is performed “freehand” using the corresponding Drill Bit (Ø 3.2 mm [315.330] for 3.9-mm bolts or Ø 4.0 mm [356.982] for 4.9-mm bolts).



## 15. Proximal locking

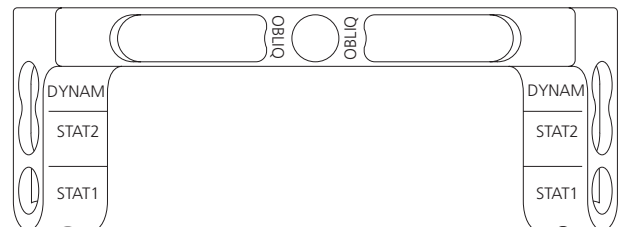
The round holes at both ends of the UTN/CTN are provided for static locking and ensure both rotational and axial stability.

In principle, a bolt should also be inserted into the dynamic locking hole to leave open the possibility of secondary dynamisation. In the case of stable fractures of types A3, B2–B3 and C2 in the AO classification, the fracture can be managed with primary dynamic stabilisation if contact between the two main fragments prevents shortening of the tibia.

**Note:** If, after primary static fixation, callus formation fails to occur and/or in the event of fragment diastasis, secondary dynamisation is carried out, normally by removal of the proximal static locking bolts. This should be carried out approximately 6–8 weeks after implantation, depending on fracture stability and callus formation.

The aiming arm for insertion handle allows the following proximal locking options:

- Static locking
  - Static (STAT1), dynamic (DYNAM) and, optionally, oblique (OBLIQ) for mid-third and lower-third shaft fractures
  - Static (STAT2) and oblique (OBLIQ) for high shaft fractures; this type of locking does not allow secondary, controlled dynamisation
  - Dynamic (DYNAM) and oblique (OBLIQ) for high shaft fractures if subsequent dynamisation is to remain an option
- Dynamic locking
  - Dynamic (DYNAM) for the above-mentioned stable fractures that allow primary dynamisation



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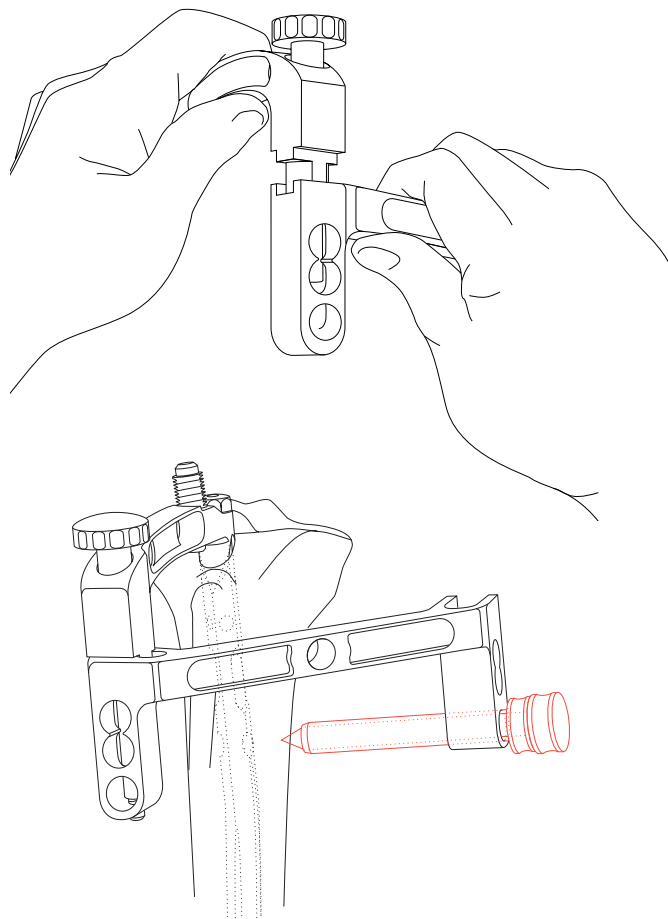
### Mount the aiming arm for insertion handle and insert trocar combination

For transverse locking, align the Aiming Arm for UTN/CTN (356.521) so that the nail can be locked from the medial to the lateral side.

