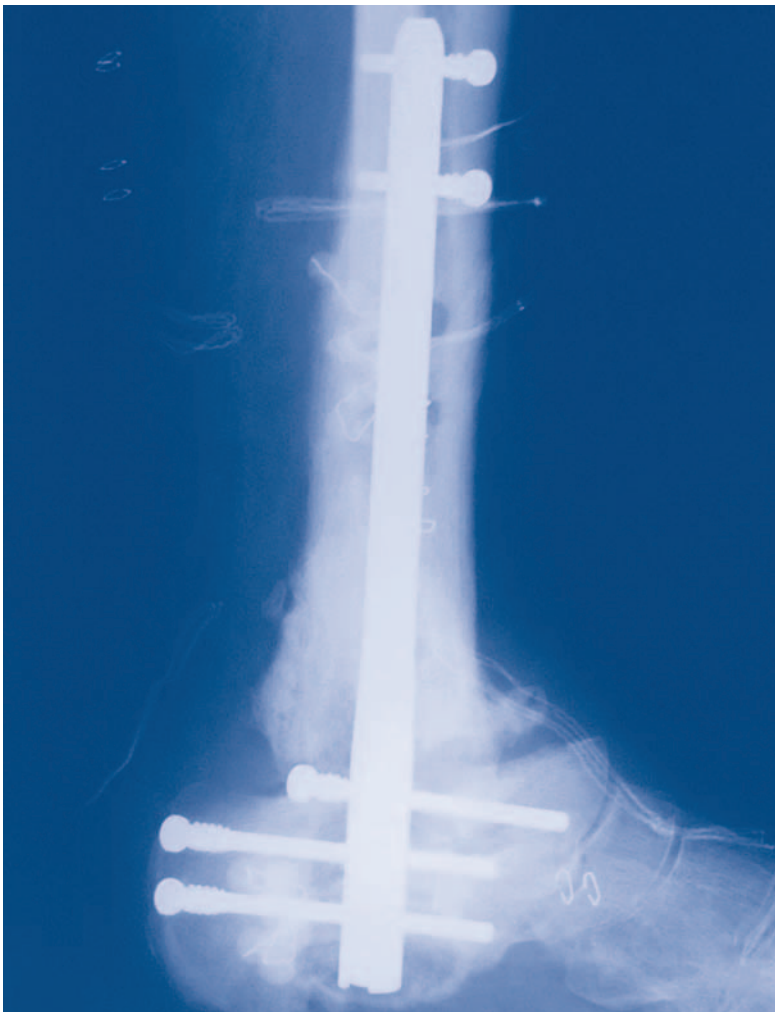
OPERATIVE TECHNIQUE



The Ankle Arthrodesis Nail

By Prof. Dr. D. Pennig

ORTHOFIX®

CONTENTS

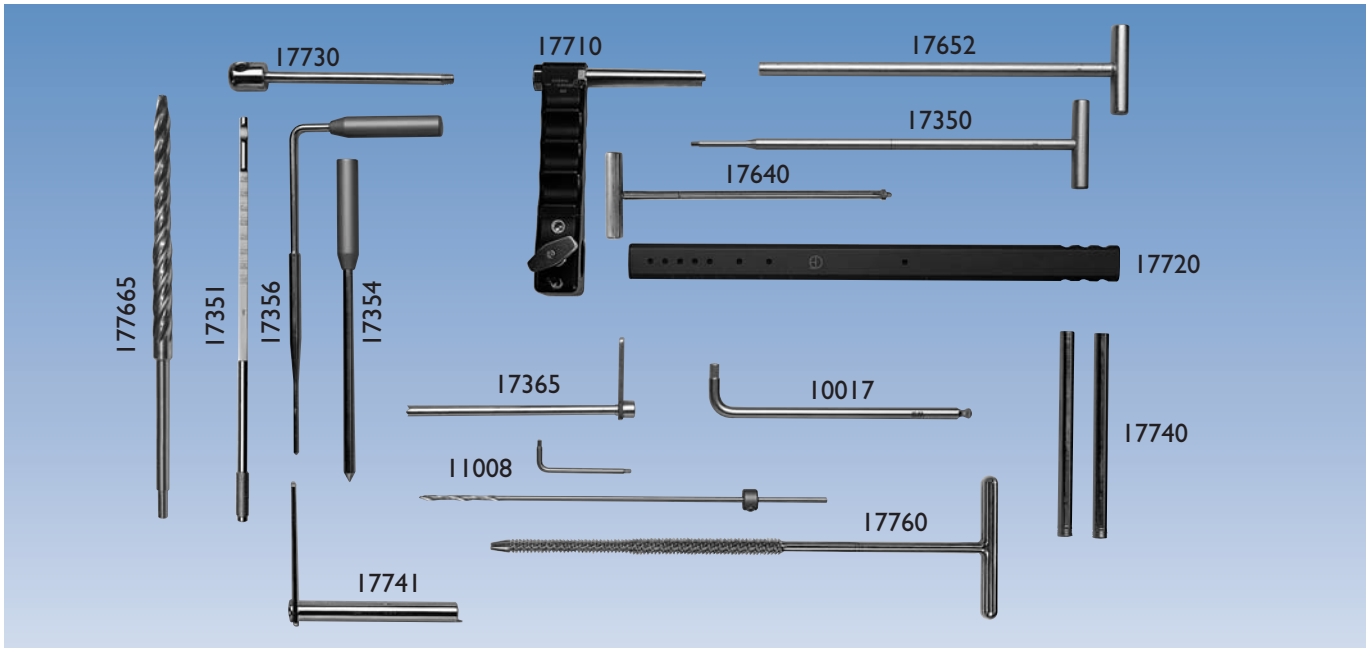
- Painful arthritic deformity of the ankle joint with stiffness in the subtalar joint
- Failed fusion of the ankle joint
- Fractures of the tibial plafond and/or talus where reconstruction is impossible
- Fracture/dislocations of the ankle joint combined with severe arthritic changes and loss of function of this joint
- Supra-malleolar non-union with ankle joint stiffness

