EXPERT™ Tibial Nail.

Surgical technique

EXPERT™ Nailing System

SYNTHES®

Original Instruments and Implants of the Association for the Study of Internal Fixation – AO/ASIF

Table of contents

AO/ASIF Principles of internal fixation	**4**
Indications	**5**
Cases	**6**
Surgical technique	**8**
Weight-bearing	**38**
Implant removal	**39**
Implants	**41**
Instruments	**46**

Image intensifier control

Warning
This description is not sufficient for immediate application of the instrumentation. Instruction by a surgeon experienced in handling this instrumentation is highly recommended.

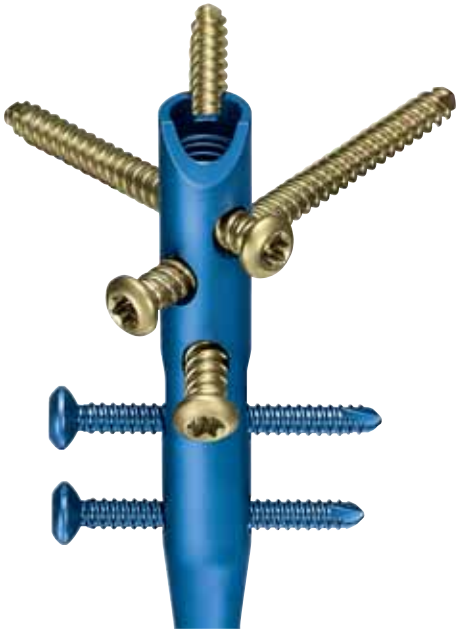
Cleaning of instruments:
For detailed information please refer to "Reprocessing, Care and Maintenance of Synthes Instruments", Article No. 035.000.090.

Expert Tibial Nail

Advanced solutions

Advanced proximal locking options:

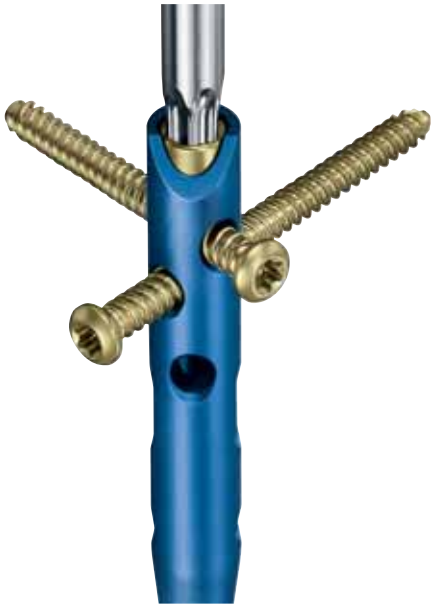
– Three unique and innovative locking options, in combination with Cancellous Bone Locking Screws, for optimised stabilization of the proximal fragment
– Two state of the art medio-lateral (ML) locking options enable primary compression or secondary controlled dynamisation



Improved stability

End Caps:

– Possibility to block one oblique locking screw with the end cap for absolute angular stability
– End cap prevents ingrowth of tissue and facilitates nail extraction
– Self-holding Stardrive recess for effortless and secure end cap pick-up



Advanced nail design:
- New anatomic bend for facilitated nail insertion and extraction
- Titanium alloy TAN for improved mechanical and fatigue properties
- Cannulated nails (from ∅ 8 mm to ∅ 13 mm) for reamed or unreamed techniques, enabling nail insertion over guide wire
- Solid nails (from ∅ 8 mm to ∅ 10 mm) for unreamed technique

Advanced distal locking options:
- One oblique locking option, placed very distally allowing optimised bone purchase and preventing damages of soft tissues
- Two ML and one antero-posterior (AP) locking options for better stabilization of the distal fragment

Multidirectional locking options for improved stability

All Locking Screws:
- Double thread for more contact points leading to enhanced stability
- Thread closer to screw head providing better bone purchase and improved stability
- Titanium alloy TAN for improved mechanical and fatigue properties
- Self-holding Stardrive recess for effortless and secure locking screw pick-up

Cancellous Bone Locking Screws:
- In combination with the three innovative and unique proximal locking options of all Tibial Nails
- Dual core design for optimised purchase in cancellous bone
- Monocortical

Standard Locking Screws:
- Larger cross section for improved mechanical resistance
- ∅ 4.0 mm for ∅ 8 mm and ∅ 9 mm Tibial Nails
- ∅ 5.0 mm for ∅ 10 mm to ∅ 13 mm Tibial Nails

AO/ASIF Principles of internal fixation

In 1958, the AO/ASIF (Association for the Study of Internal Fixation) formulated four basic principles[1], which have become the guidelines for internal fixation in general, and intramedullary nailing in particular:

Anatomic reduction
Before insert the nail the reduction can be achieved manually, using a reduction table, an external fixator or a distractor.
A guide wire marks the prescribed path into the intramedullary canal and secures alignment of the fragments while the cannulated nail is being inserted over the wire (solid nail design will not allow this procedure). The nail insertion is generally monitored using x-rays. The nail is then locked proximally and distally to the bone fragments in order to hold the reduction.

Stable fixation
Intramedullary nail act as an internal splint that controls but does not prevent micromovements of the fragments. It provides a relative stability that leads to an indirect healing through callus formation. The nails and the locking screws are available in different diameters that allow the surgeon to optimize stability. The judicious choice of locking options (number, position and direction) in the proximal and distal parts of the nail further improves the stability of the implant construct to the bone.

Preservation of blood supply
When the canal is not reamed, intramedullary nailing generates minimal trauma to the soft tissue and, therefore, the blood supply is maximised through the uninjured endosteum and periosteum. Reaming the canal temporarily disrupts the endosteal blood supply but probably stimulates the revascularization and therefore the bone healing.

Early mobilisation
Intramedullary nailing, combined with AO technique, provides relative stable fracture fixation with minimal trauma to vascular supply. This helps to create an improved environment for bone healing, accelerating the patient's return to previous mobility and function.

[1] M.E. Müller, M. Allgöwer, R. Schneider, and R. Willenegger: AO Manual of Internal Fixation, 3rd Edition. Berlin: Springer-Verlag. 1991.

Indications

Indications
The Expert Tibial Nail is indicated for fractures in the tibial shaft as well as for metaphyseal and certain intraarticular fractures of the tibial head and the pilon tibiale:
– 41-A2/A3
– All shaft fractures
– 43-A1/A2/A3
– Combinations of these fractures

For these indications the Expert Tibial Nail should be used in combination with other implants (not shown in the illustrations):
– 41-C1/C2
– 43-C1/C2

Note: The use of a cannulated Expert Tibial Nail with a large diameter offering more stability associated with the reamed technique is generally recommended for pseudarthroses, tumours, mal-unions and non-unions.

Cases

Fracture involving the proximal component

Case 1
The use of the three Locking Screws in the proximal oblique locking options ensures optimal stabilization of the Expert Tibial Tail in the proximal fragment. Distally, the Expert Tibial Nail can be locked with two ML Locking Screws (see illustrations). Stability of the distal fragment could be enhanced by the use of a third Locking Screw in the AP position.

Shaft fracture

Case 2
In simple shaft fractures, the use of two ML proximal and two ML distal Locking Screws is normally sufficient. Secondary dynamisation is achieved by removing the Locking Screw of the static locking option. In certain circumstances (unstable fractures), it is recommended to use a third distal Locking Screw.

Fracture involving the distal component

Case 3
The use of four distal Locking Screws is sometimes necessary to get the optimal stabilization of the distal fragment. In many cases though, three Locking Screws placed in the most distal positions are sufficient (see illustrations).

preoperative

postoperative

follow-up (3 weeks after surgery)

preoperative

postoperative

follow-up (1 month after surgery)

preoperative

postoperative

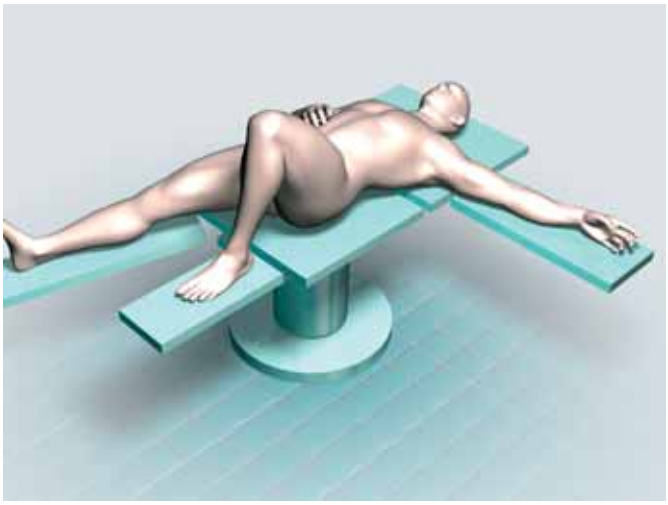
follow-up (4 months after surgery)

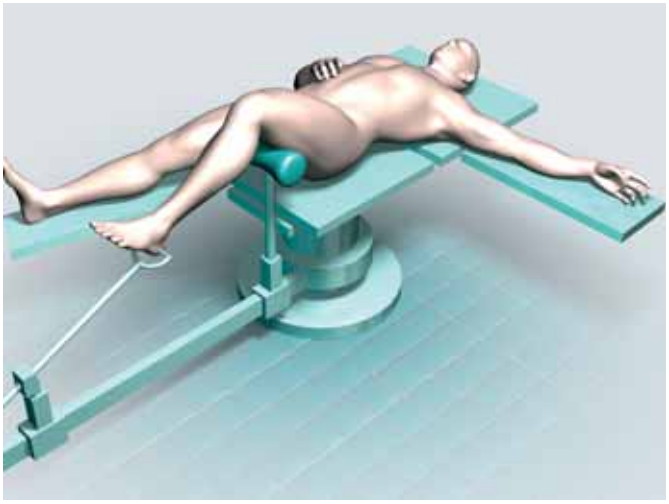
1

Position patient

Position the patient supine on the radiolucent table. Ensure that the knee of the injured leg can be flexed until at least 90°–100°. Position the image intensifier in such way that visualisation of the tibia including the articular surface proximally and distally is possible in AP and lateral views.