Mount the aiming arm on the insertion handle using the black spring-loaded screw. Check the insertion handle/nail connection and, if necessary, tighten the connecting screw. Likewise, check the fracture reduction and, if necessary, use the backstrike technique.

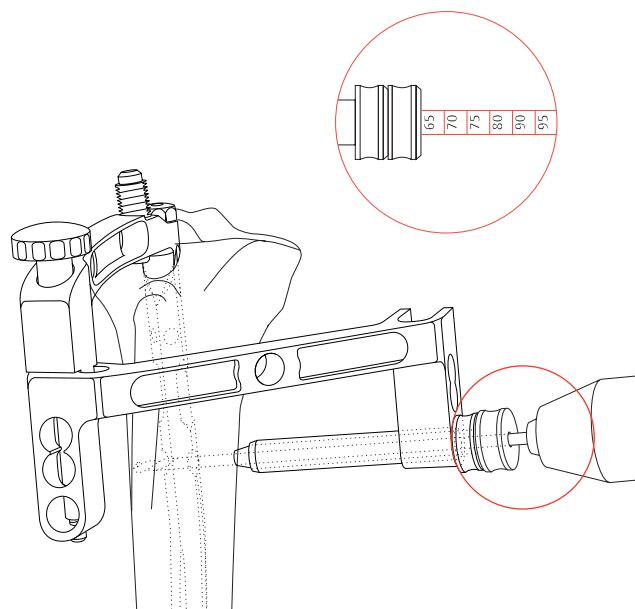
Insert the two-part trocar combination (Protection Sleeve 11.0/8.0 [355.700], Trocar  $\varnothing$  8.0 mm [355.750]) through the desired hole in the aiming arm, make a stab incision and insert the trocar to the bone. Remove the trocar and insert the drill sleeve corresponding to the bolt or drill diameter, respectively (see table on pages 31 and 32).

**Note:** There is no need to calculate locking bolt or locking screw length because the calibrated drill bit provides a direct measurement. However, since drill bit position directly represents locking bolt or locking screw position in bone, the locking bolt or screw will be too long if the drill bit is overinserted, or if the drill sleeve is not pressed down to the cortex.



## 16. Drill and determine locking bolt length

Using the corresponding Drill Bit ( $\varnothing$  3.2 mm for 3.9-mm bolts or  $\varnothing$  4.0 mm for 4.9-mm bolts), drill through both cortices until the tip of the drill bit just breaks through the lateral cortex. The required locking bolt length can be determined either by reading it directly off the calibrated drill bit or by measuring with the depth gauge. If the depth gauge is used, add 2 mm to the measured length to ensure that the locking bolt can find purchase in the opposite cortex.



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## 17. Insert locking bolt

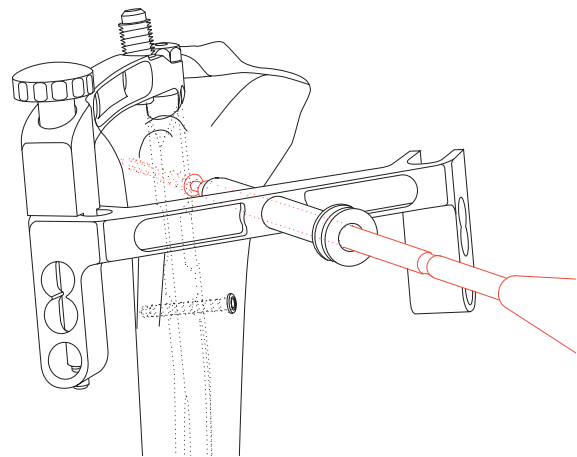
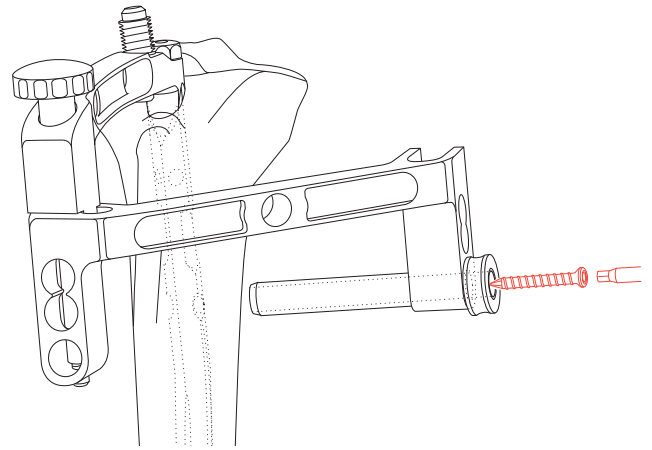
Using the corresponding hexagonal screwdriver, insert the locking bolt through the protection sleeve until the bolt head lies against the medial cortex. The tip of the locking bolt should project beyond the lateral cortex by no more than 1–2 mm.

