

Gamma3

Long Nail R2.0

Operative Technique

Hip Fracture



Long Nail R2.0

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This publication sets forth detailed recommended procedures for using Stryker Trauma devices and instruments.

It offers guidance that you should heed, but, as with any such technical guide, each surgeon must consider the particular needs of each patient and make appropriate adjustments when and as required. A workshop training is required prior to first surgery.

Note:

All bone screws referenced in this material here are not approved for screw attachment or fixation to the posterior elements (pedicles) of the cervical, thoracic or lumbar spine.

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Introduction

Introduction

The Gamma3 Locking Nail System is based on more than 16 years of Gamma Nail experience. This is the third generation of intramedullary short and long Gamma fixation nails.

The Evolution of the successful Trochanteric and Long Gamma Nails as well as the Asia Pacific and Japanese versions followed strictly a step by step improvement based on the clinical experience of the clinical outcome from surgeons all over the world.

The new Gamma3 System is designed to facilitate minimally invasive surgery and reduce the OR time down to a minimum by the aid of using new instrumentation and an optimized surgical technique.

The nails have a proximal diameter of 15.5mm to help minimize the incision length required for minimally invasive surgery. Nevertheless, they offer the same biomechanical strength and cut-out resistance as the well established Trochanteric and Long Gamma Nails.

The new Lag Screw shape has been improved, especially in the area of the thread and the cutting flutes at the tip of the screw. The new design offers superior cutting behavior during Lag Screw insertion, providing extremely low insertion torque. The new thread design also offers excellent grip in the cancellous bone of the femoral head and strong resistance against cut-out.

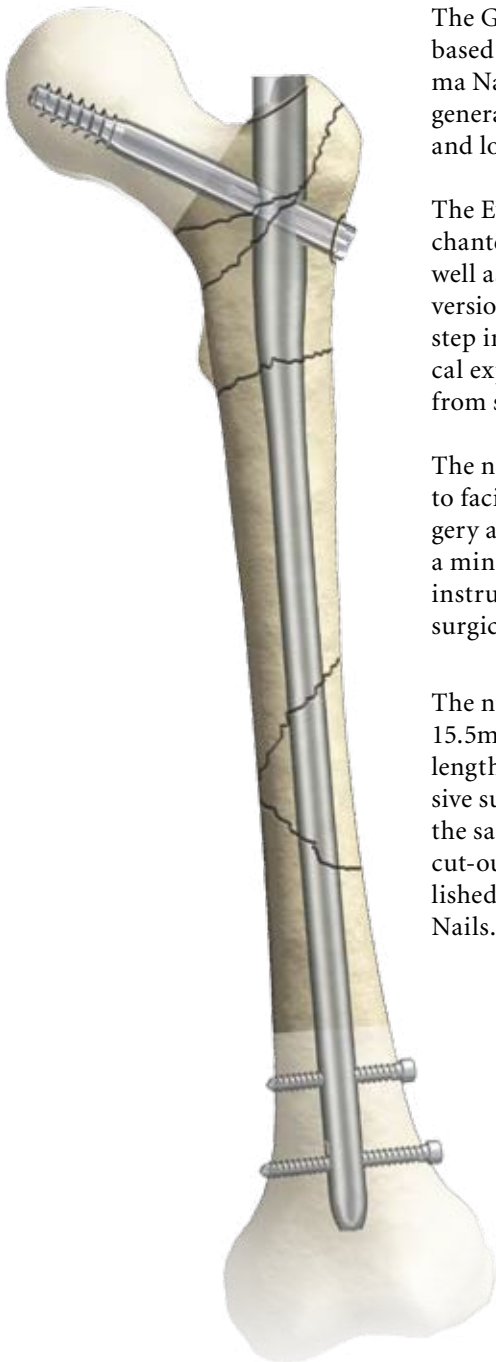
The 5mm distal locking screws are currently used in the Gamma-Ti and the T2 intramedullary nailing systems.

A major advantage of the system is the newly designed instrument platform. The instruments are designed for a minimally invasive surgical technique and reduce OR time to a minimum. The instruments are easy to use and easy to clean, and they share the same platform as the Stryker intramedullary T2 and S2 nails.

Acknowledgements:

Our thanks are due to the many surgeons who supported the development of the new Gamma3 System, with their feedback and ideas, during worldwide panel meetings and helped the Gamma3 System to be what it is today.

Special thanks to the Asian Pacific Technical Committee, who supported very early the idea of smaller implants for the treatment of proximal femur fractures.



Features

Design Features of the Gamma3 System

Gamma3 Locking Nails come in 3 neck-shaft angles of 120, 125 and 130°.

- In the following, these Gamma3 Nails are called:
Long Nail

All nails* use the same Lag Screws, Set Screw, distal Locking Screws and End Caps (see Fig. 1).

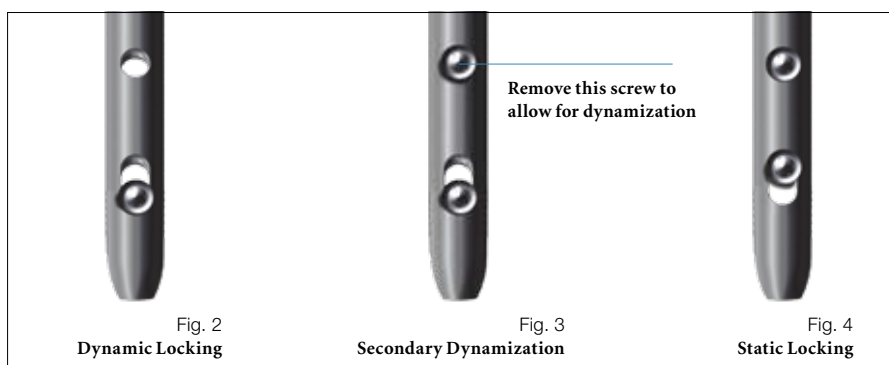
Gamma3 Nail Long

This nail incorporates several important mechanical design features. The nail is unslotted and cannulated for Guide-Wire-controlled insertion. To facilitate conformity with the human anatomy, the Long Nail is supplied in a left and right version.

The three neck-shaft angles accommodate variations in femoral neck anatomy. The Long Nail offers the opportunity to use two distal Locking Screws that are inserted through the distal nail end to control rotation and telescoping. As shown below, the nail offers the possibility for either static, dynamic or secondary dynamic distal locking, depending on the fracture pattern.

Long Nail Distal Locking Options

- Locking in the distal part of the oblong hole creates a dynamic locking mechanism – requires only one screw (see Fig. 2).
- One screw placed in the distal part of the oblong hole and the other in the round hole.
If dynamization is required after a period of time, the screw, placed in the round hole, has to be removed – requires two screws (see Fig. 3).
- One screw placed in the round hole and the other is placed in the proximal part of the oblong hole – requires two screws (see Fig. 4).



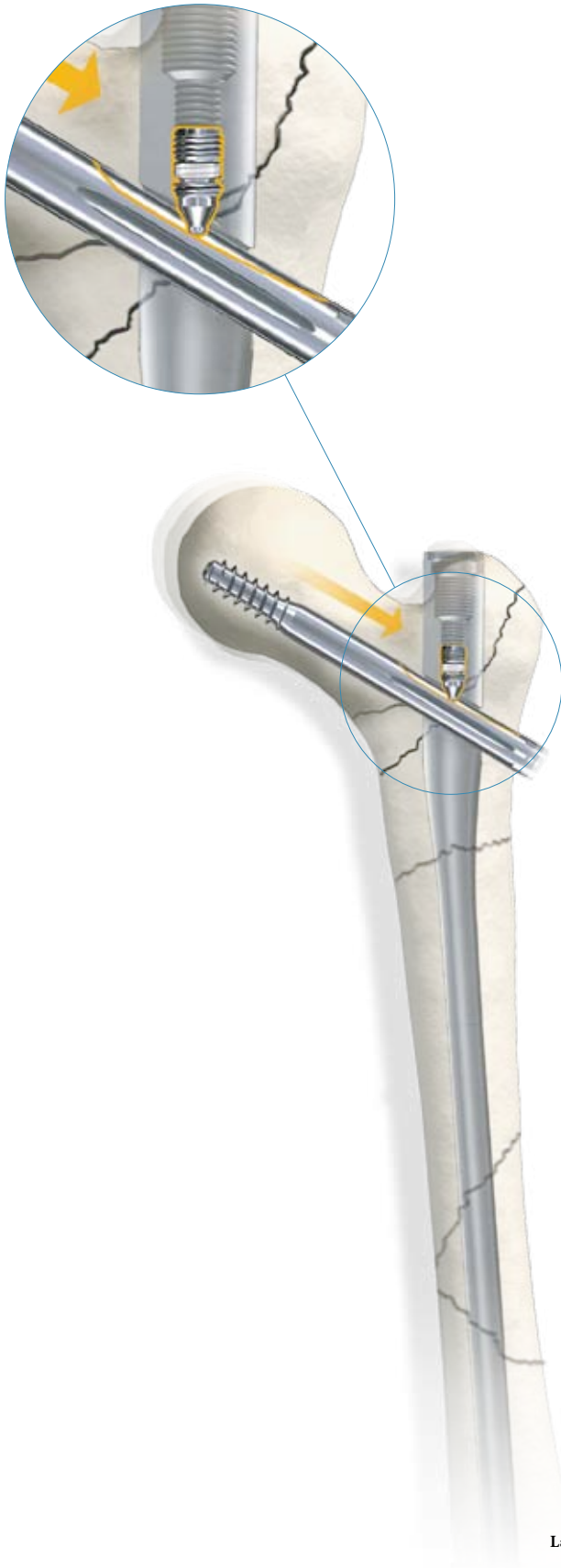
Technical Specifications:

- **Material:**
Titanium alloy with anodized type II surface treatment or Orthinox® High Strength Stainless Steel
- **Nail length:**
280mm to 460mm, in 20mm increments, shorter or longer nails are available on request
- **Nail diameter:**
proximal 15.5mm, distal: 11.0mm
- **Proximal Nail angle range:**
120°, 125°, 130°
- **M-L bend for valgus curvature:**
4 degrees
- **Proximal anteverision of 10°**
- **End Caps**
0mm, +5mm and +10mm
- **Antecurvature radius R2.0m of the shaft**
- **Distal locking holes (round and oblong)**
for 5mm screws; up to 5mm dynamization is possible



* Each nail is supplied sterile packaged together with a Set Screw in one box.

Features



Lag Screw and Set Screw Function

The Lag Screws are designed to transfer the load of the femoral head into the nail shaft by bridging the fracture line to allow fast and secure fracture healing. The load carrying thread design of the Gamma3 Lag Screw provides large surface contact to the cancellous bone. This provides high resistance against cut out. Gamma3 Lag Screws feature a special tip profile to allow use with bone substitutes and the self-tapping thread is designed for easy insertion.

The patented Set Screw is designed to fit into one of the four grooves of the shaft of the Lag Screw. This prevents both, rotation and medial migration of the Lag Screw.

The nail allows sliding of the Lag Screw to the lateral side for dynamic bone compression at the fracture site to enhance fracture healing.

Technical Specifications

- Lag Screw diameter: 10.5mm
- Lag Screw lengths: 70–120mm in 5mm increments
- Patented Lag Screw design for high load absorption and easy insertion
- Asymmetrical depth profile to allow the Lag Screw to slide in the lateral direction only (see orange arrow on Fig. 5).
- Patented self retaining Set Screw to secure the Lag Screw against rotation and simultaneously allowing sliding of the Lag Screw laterally.

Fig. 5
Lag Screw Stabilization System

Features

Distal Locking Screws

The distal Locking Screw has a short self-tapping tip which facilitates a faster and easier start as well as easy screw insertion. It promotes excellent surface to bone contact (Fig. 6).



Fig. 6

The screw has an external diameter of 5mm, and provides an even higher fatigue strength than the clinically successful 6.28mm Locking Screw of the regular Gamma™ and G/K Locking Nail System (data on file).

The screw diameter directly under the screw head has been reduced to prevent radial pressure that may cause micro fractures during screw insertion when the screw head reaches its final position. This reduction in diameter also improves the feel on the final tightening of the screw (Fig. 6a).

Length Definition of the Distal Locking Screw

The distal Locking Screw is measured from head to tip (Fig. 6b).

Technical Specifications

- Distal Locking Screw Diameter: 5mm.
- Distal Locking Screw lengths ranging from 25–50mm, in 2.5 and 5mm increments. Longer screws up to 120mm are available on request.
- Fully threaded screw design. Partially threaded screws are available on request
- Self-tapping screw tip with optimized short cutting flutes.
- Optimized diameter under the head helps to prevent micro-fractures during insertion.

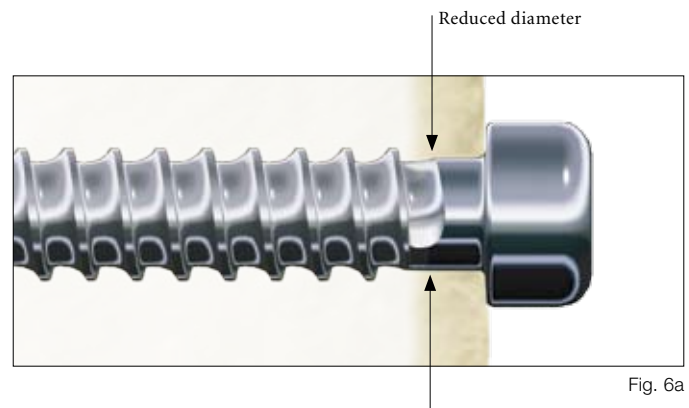


Fig. 6a

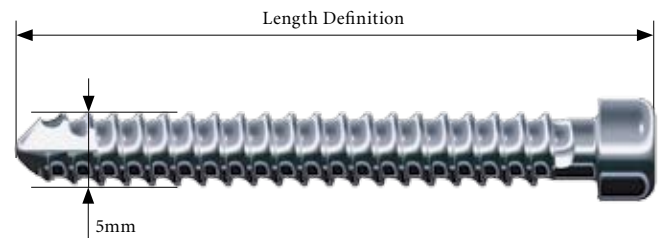


Fig. 6b

Features

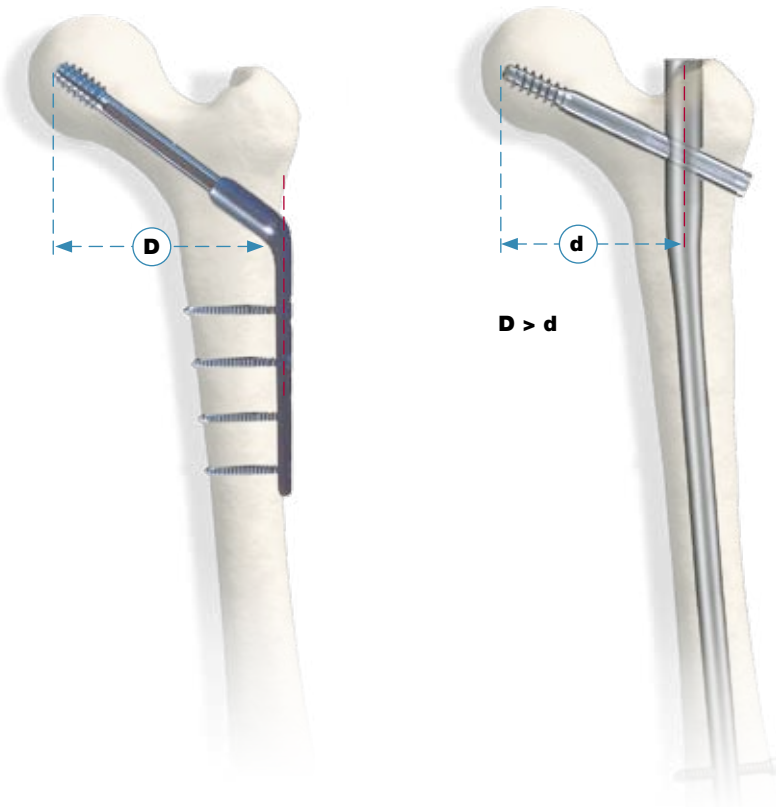


Fig. 7

Gamma3 System Benefits

Strength and Stability

The biomechanical superiority of the intramedullary system offers significantly greater strength and stability compared with the side plate, in clinical use [1]. The new Gamma3 system offers the same strength as the well established Gamma Locking Nail System.

The Biomechanical Advantage over Side-Plate Systems

Since the load-bearing axis of the Gamma3 Nail is closer to the hip joint fulcrum, the effective lever arm on the implant and femur is significantly shorter than with an extramedullary plate. The reduction factor is equivalent to d/D as shown in Figure 7 (approximately 25% [1]).

The resultant force is transmitted directly down the femur using a nail system. If a side-plate system is used, the femur shaft may be weakened through a high amount of locking screws. The Gamma3 Nail increases both the strength and reliability of the bio-mechanical repair. The distal dynamic locking option additionally allows the use of dynamic compression.

Rehabilitation Benefits

The extra strength effectively gained through the biomechanics of the Gamma3 System combined with improved control of axial telescoping and rotational instability may allow earlier weight-bearing even in patients with complex or unstable proximal and combined ipsilateral shaft fractures. Early mobilization, dynamic compression, and a less traumatic operative technique increase the chance for rapid recovery and reliable bone union.

[1] K.S.Leung et al, Multicenter Trial of the Modified Gamma™ Nail in East Asia CORR323: 146–154,1996

Operative Technique

Indications/Contraindications

Indications

- Subtrochanteric fractures
- Pertrochanteric fractures associated with shaft fractures
- Pathological fractures (including prophylactic use) in both trochanteric and diaphysal areas
- Nonunion and malunion

Contraindications

Contraindications are medial neck fractures.

Note:

If no bone consolidation occurs the system may fail. The aim of post-operative care must be to ensure the promotion of bone consolidation.