Note: The knee roller can be placed under the lower part of the thigh if it obstructs the view of the tibia plateau in AP view.





2

Reduce fracture

Perform closed reduction manually by axial traction under image intensifier. The use of the Large Distractor (394.350) or Pinless Fixator (186.310) may be appropriate in certain circumstances.

Note: The reduction can be temporarily fixed with reduction clamps. In epiphyseal fractures the condyles or the pilon tibiale are fixed first in order to enable the nail insertion.

3

Determine nail length and diameter

Instruments

Radiographic Ruler for Tibial Nails, length 450 mm	03.010.021

The required nail length must be determined after reduction of the lower leg fracture.

- Position the image intensifier as for an AP or lateral x-ray of the proximal tibia (position 1). Using long forceps, hold the Radiographic Ruler parallel to the tibia on the lateral side of the lower leg. Position the ruler such that the end is located at the level of the desired nail insertion point. Mark the skin on the lateral side.
- 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 Tibial Nail length on the Radiographic ruler as it appears in the x-ray.

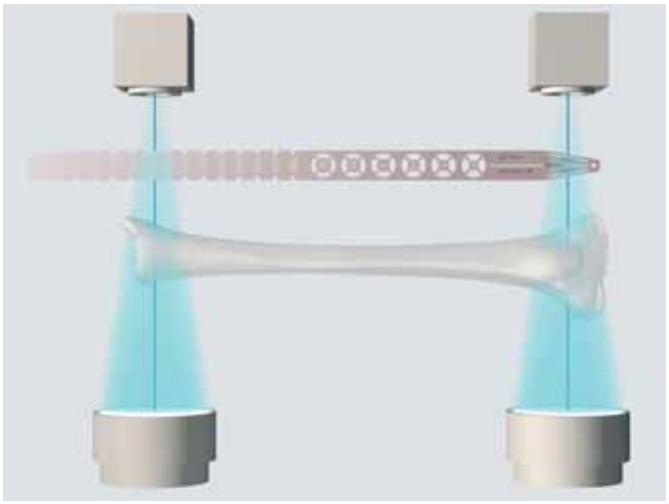
Note: The possibility of compression or dynamisation must be taken into account when determining the Tibial Nail length and a correspondingly shorter nail should be chosen. The Locking Screw in the dynamic locking option can move by up to 7 mm distally.

Alternatives

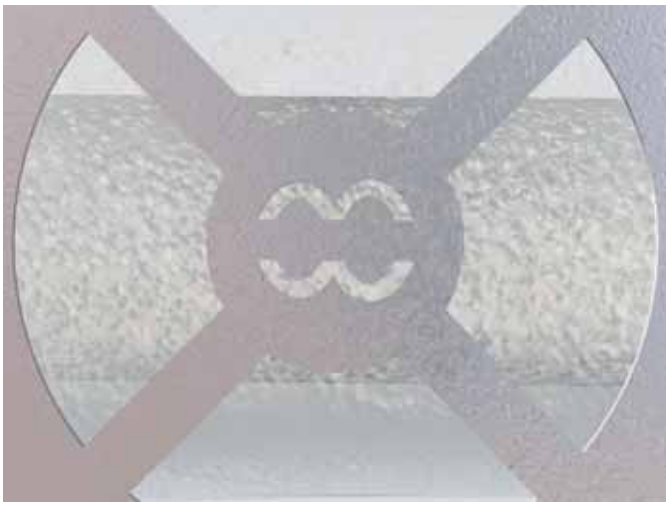
Determine the nail length by the above procedure on the uninjured leg or before draping (unsterile) or compare the length of two identical SynReam Reaming Rods ∅ 2.5 mm (352.032).

- 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 0.5 mm to 1.5 mm larger than the nail diameter.



Position 2 Position 1



4

Approach

Make an incision in line with the central axis of the intramedullary canal. Depending on the anatomy of the patient, this incision can be transpatellar, medial or even lateral parapatellar.

The incision starts proximally at the distal third of the patella along the patellar ligament down to the tibial tuberosity.

Mobilise the infrapatellar corpus adiposum laterally and dorsally without opening the synovia. A free access of the nail to the insertion point must be guaranteed.

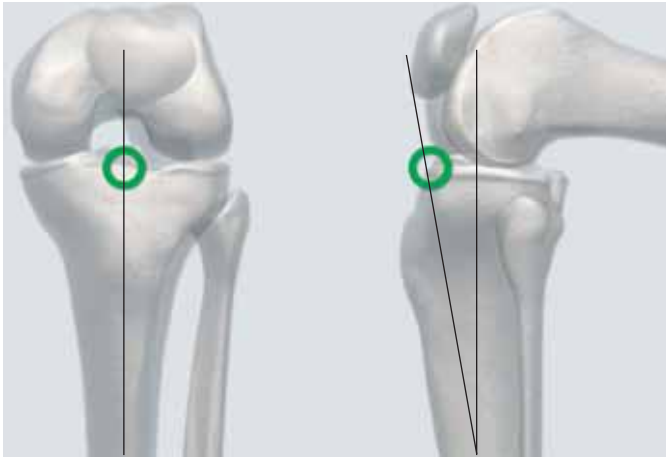
Prepare the entry site of the nail on the ventral edge of the tibial plateau.

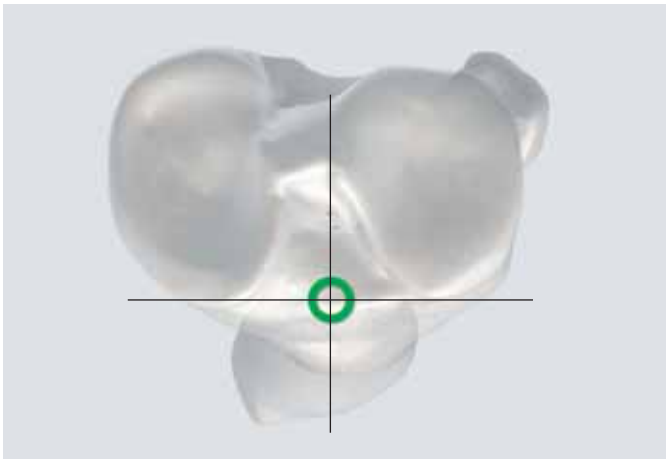
5

Determine entry point

The entry point is determinant for the optimal final position of the Expert Tibial Nail in the intramedullary canal. This is mostly important for proximal and distal metaphyseal fractures regarding fragment non-displacement.

- In AP view the entry point is in line with the axis of the intramedullary canal and with the lateral tubercle of the intercondylar eminence.
- In lateral view the entry point is at the ventral edge of the tibial plateau.





6

Insert guide wire

Instruments	
Guide Wire ∅ 3.2 mm	357.399
Universal Chuck with T-Handle	393.100

Secure the Guide Wire in the Universal Chuck and slightly punch mark the insertion point at a 10° angle to the shaft axis in lateral view.

Hold a sterile Expert Tibial Nail on the lateral side of the lower leg with its distal end parallel to the tibia shaft. The curved proximal nail end determines the definitive angle of insertion for the Guide Wire.

Insert the Guide Wire for approx. 8–10 cm and check the position under the image intensifier in AP and lateral views.

7

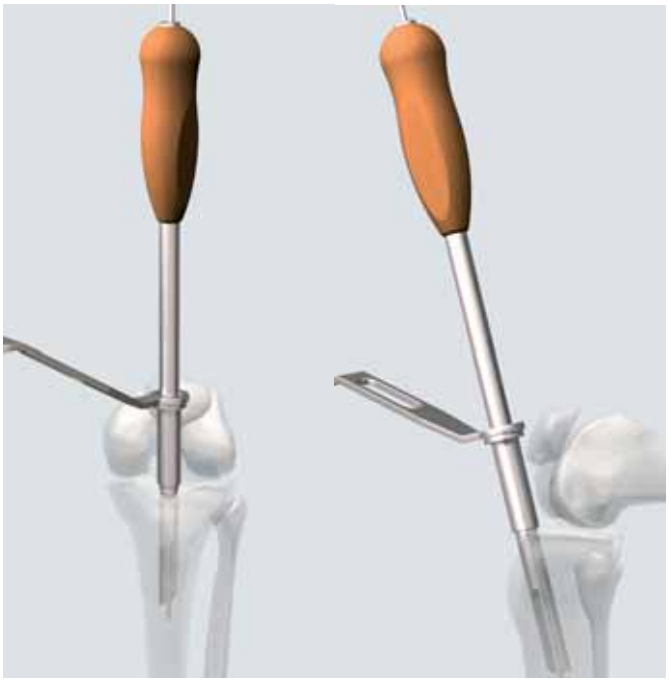
Open medullary canal – cutter

Instruments	
Guide Wire ∅ 3.2 mm	357.399
Cutter for Tibial Nails, ∅ 12.0 mm, length 350 mm	03.010.008
Protection Sleeve 14.0/12.0, length 161 mm	03.010.035

Push the Protection Sleeve and the Cutter over the Guide Wire and open the medullary canal over 8–10 cm.