BIBLIOGRAPHY

Anderson JG, Coetzee JC, Hansen ST. Revision ankle fusion using internal compression arthrodesis with screw fixation. Foot Ankle Int 1997; 18: 300-8.
Berend ME, Glisson RR, Nunley JA. A biomechanical comparison of intramedullary and crossed lag screw fixation for tibiotalocalcaneal arthrodesis. Foot Ankle Int 1997; 18: 638-43.
Buck P, Morrey BF, Chao EY. The optimum position of arthrodesis of the ankle. J Bone Joint Surg [Am] 1987; 69-A: 1052-62.
Carrier D, Harries C, Ankle arthrodesis with vertical Steinmann Pins in rheumatic arthritis. Clin Orthop 1991; 268: 10-14.
Charnley J. Compression arthrodesis of the ankle and shoulder. J Bone Joint Surg [Br] 1951; 33-B: 180-91.
Conti RJ, Walter JH Jr. Effects of ankle arthrodesis on the subtalar and midtarsal joints. J Foot Surg 1990; 29: 334-6.
Gruen GS, Mears DC. Arthrodesis of the ankle and subtalar joints. Clin Orthop 1991; 268: 15-20.
Helm R. The results of ankle arthrodesis. J Bone Joint Surg [Am] 1990; 72-A: 141-3.
Kile TA, Donnely RE, Gehrke JC, Werner ME, Johnson KA. Tibiotalocalcaneal arthrodesis with an intramedullary device. Foot Ankle Int 1994; 15: 669-73.
King HA, Watkins TB Jr, Samuelson KM. Analysis of foot position in ankle arthrodesis and its influence on gait. Foot Ankle 1980; 1: 44-9.
Moore TJ, Prince R, Pochatko D, Smith JW, Fleming S. Retrograde intramedullary nailing for ankle arthrodesis. Foot Ankle Int 1995; 16: 433-6.
Morrey BF, Wiedemann GP. Complications and long term results of ankle arthrodeses following trauma. J Bone Joint Surg [Am] 1980; 62-A: 777-84.
Papa JA, Myeerson MS. Pantalar and tibiocalcaneal arthrodesis for post-traumatic osteoarthrosis of the ankle and hindfoot. J Bone Joint Surg [Am] 1992; 74-A: 1042-9.
Pinzur MS, Kelikian A. Charcot ankle fusion with a retrograde locked intramedullary nail. Foot Ankle Int 1997; 18: 699-704.
Pochatko DJ, Smith JW, Phillips RA, Prince BD, Hedrick MR. Anatomic structures at risk: combined subtalar and ankle arthrodesis with a retrograde intramedullary rod. Foot Ankle Int 1995; 16: 542-7.

PRE-OPERATIVE PLANNING

Either general or regional anaesthesia is used. The patient is placed in a supine position on a radiolucent table. Alternatively, a lateral decubitus position may be used. The leg should be draped free and fluoroscopic control should be possible in both planes. A tourniquet may be used.
The fusion angle of the ankle joint is 90° in males and 95° in female (slight equinus), with 5° of valgus and 10°-15° of external rotation. If this position cannot be achieved, either lengthening of the Achilles tendon and/or gradual correction of the equinus deformity with the assistance of external fixation is carried out.
If the cartilage of the ankle joint is preserved, the articular surfaces are prepared, either arthroscopically, percutaneously using a 6 mm drill bit or through an open procedure.



Ankle Arthrodesis Nailing Instrumentation

1	10017	6 mm Polyhedral Allen Wrench
1	11008	Drill Bit Kit 4 mm, length 310 mm
1	17350	Screw T-wrench, hexagonal 3.5 mm
1	17351	Locking Screw Depth Gauge
1	17354	Straight Trocar 8 mm
1	17356	Graduated Angled Trocar 4/8 mm
1	17365	Drill Guide 4 mm
1	17640	Countersink Hand Drill 8/4 mm
1	17652	T-Handled Locking Screw Extractor
1	17710	Handle
1	17720	Short Guide Bar, 140-220 mm nails
1	17730	Locking Rod
2	17740	Smooth Screw Guide
1	17741	Reamer Guide Sleeve
1	17750	K-wire 3 mm, length 400 mm (not illustrated)
1	17760	Cannulated Hand Reamer 12/10 mm
1	17606	Sterilisation Box for Instruments
1	17607	Sterilisation Box for Implants
1	177665	Graduated Drill, 10-12 mm

Instruments can be supplied individually or as a complete kit:

17700	Supracondylar and Ankle Arthrodesis Nailing Kit

ADDITIONAL INSTRUMENTATION

1 5 mm Steinmann Pin (25 cm long)
1 Flexible Reamer Set 8-12.0 mm in 0.5 mm Steps

RETROGRADE NAILS

TOTAL LENGHT (mm)	DIAMETER (mm) 10	12
140	**77014**	**77214**
160	**77016**	**77216**
180	**77018**	**77218**
190	**77019**	**77219**
200	**77020**	**77220**
210	**77021**	**77221**
220	**77022**	**77222**

77900	Retrograde Nail End Cap

Note: For the first 50 mm all nails are 12 mm in diameter; they then taper to the diameter stated.