Insert the other locking bolts in the same way.

### Lock through the diagonal hole (optional)

Depending on the individual circumstances, the diagonal hole can be locked from the anteromedial or anterolateral direction. The aiming arm for insertion handle is located accordingly on the medial or lateral side and mounted on the insertion handle using the black spring-loaded screw.

Lock through the diagonal hole as described in steps 15 to 17.



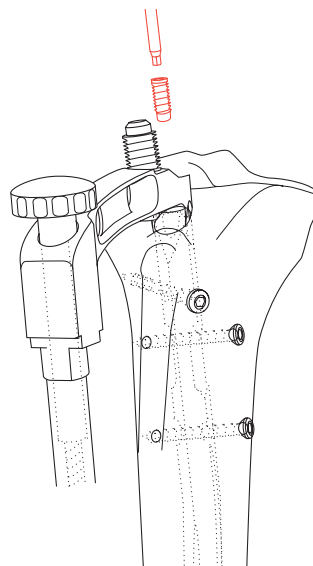
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## 18. Insert end cap

Remove the connecting screw and insert the appropriate end cap for the nail size through the insertion handle into the proximal end of the nail. The end cap prevents tissue ingrowth and thus facilitates later implant removal. The end cap can also be inserted after removal of the insertion handle.

If an excessively short UTN has been inserted too deeply and locked and if no secondary dynamisation is planned, the End Cap for UTN with 15 mm extension (458.110 [TAN] or 258.110 [Stainless Steel]) can be used. Over-insertion of the UTN is not possible if the insertion handle for UTN/CTN is used.

**Precaution:** To avoid irritation of the patellar ligament, an end cap with extension should not be used in such cases.





# Implant Removal

## 1. Mount extraction instruments

Remove any ingrown tissue from the hexagonal recesses of the end cap and the locking bolts. Unscrew all locking bolts except one using the appropriate hexagonal screwdriver and the Holding Sleeve (314.280).

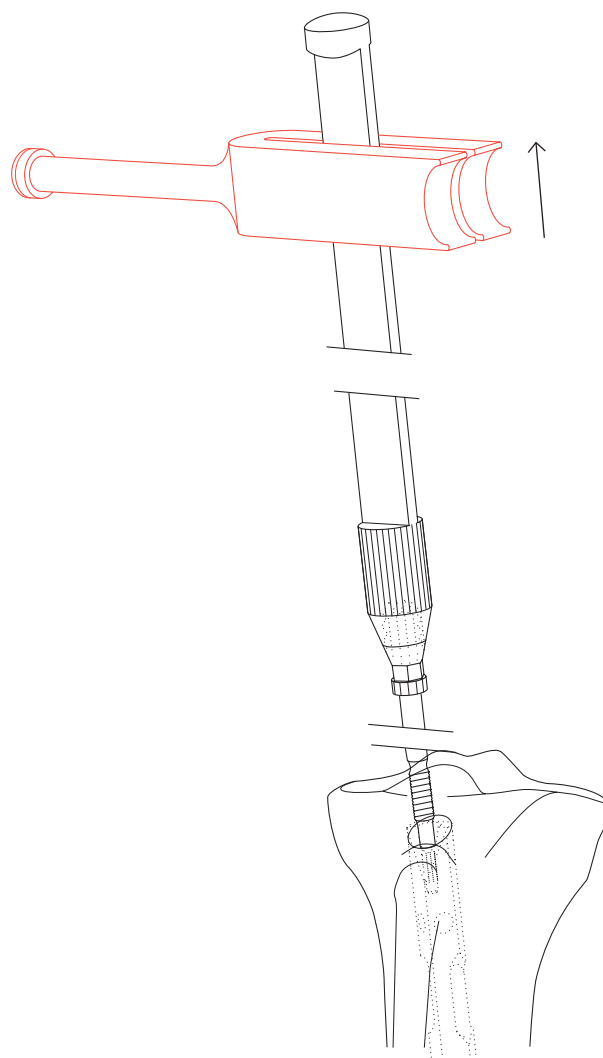
**Note:** Before removing the last locking bolt or screw, thread the extraction screw into the proximal nail end. This will prevent the nail from rotating in the medullary canal.