The Guide Wire and the Cutter should not touch the posterior cortex.

Remove Guide Wire, Cutter and Protection Sleeve.



7a

Open medullary canal – drill bit

Alternative instruments	
Guide Wire ∅ 3.2 mm	357.399
Drill Bit ∅ 12.0 mm, cannulated, length 300 mm, for No. 532.015	03.010.036
Protection Sleeve 14.0/12.0, length 161 mm	03.010.035

Push the Protection Sleeve and the Drill Bit ∅ 12.0 mm over the Guide Wire and open the medullary canal over 8–10 cm.

The Guide Wire and the Drill Bit should not touch the posterior cortex.

Remove Guide Wire, Drill and Protection Sleeve.

7b

Open medullary canal – awl

Alternative instruments	
Guide Wire ∅ 3.2 mm	357.399
Awl ∅ 12.0 mm, cannulated, length 243 mm	03.010.040

Push the Awl ∅ 12.0 mm over the Guide Wire and open the medullary canal over 8–10 cm.

The Awl should not touch the posterior cortex.

Remove Guide Wire and Awl.

8

Reaming medullary canal (optional)

Instruments

SynReam Intramedullary Reaming System	189.060

If necessary enlarge the tibia canal with the medullary reamer up to the desired diameter.

Check fracture reduction under the image intensifier.

Inserting the reaming rod

Insert the SynReam Reaming Rod ∅ 2.5 mm (352.032) in the medullary canal.

Reaming

Starting with the diameter 8.5 mm, ream the medullary canal in 0.5 mm increments. The Holding Forceps is used to control the rotation of the 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 0.5–1.5 mm larger than the Tibial Nail diameter.

If a solid Tibial Nail is used, remove the Reaming Rod before inserting the Tibial Nail.

Note: All cannulated Expert Tibial Nails can be inserted over the SynReam Reaming Rod ∅ 2.5 (352.032). The tip of the SynReam Reaming Rod must be correctly positioned in the intramedullary canal since it determines the final distal position of the Expert Tibial Nail.

9

Mount nail on insertion handle

Instruments

Insertion Handle, for Tibial and Femoral Nails	03.010.045
Connecting Screw, for Tibial and Femoral Nails	03.010.044
Screwdriver, hexagonal with spherical head ∅ 8.0 mm	03.010.092

Orient the Insertion Handle anteriorly, and match the notch on the handle to the Tibial Nail.

Place the Connecting Screw into the Insertion Handle and thread it into the proximal nail end using the Screwdriver Hexagonal with Spherical Head.

Check that the Connecting Screw is correctly and well tightened to the nail. Do not overtighten.

Alternative instruments (cannulated Expert Tibial Nails only)

Tappet for Reaming Rod with Hexagonal Screwdriver ∅ 8.0 mm	03.010.093

Use the Tappet for Reaming Rod with Hexagonal Screwdriver ∅ 8.0 mm instead of the described Screwdriver.

10

Insert nail

Note: Knee flexion of more than 90° is sometimes necessary to insert the Expert Tibial Nail.

Using the Insertion Handle, insert the nail into the intramedullary canal. Rotational movements of small amplitude can help.

- Monitor the nail passage across the fracture, control in two planes to avoid malalignment.
- Check final nail position in AP and lateral views.

Note: For proximal locking mount the Aiming Arm only when the Tibial Nail has been completely inserted, otherwise the Aiming Arm may loosen during nail insertion.

Optional instruments

Connector, for Insertion Handle	03.010.047
Hammer, 700 g	03.010.056
Hammer Guide, for No. 357.250 (*)	357.220
Combination Wrench ∅ 11 mm	321.160
Pin Wrench ∅ 4.5 mm	321.170

If necessary, insert the nail using light hammer blows. Attach the Connector and tighten it to the insertion handle and use the Hammer in the fixed mode.

If more insertion forces are necessary, attach the Hammer Guide to the Connector and use the Hammer in sliding mode. To obtain the "sliding" mode of the Hammer, first loose the nut on the hammer shaft and fix it at the position close to the handle.

Note: If insertion is not easily possible, you may chose an Expert Tibial Nail with a smaller diameter or enlarge the entry canal by reaming the intramedullary canal to a larger diameter.

(*) Also adapted for No. 03.010.056

11

Check proximal nail position

Instruments

Aiming Arm for Tibial Nail	03.010.018
Guide Wire ∅ 3.2 mm	357.399

Attach the Aiming Arm and insert a Guide Wire ∅ 3.2 mm in the hole as shown in the illustration.

The tip of the Guide Wire indicates the exact proximal position of the Tibial Nail.

Remove the Aiming Arm unless proximal locking is the next step.

Check proximal nail position under image intensifier in lateral view.

Notes: The distance between the markings on the Insertion Handle is 5 mm and corresponds to the extensions of the End Caps. This feature can be used for over insertion of the nail or for correcting the nail length.

If primary compression or secondary dynamisation are planned, it is recommended to over insert the nail by more than 7 mm, which corresponds to the maximum distance between the positions in static and dynamic modes.

12

Check distal nail position

Check final nail position under image intensification in AP and lateral views.

Remove the Reaming Rod. Check whether the Connecting Screw is sufficiently tightened as the hammer blows may have loosened it.

Note: The correct position of the nail tip is mostly important in case of distal fractures. At least two Locking Screws must be positioned distal to the fracture lines.

13

Distal locking

Use the Locking Screws ∅ 4.0 mm (dark blue) in combination with the distal locking options of Tibial Nails with ∅ 8 and ∅ 9 mm (dark blue).

Use the Locking Screws ∅ 5.0 mm (light green) in combination with the distal locking options of Tibial Nails with ∅ 10 to ∅ 13 mm (light green).

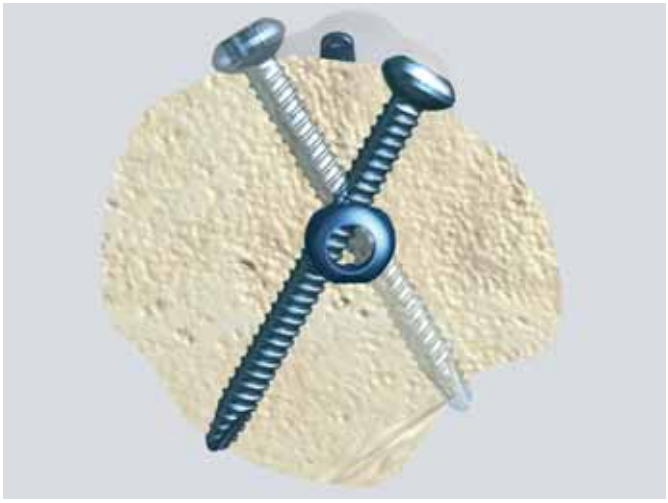
Use the Drill Bit with ∅ 3.2 mm for ∅ 4.0 mm Locking Screws and use the Drill Bit with ∅ 4.2 mm for ∅ 5.0 mm Locking Screws.

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.

Locking of the Tibial Nail 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.

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

Note: The use of the most distal locking option is recommended for fractures type 43. The locking option is not in the AP or lateral directions but has an orientation of 30°.



14

Align image intensifier

- Check the reduction, correct alignment of the fragments and leg length before locking the Expert Tibial Nail.
- Align the image intensifier until the nail hole appears completely round (here the lower ML hole).

15

Make incision

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

16

Drill

Instruments

Drill Bit ∅ 3.2 mm, calibrated, length 145 mm, 3-flute, with Coupling for RDL	03.010.100
Drill Bit ∅ 4.2 mm, calibrated, length 145 mm, 3-flute, with Coupling for RDL	03.010.101

- Insert desired Drill Bit 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 Drill Bit in this position and drill through both cortices until the tip of the Drill Bit just breaks through the lateral cortex.

Alternative instruments

Drill Bit ∅ 3.2 mm, calibrated, length 145 mm, 3-flute, for Quick Coupling	03.010.103
Drill Bit ∅ 4.2 mm, calibrated, length 145 mm, 3-flute, for Quick Coupling	03.010.104

If there is no radiolucent drive available and locking is performed with the standard freehand technique use the Drill Bit ∅ 3.2 mm or Drill Bit ∅ 4.2 mm for Quick Coupling.

17

Determine the length of the locking screw

Instruments

Depth Gauge for Locking Screws	03.010.072

Measure the Locking Screw length using the Depth Gauge for Locking Screws. Make sure that the hook is just outside the far cortex and that the sleeve is firmly pressed against the near cortex.

Control the correct position of the hook of the Depth Gauge in regard to the far cortex of the tibia.

Read the measurement on the shaft of the Depth Gauge, which corresponds to the appropriate length of the Locking Screw.