STANDARD LOCKING SCREWS (6 mm thread diameter)

TOTAL LENGHT (mm)	THREAD LENGTH (mm) 8	12	20
30	**73930**		
35	**73935**		
40	**73940**		
45	**73945**		
50		**73950**	
55		**73955**	
60		**73960**	
65		**73965**	
70			**73970**
75			**73975**
80			**73980**
85			**73985**
90			**73990**
95			**73995**
100			**73900**
105			**73905**
110			**73910**

REVISION LOCKING SCREWS (8 mm thread diameter)

TOTAL LENGHT (mm)	THREAD LENGTH (mm) 7	9	12	20
30	**74530**			
35	**74535**			
40	**74540**			
45	**74545**			
50		**74550**		
55		**74555**		
60		**74560**		
65		**74565**		
70			**74570**	
75			**74575**	
80			**74580**	
85			**74585**	
90			**74590**	
95				**74595**
100				**74500**
105				**74505**
110				**74510**

74405	Pack of 4 washers

Washers are usually used with Revision Locking Screws.

CLEANING OF EQUIPMENT

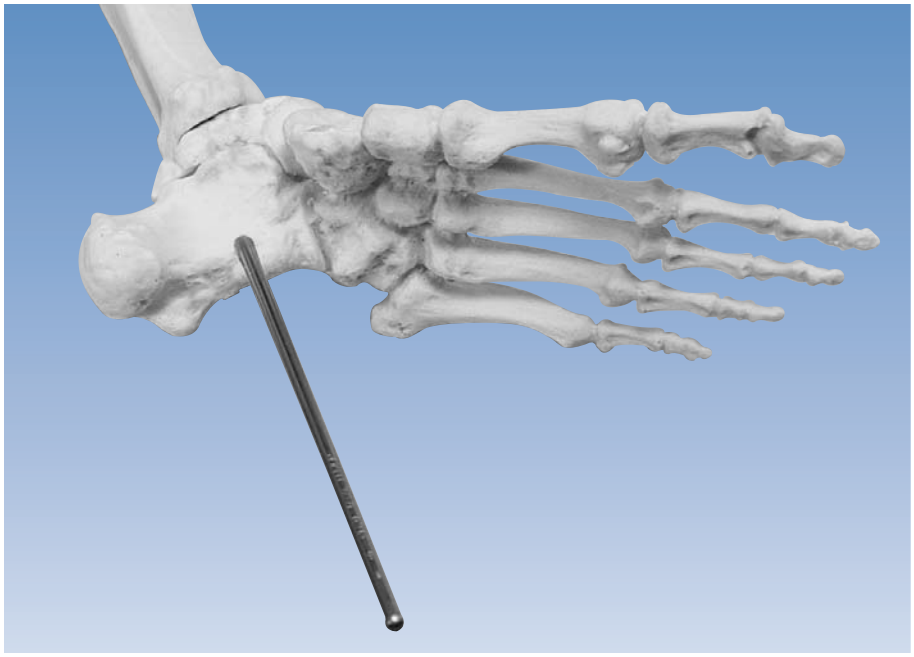
The implants and instrumentation should be removed from their packaging and cleaned thoroughly using medical grade alcohol 70% + distilled water 30% (Detergents with free fluoride, chloride, bromide, iodide or hydroxyl ions must not be used, as they will damage the black anodised coating on any Orthofix products). After cleaning, the devices should be rinsed with sterile distilled water and dried using clean non-woven fabric.

STERILIZATION

Prior to surgical use, the products should be cleaned as described above and sterilized by steam autoclaving following a validated sterilization procedure, utilizing a prevacuum cycle (Orthofix recommends the following cycle: steam autoclave 132°-135°C [270°-275°F], minimum holding time 10 minutes).

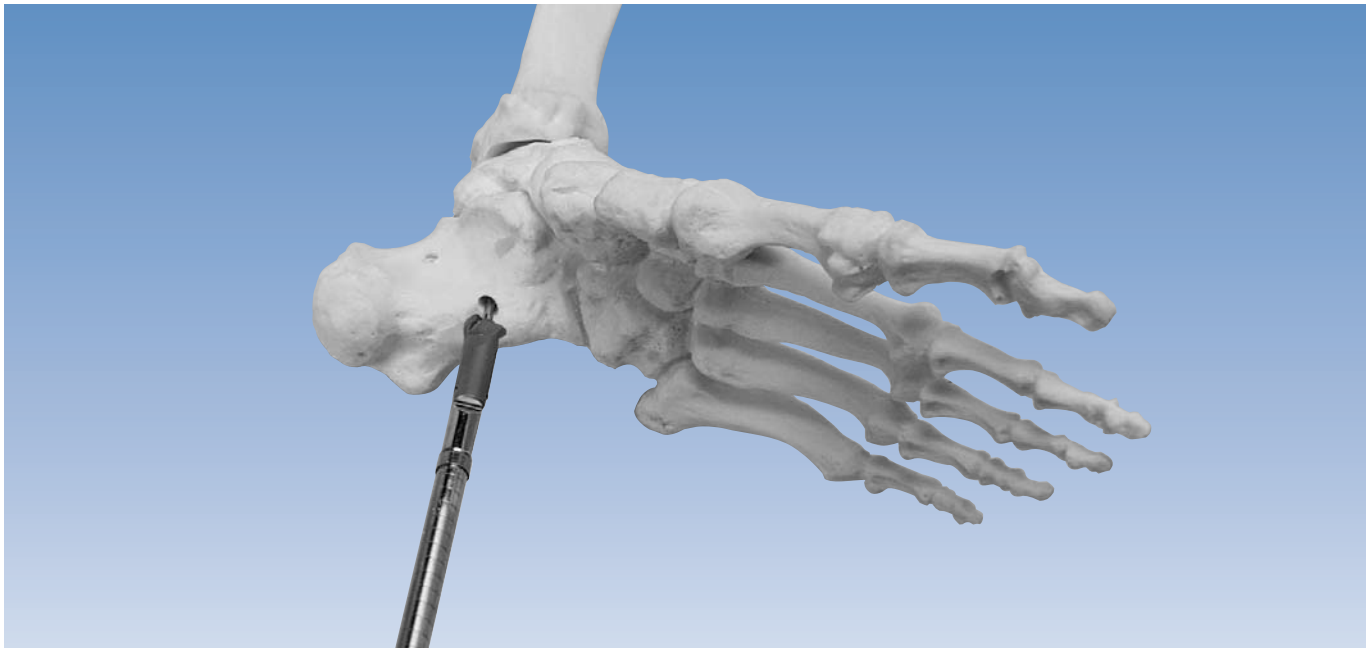
THE NAILS, NAIL END CAPS AND LOCKING SCREWS MUST NEVER BE REUSED

These implants may look "as new" when removed, but will have been subjected to considerable stresses while in the patient. All Orthofix implants are for **single use only.**