The aim of this operative technique manual is to provide the surgeon with a simple step-by-step operating guide to aid in successful addition of the Gamma3 System into their standard trauma care. Once the technique has been learned, the surgeon should find the operative procedure simple to implement. In fact, many of the basic principles for the Gamma3 System are those employed for all closed intramedullary nailing procedures.

This operative technique has been devised in consultation with leading surgeons in many countries to be a basic guide, particularly for less experienced users of the Gamma3 System. It is acknowledged that several alternative approaches to certain elements of the procedure are available, and may have advantages for particular situations or surgeons.



Fig. 8

Implant Selection

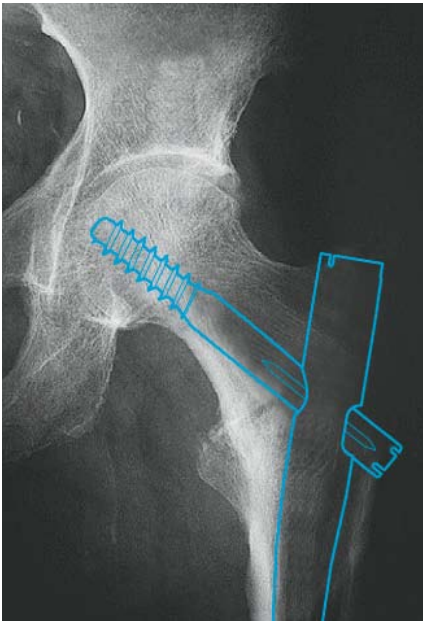


Fig. 9
X-ray in a-p view,
showing implant

The Gamma3 Nail with a 125° nail angle may be used in the majority of patients. The 120° nail may be needed in patients with osteoarthritic coxa vara, and the 130° nail for coxa valga.

Where such variations in femoral anatomy require an alternative, the following chapter describes how to select the optimal implant size.

Preoperative Planning

X-ray templates are very helpful during preoperative planning. Use the X-ray Templates (Fig. 9a) for short and long nails to select the correct implant and the optimal nail angle.

These templates show the true implant size at a magnification of 15% in anterior-posterior view. The X-rays should be taken at this magnification (15%) for an optimum surgical outcome (see Fig. 9). If accurate anatomical reduction has been achieved, the X-ray can be taken from the fractured hip or from the contralateral side.

Alternatively the femoral neck angle, i.e. the angle between the femoral shaft mid-axis and the femoral neck mid-axis, could be measured using a goniometer. The nail length may also be determined intraoperatively using the Guide Wire Ruler together with the Guide Wire.

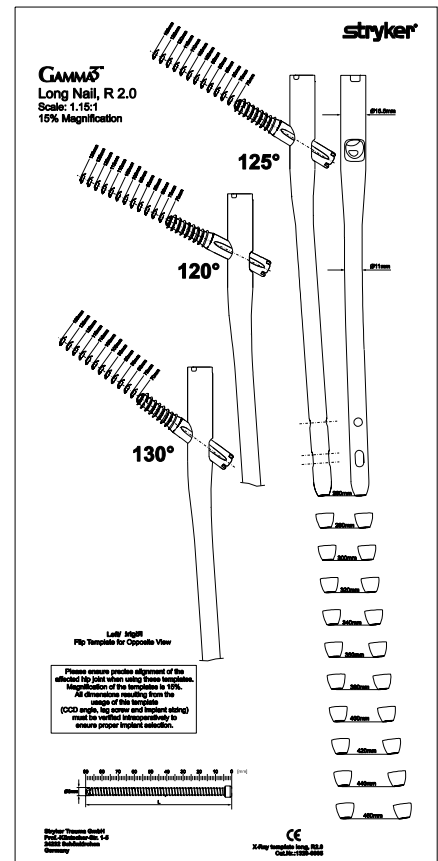


Fig. 9a
Gamma3 Long Nail X-ray Template
(Ref. No 1320-0005)

Note:

Please ensure precise alignment of the affected hip joint when using these templates. Template magnification is 15%. All dimensions (nail angle and implant sizing) resulting from using these templates must be verified intraoperatively to ensure proper implant selection.

Operative Technique

Patient Positioning and Fracture Reduction

The procedure for patient positioning is usually similar to that of a subtrochanteric fracture, however, in fractures that are particularly difficult to reduce, a transcondylar sterile Steinmann pin may be used. The pin is fixed directly to the orthopaedic table by an adaptable stirrup, and traction is applied until anatomical reduction in the A-P view is obtained (Fig. 10).

The patient is placed in a supine position on the fracture table and closed reduction of the fracture is recommended (Fig. 10a).

Traction is applied to the fracture, keeping the leg straight. The upper trunk should be flexed to the opposite side so that the fracture can be reduced by not too much adduction of the lower limb. It also gives easy access to the greater trochanter.

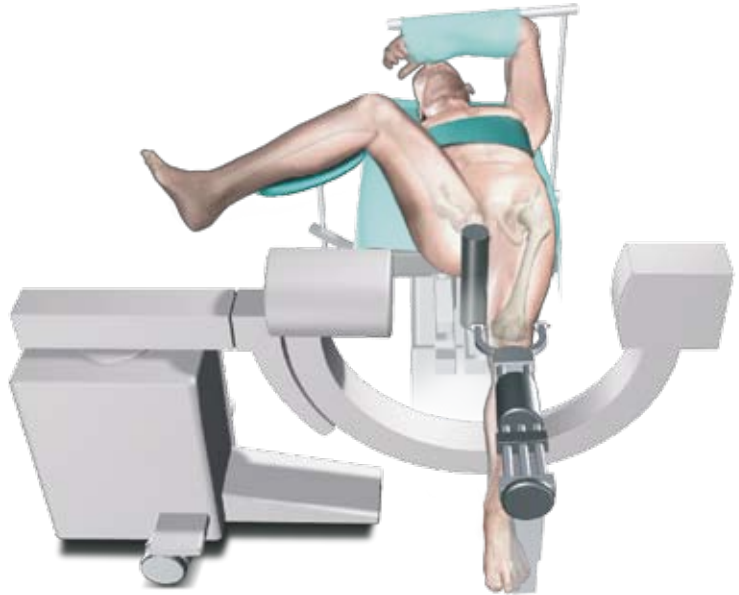


Fig. 10

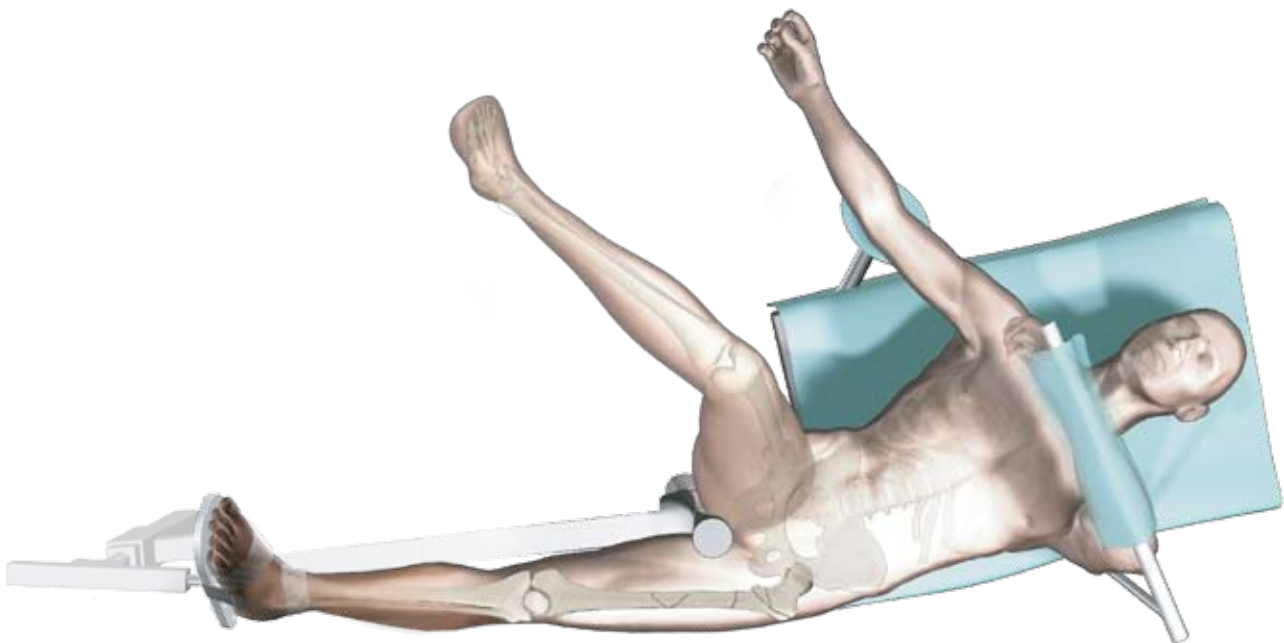


Fig. 10a

Operative Technique

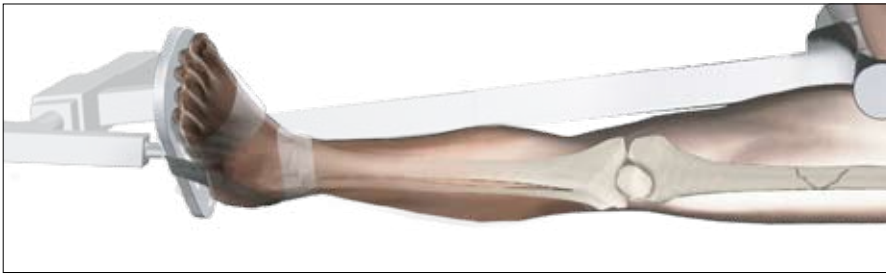


Fig. 11

Patient Positioning and Fracture Reduction

Maintaining traction, the leg is internally rotated 10–15 degrees to complete fracture reduction; the patella should have either a horizontal or slightly inward position (Fig. 11). Position the image intensifier so that anterior-posterior and mediolateral views of the trochanteric region of the affected femur can be easily obtained. This position is best achieved if the image intensifier is positioned so that the axis of rotation of the intensifier is centered on the femoral neck of the affected femur (Fig. 11a). The views of the distal femur should also be easily obtained for distal locking.

It is important to ensure that a view of both the distal and proximal tips of the nail can be obtained during the procedure without obstruction by the traction table.

The patient is then prepared and draped as for standard femoral nailing procedures. When positioning the drapes, bear in mind that the incision will be more proximal.

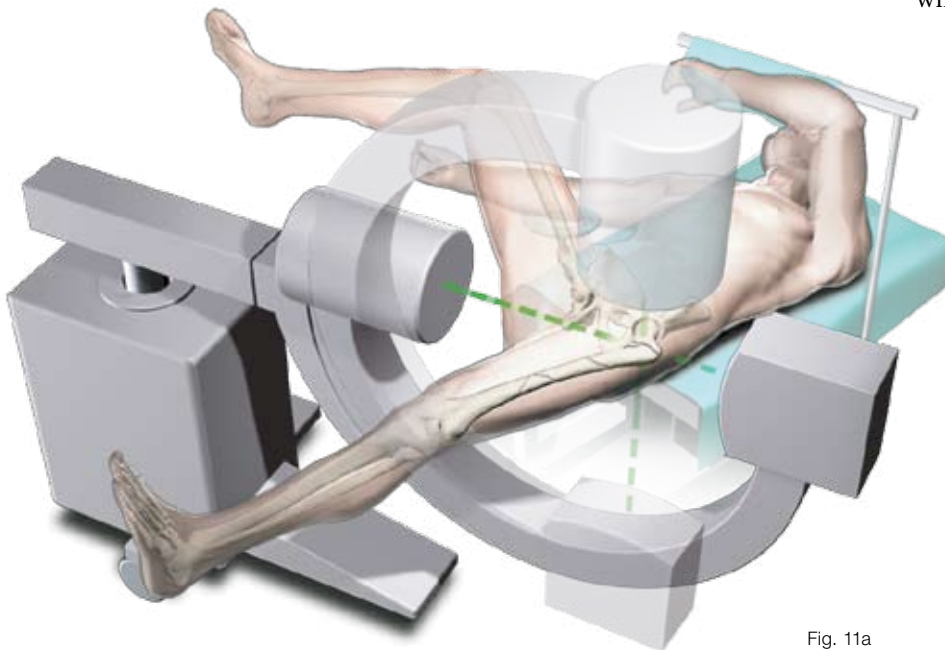


Fig. 11a

Note:

Reduction should be achieved as anatomically as possible. If this is not achievable, reduction should be achieved at least in one plane. Reduction in the other plane may be achieved with the Gamma3 Long Nail during insertion.

Operative Technique

Special Techniques for Fracture Reduction

For specific situations, special techniques have been developed for fracture reduction, that are explained below.

To counter this misalignment, the trunk is turned to the opposite side and held in position by a thoracic rest or by a large drape. This tightens the gluteus medius muscles and relaxes the psoas, externally rotating the proximal fragment into alignment and exposing the trochanter for easier introduction of the nail. The fractured limb is kept straight, with the knee in flexion (Fig. 12), using the stirrup to avoid adduction. This position helps to align the distal portion. Reduction is confirmed in the AP view.

Subtrochanteric fractures cannot always be reduced during positioning in the lateral view, because the proximal fragment is drawn forward by tension from the psoas muscles. This may be reduced during surgery by using the Universal Rod (Fig. 12a).

Care must be taken when introducing the implant as the proximal fragment may rotate during insertion.



Fig. 12

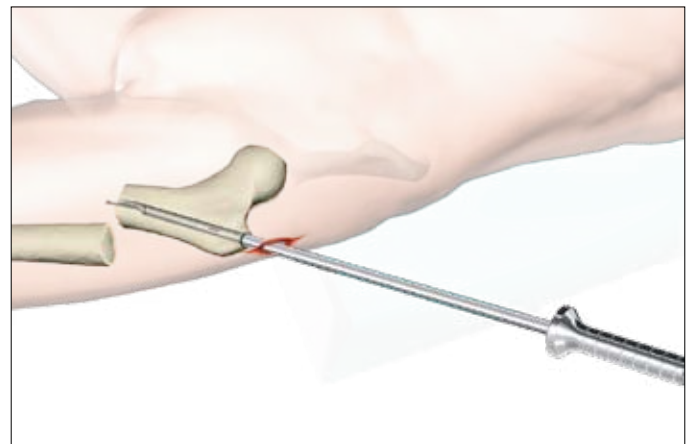


Fig. 12a

Operative Technique



Fig. 13

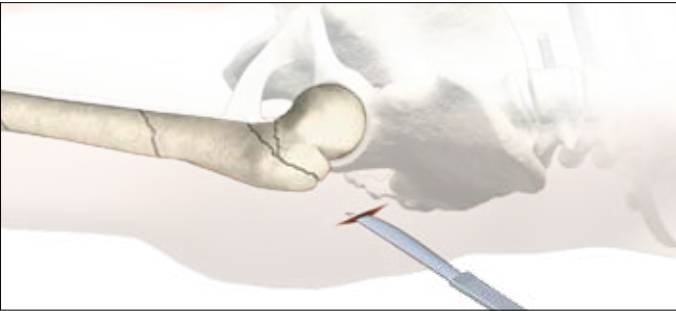


Fig. 14

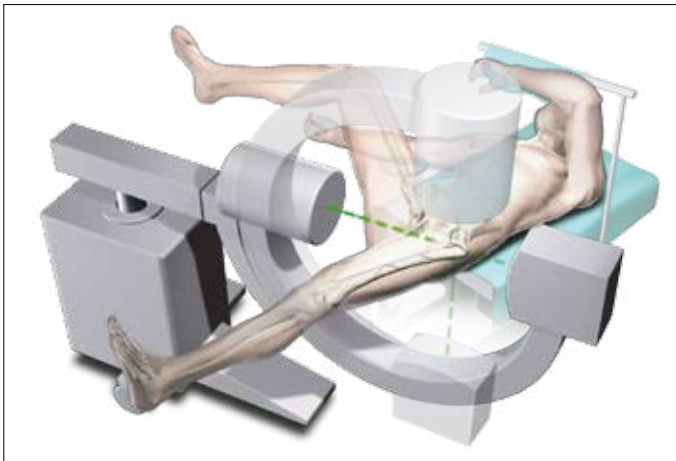


Fig. 15

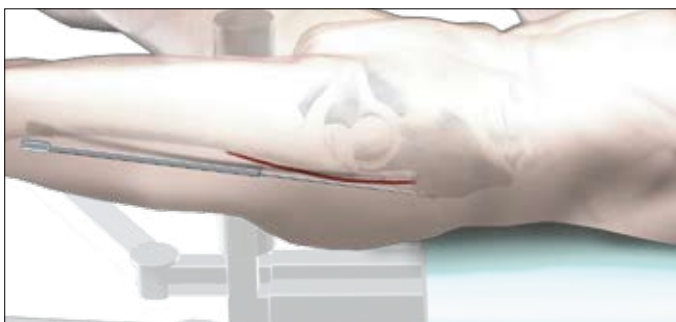


Fig. 16

Incision

Incisions may be developed in different manners. Two alternatives will be described below.

Alternative 1:

The tip of the greater trochanter may be located by palpation (Fig. 13) and a horizontal skin incision of approximately 2–3cm is made from the greater trochanter in the direction of the iliac crest (Fig. 14). In obese patients the incision length may need to be longer, depending on obesity of the patient.

A small incision is deepened through the fascia lata, splitting the abductor muscle approximately 1–2cm immediately above the tip of the greater trochanter, thus exposing its tip. A self-retaining retractor, or tissue protection sleeve is put in place.

Alternative 2:

A long and thin metal rod (e.g. Screw Scale, Long) is placed on the lateral side of the leg. Check with image intensifier, using l-m view, that the metal rod is positioned parallel to the bone in the center of the proximal part of the femoral canal (Fig. 16a). A line is drawn on the skin (Fig. 16).