Alternative instruments

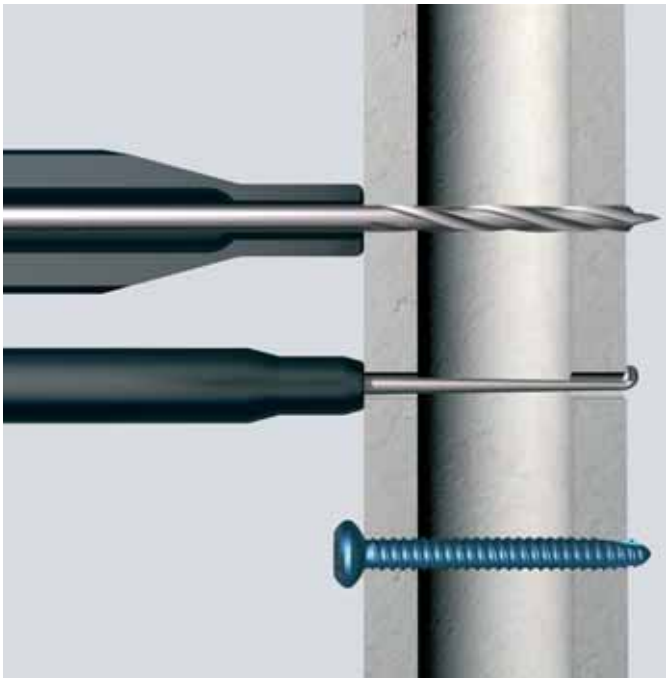
Direct Measuring Device for Drill Bits, length 145 mm	03.010.106
Drill Bit ∅ 3.2 mm, calibrated, length 145 mm, 3-flute, with Coupling for RDL	03.010.100
Drill Bit ∅ 4.2 mm, calibrated, length 145 mm, 3-flute, with Coupling for RDL	03.010.101
Drill Bit ∅ 3.2 mm, calibrated, length 145 mm, 3-flute, for Quick Coupling	03.010.102
Drill Bit ∅ 4.2 mm, calibrated, length 145 mm, 3-flute, for Quick Coupling	03.010.103

Stop drilling immediately after both cortices and dissemble the Drill Bit from the AO Radiolucent Drive. Insert the Direct Measuring Device onto the Drill Bit.

Control the correct position of the Drill Bit in regard to the far cortex of the tibia.

Read the measurement on the Direct Measuring Device, which corresponds to the appropriate length of the Locking Screw.

Note: A correct end position of Drill Bit is important in order to choose the optimal Locking Screw length.



18

Insert locking screw

Instruments

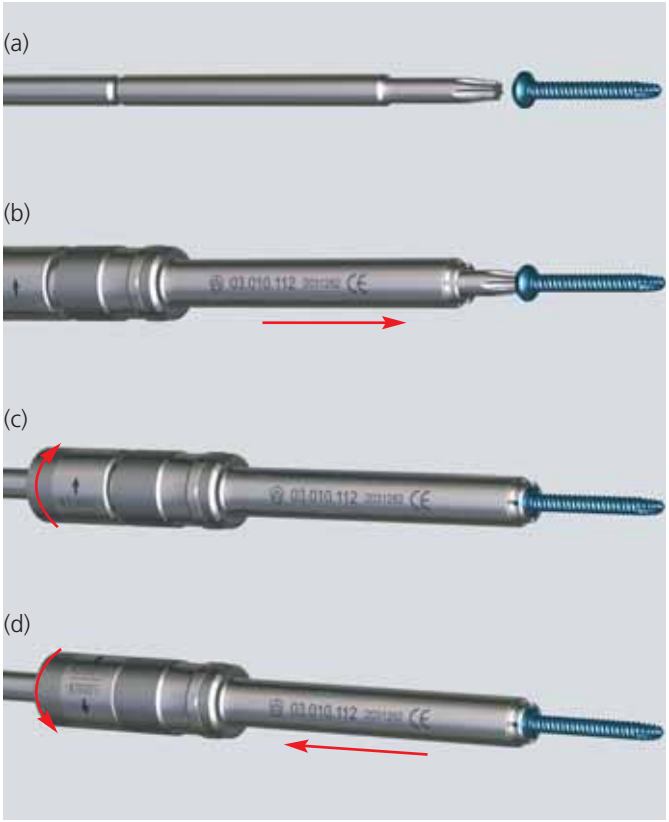
Screwdriver Stardrive®, T25, length 330 mm	03.010.107
Holding Sleeve, with Locking Device	03.010.112

Insert the Locking Screw with the correct length with the self-holding Screwdriver Stardrive T25, alone or used in combination with the Holding Sleeve.

Control the correct position and length of the Locking Screws. Exchange the Locking Screws with the appropriate length if necessary.

Note: In the event of diastasis, the backstroke technique can be used after insertion of the second distal Locking Screw.

Use the Holding Sleeve as described below:
(a) Insert the Holding Sleeve onto the shaft of the Screwdriver and place the tip of the Screwdriver in the recess of the Locking Screw.
(b) Push the Holding Sleeve in the direction of the Locking Screw, the sleeve now holds the Locking Screw.
(c) Lock the Holding Sleeve by tightening it anticlockwise.
(d) Release the Holding Sleeve after insertion of the Locking Screw by loosening it clockwise and pushing backwards.



19a

Variant A: Medio-lateral proximal locking

Use the Locking Screws ∅ 4.0 mm (dark blue) in combination with the ML locking options of Expert Tibial Nails with ∅ 8 and ∅ 9 mm.

Use the Locking Screws ∅ 5.0 mm (light green) in combination with the ML locking options of Expert Tibial Nails with ∅ 10 to ∅ 13 mm.

Use the Drill Bit with ∅ 3.2 mm for ∅ 4.0 mm Locking Screws and use the Drill Bit with ∅ 4.2 mm for ∅ 5.0 mm Locking Screws.

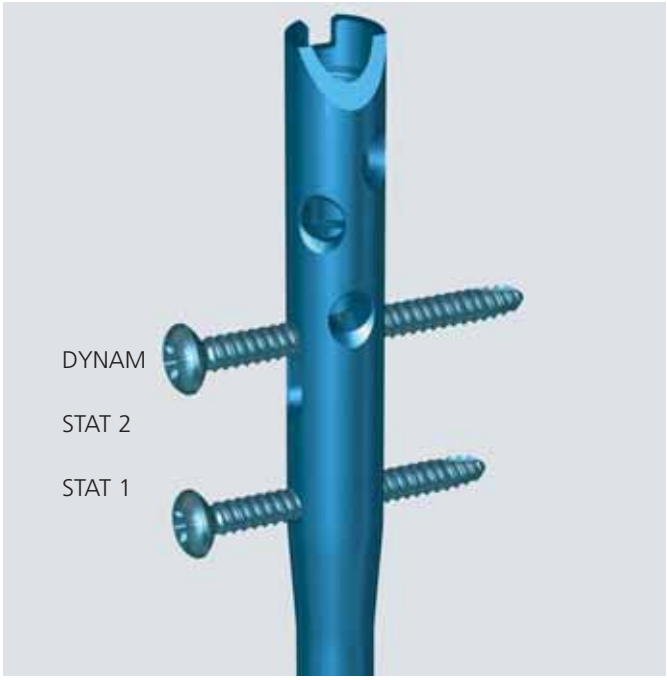
The Aiming Arm enables to choose between three proximal ML locking options:

1. The dynamic locking option (DYNAM) corresponds to the upper position of the proximal locking slot. This type of locking allows primary compression or secondary, controlled dynamisation of the bone fragments.

2. Static 2 (STAT 2) corresponding to the lower position of the proximal locking slot. This type of locking does not allow primary compression or secondary controlled dynamisation.

3. Static 1 (STAT 1) corresponding to the lower proximal locking hole.

Position patient's leg
If the leg is not fixed on the extension table, it is strongly recommended to position the leg in extension (as much as possible) in order to relax the muscles acting on the proximal part of the tibia during locking.



20a

Mount the aiming arm

Instruments

Aiming Arm for Tibial Nail	03.010.018

Using the Screwdriver ∅ 8.0 mm (03.010.092), confirm that the Connecting Screw between the Insertion Handle and the Tibial Nail is well tightened. Mount the Aiming Arm to the Insertion Handle.

Note: Do not exert forces on the Aiming Arm, Protection Sleeve, Drill Sleeves and Drill Bits in order to guarantee a good drilling precision through the proximal locking holes and to avoid breakage of the Drill Bits.

Important: The Insertion Handle allows locking of the antegrade locking option of the Lateral Femoral Nail LFN. Do not use this locking option together with the Tibial Nail.

21a

Insert trocar combination

Instruments

Protection Sleeve 12.0/8.0, length 188 mm	03.010.063
Drill Sleeve 8.0/4.2, for No. 03.010.063 (with green marking)	03.010.065
Drill Sleeve 8.0/3.2, for No. 03.010.063 (with blue and gold marking)	03.010.064
Trocar ∅ 3.2 mm, for No. 03.010.063 (with blue and gold marking)	03.010.069
Trocar ∅ 4.2 mm, for No. 03.010.063 (with green marking)	03.010.070

Insert the three-part trocar combination (Protection Sleeve, corresponding Drill Sleeve and Trocar) through the desired ML hole in the Aiming Arm, make stab incision and insert the Trocar to the bone. Remove the Trocar.