If the Connecting Screw for UTN (356.540) is used, it is compulsory to use the Coupling Block for Extraction of UTN (356.560).

With the CTN, the locking bolts in the oblique and dynamic holes must be removed before the extraction screw is inserted since these would otherwise be blocked by the screw.

Screw the Inserter/Extractor for UTN/CTN (356.490) onto the extraction screw.

**Note:** Ingrown bone tissue in the diagonal hole can prevent insertion of the extraction screw and must first be pushed out from the proximal end of the nail using a Steinmann pin. Be careful not to damage the nail thread during this procedure.



## 2. Remove nail

Remove the remaining locking bolt and extract the nail by applying gentle blows with the Slotted Hammer (332.200).

# Option for UTN

## Mount insertion instruments with coupling block for UTN

The insertion instruments are screwed onto the end of the nail, facilitating controlled insertion and removal.

Insert the Connecting Screw for UTN (A) (356.540) through the Insertion Handle for UTN (B) (356.510) and a Coupling Block for UTN (C1/C2) (356.580/356.570) and screw this assembly onto the nail. Ensure that the notches of the insertion handle fit into the grooves of the coupling block (C1 or C2).

The coupling blocks (C1/C2) ensure a torque-resistant connection between insertion handle and nail. If considerable forces are expected to act upon the instruments during nail insertion and reduction the Coupling Block with Sleeve for UTN (C1) (356.580) should be used.

Use the Coupling Block for UTN (C2) (356.570) if the UTN must be countersunk for primary or secondary dynamisation. The external diameter of the coupling block without the sleeve matches the width of the nail head.