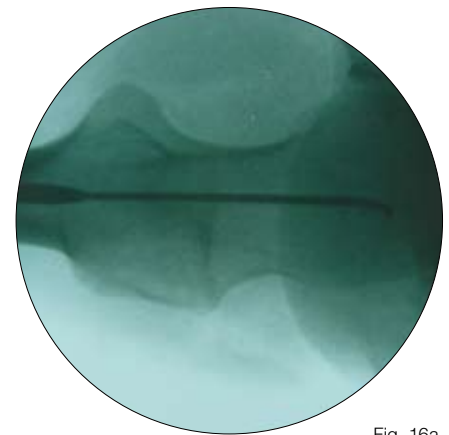


Fig. 16a

Operative Technique

The C-arm is turned approx. 90° to provide an A-P image of the tip of the trochanter using the metal rod as shown in Fig. 17 and 17a.

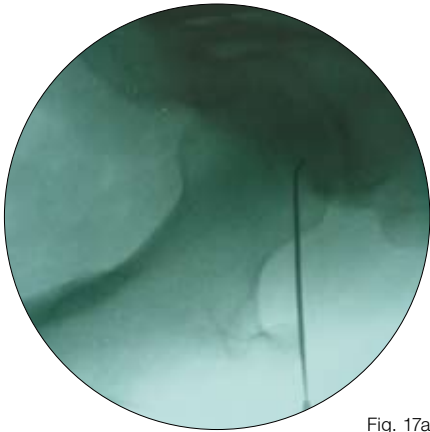


Fig. 17a

A vertical line is drawn onto the skin (Fig. 18). The intersection of the lines indicates the position for the entry point of the nail. This is usually the anterior third of the tip of the greater trochanter as shown in Fig. 22.

The skin incision is made cranially to the indicated intersection, following the sagittal line in cranial direction. The distance between the intersection and the starting point for the incision differs, depending on the obesity of the patient. Under normal conditions it is a distance of approximately 2 cm.

A small skin incision is made as described in Alternative 1 and shown in Fig. 20.

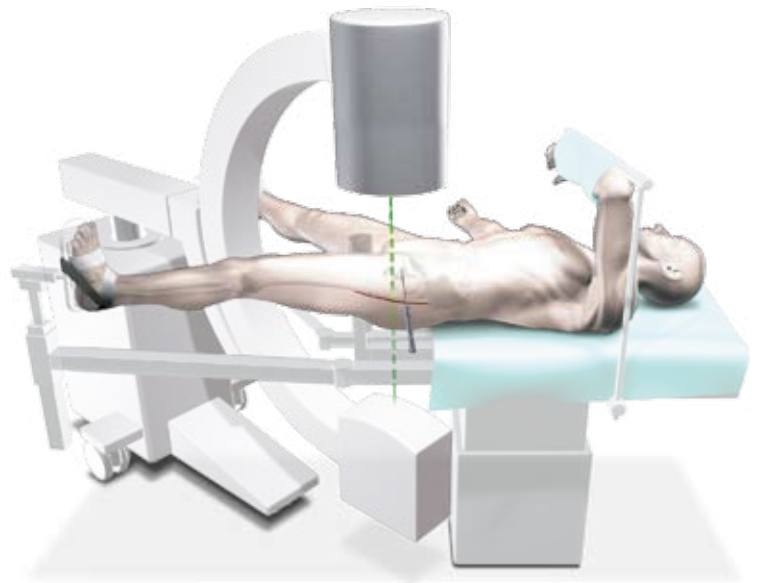


Fig. 17



Fig. 18



Fig. 19

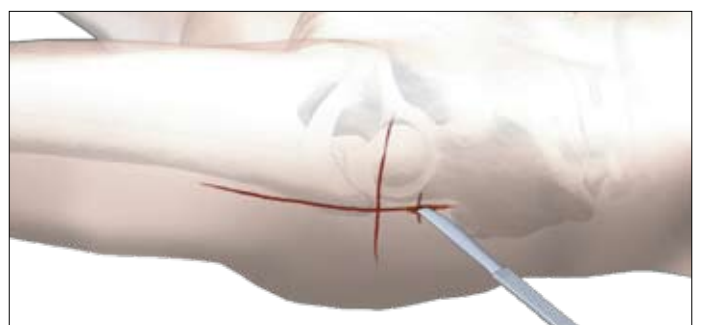


Fig. 20

Operative Technique



Fig. 21

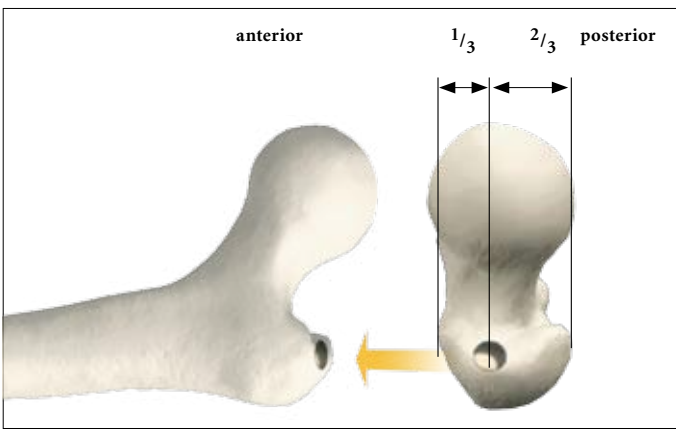


Fig. 22

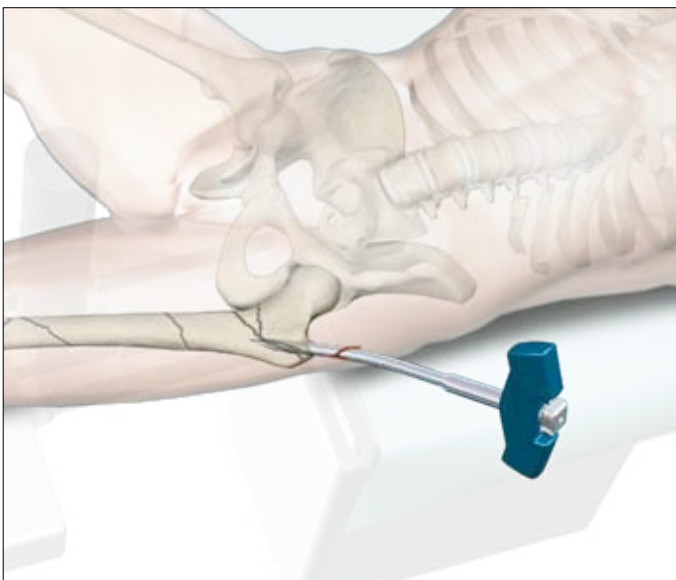


Fig. 23

Incision

Using a finger, the tip of the trochanter should be felt easily (Fig. 21).

Entry Point

The correct entry point is located at the junction of the anterior third and posterior two-thirds of the tip of the greater trochanter and on the tip itself (Fig. 22).

Preparation of the Medullary Canal

In order to prepare the medullary canal for the Gamma3 Long Nail, 3 possibilities are described in the next chapters.

Alternative 1: Opening the Cortex

The medullary canal has to be opened under image intensification. The use of the cannulated Curved Awl (Fig. 23) is recommended if conventional reaming or the One Step Conical Reamer will be used to prepare the canal for the nail.

Operative Technique

Reaming the Medullary Canal

A 3mm ball-tipped Guide-Wire is recommended as a reamer guide. Pass the reamer Guide Wire through the cannulated curved awl into the shaft of the femur as shown, using the Guide Wire Handle (Fig. 24).

Rotating the Guide Wire during insertion makes it easier to achieve the desired position in the middle of the medullary canal.

Flexible reamers are used to ream the shaft of the femur in stages starting from 9mm diameter and increasing in 0.5mm increments (Fig. 25). The canal should be reamed at least 2mm larger than the distal diameter of the nail, 13mm for the Gamma3 Long Nail (Fig. 26).

In order to accommodate the proximal part of the Gamma3 Long Nail, the subtrochanteric region must be opened up to 15.5mm (Fig. 27). This can be done either by reaming with the Stryker BIXCUT™ Reaming System (Fig. 25) or, alternatively, with the One Step Conical Reamer. For soft tissue protection, the Conical Reamer Sleeve should be used during reaming.

Care must be taken with flexible reamers to ensure that the Guide-Wire is not displaced laterally during reaming. This could lead to resection of more bone on the lateral side, which in turn would lead to an offset position for the nail and a risk of shaft fracture.

Note:

Where the shaft is comminuted, reaming should be stopped at the fracture site and penetration continued with the power drill off.

Bixcut Reamer

The complete range of Bixcut™ reamers is available with either modular or fixed heads.

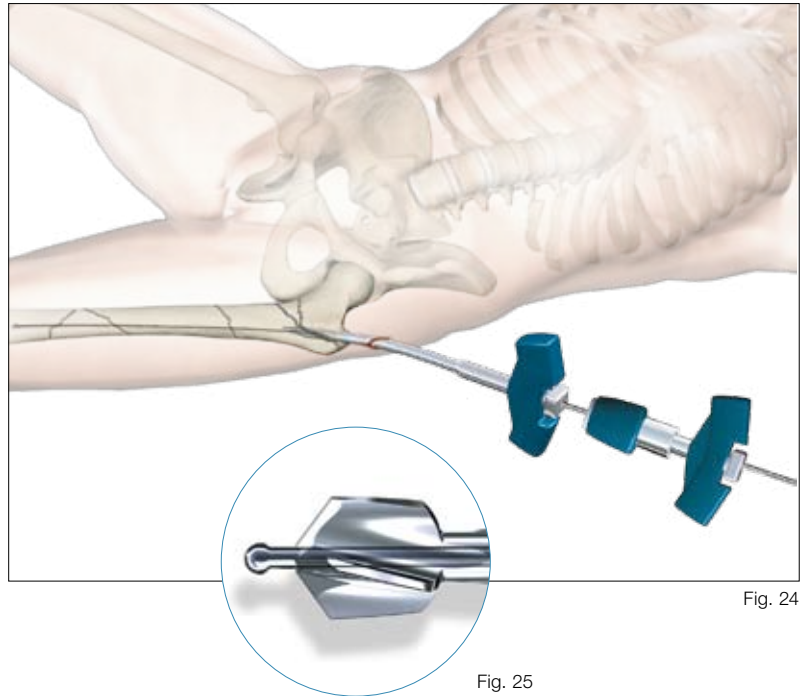


Fig. 24

Fig. 25

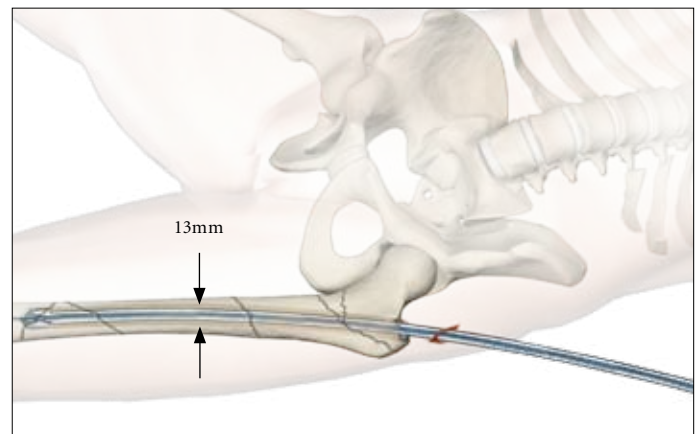


Fig. 26

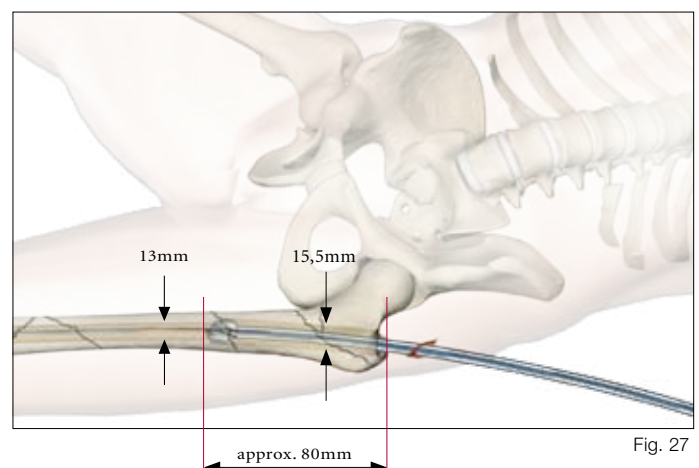


Fig. 27

Operative Technique

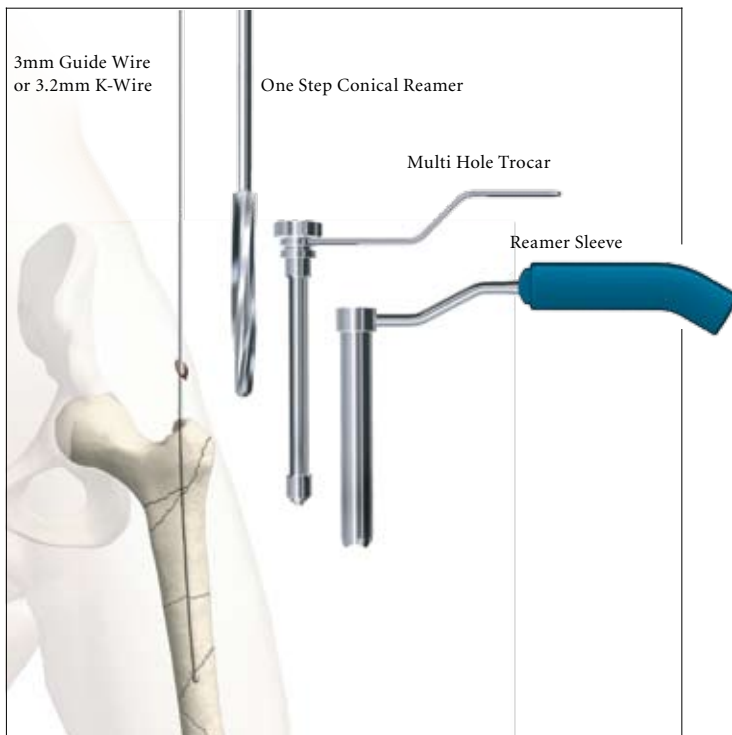


Fig. 28

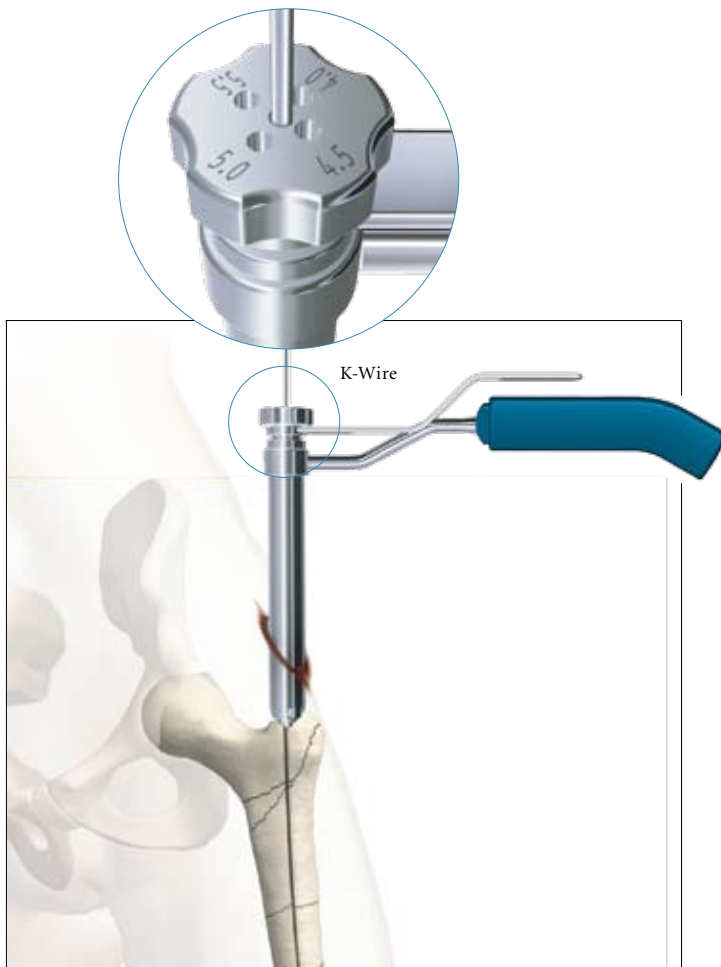


Fig. 29

Alternative 2: One Step Conical Reamer

The One Step Conical Reamer is an optional instrument and has been developed to provide surgeons with another option to prepare the proximal canal of the trochanter using only one drilling step.

Using Gamma3 Long Nails, it is recommended to ream the medullary canal all the way down to the condyle area, at least up to a diameter of 13mm.

After skin incision and positioning of the Guide Wire as described above, the Trocar or Multi Hole Trocar is inserted into the Reamer Sleeve to protect the soft tissue during insertion. Push the Trocar (use center hole, if Multi Hole Trocar is used) and Sleeve Assembly down over the 3mm Guide Wire to the tip of the trochanter (Fig. 28 and 29).

Entry Point Optimization

The Entry Portal can also be made without using the awl. A 3.2mm K-Wire is placed through the tip of the trochanter.

If you find that the K-Wire is not positioned in the optimal position, it may easily be corrected using a second K-Wire in combination with the Multi Hole Trocar.

The Multi Hole Trocar has a special design for more precise insertion. In addition to the central hole, 4 other holes are located eccentrically at different distances from the center (Fig. 29) to easily revise insertion of the guiding K-Wire in the proper position (Entry Point).