22a

Drill and determine the locking screw length

Instruments

Drill Bit ∅ 3.2 mm, calibrated, length 340 mm, 3-flute, for Quick Coupling (with blue and gold marking)	03.010.060
Drill Bit ∅ 4.2 mm, calibrated, length 340 mm, 3-flute, for Quick Coupling (with green marking)	03.010.061

Using the corresponding Drill Bit (∅ 3.2 mm for 4.0 mm Locking Screws or ∅ 4.2 mm for 5.0 mm Locking Screws), drill through both cortices until the tip of the drill bit just breaks through the far cortex.

Just after drilling both cortices, confirm Drill Bit position.

Ensure that the Drill Sleeve is pressed firmly to the near cortex and read the measurement from the calibrated Drill Bit at the back of the Drill Sleeve. This measurement corresponds to the appropriate length of the Locking Screw. Remove the Drill Bit and the Drill Sleeve.

Alternative instrument

Depth Gauge for Locking Screws	03.010.072

After drilling both cortices, remove the Drill Bit and the Drill Sleeve.

Disassemble the Depth Gauge into 2 parts: the sleeve and the slider with hook. Insert the Slider with Hook into the Protection Sleeve. Make sure that the hook is just outside the far cortex and that the Protection Sleeve is firmly pressed against the near cortex.

Control the correct position of the hook of the Depth Gauge in regard to the far cortex of the tibia.

Read the measurement on the shaft of the Depth Gauge, which corresponds to the appropriate length of the Locking Screw.

23a

Insert Locking Screw

Instruments

Screwdriver Stardrive®, T25, length 330 mm	03.010.107

Insert a Locking Screw of the measured length with the Screwdriver Stardrive T25 through the Protection Sleeve until the Locking Screw head lies against the near cortex. The tip of the Locking Screw should project beyond the far cortex by no more than 1–2 mm.

Repeat the steps 21a to 23a for the second proximal ML Locking Screw.

Option

Especially for proximal metaphyseal fractures or for highly unstable fractures, additional Cancellous Bone Locking Screws with can be used.

For locking procedure of Cancellous Bone Locking Screws with refer to Variant B, steps 19b to 25b on pages 30 to 36.

Note: Secondary, controlled dynamisation of the Expert Tibial Nail is possible by removing all proximal Locking Screws except of the dynamic locking position.

24a

Compression locking mode (optional)

In case of diastasis, compression of the fracture gap can be needed.

The Expert Tibial Nail allows a maximum compression of 7 mm. If more compression of the fracture gap is needed, the conventional backstrike technique is recommended.

Notes: At that stage of the surgery the Expert Tibial Nail has been locked distally, refer to steps 13 to 18 on pages 18 to 22. One proximal Locking Screw has been introduced in the dynamic locking option (DYNAM), refer to variant A, steps 19a to 23a on pages 23 to 26.

This type of locking procedure does not allow secondary dynamisation of the Expert Tibial Nail.

25a

Insert compression screw

Instruments

Compression Screw for Tibial Nail, for No. 03.010.044	03.010.015
Screwdriver, hexagonal with spherical head ∅ 8.0 mm	03.010.092

Using the Screwdriver ∅ 8.0 mm, confirm that the Connecting Screw between the Insertion Handle and the Tibial Nail is well tightened.

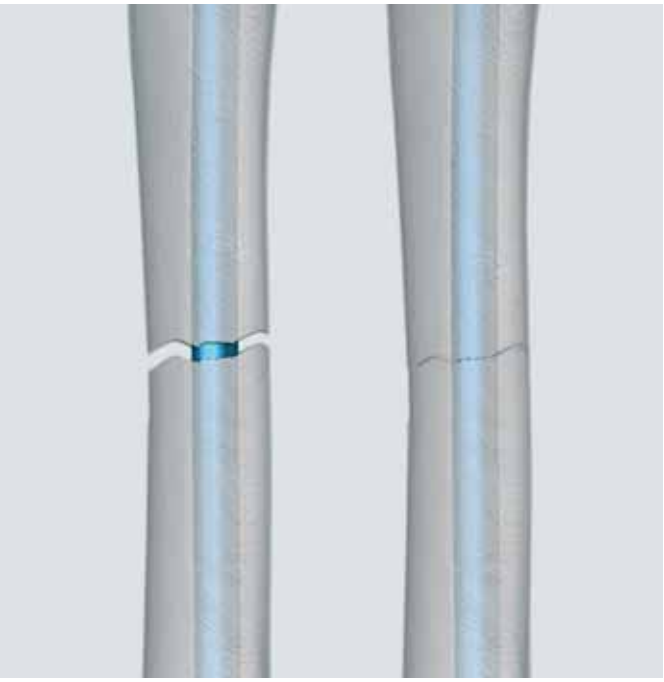
Insert the Compression Screw into the Connecting Screw with the Screwdriver ∅ 8.0 mm until the Compression Screw (see chapter 9, page 14) contacts the Locking Screw.

Every further insertion of the Compression Screw pushes the Locking Screw down in the dynamic slot, respectively the distal fragment of the bone will be pulled up against the proximal fragment. Each revolution of the Compression Screw corresponds to a compression of 1 mm (maximum 7 mm).

26a

Monitor fracture

Control the fracture gap before, during and after the compression procedure.



27a

Insert Static Locking Screw

Insert second proximal Locking Screw in the most distal hole of the proximal locking options (Static 1), refer to Variant A, steps 19a to 23a on pages 23 to 26.

Remove the Compression Screw using the Screwdriver ∅ 8.0 mm.

According to the circumstances, additional oblique Cancellous Locking Screws can be inserted, refer to Variant B, steps 19b to 25b on pages 30 to 36.

28a

Insertion of the end cap

Instrument	
Screwdriver Stardrive®, T40, cannulated, length 300 mm	03.010.110
Guide Wire ∅ 3.2 mm	357.399

Besides preventing bone ingrowth into the proximal end of the Tibial Nail and, therefore, facilitating the nail removal, the End Cap enables also angular stability of the Cancellous Bone Locking Screw of the first or of the second oblique locking option.

Note: The patient's leg should be positioned in flexion, in order to have enough place to insert the End Cap.

Remove the Aiming Arm, the Connecting Screw and the Insertion Handle.

Insert the Guide Wire into the proximal end of nail and push the End Cap and the Screwdriver T40 over the guide wire.

To minimise the chance of cross threading, turn the End Cap counter clockwise until the thread of the End Cap aligns with that of the nail.

By turning clockwise, screw the End Cap into the nail and tighten it firmly.

Remove the Guide Wire and Screwdriver Stardrive T40.

19b

Variant B: Oblique proximal locking

Use the Cancellous Bone Locking Screws (gold) only in combination with the two oblique proximal locking holes (OBLI 1, OBLI 2) and AP proximal locking hole) for all nail diameters.

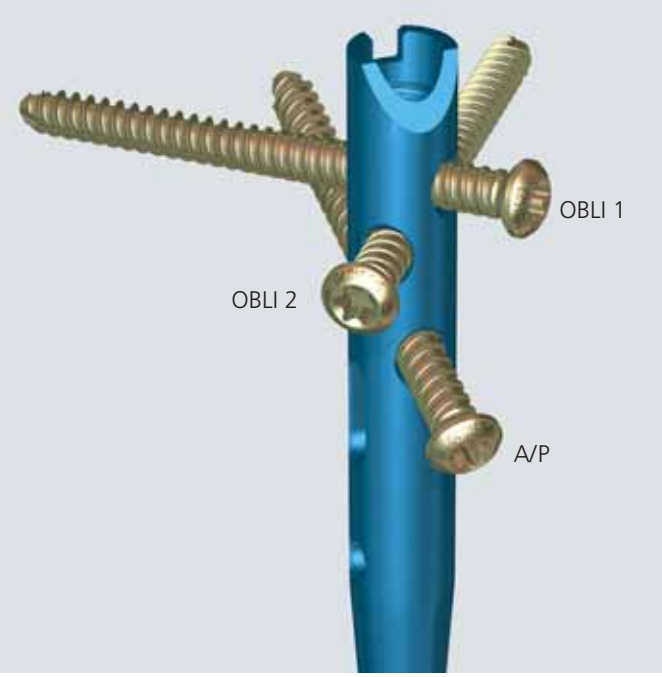
Use the Drill Bit with ∅ 3.2 mm for ∅ 5.0 mm Cancellous Bone Locking Screws.

The Aiming Arm enables to chose between three proximal oblique locking options:

1. The oblique locking option (OBLI1) corresponds to the most proximal locking position. Angular stability can be achieved by using End Cap for Tibial Nail, 04.004.000 to 04.004.003.

2. The oblique locking option (OBLI2) corresponds to the second proximal locking position. Angular stability can be achieved by using End Cap for Tibial Nail, 04.004.004 (OBLI 1 must be kept empty).