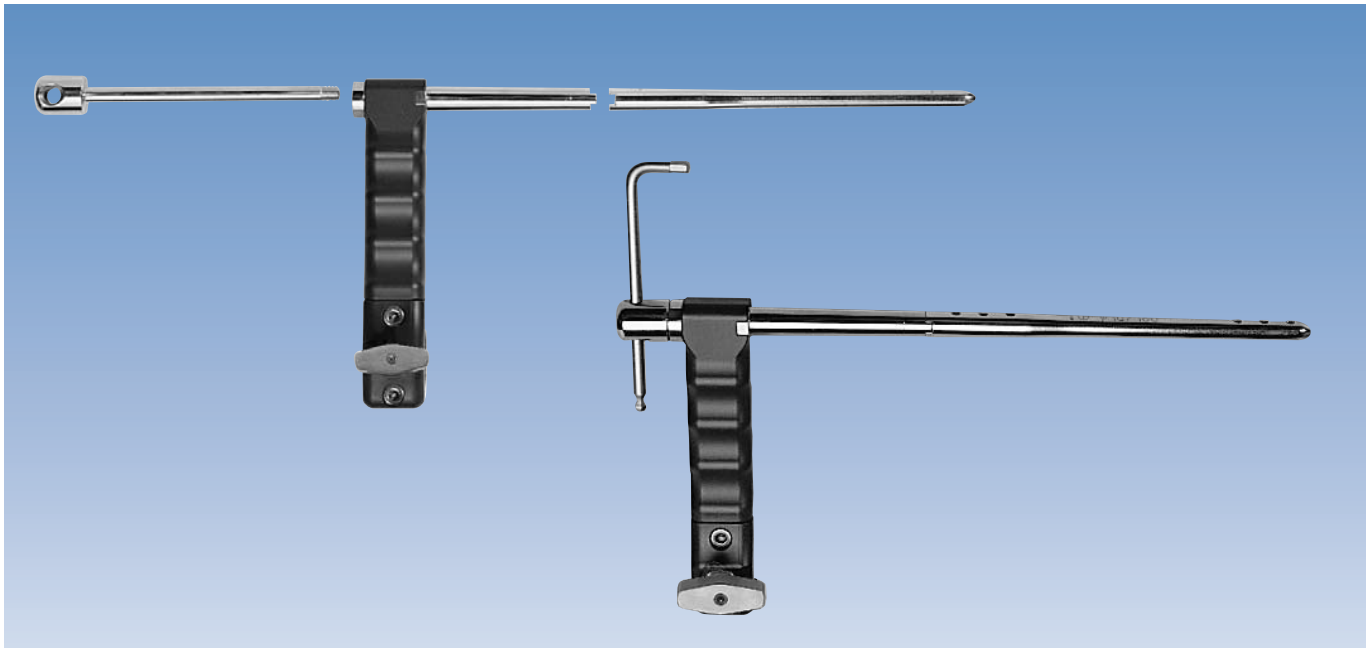


NAIL INSERTION

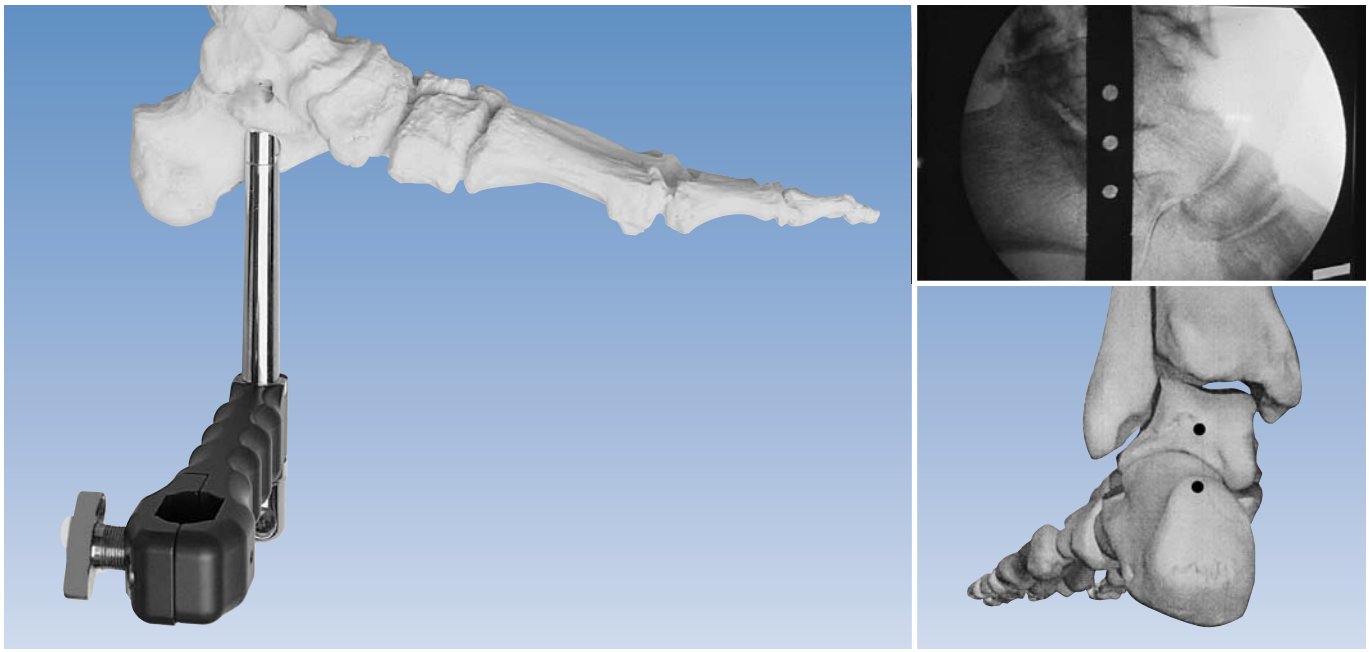
A partial fibulectomy (about 15 mm) is performed approximately 10-12 cm proximal to the distal tip of the bone through a lateral incision followed by preparation of the articular surface.
A 2.5 cm incision is made in the non-weightbearing part of the sole of the foot in line with the tibial axis, and plantar dissection extended to the distal surface of the os calcis, protecting the neurovascular bundle with Langenbeck retractors.
In the selected fusion position of the ankle joint, a sharp-tipped 5 mm Steinmann pin is inserted through the os calcis, talus and tibial articular surface into the distal tibia, and its position confirmed radiographically in both planes.