Operative Technique

The Trocar is then removed and the One Step Conical Reamer is connected to the T-handle and slid over the Guide or K-Wire to the tip of the trochanter. With gentle clockwise turning and pushing movements, the Conical Reamer will drill into the proximal part of the trochanter (Fig. 30 and 31) and prepare the canal for the proximal part of the Gamma3 Nail. The One Step Conical Reamer stops when the correct depth is reached.

Note:

The One Step Conical Reamer is a front and side cutting instrument and should be used with great care to ensure that the sharp edges of the reamer do not damage intact bone inadvertently.

If a 3.2mm K-Wire was used it should be replaced by a Guide Wire afterwards.

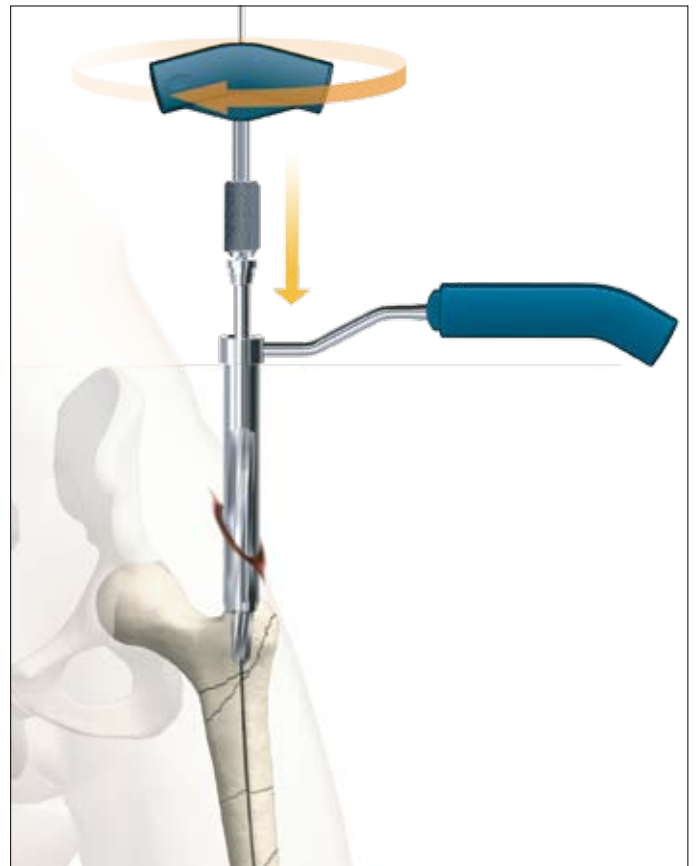


Fig. 30

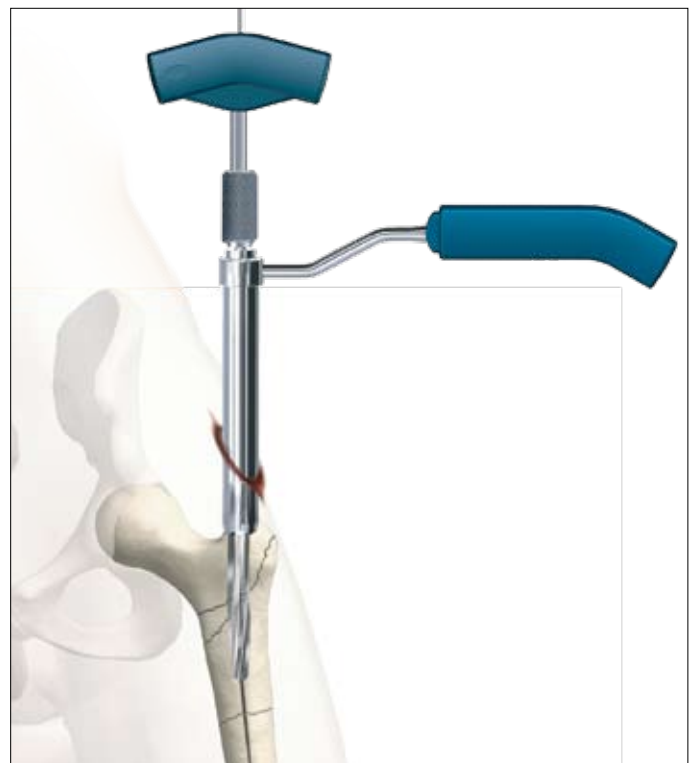


Fig. 31

Operative Technique



Fig. 32

Alternative 3: Cannulated Cutter

Opening the cortex

The Cannulated Cutter is a front cutting device used to prepare the proximal part of the femur for the Gamma3 Long Nail.

It provides surgeons with an advanced option to open the proximal femur cavity without reaming. Especially in older patients it may reduce the requirement for reaming of the femoral cavity. For the Long Nail, it is recommended to ream the complete femur all the way down to the condyle area up to a diameter of at least 13mm.

The Cannulated Cutter is guided over a solid 4mm Guide Pin. The fixation of this Guide Pin in the bone allows for an optimal placement for the Cannulated Cutter.

This device allows for easy collection of bone graft material which might be helpful in difficult healing conditions.

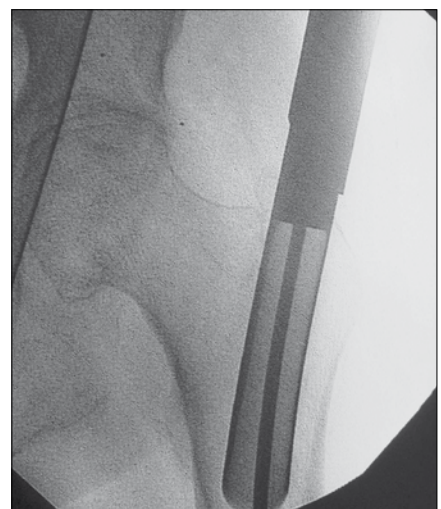
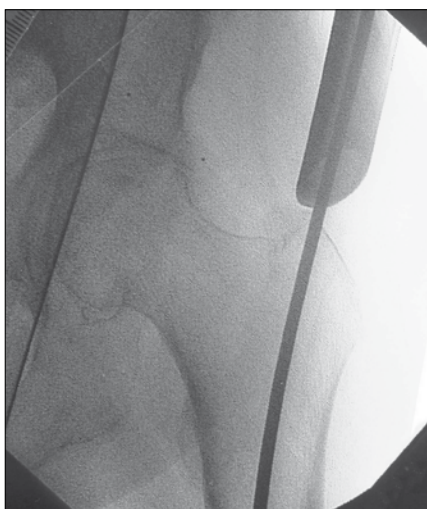


Fig. 33

Operative Technique

Assembly of Targeting Device

1. Targeting Sleeve and Knob Assembly

First assemble the Knob to the Targeting Sleeve (Fig. 34) and adjust the point on the Knob to be in line with the arrow on the Targeting Sleeve. Push the knob hard against the sleeve (Fig. 34a). The Knob moves approximately 5mm to the sleeve and has to be turned clockwise by approximately 30 degrees. Release the Knob and it will slip back the same distance. Now the Knob is assembled to the Targeting Sleeve and has to be connected to the Targeting Arm (Fig. 34b).

2. Targeting Arm and Targeting Sleeve Assembly

Slide the Sleeve assembly over the Targeting Arm along the line until it stops (arrow line to arrow line).

Rotate the Targeting Sleeve around to the required nail angle position for the Lag Screw, e. g. 125° (point to point) or distal locking positions, either “Dynamic” or “Static”. Now the Targeting Sleeve must be fixed in this position by pushing it strongly against the Targeting Arm. You will feel and hear, as the sleeve snaps into position.

The Knobs only function is to lock the Lag Screw Guide Sleeve and the Tissue Protection Sleeve.

Note:

The Knob has to be assembled first to the Targeting Sleeve (Fig. 34a), otherwise the locking function of the sleeve may not work properly.

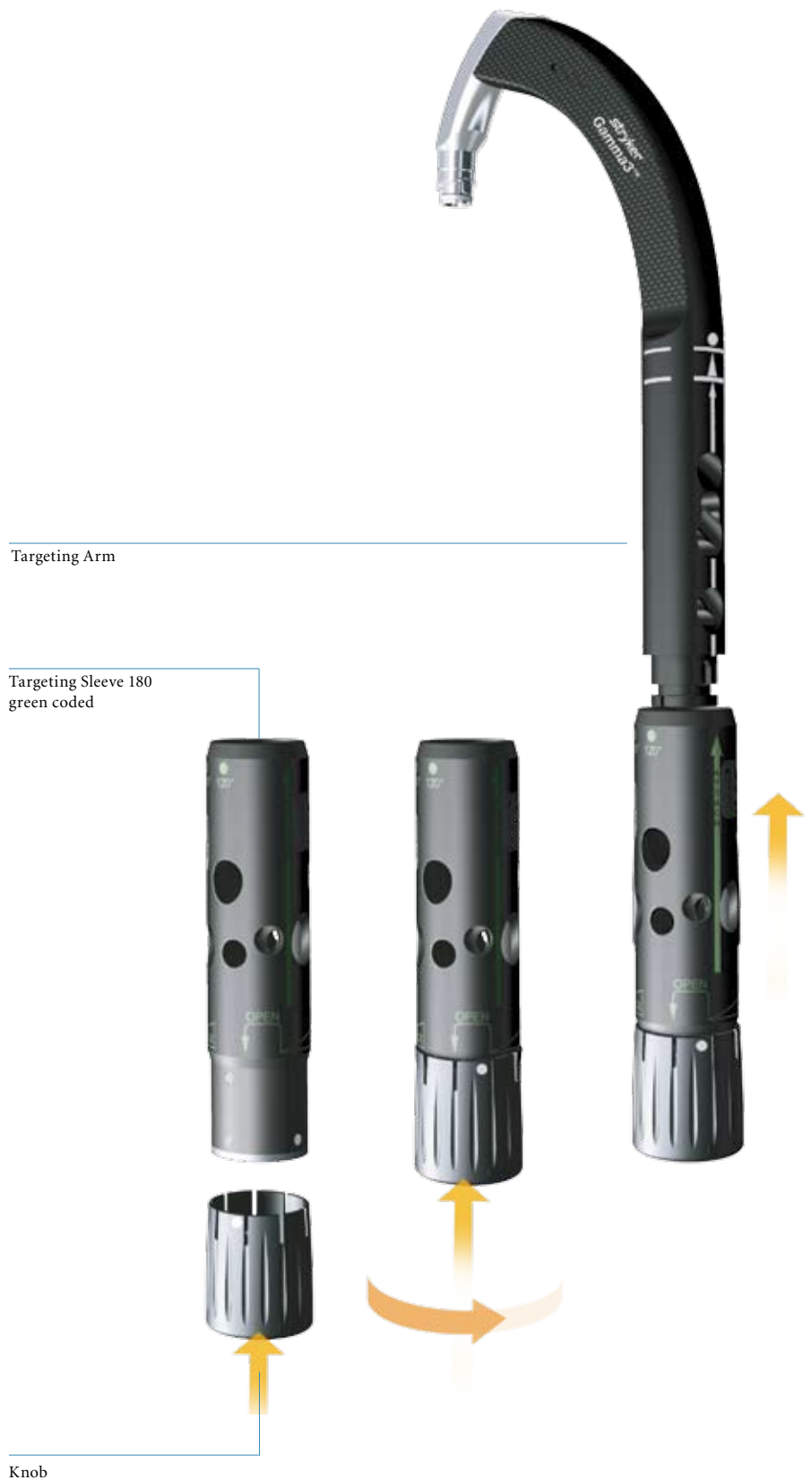


Fig. 34

Fig. 34a

Fig. 34b

Operative Technique



3. Assembly of the Targeting Device and the Gamma3 Long Nail

The selected Gamma3 Long Nail is now assembled to the Carbon Fibre Targeting Device as shown in Figure 35. The nail connecting part of the Targeting Device is designed with an easy assembly function for fast and secure nail fixation.

Ensure that the locating pegs fit into the corresponding notches of the proximal part of the nail.

Fully tighten the Nail Holding Screw with the Ball Tip Screwdriver, so that it does not loosen during nail insertion.

Before starting surgery the following two functions of the Targeting Device have to be checked:

1. Secure fixation between Nail and Targeting Device
2. Lag Screw Guide Sleeve matches the selected nail angle.

Fig. 35
Gamma3 Long Nail Assembly

Operative Technique

Before checking the function of the Lag Screw Guide Sleeve, the Knob must be positioned in the counter clockwise position. Pass the Lag Screw Guide Sleeve gently through the hole of the Targeting Sleeve and tighten it gently in its final position by turning the Knob clockwise. Check correct nail angle using the K-Wire, 4.2mm Drill or Lag Screw Step Drill (Fig. 36). Remove the Lag Screw Guide Sleeve by turning the Knob counter clockwise and pulling the sleeve back.

Note:

Before starting surgery, the implant and instrument assembly has to be checked. Ensure that the Targeting Sleeve angle matches the corresponding nail angle chosen, e. g. a 125° Targeting Sleeve for a 125° nail (Fig 36).



Fig. 36

Operative Technique



Fig. 37

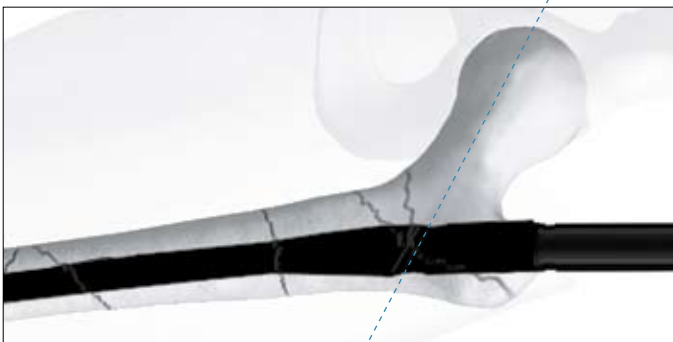


Fig. 38

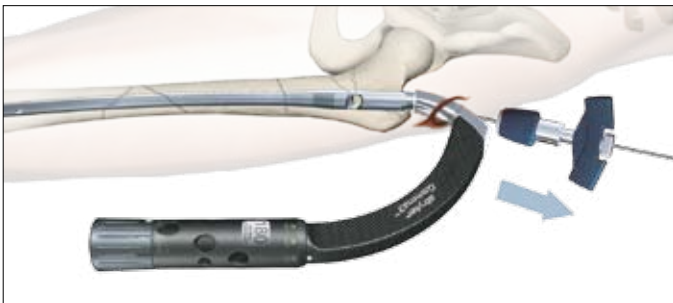


Fig. 39



Fig. 40



Fig. 41

Nail Insertion and Positioning

Insert the Gamma3 Nail by hand (Fig. 37).

DO NOT use undue force – NEVER use a hammer for nail insertion.

The final nail depth is monitored with the image intensifier; the axis of the Lag Screw may be projected with a ruler on the monitor screen to ensure that the Lag Screw is placed in the optimal position.

Proceed until the axis of the Lag Screw hole (visible as a crescent shape on the screen) is aligned with the lower half of the femoral neck (Fig. 38). The objective of this is to ultimately position the Lag Screw slightly inferior in the femoral head in the frontal plane.

Note:

Make sure to remove the Guide Wire using the Guide Wire Handle (Fig. 39).

When the Gamma3 Nail has been inserted to its final depth, check the anteversion of the nail. Use of the K-Wire Clip (Fig. 40) or the “One Shot Device” is recommended (see next page).

Lag Screw Positioning using the K-Wire Clip

The K-Wire Clip is mounted in the slots of the Targeting Arm by pressing the Clip flanges together.

Using image intensification of the lateral view, the projection of the U-Wire on the bone shows the A-P positioning of the Lag Screw. The Lag Screw should be placed in the central position of the femoral head (Fig. 41).

Before proceeding ensure that the Nail Holding Screw is still fully tightened.

Operative Technique

Lag Screw Positioning using the One Shot Device

The One Shot Device is recommended for optimal Lag Screw placement:

The One Shot Device is recommended for verifying that the Lag Screw is placed in its optimal position. This device enables correct positioning of the K-Wire for Lag Screw placement before performing lateral skin incision and opening of the lateral cortex. Figures 42–43a give an overview of the working principle of the One Shot Device.