3. The oblique locking option in antero-posterior direction (A/P) corresponds to the third proximal locking position.

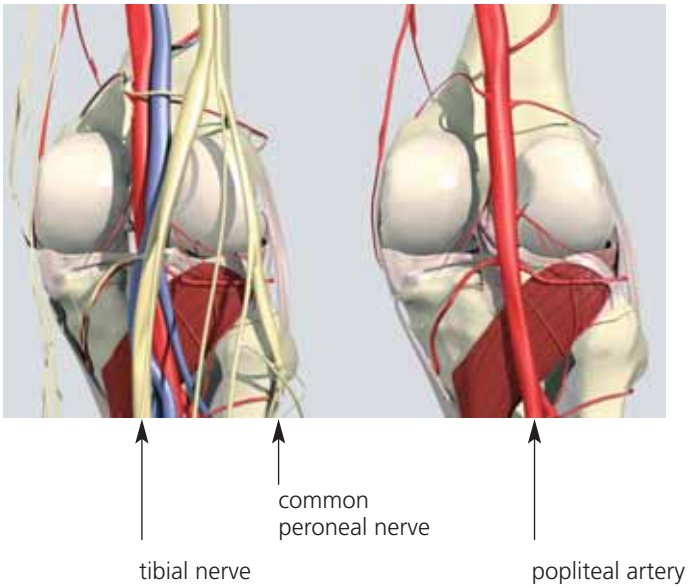


Important: Drilling for the oblique proximal locking requires special attention.

To avoid lesion of the popliteal artery, the tibial nerve and the common peroneal nerve as well as damages of the proximal tibiofibular joint, drilling must be stopped immediately before penetrating the far cortex.

Position patient's leg
If the leg is not fixed on the extension table, it is strongly recommended to position the leg in extension (as much as possible) in order to relax the muscles acting on the proximal part of the tibia.

In case of C-type fractures of the tibial head, the articulation surface of the proximal tibia should be restored before inserting the Tibial Nail. The most recommended procedure is the use of two cannulated Screws parallel to and below the tibia plateau surface.



20b

C-type fractures of the tibial head (optional)

Insert two Cannulated Screws under image intensifier control according to standard technique. These cannulated screws must not interfere with the nail and must not damage the tibial plateau.

Cannulated Screws

Using TAN screws is strongly recommended. The following Cannulated Screws can be considered:
- Cannulated Screws ∅ 6.5 mm, TAN, dark blue (408.401–408.482)
- Cannulated Screws ∅ 7.0 mm, TAN, light blue (408.151–408.223)
- Cannulated Screws ∅ 7.3 mm, TAN, gold (408.830–409.950)

Insert Expert Tibial Nail

Follow the steps of the surgical technique until insertion of the Tibial Nail, refer to steps 1 to 10 on pages 8 to 15.

21b

Mount the aiming arm

Instruments

Aiming Arm for Tibial Nail	03.010.018

Using the Screwdriver ∅ 8.0 mm (03.010.092), confirm that the Connecting Screw between the Insertion Handle and the Tibial Nail is well tightened. Mount the Aiming Arm to the Insertion Handle as shown in the illustration.

Note: Do not exert forces on the Aiming Arm, Protection Sleeve, Drill Sleeves and Drill Bits in order to guarantee a good drilling precision through the proximal locking holes and to avoid breakage of the Drill Bits.

Important: The Insertion Handle allows locking of the antegrade locking option of the Lateral Femoral Nail LFN. Do not use this locking option together with the Tibial Nail.

22b

Check proximal nail position (optional)

Instruments

Aiming Arm for Tibial Nail (use blue and green marked guide holes)	03.010.018
Protection Sleeve 12.0/8.0, length 188 mm	03.010.063
Drill Sleeve 8.0/3.2, for No. 03.010.063 (with blue and gold marking)	03.010.064
Drill Bit ∅ 3.2 mm, calibrated, length 340 mm, 3-flute, for Quick Coupling (with blue and gold marking)	03.010.060

Insert the Protection Sleeve 12.0/8.0 mm and the Drill Sleeve 8.0/3.2 mm through the oblique guide hole (OBLI 1) of the Aiming Arm.

Insert one Drill Bit ∅ 3.2 mm through the corresponding guide hole of the Aiming Arm as illustrated. Do not drill until now.

Position the image intensifier in lateral view and adjust until the Drill Bit and the Protection Sleeve are perfectly aligned.

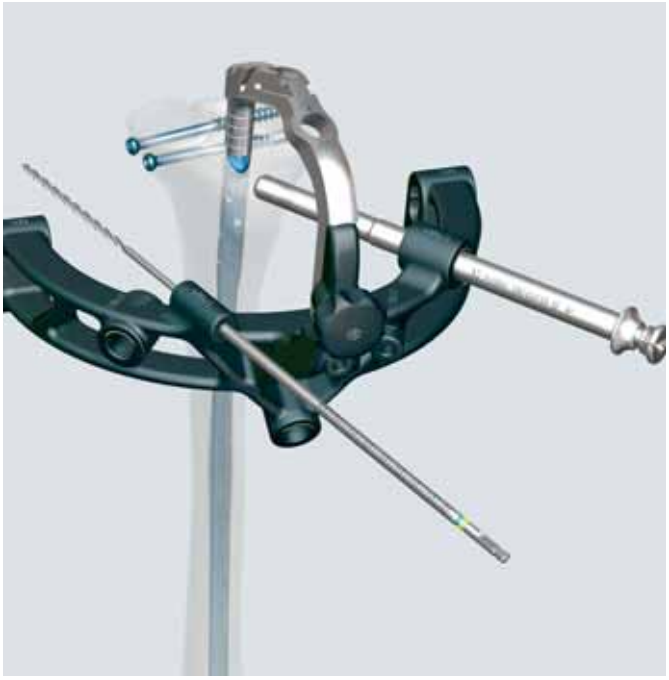
The view obtained when the Drill Bit and the Protection Sleeve are perfectly aligned is exactly perpendicular to the plane formed by the nail and the Insertion Handle and, therefore, almost parallel to the knee joint.

The Drill Bit shows the exact position of the first proximal Cancellous Bone Locking Screw.

If necessary, insert the nail more distally.

Note: It is important that the Cannulated Screws and the Cancellous Bone Locking Screws do not interfere, and that the Cancellous Bone Locking Screws do not damage the surface of the tibia plateau.

Note: Depending on the anatomy of the patient's proximal tibia and on the specific situation, the second proximal oblique locking option can be chosen instead of the first locking option.



Alternative

The position of the second oblique locking option can be checked similarly to the above description but using the oblique guide hole (OBLI 2) of the Aiming Arm and corresponding guide hole for the Drill Bit ∅ 3.2.

23b

Insert trocar combination

Instruments

Protection Sleeve 12.0/8.0, length 188 mm	03.010.063
Drill Sleeve 8.0/3.2, for No. 03.010.063 (with blue and gold marking)	03.010.064
Trocar ∅ 3.2 mm, for No. 03.010.063 (with blue and gold marking)	03.010.069

Insert the three part trocar combination (Protection Sleeve, corresponding Drill Sleeve and Trocar) through the desired hole for oblique locking options in the Aiming Arm, make stab incision and insert the Trocar to the bone. Remove the Trocar.

24b

Drill and determine the length of the cancellous bone locking screws

Instruments

Drill Bit ∅ 3.2 mm, calibrated, length 340 mm, 3-flute, for Quick Coupling (with gold and blue markings)	03.010.060

Insert Protection Sleeve and Drill Sleeve further to the near cortex of the tibia, insert the calibrated Drill Bit ∅ 3.2 mm and start drilling the near cortex.

Stop drilling immediately after penetrating the near cortex.

- By orienting the image intensifier perpendicular to the Drill Bit one can control the exact position of the tip of the Drill Bit in the oblique direction.
- Drill further and control the penetration of the Drill Bit. A long Cancellous Bone Locking Screw will achieve better bone purchase and, therefore, a better stabilization, than a shorter Cancellous Bone Locking Screw.

Important: Do not perforate the far cortex with the Drill Bit. Make sure not to damage the tibial plateau.

Confirm Drill Bit position after drilling.

Ensure that the Drill Sleeve is pressed firmly to the near cortex and read the measurement from the calibrated Drill Bit at the back of the Drill Sleeve.

This measurement corresponds to the appropriate length of the Cancellous Bone Locking Screw.

Remove the Drill Bit and the Drill Sleeve.

Important: To avoid perforation of the far cortex with the Cancellous Bone Locking Screw, it is recommended to choose a Cancellous Bone Locking Screw 5 mm shorter than the measured length.

25b

Insert cancellous bone locking screws

Instruments

Screwdriver Stardrive®, T25, length 330 mm	03.010.107

Insert a Cancellous Bone Locking Screw of the appropriate length with the Screwdriver Stardrive T25 through the Protection Sleeve until the Screw head lies against the near cortex. Do not overthighten.

Repeat the same steps as described above for the second Cancellous Bone Locking Screw.

Option

Repeat the same steps as described above for the third proximal Cancellous Bone Locking Screw in the AP direction.

The position of the Cancellous Bone Locking Screw should be controlled under image intensifier to ensure a correct position of the AP Cancellous Bone Locking Screw.

26b

Insertion of the end cap

Instruments

Screwdriver Stardrive®, T40, cannulated, length 300 mm	03.010.110
Guide Wire ∅ 3.2 mm	357.399

Besides preventing bone ingrowth into the proximal end of the Tibial Nail and, therefore, facilitating the nail removal, the End Cap enables also angular stability of the Cancellous Bone Locking Screw of the first or of the second oblique locking option.

Note: The patient's leg should be positioned in flexion, in order to have enough place to insert the End Cap.

Remove the Aiming Arm, the Connecting Screw and the Insertion Handle.

Insert the Guide Wire into the proximal end of the nail and push the End Cap and the Screwdriver T40 over the guide wire.