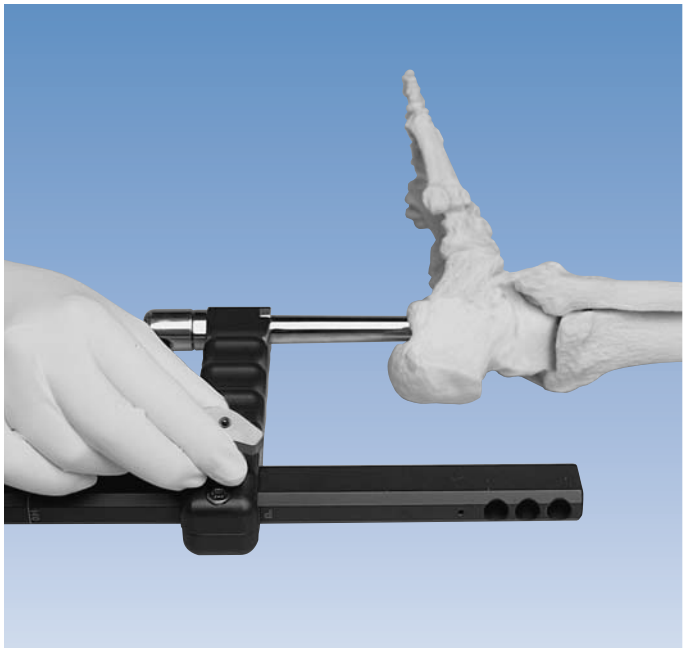
The 5 mm Steinmann pin is then replaced with a 3 mm guide wire with olive (80-100 cm long). Passage of the guide wire with olive through the bone must be confirmed prior to nail insertion.
In most cases a 10 mm diameter nail is used, but with a wide medullary canal a larger diameter nail is recommended.
A graduated drill (10-12 mm) is used to penetrate the os calcis, talus and distal tibia up to the diaphysis. Alternatively, stepwise reaming is performed.
Stepwise reaming of os calcis, talus and distal tibial diaphysis is performed up to 12 mm. The diaphysis is reamed to the diameter of the nail, or at most 0.5 mm more.
The selected fusion position most be maintained throughout the procedure.

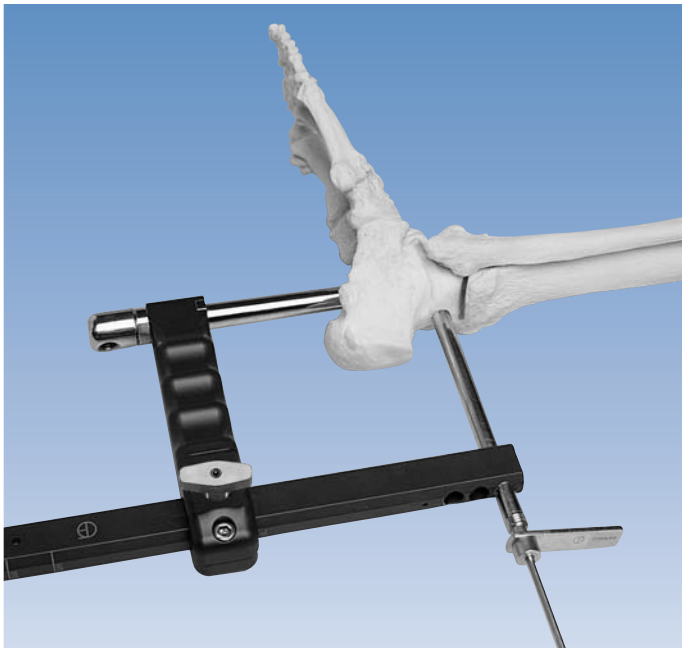


A nail of correct length (usually 140/160/180 mm) and diameter (10, 11 or 12 mm) is inserted into the handle and locked into position with a 6 mm Allen wrench.
Before the nail is inserted, it is important to check alignment of the distal and proximal holes in the nail and the guide bar. In order to do this, the guide bar is mounted on to the handle following the procedures described below under "Distal Locking" page 7 and "Proximal Locking" page 9.
A screw guide and drill guide are inserted into the holes in the guide bar and alignment checked using the drill bit.
The guide wire must be exchanged for a plain 3 mm guide wire after reaming and before nail insertion.