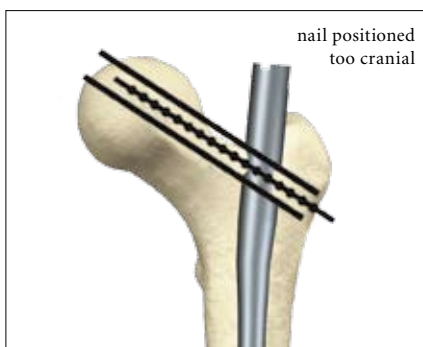
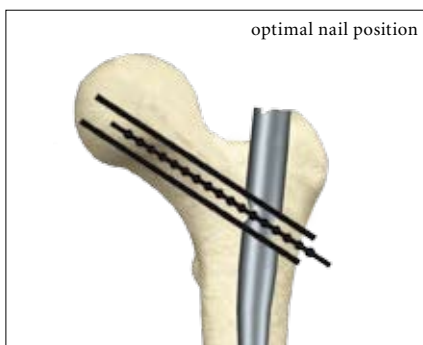
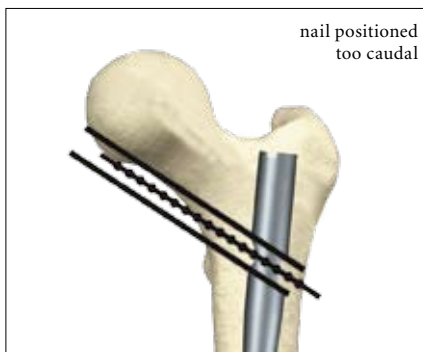


Fig. 42a
A/P view

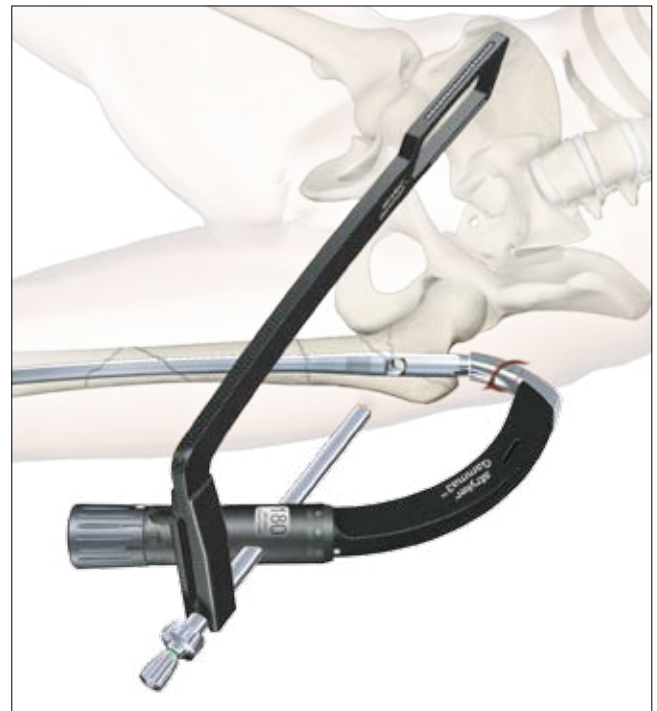
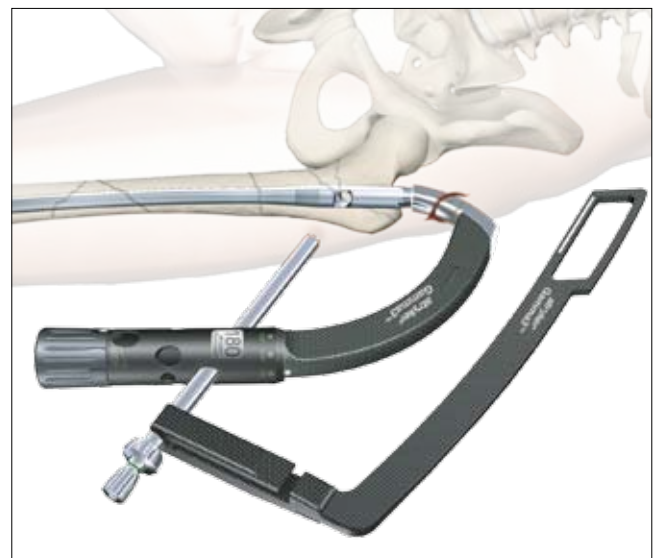


Fig. 42



Positioning of anteversion

Fig. 43



Fig. 43a
Lateral view

Operative Technique

Lag Screw Insertion

The Targeting Device may be held by an assistant to prevent it from externally rotating the nail until the next stage is completed.

Next, assemble the Lag Screw Guide Sleeve and the green coded 4.2mm Lag Screw Drill Guide Sleeve and pass them through the Targeting Sleeve to the level of the skin. At the point of contact, perform a small incision down to the bone (Fig. 44). The Guide Sleeve assembly is then advanced through the incision. If the sleeves catches the fascia lata, twisting it will usually allow it to pass through to the bone.

In order to assure accurate Lag Screw length measurement, the outer Guide Sleeve must be in good contact to the lateral cortex of the femur (Fig. 45). The Knob of the Target Sleeve must be turned gently clockwise to lock the Guide Sleeve in place and further stabilize the targeting assembly.

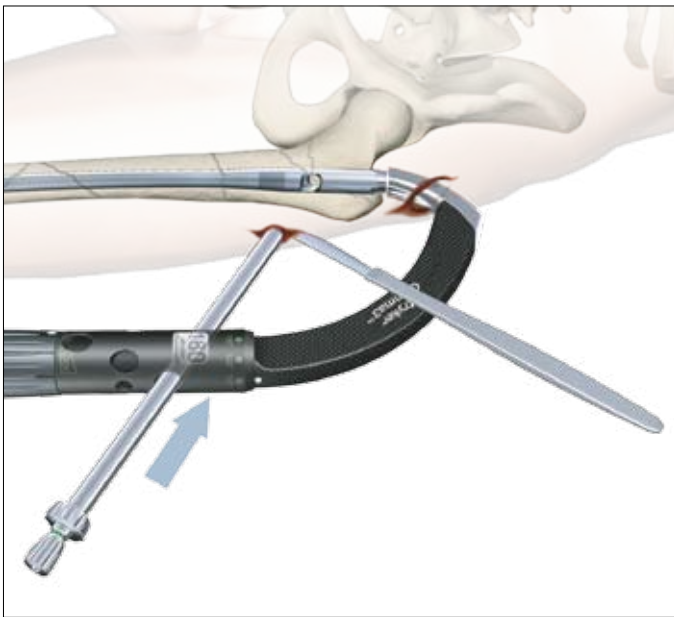


Fig. 44

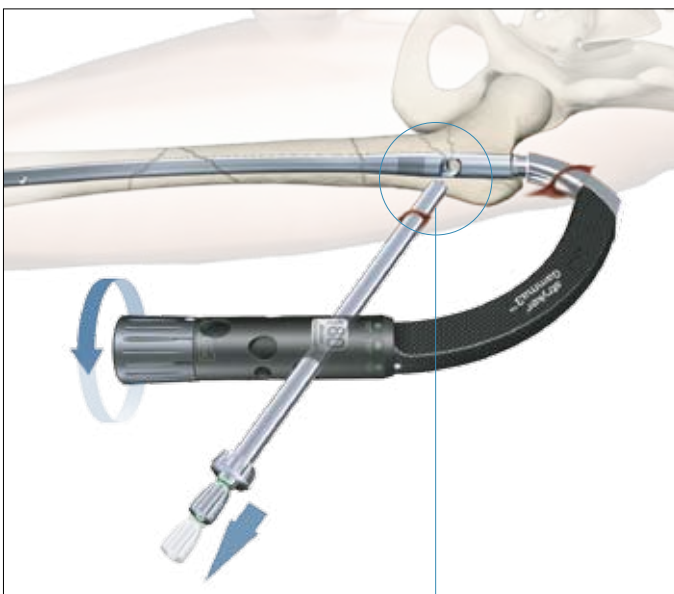
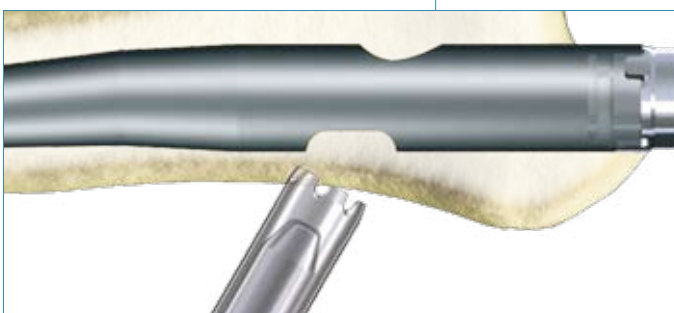


Fig. 45



Lag Screw Guide Sleeve in good contact to the lateral cortex

Operative Technique

With the Lag Screw Guide Sleeve firmly engaged in the cortex, the green coded 4.2mm Lag Screw Drill Guide Sleeve should be pushed gently against the cortex. Using the green coded 4.2mm × 300mm center tipped drill, the lateral cortex should be opened by power tool or by hand (Fig. 46).

The green coded 4.2mm Lag Screw Drill Guide Sleeve is then replaced by the K-Wire Sleeve.

Both sleeves look similar but have different inner hole diameters. The K-Wire Sleeve has no colored ring.



Note:
Before proceeding, check that the Guide Wire for the flexible reamer and nail insertion used earlier has been removed.

The single use K-Wire inserted through the K-Wire Sleeve should be advanced up to the subchondral bone (Fig. 48), using the Guide Wire Handle. Check that the K-Wire is placed in the lower half of the femoral head in the frontal plane and on the midline in the lateral plane (Fig. 48).

Check the position with the image intensifier in both the anterior-posterior and mediolateral views as shown in Figure 38 to ensure optimal K-Wire positioning.

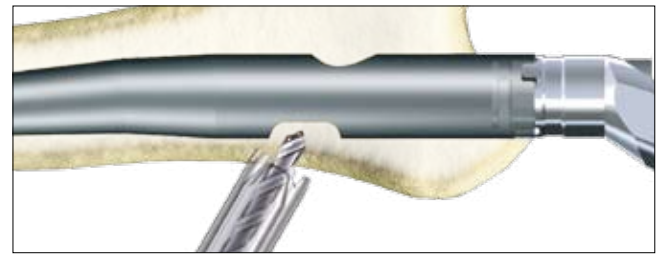


Fig. 46
Opening of the lateral cortex

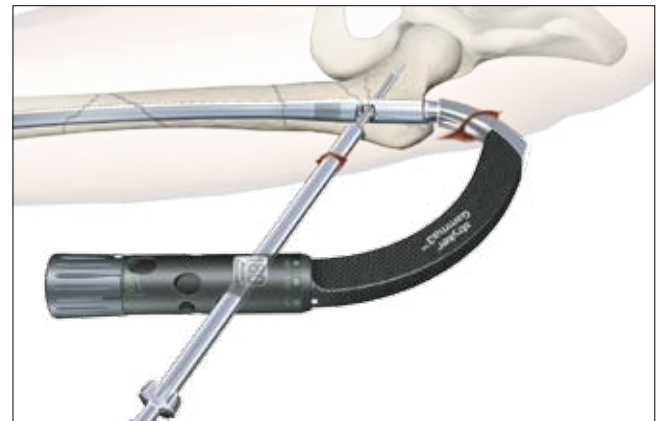


Fig. 47
K-Wire placement

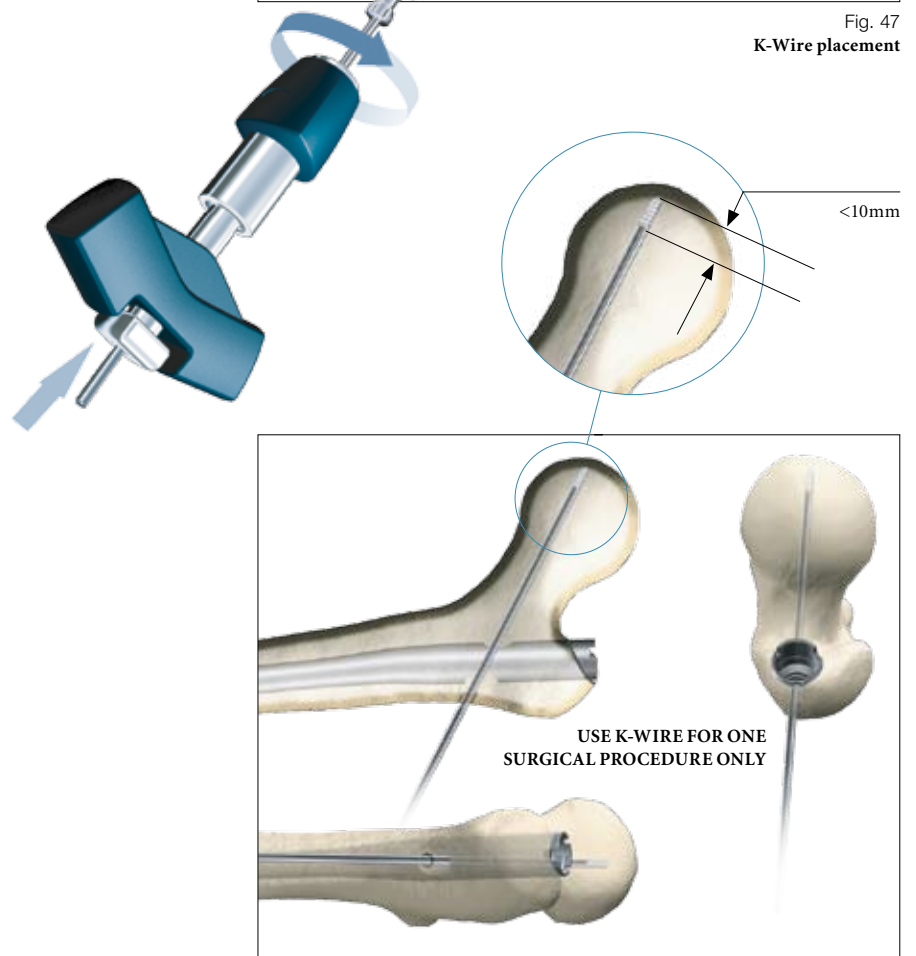


Fig. 48
K-Wire placement

Operative Technique

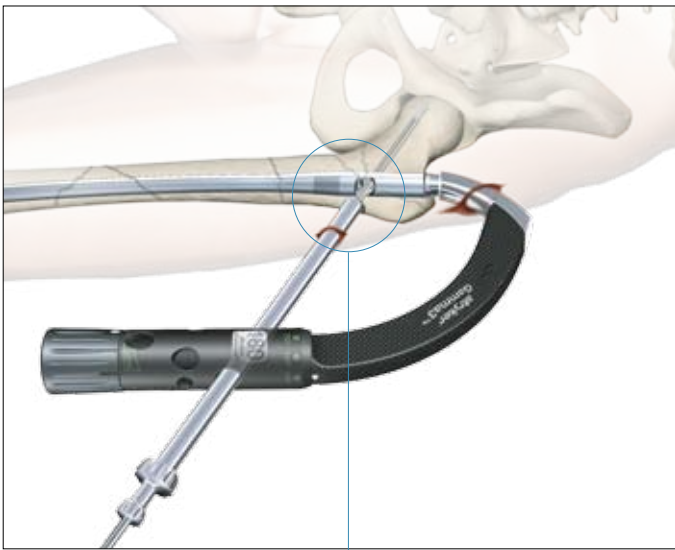


Fig. 49
Lag Screw length measurement

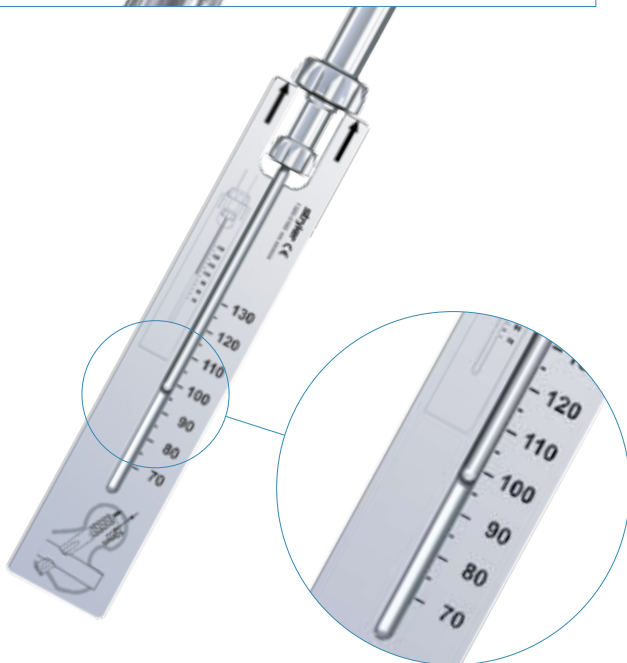
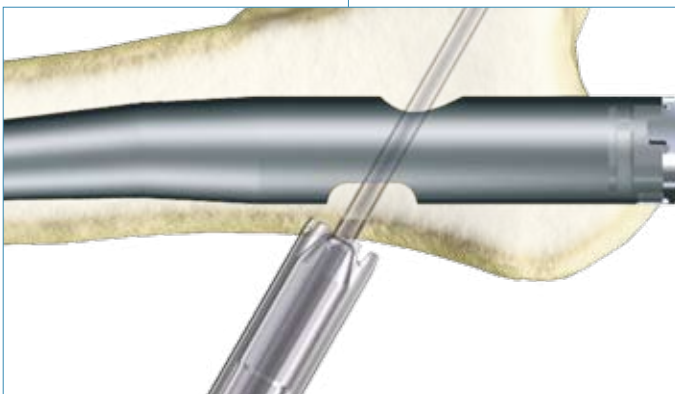


Fig. 50
Lag Screw Length Measurement

Lag Screw Insertion

The objective is to position the Lag Screw below the center of the femoral head in the anterior-posterior view and centrally in the lateral view, to provide the best load transfer to the Lag Screw.

After satisfactorily positioning the K-Wire, the required Lag Screw length is measured using the Lag Screw Ruler.

Before starting to measure, ensure that the Lag Screw Guide Sleeve is still pressed firmly against the lateral cortex of the femur (Fig. 49).

Place the Lag Screw Ruler directly under the K-Wire (Fig. 50).

The recommended value for the Step Drill depth and the Lag Screw length can be read directly off the Lag Screw Ruler. If the value is between markings on the scale, e. g. 97mm, it should always be rounded up to the next higher value, e. g. 100mm.

Note:

K-Wires are not intended for re-use. They are single use only. K-Wires may be damaged or bent during surgical procedures. If a K-Wire is re-used, it may get lodged in the drill and could be advanced into the pelvis during the following steps of the procedure. This may damage large blood vessels or cause other serious injuries.

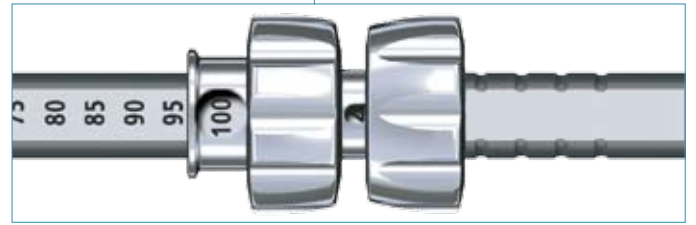
Operative Technique



Fig. 51

The value of the measurement (Fig. 50) is now transferred to the adjustable stop on the Lag Screw Step Drill.