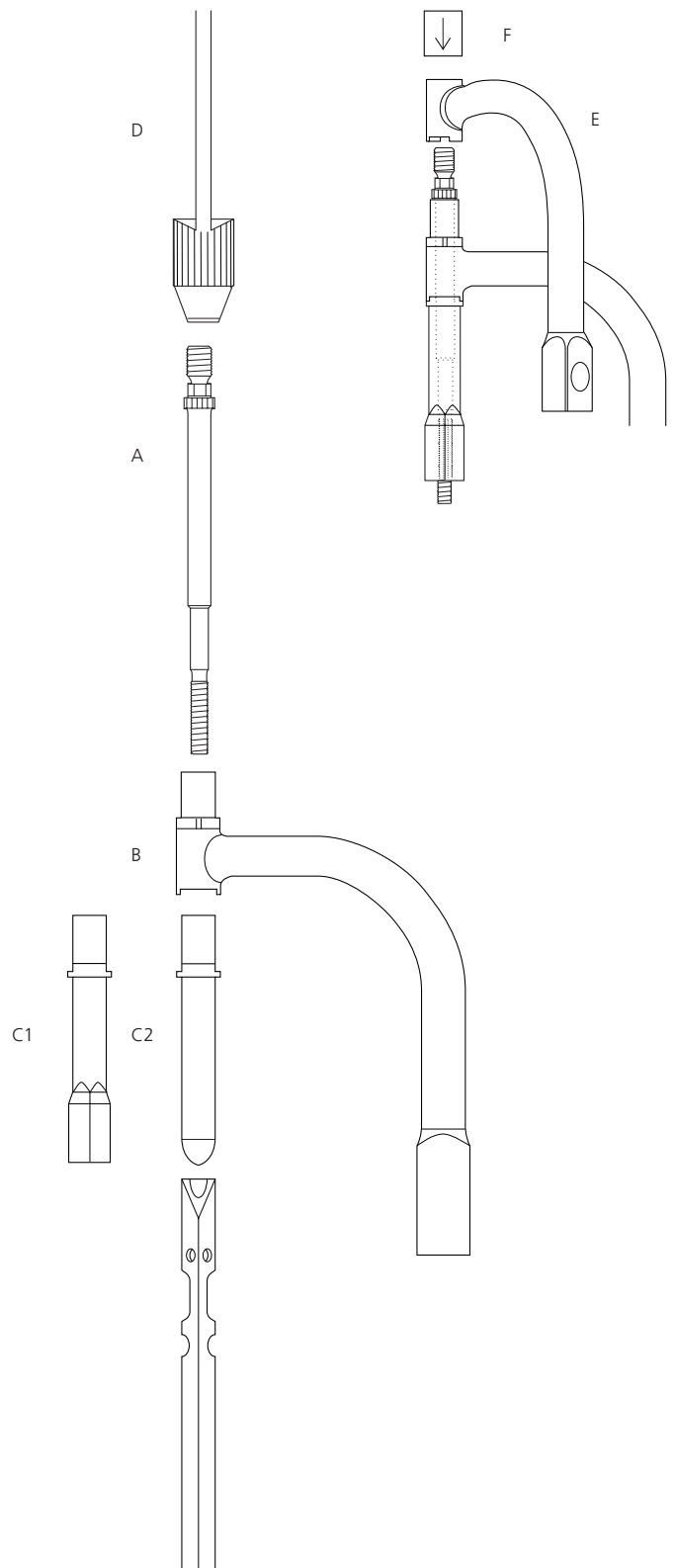
Apply the insertion handle to the medial side of the tibia for nail insertion and proximal locking. Tighten the whole assembly with the 11.0 mm Combination Wrench (321.160). Check that the assembly is stable but not overtightened. Screw the Inserter/Extractor for UTN/CTN (D) (356.490) onto the connecting screw.

Insert nail (see page 20).

## Mount 45° insertion handle

The 45° Insertion Handle for UTN (E) (356.520) can be screwed onto the insertion handle after insertion of the UTN without any need for dismantling the whole assembly.

Remove the inserter/extractor. Mount the 45° insertion handle in the desired direction and secure with the Knurled Nut for UTN (F) (356.530). Insert the locking bolts in the standard way.



# Dimensions of Implants and Instruments for Proximal and Distal Locking

## Proximal locking with UTN and CTN

	UTN			CTN	UTN	
	TAN			TAN	Stainless Steel	
Nail	∅ 8.0 mm (478.XXX)	∅ 9.0 mm (479.XXX)	∅ 10.0 mm (476.XXX)	∅ 10.0–13.0 mm (485.XXX)	∅ 8.0 mm (278.XXX)	∅ 9.0 mm (279.XXX)
Locking bolt	∅ 3.9 mm (458.XXX)	∅ 3.9 mm (458.XXX)	∅ 4.9 mm (459.XXX)	∅ 4.9 mm (459.XXX)	∅ 3.9 mm (258.XXX)	∅ 3.9 mm (258.XXX)
Drill bit	∅ 3.2 mm (315.330)	∅ 3.2 mm (315.330)	∅ 4.0 mm (356.982)	∅ 4.0 mm (356.982)	∅ 3.2 mm (315.330)	∅ 3.2 mm (315.330)
Protection sleeve	(355.700)	(355.700)	(355.700)	(355.700)	(355.700)	(355.700)
Trocar	(355.750)	(355.750)	(355.750)	(355.750)	(355.750)	(355.750)
Drill sleeve	(355.722)	(355.722)	(355.711)	(357.711)	(355.720)	(355.720)
Screwdriver	(314.750)	(314.750)	(314.750)	(314.750)	(314.240)	(314.240)