The nail is inserted by hand over the guide wire, which is then removed.
With the nail holes in the frontal (coronal) plane, a lateral view (top right) is taken with the Image Intensifier to confirm that the position of the most proximal of the distal holes is at the level of the talus.
The pictures on the right illustrate the positions of the locking screws.
The inset at bottom right illustrates the position of the locking screws after 90° rotation of the nail.





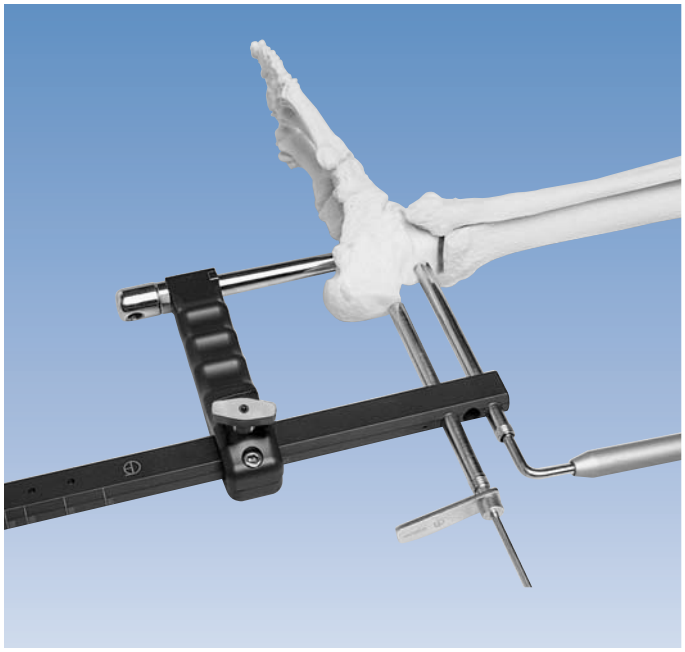
DISTAL LOCKING

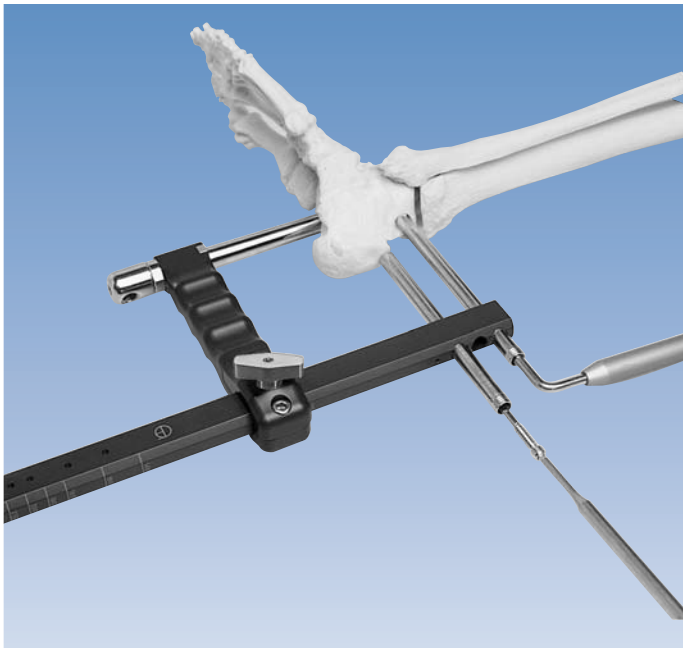
The handle is turned 90° posteriorly to allow postero-anterior drilling of the talus through stab incisions.
The guide bar is inserted into the handle until the D mark is level with the front surface of the handle, where it is locked firmly into position.
A screw guide is inserted into the most proximal hole which is at the level of the talus. A stab incision is made, splitting the Achilles tendon longitudinally, and the screw guide advanced down to the posterior tubercle of the talus.
A 4 mm drill guide is inserted into the screw guide and gently tapped into the bone.
The bone is then drilled with the 4 mm drill bit, with the drill stop mounted near the drill. **The drill bit should be aimed at the base of the 2nd metatarsal; a radiographic check is mandatory to avoid penetration of the anterior articular surface.**

Note: The surgeon should resist the temptation to insert the locking screws in the frontal or an oblique plane. This may be easier technically, but sagittal plane locking screws provide the best stability for reliable ankle fusion.

STANDARD LOCKING SCREW LENGTH

When drilling is completed, the drill stop should be positioned touching the drill guide. After removal with the drill guide, the amount of protruding drill bit is the maximum length of the locking screw. This length may be measured using the scale on the T-Handled Locking Screw Extractor (17652).





The drill bit and drill guide are removed and the graduated angled trocar inserted into the screw guide, so that it passes through the nail. Correct placement may be verified by insertion of the guide wire into the nail until resistance is felt.
A screw guide is now inserted into the most distal hole of the guide bar, which is located over the os calcis, and advanced down to the bone through a stab incision.

Note: The intermediate locking hole is used when a talectomy has been performed or when the talus is damaged and its height significantly reduced, or for extra purchase in soft osteoporotic bone.

A 4 mm drill guide is inserted into the screw guide and the bone drilled with the 4 mm drill bit. A radiographic check is mandatory. Position the drill stop touching the drill guide as before.
The drill bit and drill guide are removed and in the os calcis a revision locking screw, and in the talus a standard locking screw of the correct length are inserted of the correct length inserted.