To minimise the chance of cross threading, turn the End Cap counter clockwise until the thread of the End Cap aligns with that of the nail.

By turning clockwise, screw the End Cap into the nail and tighten it firmly

Remove the Guide Wire and Screwdriver Stardrive T40.

Note: The patient's leg should be positioned in flexion, in order to have enough place to insert the End Cap.

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.

1

Remove end cap and locking screws

Instruments	
Screwdriver Stardrive®, T40, cannulated, length 300 mm	03.010.110
Screwdriver Stardrive®, T25, length 330 mm	03.010.107
Holding Sleeve, with Locking Device	03.010.112

Implant removal is an elective procedure.

Clear the Stardrive socket of the End Cap and the Locking Implants from any ingrown tissue. Remove the End Cap with the Screwdriver Stardrive T40.

Remove all Locking Screws except one proximal Locking Screw using the Screwdriver Stardrive T25 and Holding Sleeve.

Note: Always remove the most proximal Cancellous Bone Locking Screw in order to enable the complete introduction of the Extraction Screw into the proximal end of the Tibial Nail.

2

Attach extraction screw and hammer guide

Instruments	
Extraction Screw	03.010.000
Hammer Guide	357.220
Screwdriver Stardrive® T25, length 330 mm	03.010.107

Before removing the final Locking Screw, screw the Extraction Screw into the Tibial Nail and tighten it to prevent rotation or displacement of the nail posteriorly below the tibial plateau.

Attach the Hammer Guide to the Extraction Screw.

Remove the remaining Locking Screw with the Screwdriver Stardrive T25.

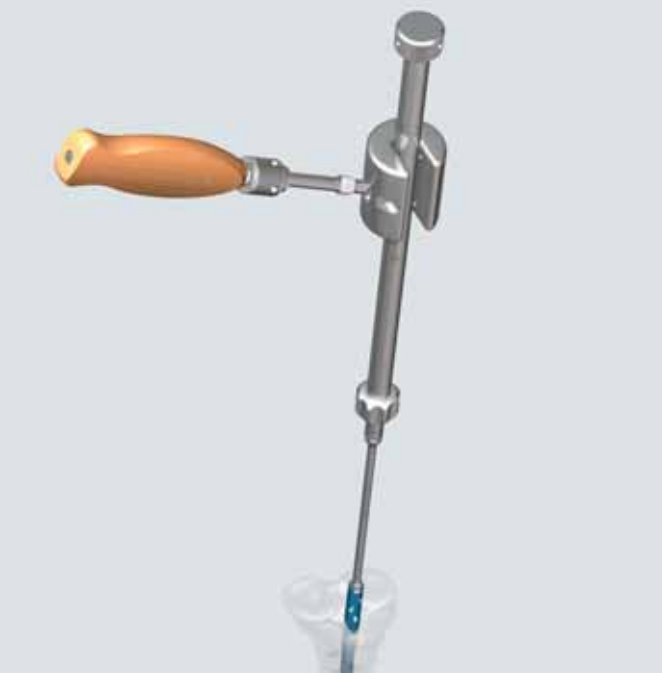
3

Remove nail

Instruments

Hammer, 700 g	03.010.056

Extract the nail by applying gentle blows with the Hammer.



Alternative instruments

Extraction Screw for 516.100	03.010.001
Air Pulse™ For implantation or extraction of intramedullary femoral and tibial nails	516.100

Before removing the final Locking Screw, screw the Extraction Screw into the nail and tighten it to prevent rotation or displacement of the nail posteriorly below the tibial plateau. Remove the remaining Locking Screw with the Screwdriver Stardrive T25. Attach Air Pulse to the Extraction Screw and extract the Expert Tibial Nail.

Implants

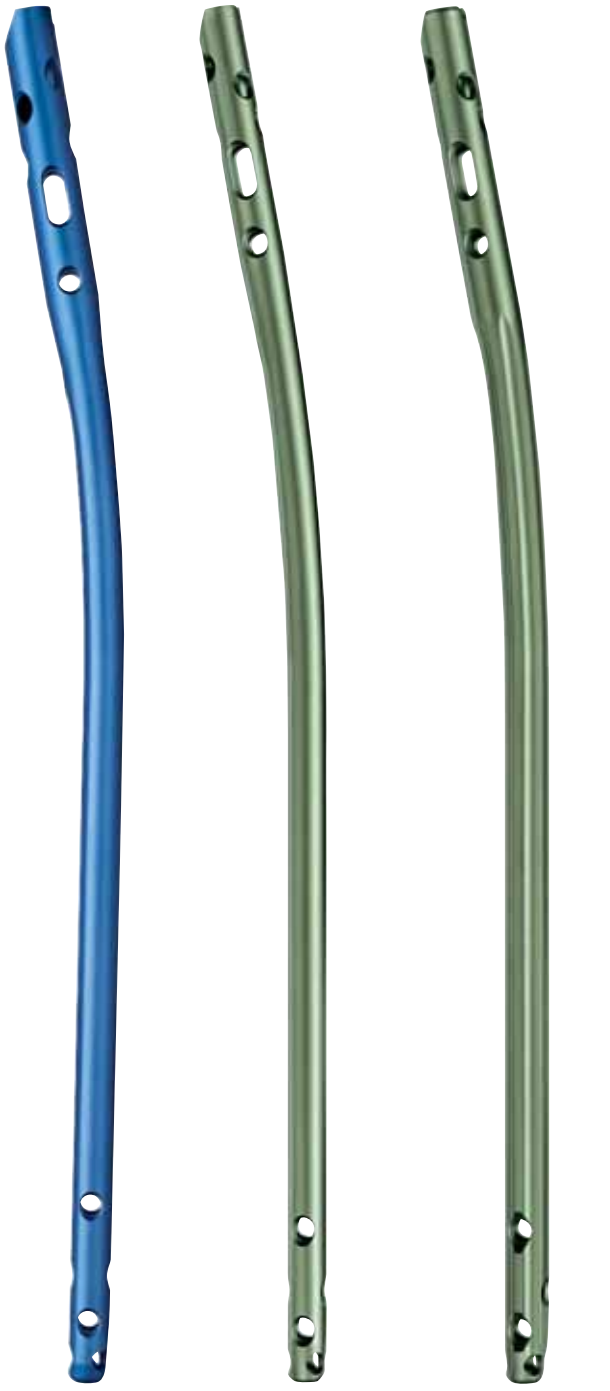
All implants are available in TAN*.

Expert Tibial Nails, cannulated

Length mm	∅ 8 mm dark blue	∅ 9 mm dark blue	∅ 10 mm light green
255	04.004.231	04.004.331	04.004.431
270	04.004.234	04.004.334	04.004.434
285	04.004.237	04.004.337	04.004.437
300	04.004.240	04.004.340	04.004.440
315	04.004.243	04.004.343	04.004.443
330	04.004.246	04.004.346	04.004.446
345	04.004.249	04.004.349	04.004.449
360	04.004.252	04.004.352	04.004.452
375	04.004.255	04.004.355	04.004.455
390	04.004.258	04.004.358	04.004.458
405	04.004.261	04.004.361	04.004.461
420	04.004.264	04.004.364	04.004.464
435	04.004.267	04.004.367	04.004.467
450	04.004.270	04.004.370	04.004.470
465	04.004.273	04.004.373	04.004.473

Length mm	∅ 11 mm light green	∅ 12 mm light green	∅ 13 mm light green
255	04.004.531	04.004.631	04.004.731
270	04.004.534	04.004.634	04.004.734
285	04.004.537	04.004.637	04.004.737
300	04.004.540	04.004.640	04.004.740
315	04.004.543	04.004.643	04.004.743
330	04.004.546	04.004.646	04.004.746
345	04.004.549	04.004.649	04.004.749
360	04.004.552	04.004.652	04.004.752
375	04.004.555	04.004.655	04.004.755
390	04.004.558	04.004.658	04.004.758
405	04.004.561	04.004.661	04.004.761
420	04.004.564	04.004.664	04.004.764
435	04.004.567	04.004.667	04.004.767
450	04.004.570	04.004.670	04.004.770
465	04.004.573	04.004.673	04.004.773

* Ti-6Al-7Nb



∅ 8 mm
∅ 9 mm

∅ 10 mm

∅ 11 mm
∅ 12 mm
∅ 13 mm

Expert Tibial Nails, solid

Length mm	∅ 8 mm dark blue	∅ 9 mm dark blue	∅ 10 mm light green
255	04.024.231	04.024.331	04.024.431
270	04.024.234	04.024.334	04.024.434
285	04.024.237	04.024.337	04.024.437
300	04.024.240	04.024.340	04.024.440
315	04.024.243	04.024.343	04.024.443
330	04.024.246	04.024.346	04.024.446
345	04.024.249	04.024.349	04.024.449
360	04.024.252	04.024.352	04.024.452
375	04.024.255	04.024.355	04.024.455
390	04.024.258	04.024.358	04.024.458
405	04.024.261	04.024.361	04.024.461
420	04.024.264	04.024.364	04.024.464
435	04.024.267	04.024.367	04.024.467
450	04.024.270	04.024.370	04.024.470
465	04.024.273	04.024.373	04.024.473