## Distal locking with UTN and CTN

	UTN			CTN	UTN	
	TAN			TAN	Stainless Steel	
Nail	∅ 8.0 mm (478.XXX)	∅ 9.0 mm (479.XXX)	∅ 10.0 mm (476.XXX)	∅ 10.0–13.0 mm (485.XXX)	∅ 8.0 mm (278.XXX)	∅ 9.0 mm (279.XXX)
Locking bolt	∅ 3.9 mm (458.XXX)	∅ 3.9 mm (458.XXX)	∅ 4.9 mm (459.XXX)	∅ 4.9 mm (459.XXX)	∅ 3.9 mm (258.XXX)	∅ 3.9 mm (258.XXX)
Drill bit for radiolucent drive	∅ 3.2 mm (511.414)	∅ 3.2 mm (511.414)	∅ 4.0 mm (511.432)	∅ 4.0 mm (511.432)	∅ 3.2 mm (511.414)	∅ 3.2 mm (511.414)
Screwdriver	(314.750)	(314.750)	(314.750)	(314.750)	(314.240)	(314.240)

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

### Proximal locking with UTN and CTN

	UTN			CTN	
	TAV			TAV	
Nail	Ø 8.0 mm (478.XXX VS)	Ø 9.0 mm (479.XXX VS)	Ø 10.0 mm (476.XXX VS)	Ø 9.0 mm (484.XXX VS)	Ø 10.0–13.0 mm (485.XXX VS)
Locking bolt	Ø 3.9 mm (458.XXX VS)	Ø 3.9 mm (458.XXX VS)	Ø 4.9 mm (459.XXX VS)	Ø 3.9 mm (458.XXX VS)	Ø 4.9 mm (459.XXX VS)
Drill bit	Ø 3.2 mm (315.330)	Ø 3.2 mm (315.330)	Ø 4.0 mm (356.982)	Ø 3.2 mm (315.330)	Ø 4.0 mm (356.982)
Protection sleeve	(355.700)	(355.700)	(355.700)	(355.700)	(355.700)
Trocar	(355.750)	(355.750)	(355.750)	(355.750)	(355.750)
Drill sleeve	(355.722)	(355.722)	(355.711)	(355.722)	(357.711)
Screwdriver	(314.750)	(314.750)	(314.750)	(314.750)	(314.750)

### Distal locking with UTN and CTN

	UTN			CTN	
	TAV			TAV	
Nail	Ø 8.0 mm (478.XXX VS)	Ø 9.0 mm (479.XXX VS)	Ø 10.0 mm (476.XXX VS)	Ø 9.0 mm (484.XXX VS)	Ø 10.0–13.0 mm (485.XXX VS)
Locking bolt	Ø 3.9 mm (458.XXX VS)	Ø 3.9 mm (458.XXX VS)	Ø 4.9 mm (459.XXX VS)	Ø 3.9 mm (458.XXX VS)	Ø 4.9 mm (459.XXX VS)
Drill bit for radiolucent drive	Ø 3.2 mm (511.414)	Ø 3.2 mm (511.414)	Ø 4.0 mm (511.414)	Ø 3.2 mm (511.414)	Ø 4.0 mm (511.414)
Screwdriver	(314.750)	(314.750)	(314.750)	(314.750)	(314.750)

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

# MRI Information

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## **Torque, Displacement and Image Artifacts according to ASTM F 2213-06, ASTM F 2052-14 and ASTM F 2119-07**

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 F 2182-11a**

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.

# References

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Müller ME, Allgöwer M, Schneider R, Willenegger H. Manual of Internal Fixation. 3<sup>rd</sup> ed. Berlin, Heidelberg, New York: Springer. 1991.

Rüedi TP, Buckley RE, Moran CG. AO Principles of Fracture Management. 2<sup>nd</sup> ed. Stuttgart, New York: Thieme. 2007.