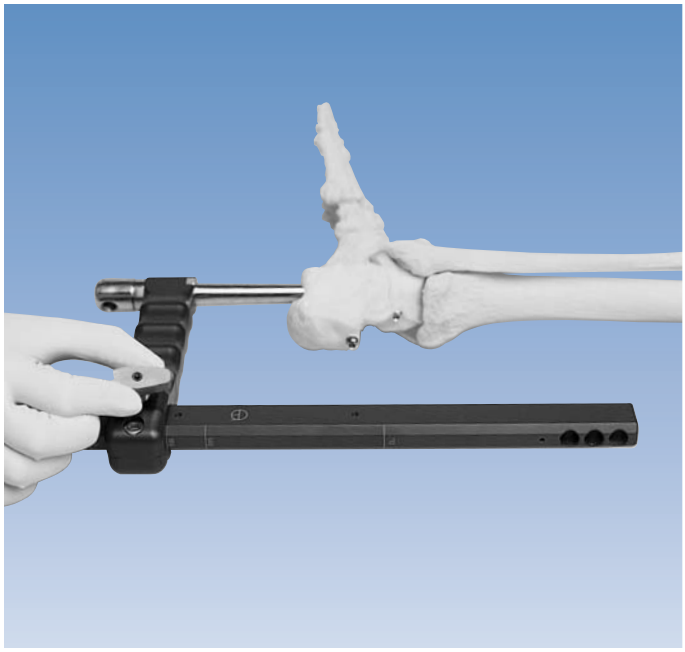
Note: The tips of the locking screws must not protrude anteriorly beyond the talus and os calcis.
It is advisable to countersink the head of the os calcis screw especially with thin soft tissue cover, using the Countersink Hand Drill (12640).

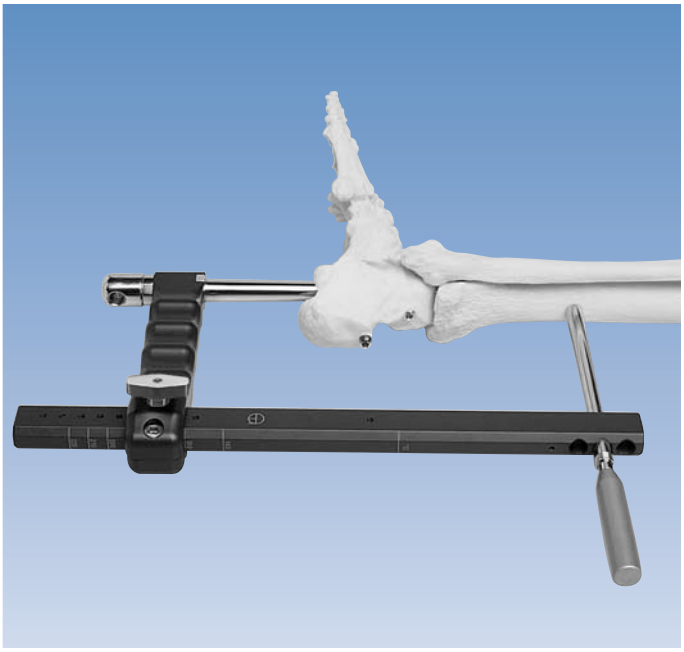
COMPRESSION OF ARTHRODESIS

Manual pressure is used on the nail handle to close the ankle joint space and perform compression.

REVISION LOCKING SCREWS

When the thread of the locking screw seems to have a poor grip for any reason, particularly if the bone is osteoporotic, Revision Locking Screws, with an 8 mm diameter thread, can be used.