The value e.g. 100 must be visible in the window of the Step Drill Stop (Fig. 51).



Window of the Step Drill Stop

The K-Wire Sleeve is now removed and the adjusted Lag Screw Step Drill is passed over the K-Wire (Fig. 51a), through the Lag Screw Guide Sleeve.

The channel for the Lag Screw is prepared using the T-handle connected to the Lag Screw Step Drill. If exceptional resistance is encountered, a power drill may be used with great care.

Drilling should continue until the stop of the Step Drill comes into contact with the Lag Screw Guide Sleeve (Fig. 51a). Ensure that the Targeting Device is well supported to prevent it from slipping back or rotating.

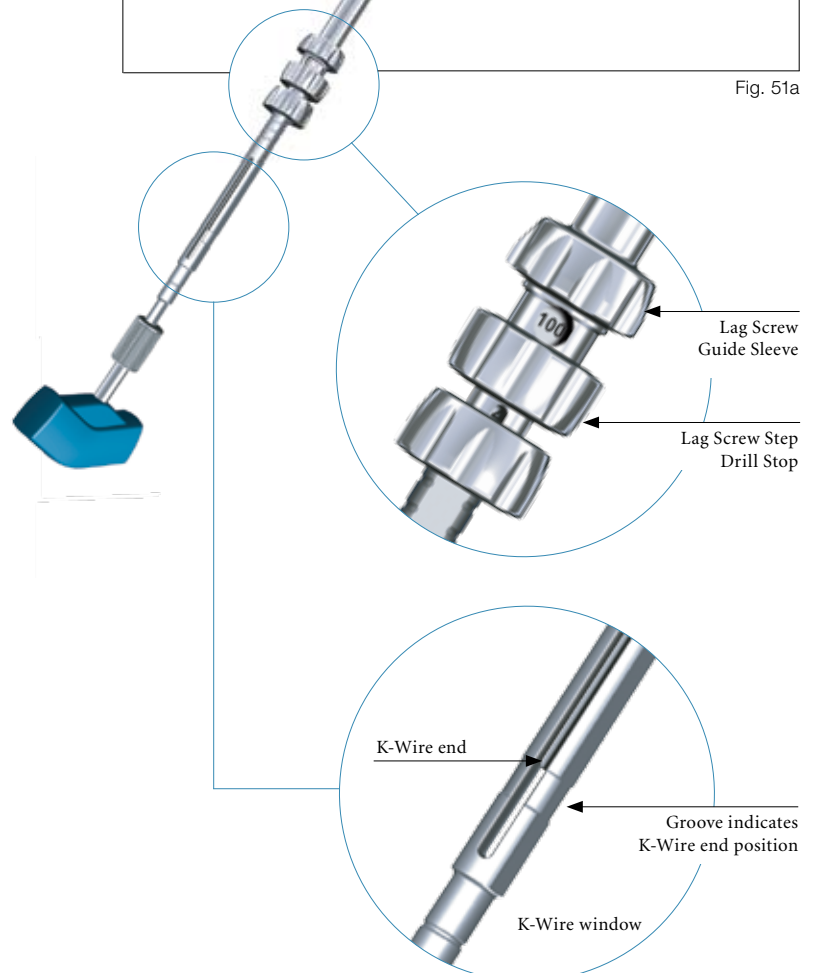


Fig. 51a

The drilling process, especially when the tip of the drill comes close to its final position in the femoral head, should be controlled under an image intensifier to avoid hip joint penetration. The K-Wire can also be observed in the K-Wire window of the Step Drill.

Note:

It is important to observe the K-Wire tip during drilling on the intensifier. The K-Wire window provides an additional possibility to double check the K-Wire end position. Ensure that under no circumstances the K-Wire is advanced into the pelvis.



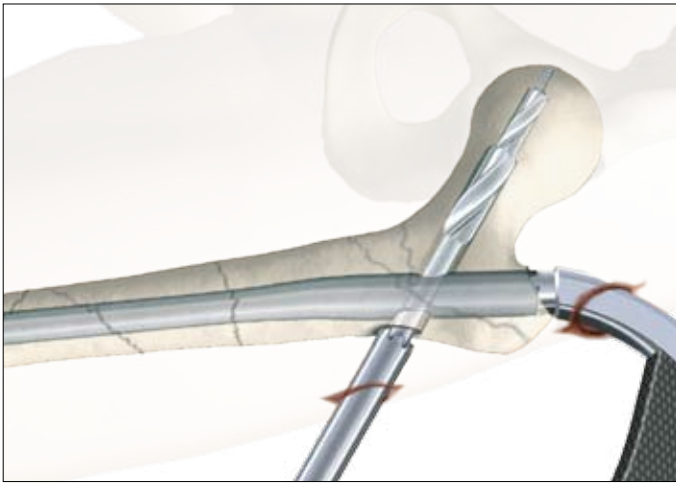


Fig. 52

Lag Screw Insertion

During drilling, monitor the depth of the drill near the subchondral bone on image intensification. At this stage, you should see the tip of the K-Wire protruding about 6 to 10mm out of the step drill (Fig. 52) because the threaded portion of the K-Wire was intentionally not included in the drill measurement. This is to prevent the drill from penetrating the joint and to ensure that the K-Wire remains anchored in the subchondral bone after reaming. Remove the Step Drill by turning it clockwise and pulling it backwards.

The length of the Lag Screw chosen should be the same as that of the Step Drill (in this example 100mm). The screw is then assembled to the Lag Screwdriver (Fig. 53).

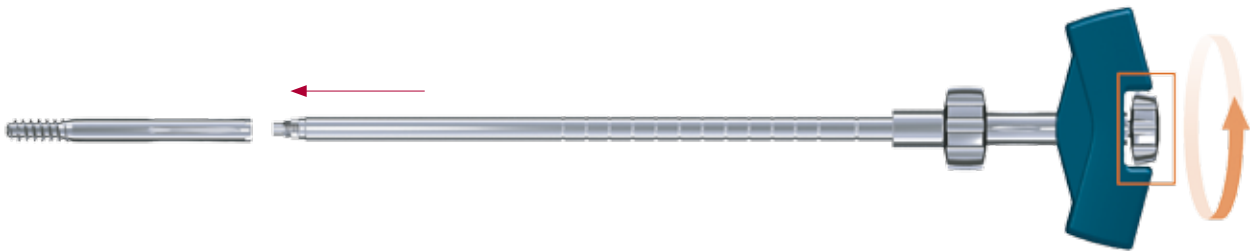


Fig. 53

Lag Screw and Lag Screwdriver assembly

In a case where compression is to be applied, a shorter Lag Screw length should be chosen to avoid the Lag Screw sticking out too far out of the lateral cortex (see chapter Compression/ Apposition below). Ensure that the pegs of the Lag Screwdriver are in the notches of the Lag Screw. The thumbwheel of the handle must be turned clockwise and finally tightened using the Ball Tip Screwdriver.

The Lag Screw assembly is now passed over the K-Wire, through the Lag Screw Guide Sleeve and threaded up to the end of the predrilled hole into the femur head. Check the end position of the Lag Screw on the image intensifier. A double check of the end position is also possible with the indicator ring on the Lag Screw Screwdriver. The final position is obtained when the indicator ring reaches the end of the Lag Screw Guide Sleeve.

Operative Technique

Lag Screw Fixation

The handle of the Lag Screwdriver must be either parallel or perpendicular (90°) to the Targeting Arm (Fig. 55 on next page) to ensure that the Set Screw is able to fit into one of the four grooves of the Lag Screw shaft.

The Set Screw alignment indicator will help to find the right position of the handle.

If the T-handle is not perpendicular or parallel to the Targeting Arm, turn it clockwise until it reaches this position. NEVER TURN THE LAG SCREW COUNTER CLOCKWISE.

If the K-Wire is inadvertently removed, the screw may still be inserted without it, provided that the Guide Sleeve is still in contact with the cortex.

Note:

It is strongly recommended to place the Lag Screw at the end of predrilled hole in order to provide maximal resistance against cut out. Never turn the Lag Screw counter clockwise after the final position is reached because otherwise the Lag Screw may lose full bony surface contact to its tip.

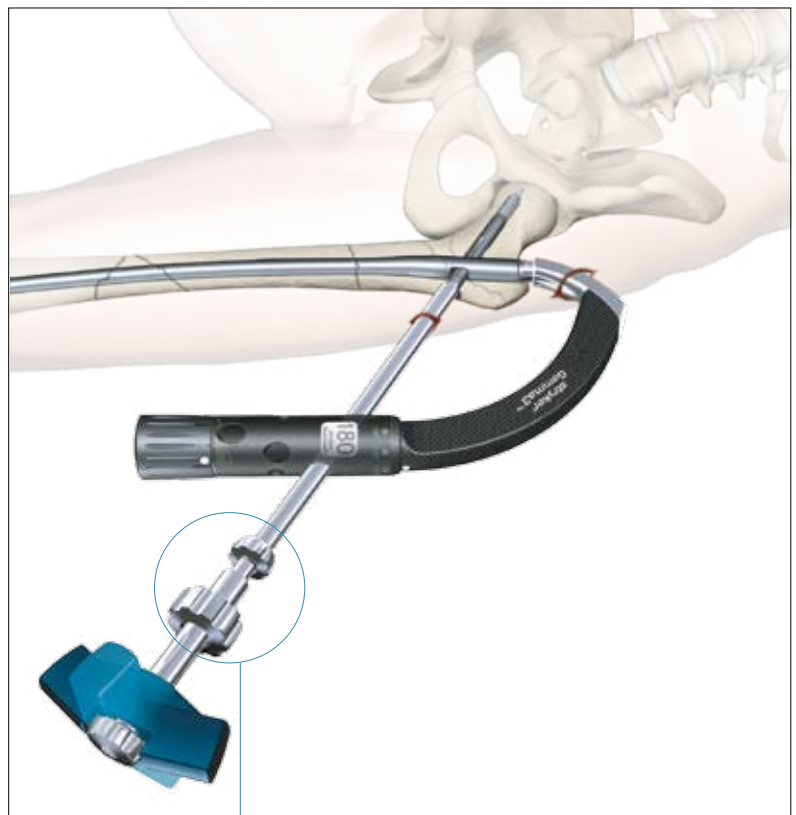
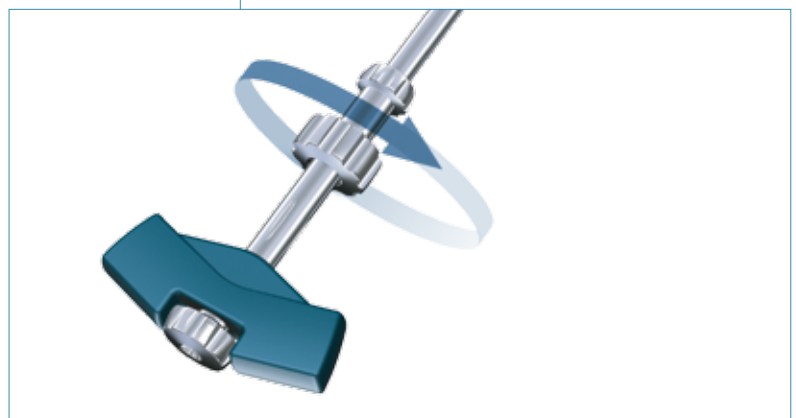


Fig. 54

Compression/ Apposition

If compression or apposition of the fracture gap is required, this can be achieved by gently turning the thumbwheel of the Lag Screwdriver clockwise against the Guide Sleeve (Fig. 54). Before starting compression, make sure that the Lag Screw Guide Sleeve is unlocked to allow its free sliding. To unlock the Lag Screw Guide Sleeve, the Knob of the Target Device has to be turned counter clock-wise. In osteoporotic bone care must be taken to prevent Lag Screw pullout in the femoral head. The Lag Screw should be chosen shorter depending on the expected amount of compression.



Compression / Apposition turning the thumbwheel clockwise.

Operative Technique

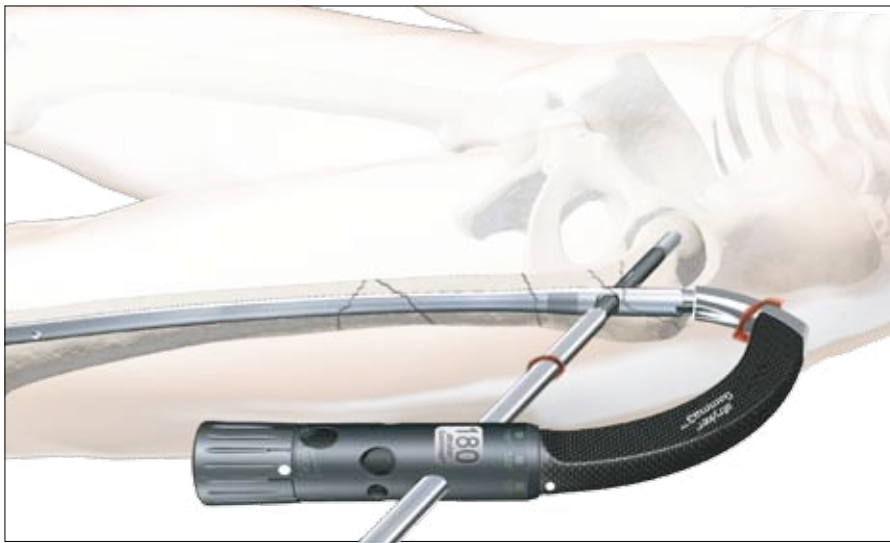


Fig. 55
T-handle end position

Lag Screw Fixation

Note:

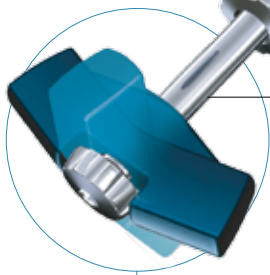
The Set Screw must be used.
The use of the Set Screw is not an option.

Assemble the Set Screw to the Set Screw Driver. Insert the Set Screw as shown in Figure 56 along the opening of the post of the Targeting Device and advance it through the Nail Holding Screw.

Push the Set Screw Driver down until you are sure, that the Set Screw engages the corresponding thread in the nail. During pushing down the assembly, you may feel a slight resistance.

Turn the Screwdriver handle clockwise under continuous pressure. You may notice a slight resistance when turning the Set Screw. This is because the Set Screw thread is equipped with the “Nylstop” system to prevent spontaneous loosening.

This is not the final position for the Set Screw.
Keep on turning the Set Screw until you feel contact in one of the grooves of the Lag Screw.



Set Screw Alignment Indicator

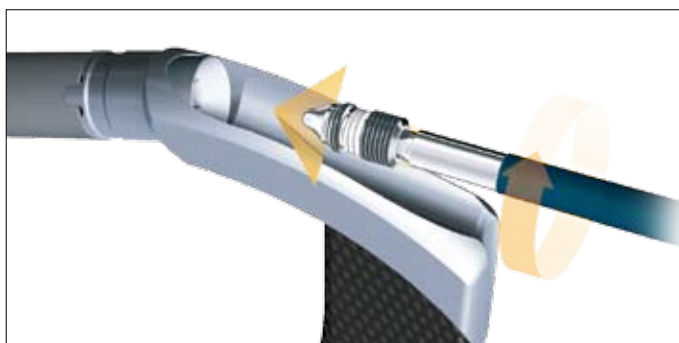
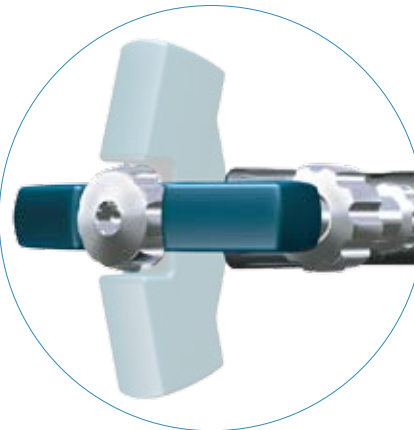


Fig. 56
Set Screw insertion

Operative Technique

To verify the engagement the Set Screw in a groove of the Lag Screw, try to turn the Lag Screwdriver gently clockwise and counter-clockwise. If it is not possible to turn the Lag Screwdriver the Set Screw is engaged in one of the grooves. If the Lag Screw Driver still moves, reconfirm the T-handle position and tighten the Set Screw again until it engages in one of the four Lag Screw grooves.

After slightly tightening the Set Screw, **it should then be unscrewed by one quarter ($\frac{1}{4}$) of a turn**, until a small play can be felt at the Lag Screwdriver. This ensures a free sliding of the Lag Screw.

Make sure that the Set Screw is still engaged in the groove by checking that it is still not possible to turn the Lag Screw with the Lag Screwdriver.

Note:

Do not unscrew the Set Screw more than $\frac{1}{4}$ of a turn.

If distal locking is not indicated, the End Cap should be assembled to the nail end to prevent bone ingrowth. Leaving the Lag Screwdriver in place, the Nail Holding Screw is now removed using the Ball Tip Screwdriver, Universal Socket Wrench or Spreading Screwdriver and turning it counter clockwise. Insert the End Cap (size 0) using the Socket Wrench, Spreading Screwdriver or the Ball Tip Screwdriver. The End Cap should be tightened slightly.

Please see “End Cap Insertion” chapter.

Alternatively the End Cap could also be inserted free hand after removal of the Target Device.