∅ 8 mm
∅ 9 mm

∅ 10 mm

Locking Screws for Expert Tibial Nail

Cancellous Bone Locking Screws ∅ 5.0 mm (gold), Drill ∅ 3.2 mm

Article No.	Length mm
04.015.520	30
04.015.525	35
04.015.530	40
04.015.535	45
04.015.540	50
04.015.545	55
04.015.550	60
04.015.555	65
04.015.560	70
04.015.565	75
04.015.570	80
04.015.575	85
04.015.580	90

Locking Screws ∅ 4.0 mm (dark blue), Drill ∅ 3.2 mm

Article No.	Length mm
04.005.408	18
04.005.410	20
04.005.412	22
04.005.414	24
04.005.416	26
04.005.418	28
04.005.420	30
04.005.422	32
04.005.424	34
04.005.426	36
04.005.428	38
04.005.430	40
04.005.432	42
04.005.434	44
04.005.436	46
04.005.438	48
04.005.440	50
04.005.442	52
04.005.444	54
04.005.446	56
04.005.448	58
04.005.450	60
04.005.452	62
04.005.454	64

Locking Screws ∅ 4.0 mm (dark blue), Drill ∅ 3.2 mm

Article No.	Length mm
04.005.456	66
04.005.458	68
04.005.460	70
04.005.462	72
04.005.464	74
04.005.466	76
04.005.468	78
04.005.470	80

Locking Screw ∅ 5.0 mm (light green), Drill ∅ 4.2 mm

Article No.	Length mm
04.005.516	26
04.005.518	28
04.005.520	30
04.005.522	32
04.005.524	34
04.005.526	36
04.005.528	38
04.005.530	40
04.005.532	42
04.005.534	44
04.005.536	46
04.005.538	48
04.005.540	50
04.005.542	52
04.005.544	54
04.005.546	56
04.005.548	58
04.005.550	60
04.005.552	62
04.005.554	64
04.005.556	66
04.005.558	68
04.005.560	70
04.005.562	72
04.005.564	74
04.005.566	76
04.005.568	78
04.005.570	80
04.005.575	85
04.005.580	90
04.005.585	95
04.005.590	100

End Caps for Tibial Nails, (gold)

Enable angular stable fixation of the most proximal oblique locking option.

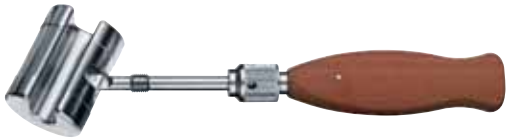
Article No.	Extension (in mm)
04.004.000	0
04.004.001	5
04.004.002	10
04.004.003	15

Enable angular stable fixation of the second proximal oblique locking option.

Article No.	Extension (in mm)
04.004.004	0

Standard instrumentation

03.010.021	Radiographic Ruler for Tibial Nail, length 450 mm	
357.399	Guide Wire ∅ 3.2 mm	
393.100	Universal Chuck with T-Handle	
03.010.008	Cutter for Tibial Nails, ∅ 12.0 mm, length 350 mm	
03.010.035	Protection Sleeve 14.0/12.0	
03.010.044	Connecting Screw, for Tibial and Femoral Nails	
03.010.045	Insertion Handle, for Tibial and Femoral Nails	

03.010.092	Screwdriver, hexagonal with spherical head ∅ 8.0 mm	
03.010.047	Connector, length 141 mm, for Aiming Arm	
321.160	Combination Wrench ∅ 11 mm	
321.170	Pin Wrench ∅ 4.5 mm	
357.220	Hammer Guide, for No. 357.250 (*)	
03.010.056	Combined Hammer, 700 g, can be mounted	
357.398	Shaft, hexagonal, ∅ 8.0 mm, cannulated, short, length 125 mm	

(*) Also suitable for No. 03.010.056

03.010.100	Drill Bit ∅ 3.2 mm, length 145 mm, 3-flute, with Coupling for RDL	
03.010.101	Drill Bit ∅ 4.2 mm, length 145 mm, 3-flute, with Coupling for RDL	
03.010.106	Direct Measuring Device for Drill Bits of length 145 mm, for Nos. 03.010.100–105	
03.010.107	Screwdriver Stardrive®, T25, length 330 mm	
03.010.112	Holding Sleeve, with Locking Device, for No. 03.010.107	
03.010.018	Aiming Arm for Tibial Nail	

03.010.063	Protection Sleeve 12.0/8.0, length 188 mm	
03.010.064	Drill Sleeve 8.0/3.2, for No. 03.010.063	
03.010.065	Drill Sleeve 8.0/4.0, for No. 03.010.063	
03.010.069	Trocar ∅ 3.2 mm	
03.010.070	Trocar ∅ 4.0 mm	
03.010.060	Drill Bit ∅ 3.2 mm, calibrated, length 340 mm, 3-flute, for Quick Coupling	
03.010.061	Drill Bit ∅ 4.0 mm, calibrated, length 340 mm, 3-flute, for Quick Coupling	

03.010.072	Depth Gauge for Locking Screws 18 to 110 mm, for No. 03.010.063	
03.010.015	Compression Screw for Tibial Nail, for No. 03.010.044	
03.010.110	Screwdriver Stardrive®, T40, cannulated, length 300 mm	
03.010.000	Extraction Screw for Tibial and Femoral Nails	

Radiolucent Instrumentation (Alternative)

03.010.013	Insertion Handle for Tibial Nail, radiolucent, short	
03.010.095	Connecting Screw, cannulated, short, for Tibial Nail	
03.010.004	Compression Screw for Tibial Nail	

03.010.011	Insertion Handle for Tibial Nail, radiolucent, long	
03.010.014	Connecting Screw for Tibial Nail, long, for No. 03.010.011	
03.010.007	Compression Screw for Tibial Nail, for No. 03.010.014	
03.010.010	Aiming Arm for Tibial Nail, radiolucent	
357.117	Hammer Guide for DFN, for No. 357.026 (**)	
03.010.124	Combined Hammer 500 g, can be mounted	

(**) Also suitable for Expert Tibial Nail for No. 03.010.124

Optional Instruments for Standard and Radiolucent Instrumentation

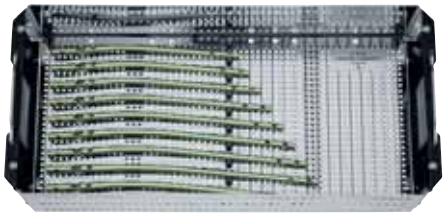
03.010.093	Rod Pusher for Reaming Rod with Hexagonal Screwdriver ∅ 8.0 mm	
03.010.036	Drill Bit ∅ 12.0 mm, cannulated, length 300 mm, for No. 532.015	
03.010.040	Awl ∅ 12.0 mm, cannulated	
03.010.103	Drill Bit ∅ 3.2 mm, length 145 mm, 3-flute, for Quick Coupling	
03.010.104	Drill Bit ∅ 4.2 mm, length 145 mm, 3-flute, for Quick Coupling	
03.010.009	Protection Sleeve 12.0/8.0, length 128 mm	
03.010.073	Drill Sleeve 8.0/3.2, for No. 03.010.009	

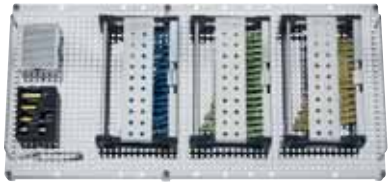
03.010.074	Drill Sleeve 8.0/4.2, for No. 03.010.009	
03.010.098	Trocar ∅ 3.2 mm, for No. 03.010.073	
03.010.099	Trocar ∅ 4.2 mm, for No. 03.010.074	
03.010.122	Drill Bit ∅ 3.2 mm, calibrated, length 270 mm, 3-flute, for Quick Coupling	
03.010.123	Drill Bit ∅ 4.0 mm, calibrated, length 270 mm, 3-flute, for Quick Coupling	
03.010.019	Depth Gauge for Locking Screws, measuring range up to 110 mm, for No. 03.010.009	
03.010.001	Extraction Screw for Tibial and Femoral Nails, for No. 516.100	

Do not use standard instruments together with alternative instruments before contacting your Synthes representative.

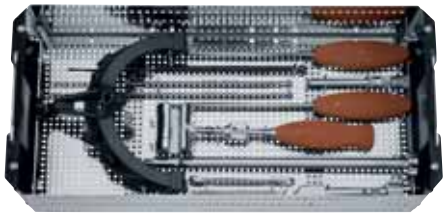
VarioCase™

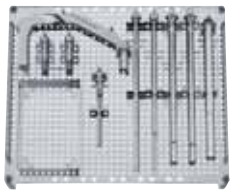
68.004.001 Vario Case™ for Expert™ Tibial Nails (Titanium Alloy), incl. Locking Screws and End Caps, without Lid, without Contents

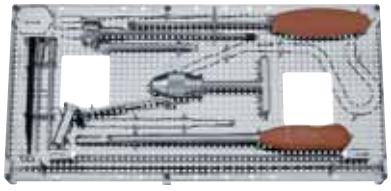




68.004.002 Vario Case™ for Standard Instruments for Expert™ Tibial Nail, without Lid, without Contents







Power Tools

530.010	Power Drive, complete
530.100	Power Drive
530.280	Battery Casing

511.300	Radiolucent Drive

SYNTHES®

Manufacturer: Stratec Medical
Eimattstrasse 3, CH-4436 Oberdorf
www.synthes.com

Presented by:

CE
0123

036.000.380 SE_001078 AA Printed in Switzerland LAG