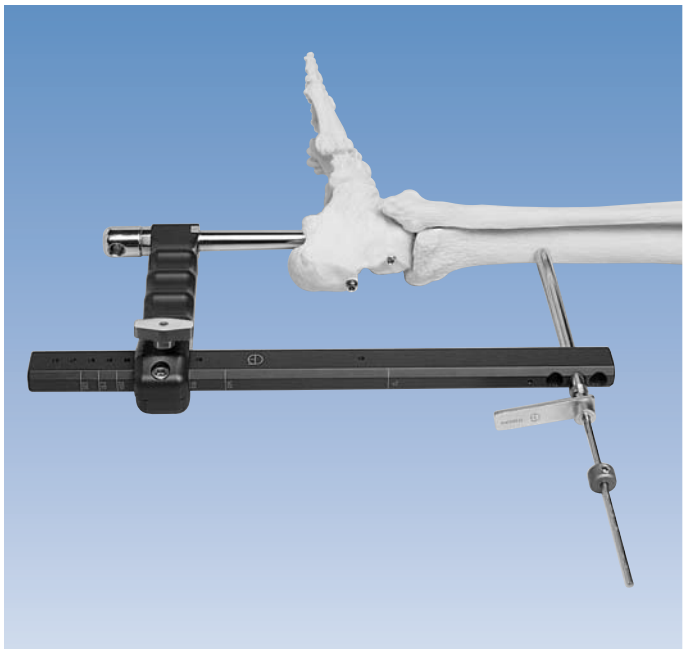


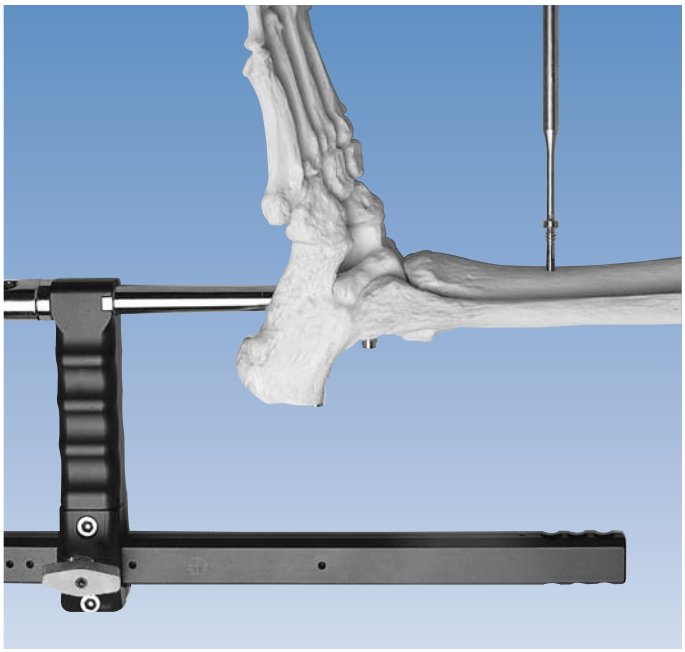


PROXIMAL LOCKING

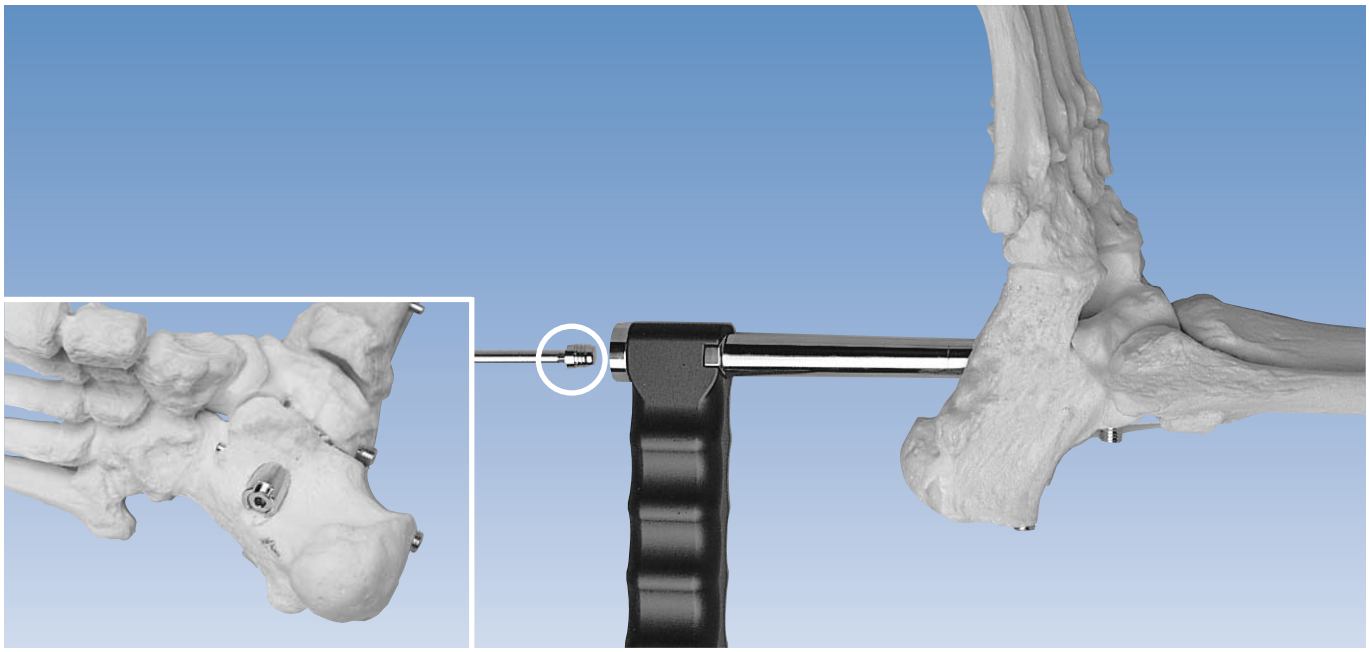
The guide bar is advanced until the number corresponding to the selected nail length is lined up with the front of the handle, and is then locked firmly into place.

A screw guide and straight trocar are inserted into one of the three proximal holes of the guide bar and, through a posterior stab incision, advanced down to the posterior aspect of the tibia after careful blunt dissection.





A 4 mm drill guide is inserted into the screw guide and the 4 mm drill bit used to perforate the tibia from the posterior to the anterior surface. The tip of the drill bit can be felt through the skin anteriorly and an incision is made in this position. Again, the drill stop can be advanced to the drill guide to give an accurate estimate of locking screw length.
The drill bit, drill guide and screw guide are removed and a locking screw of appropriate length inserted in an anterior-posterior direction. Locking screw positions are confirmed with the Image Intensifier.
Usually one proximal locking screw is sufficient but two should be used in difficult cases or where the bone quality is poor.



CLOSING PROCEDURES

The guide bar and locking rod are removed, but the handle kept in place so that the nail end cap (see circle) can be inserted through the nail support with the T-wrench. The nail end cap must be securely tightened. The handle is then removed and all incisions closed.

Note: The most distal locking screw shown in these images should normally be countersunk in the patient.

Post-operatively, a plaster cast is applied, and changed to a partial weightbearing cast (15 Kg) after two weeks, when the stitches are removed. The period of immobilization is six weeks in total. As in all patients with arthrodesis of the hindfoot, a stiff sole should be prescribed for the patient's shoes on the operated side.

Dynamization of the nail is performed after four to six months by removal of the proximal locking screw. This can be done under local anaesthesia since the screw head can easily be identified. The implant is not normally removed.

It may be necessary to perform additional procedures in cases of ankle arthrodesis and reference is made to the relevant literature.

Orthofix wishes to thank

Prof. Dr. Dietmar Pennig
St. Vinzenz-Hospital
Köln - Germany

for his invaluable help
in the preparation of this manual.

Manufactured by: ORTHOFIX Srl
Via Delle Nazioni 9
37012 Bussolengo (Verona)
Italy

Telephone +39-0456719000
Fax +39-0456719380

CE 0123

Your Distributor is:

Deformity Correction | Trauma | Pediatrics | Bone Growth Stimulation

www.orthofix.com

PM AAN E0 06D-11/09

ORTHOFIX®
Orthopedics International