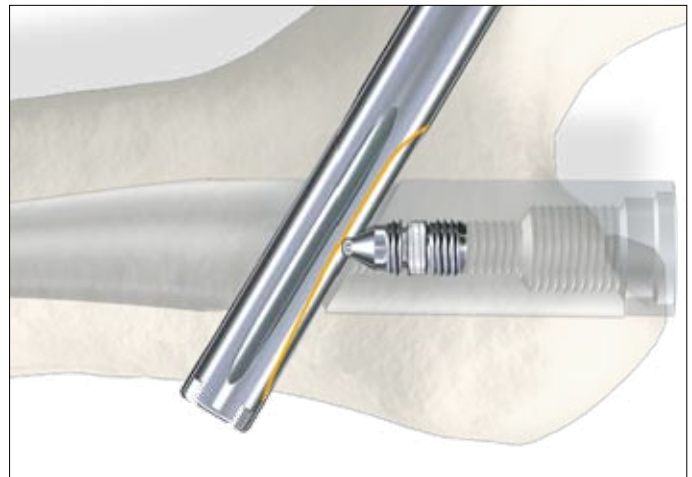


Fig. 57

Operative Technique

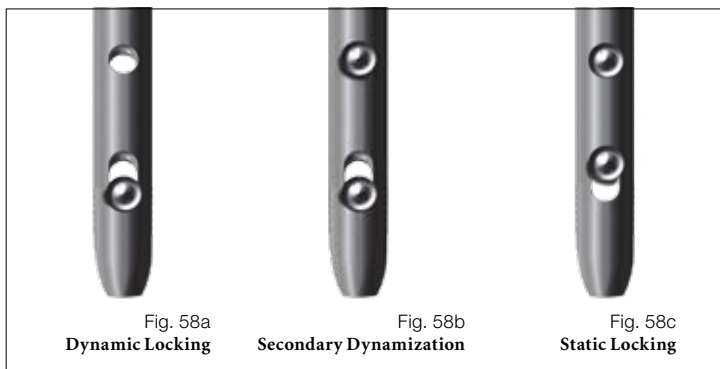


Fig. 58

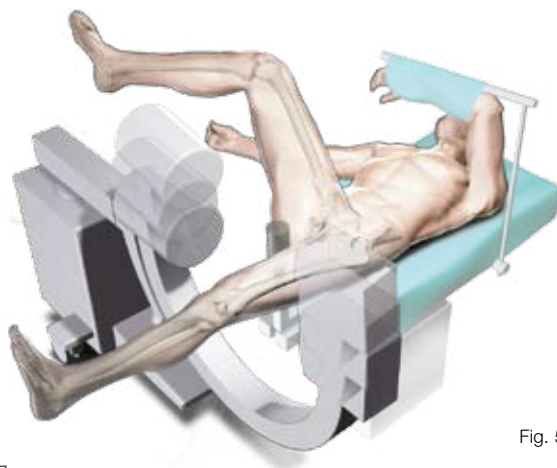


Fig. 59

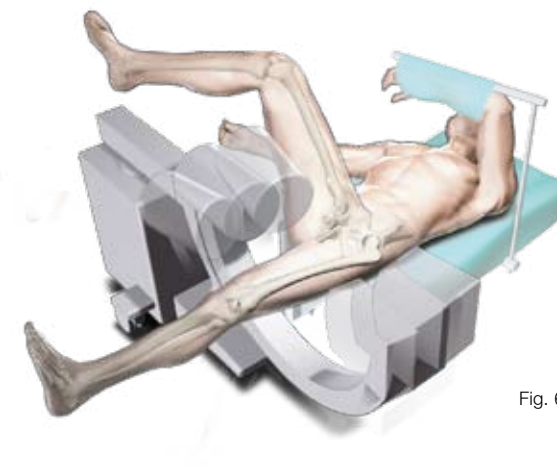
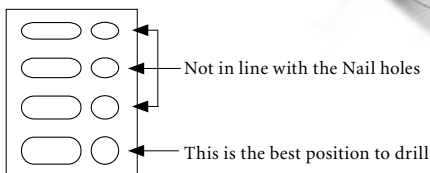
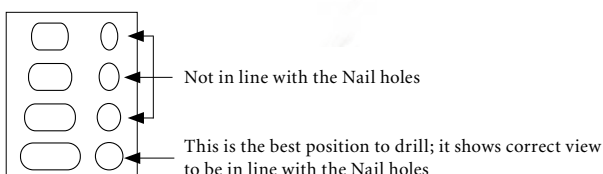


Fig. 60



Distal Screw Locking

Gamma3 Long Nails offer the possibility to be locked distally. For distal locking, the Long Nail offers the following three locking options (Fig. 58), depending on the fracture pattern.

Long Nail Distal Locking Options

- Locking in the distal part of the oblong hole creates a dynamic locking mechanism – requires only one screw (see Fig. 58a).
- One screw placed in the distal part of the oblong hole and the other in the round hole. If dynamization is required after a period of time, the screw, placed in the round hole, has to be removed – requires two screws (see Fig. 58b).
- One screw placed in the round hole and the other is placed in the proximal part of the oblong hole – requires two screws (see Fig. 58c).

Distal locking is recommended:

- if the fracture is unstable
- if rotational stability is required
- if there is a wide disparity between the diameter of the nail and the femoral cavity.

Various techniques can be used to guide drilling and insertion of screws through the distal holes. The free-hand technique is described below.

Visualizing the distal holes

The essential initial step in distal targeting is to position the image intensifier so that the distal hole in the nail appears perfectly round. Naturally, this visualization steps refer to the appearance of the round and not the oblong hole. If the hole appears to be elliptical in either the vertical or horizontal plane, the image intensifier position must be adjusted appropriately as shown in Figures 59 and 60.

It is advised to correct image in one plane at a time.

Operative Technique

Free-hand Technique

The free-hand drill technique is used to fix the distal bone fragment to the nail using Locking Screws. Length and rotational alignment of the leg must be checked before locking the nail. The distal nail locking is described as follows, using the Static Locking mode according to Figures 61–63. Skin incisions are made in line with the distal holes of the nail.

Once the image intensifier is correctly positioned as shown in Figures 59 and 60, use the centre tipped $\text{Ø}4.2\text{mm}\times 180\text{mm}$, green coded drill and place the tip of the drill at an oblique angle to the centre of the hole (Fig. 61). Verify the position by X-ray and move the drill into the same plane as the holes in the nail, then drill through the first cortex and the nail until resistance of the second cortex is felt as shown in Figure 62.

Alternatively, the drill can be drilled through the second cortex while viewing the image intensifier. The screw length can then be read directly from the Screw Scale on the drill (Fig. 64).

If the Tissue Protection Sleeve is used with the drill, it has to be removed for the measurement.

It is also possible to measure the correct screw length using the Free Hand Screw Gauge. After drilling through the second cortex, remove the drill and advance the small hook of the Screw Gauge through the holes behind the medial cortex and read out the required locking screw length.

Insert the 5mm distal Locking Screw through the skin by using the 3.5mm Screwdriver; advance the screw head carefully until it is just in direct contact with the cortex (Fig. 65).

Note:

Take care not to overtighten. The screw head should just come into contact with the cortex and resistance should be felt.



Fig. 61



Fig. 62

add thickness of the cortex
(approx +5mm) to the read out value



Fig. 63

direct read out

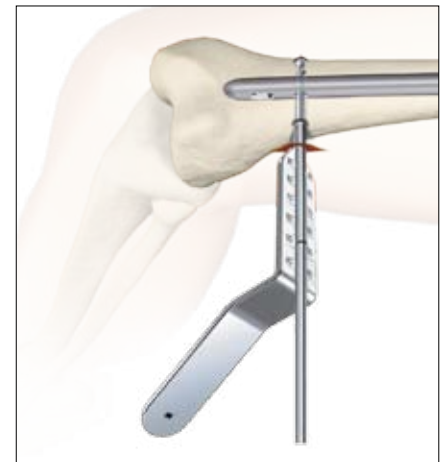


Fig. 64



Fig. 65

Operative Technique

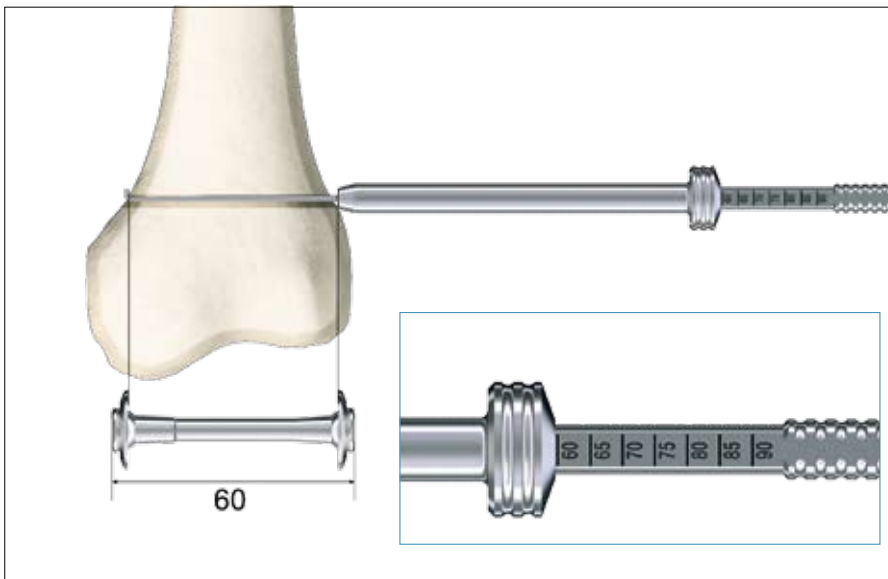


Fig. 66

Alternative

Alternatively Condyle Screws could be used for distal locking. If a Condyle Screw will be inserted, both cortices are drilled to a diameter of 5mm using the $\text{Ø}5 \times 230\text{mm}$ Drill in a free-hand drill technique. After drilling through the second cortex, remove the drill and advance the small hook of the Screw Gauge through the holes behind the medial cortex and read out the required condyle screw length (see Fig. 66).

Note:

The measurement equals Condyle Screw fixation length (from top of the Condyle Screw head to the top of Condyle Nut head, as shown in Fig. 66). The Condyle Screw length is defined with the Condyle Screw tip flush to the Condyle Nut head. The possible fixation length can be 2mm longer than the Condyle Screw length or 5mm shorter. Please ensure that the Condyle Nut is tightened a minimum of 5 turns on the Condyle Screw!

Examples:

| Measurement (mm) | Condyle Screw Length (mm) |
|------------------|---------------------------|
| 56 | 55 |
| 57 | 55 or 60 |
| 58 | 60 |
| 59 | 60 |



Fig. 67

The Condyle Screw K-Wire $\text{Ø}1.8 \times 310\text{mm}$ inserted from the lateral side to the medial side. At the medial point of the perforation, a skin incision is made for the Condyle Screw. From the medial side, the Condyle Screw is now brought forward over the Condyle Screw K-Wire and inserted using the Condyle Screw Screwdriver. Insert the Condyle Nut over the K-Wire using the other Condyle Screw Screwdriver (Fig. 67). Alternatively, if patient anatomy allows, the Condyle Screw may be introduced from lateral to medial in a similar manner as described above.

Operative Technique

Using both Condyle Screw Screwdrivers, the Condyle Nut and the Condyle Screw are tightened. Once tightened, the K-Wire is removed. The adjustable screw washers of the Condyle Screw and the Condyle Nut adapt to the surface of the bone.

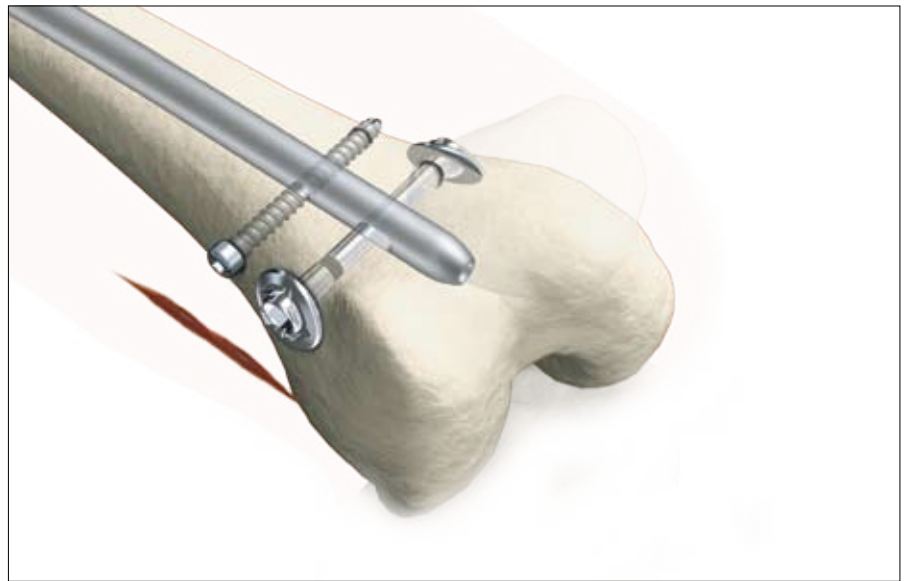


Fig. 68

Operative Technique

End Cap Insertion

It is recommended to use an End Cap to close the proximal part of the nail to prevent bone ingrowth.

Remove the Nail Holding Screw using the Ball Tip Screwdriver, Spreading Screwdriver, Universal Socket Wrench or Strike Plate. Load the End Cap (size 0) to one of the Screwdrivers and pass the assembly through the top of the Targeting Device down into the nail.

Turn the handle clockwise until it stops mechanically. Remove the Screwdriver and remove the Targeting Device in cranial direction.

Alternatively the End Cap could also be inserted free hand after removal of the Targeting Device.



Fig. 69
End Cap assembly



Fig. 70
Final Nail assembly

Operative Technique

Nail Extension End Caps

If the proximal end of the nail is completely sunk in the trochanter, End Caps in size +5mm and +10mm are available and can be assembled to the nail instead of the End Cap size 0, to achieve cortical bone support proximally. The proximal part of the nail will be elongated by 5mm or 10mm.

These elongation End Caps are assembled using the Strike Plate with the self-retaining ring, the Spreading Screwdriver or Ball Tip Screwdriver. This can only be done if the Targeting Device is already removed from the nail.

Postoperative Care and Rehabilitation

Active and passive mobilization of the lower limbs may be started immediately. The injured limb should be kept elevated.

For stable fractures that are locked statically or dynamically, full weight bearing walking may be started immediately.

For unstable fractures with static locking, immediate full weight bearing walking is allowed in fractures with good bone contact.

For fractures with poor bone contact due to comminution, partial weight-bearing walking is allowed for the first 6 to 8 weeks. Full weight bearing walking can be commenced when there is a bridging callus formed as evident on the follow up X-ray.



Fig. 71

Operative Technique

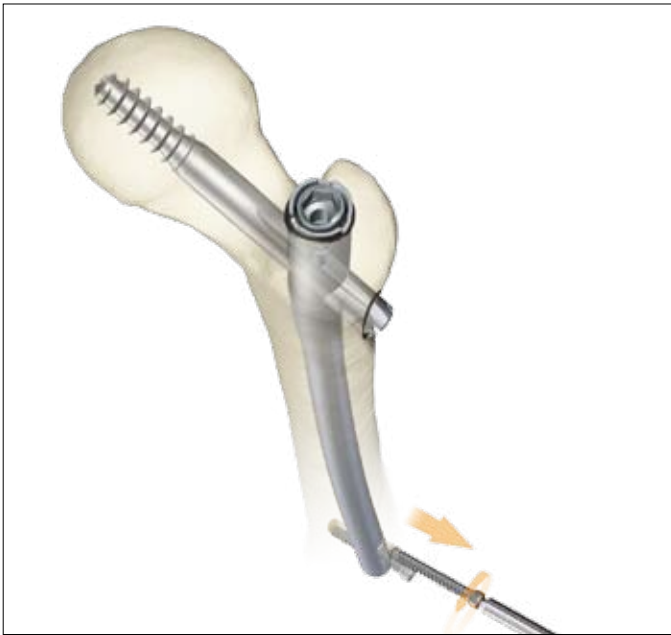


Fig. 72

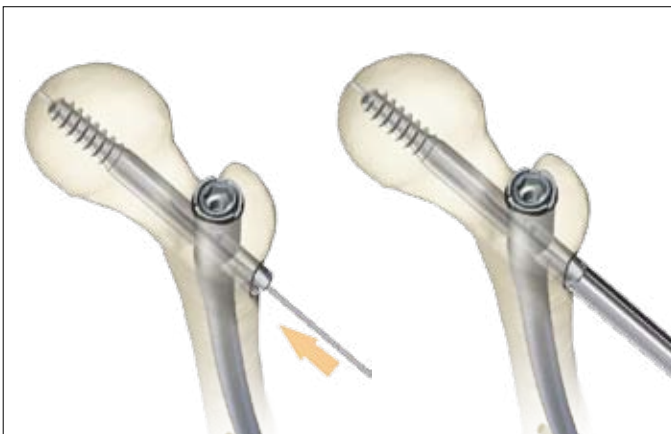


Fig. 73

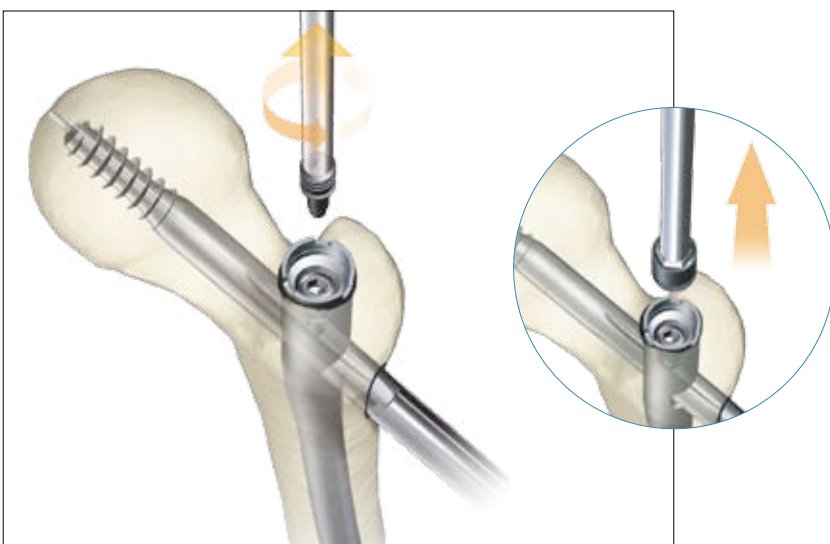


Fig. 74

Extraction of the Gamma3 Implant

Where implant extraction is indicated, please proceed as follows:

Step I (Fig. 72)

Remove the distal screw using the 3.5mm Screwdriver after making an incision through the old scar.

Step II (Fig. 73)

Make a small incision through the old scar below the greater trochanter to expose the outer end of the Lag Screw. Remove any bony ingrowth which may be obstructing the outer end or internal thread of the Lag Screw as necessary to enable the Lag Screwdriver to engage fully.

The K-Wire is then introduced via the Lag Screw into the head of the femur. The Lag Screwdriver is passed over the K-Wire, using the Lag Screw Guide Sleeve as a Tissue Protector, and engaged with the distal end of the Lag Screw.

Check that ingrowth does not obstruct secure engagement of the Lag Screwdriver, otherwise the Lag Screw or Screwdriver may be damaged and extraction will be much more difficult. Tighten the thumbwheel clockwise.

Step III (Fig. 74)

An incision is made over the proximal end of the nail, the proximal End Cap if used is removed using the Ball Tip Screwdriver, Spreading Screwdriver or Strike Plate, and the Set Screwdriver is engaged with the Set Screw. The Set Screw is rotated anti-clockwise until it is removed.

Note:

As the targeting device is not connected to the nail, we recommend using the Straight Set Screwdriver (1320-0210) for better guidance through the soft tissue to get access to the Set Screw.

Operative Technique

Step IV (Fig. 75)

The Conical Extraction Rod is then threaded and tightened into the proximal end of the nail. The Lag Screw is extracted by anti clockwise rotation and pulling of the Lag Screwdriver. The K-Wire must then be removed.

Note:

It is useful to first turn the Lag Screw Screwdriver clockwise slightly to loosen possibly bony ingrowth in the screw threads before turning it counter clockwise.

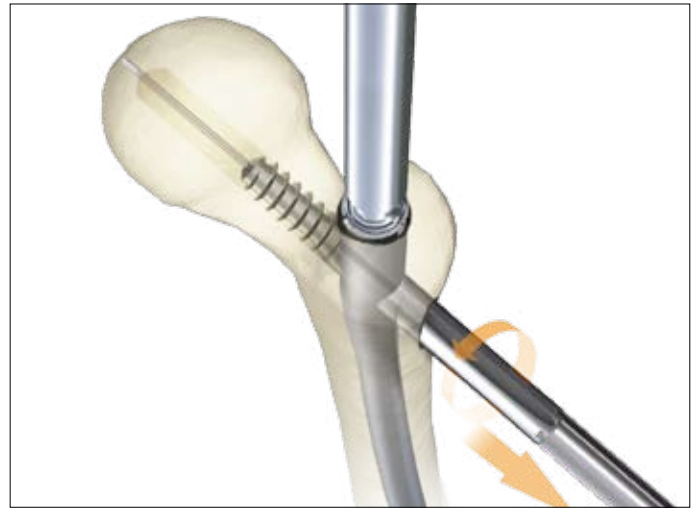


Fig. 75

Step V (Fig. 76 & 77)

An appropriate sliding hammer assembly is attached to the Extraction Rod and the nail extracted.

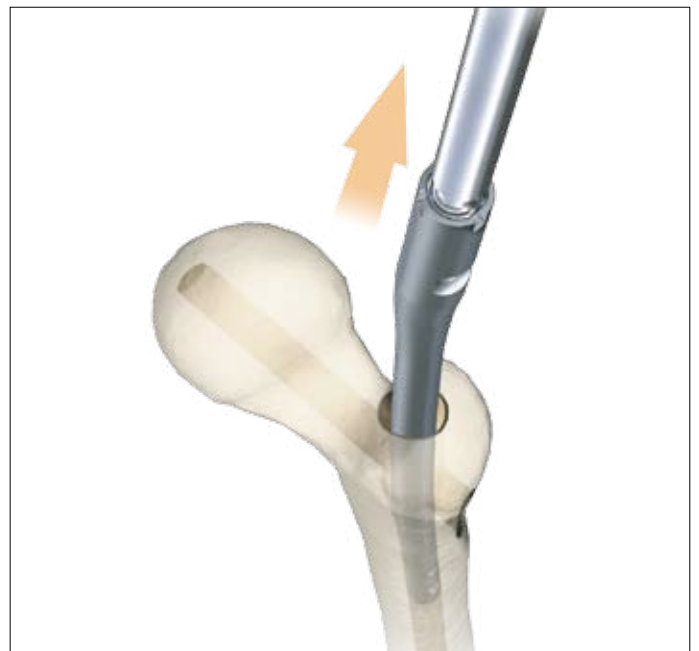


Fig. 76

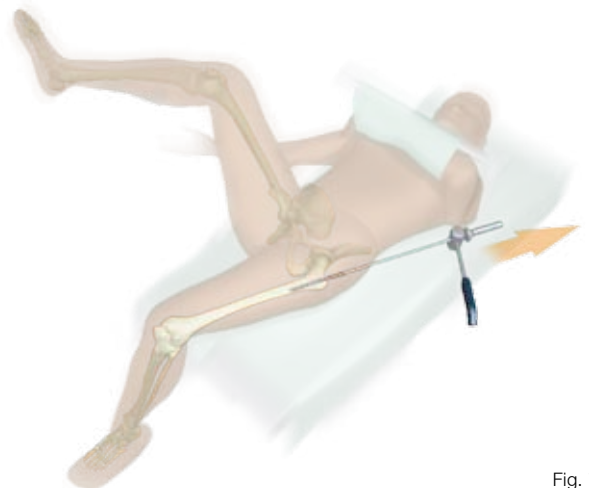


Fig. 77

Operative Technique

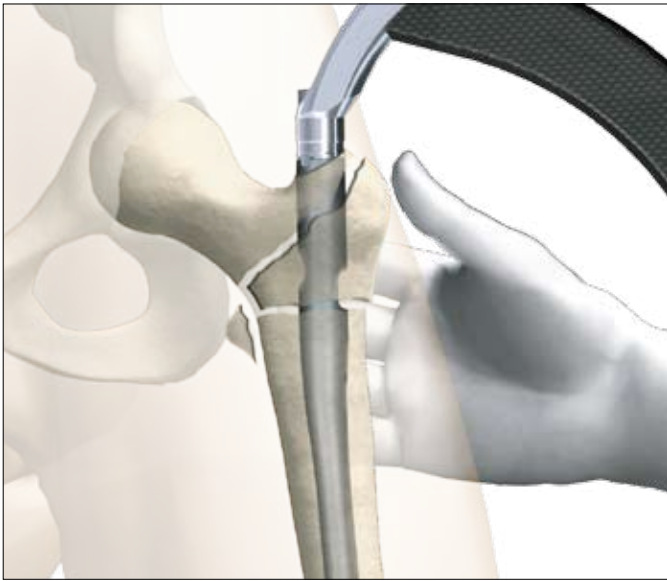


Fig. 78

Dealing with Special Cases

Posterior Displacement

In case of a comminuted fracture, there is a tendency of the fracture to become displaced posteriorly, making it difficult to place the K-Wire into the center of the neck and head. This can be solved by lifting the nail insertion Targeting Device (Fig. 78).

Alternatively, an assistant can lift up the greater trochanter manually or with a reduction spoon; or support it with a sandbag. This will maintain the neck and the femur in almost the same axis, facilitating passage of the K-Wire through the center of the neck and head.

The position should then be checked in both the anterior-posterior and lateral views using the image intensifier.

Ordering Information – Implants

Packaging

All implants are packed sterile only.

The Nail and Lag Screw Implant have to be secured using the Set Screw in every surgical operation, without exception (see also page 33).

The Nail and the Set Screw are therefore supplied together in the same blister pack (see Fig. 79).

The blister is packed in a white carton and wrapped to protect the contents during transportation and storage.

Only two package sizes are used for all the nails (Fig. 80).

The long nails are packed in a longer box and the short nails in a shorter box.

This facilitates identification in the storage area.

The package carries also the date of sealing and a sterility expiration date.



Long Nail, packaging example



Trochanteric Nail, packaging example

Fig. 80

Fig. 79

Ordering Information – Implants

Long Nail Kit R2.0, Ti, Left*, Ø15.5/11mm



| Titanium REF | Length mm | Angle ° |
|--------------|-----------|---------|
| 3320-0280S | 280 | 120 |
| 3320-0300S | 300 | 120 |
| 3320-0320S | 320 | 120 |
| 3320-0340S | 340 | 120 |
| 3320-0360S | 360 | 120 |
| 3320-0380S | 380 | 120 |
| 3320-0400S | 400 | 120 |
| 3320-0420S | 420 | 120 |
| 3320-0440S | 440 | 120 |
| 3320-0460S | 460 | 120 |
| 3325-0280S | 280 | 125 |
| 3325-0300S | 300 | 125 |
| 3325-0320S | 320 | 125 |
| 3325-0340S | 340 | 125 |
| 3325-0360S | 360 | 125 |
| 3325-0380S | 380 | 125 |
| 3325-0400S | 400 | 125 |
| 3325-0420S | 420 | 125 |
| 3325-0440S | 440 | 125 |
| 3325-0460S | 460 | 125 |
| 3330-0280S | 280 | 130 |
| 3330-0300S | 300 | 130 |
| 3330-0320S | 320 | 130 |
| 3330-0340S | 340 | 130 |
| 3330-0360S | 360 | 130 |
| 3330-0380S | 380 | 130 |
| 3330-0400S | 400 | 130 |
| 3330-0420S | 420 | 130 |
| 3330-0440S | 440 | 130 |
| 3330-0460S | 460 | 130 |

Long Nail Kit R2.0, Ti, Right*, Ø15.5/11mm



| Titanium REF | Length mm | Angle ° |
|--------------|-----------|---------|
| 3220-0280S | 280 | 120 |
| 3220-0300S | 300 | 120 |
| 3220-0320S | 320 | 120 |
| 3220-0340S | 340 | 120 |
| 3220-0360S | 360 | 120 |
| 3220-0380S | 380 | 120 |
| 3220-0400S | 400 | 120 |
| 3220-0420S | 420 | 120 |
| 3220-0440S | 440 | 120 |
| 3220-0460S | 460 | 120 |
| 3225-0280S | 280 | 125 |
| 3225-0300S | 300 | 125 |
| 3225-0320S | 320 | 125 |
| 3225-0340S | 340 | 125 |
| 3225-0360S | 360 | 125 |
| 3225-0380S | 380 | 125 |
| 3225-0400S | 400 | 125 |
| 3225-0420S | 420 | 125 |
| 3225-0440S | 440 | 125 |
| 3225-0460S | 460 | 125 |
| 3230-0280S | 280 | 130 |
| 3230-0300S | 300 | 130 |
| 3230-0320S | 320 | 130 |
| 3230-0340S | 340 | 130 |
| 3230-0360S | 360 | 130 |
| 3230-0380S | 380 | 130 |
| 3230-0400S | 400 | 130 |
| 3230-0420S | 420 | 130 |
| 3230-0440S | 440 | 130 |
| 3230-0460S | 460 | 130 |

Lag Screw, TI**



| Titanium REF | Diameter mm | Length mm |
|--------------|-------------|-----------|
| 3060-0070S | 10.5 | 70 |
| 3060-0075S | 10.5 | 75 |
| 3060-0080S | 10.5 | 80 |
| 3060-0085S | 10.5 | 85 |
| 3060-0090S | 10.5 | 90 |
| 3060-0095S | 10.5 | 95 |
| 3060-0105S | 10.5 | 100 |
| 3060-0105S | 10.5 | 105 |
| 3060-0115S | 10.5 | 110 |
| 3060-0115S | 10.5 | 115 |
| 3060-0120S | 10.5 | 120 |

5mm fully threaded Locking Screws, TI***



| Titanium REF | Diameter mm | Length mm |
|--------------|-------------|-----------|
| 1896-5025S | 5.0 | 25.0 |
| 1896-5027S | 5.0 | 27.5 |
| 1896-5030S | 5.0 | 30.0 |
| 1896-5032S | 5.0 | 32.5 |
| 1896-5035S | 5.0 | 35.0 |
| 1896-5037S | 5.0 | 37.5 |
| 1896-5040S | 5.0 | 40.0 |
| 1896-5042S | 5.0 | 42.5 |
| 1896-5045S | 5.0 | 45.0 |
| 1896-5050S | 5.0 | 50.0 |
| 1896-5055S | 5.0 | 55.0 |
| 1896-5060S | 5.0 | 60.0 |
| 1896-5065S | 5.0 | 65.0 |
| 1896-5070S | 5.0 | 70.0 |
| 1896-5075S | 5.0 | 75.0 |
| 1896-5080S | 5.0 | 80.0 |
| 1896-5085S | 5.0 | 85.0 |
| 1896-5090S | 5.0 | 90.0 |

* Nails are packed together with the Set Screw, sterile

** Longer Lag Screws are available on request.

*** Longer Locking Screws as well as partly threaded screws are available on request.

Ordering Information – Implants

Set Screws, TI (available separately)



| Titanium REF | Diameter mm | Length mm |
|--------------|-------------|-----------|
| 3003-0822S | 8.0 | 17.5 |

End Caps, TI



| Titanium REF | Diameter mm | Length mm |
|--------------|-------------|-----------|
| 3005-1100S | 11.0 | 0 |
| 3005-1105S | 15.5 | +5 |
| 3005-1110S | 15.5 | 10 |

Condyle Screws, TI



| Titanium REF | Diameter mm | Length mm |
|--------------|-------------|-----------|
| 1895-5040S | 5.0 | 40 |
| 1895-5045S | 5.0 | 45 |
| 1895-5050S | 5.0 | 50 |
| 1895-5055S | 5.0 | 55 |
| 1895-5060S | 5.0 | 60 |
| 1895-5065S | 5.0 | 65 |
| 1895-5070S | 5.0 | 70 |
| 1895-5075S | 5.0 | 75 |
| 1895-5080S | 5.0 | 80 |
| 1895-5085S | 5.0 | 85 |
| 1895-5090S | 5.0 | 90 |

Nut for Condyle Screw, TI



| Titanium REF | Diameter mm | Length mm |
|--------------|-------------|-----------|
| 1895-5001S | – | 17.0 |

Ordering Information – Implants

Long Nail Kit R2.0, StSt, Left*, Ø15.5/11mm



| Stainless Steel REF | Length mm | Angle ° |
|---------------------|-----------|---------|
| 4320-0280S | 280 | 120 |
| 4320-0300S | 300 | 120 |
| 4320-0320S | 320 | 120 |
| 4320-0340S | 340 | 120 |
| 4320-0360S | 360 | 120 |
| 4320-0380S | 380 | 120 |
| 4320-0400S | 400 | 120 |
| 4320-0420S | 420 | 120 |
| 4320-0440S | 440 | 120 |
| 4320-0460S | 460 | 120 |
| 4325-0280S | 280 | 125 |
| 4325-0300S | 300 | 125 |
| 4325-0320S | 320 | 125 |
| 4325-0340S | 340 | 125 |
| 4325-0360S | 360 | 125 |
| 4325-0380S | 380 | 125 |
| 4325-0400S | 400 | 125 |
| 4325-0420S | 420 | 125 |
| 4325-0440S | 440 | 125 |
| 4325-0460S | 460 | 125 |
| 4330-0280S | 280 | 130 |
| 4330-0300S | 300 | 130 |
| 4330-0320S | 320 | 130 |
| 4330-0340S | 340 | 130 |
| 4330-0360S | 360 | 130 |
| 4330-0380S | 380 | 130 |
| 4330-0400S | 400 | 130 |
| 4330-0420S | 420 | 130 |
| 4330-0440S | 440 | 130 |
| 4330-0460S | 460 | 130 |

Long Nail Kit R2.0, StSt, Right*, Ø15.5/11mm



| Stainless Steel REF | Length mm | Angle ° |
|---------------------|-----------|---------|
| 4220-0280S | 280 | 120 |
| 4220-0300S | 300 | 120 |
| 4220-0320S | 320 | 120 |
| 4220-0340S | 340 | 120 |
| 4220-0360S | 360 | 120 |
| 4220-0380S | 380 | 120 |
| 4220-0400S | 400 | 120 |
| 4220-0420S | 420 | 120 |
| 4220-0440S | 440 | 120 |
| 4220-0460S | 460 | 120 |
| 4225-0280S | 280 | 125 |
| 4225-0300S | 300 | 125 |
| 4225-0320S | 320 | 125 |
| 4225-0340S | 340 | 125 |
| 4225-0360S | 360 | 125 |
| 4225-0380S | 380 | 125 |
| 4225-0400S | 400 | 125 |
| 4225-0420S | 420 | 125 |
| 4225-0440S | 440 | 125 |
| 4225-0460S | 460 | 125 |
| 4230-0280S | 280 | 130 |
| 4230-0300S | 300 | 130 |
| 4230-0320S | 320 | 130 |
| 4230-0340S | 340 | 130 |
| 4230-0360S | 360 | 130 |
| 4230-0380S | 380 | 130 |
| 4230-0400S | 400 | 130 |
| 4230-0420S | 420 | 130 |
| 4230-0440S | 440 | 130 |
| 4230-0460S | 460 | 130 |

Lag Screw, StSt**



| Stainless Steel REF | Diameter mm | Length mm |
|---------------------|-------------|-----------|
| 4060-0070S | 10.5 | 70 |
| 4060-0075S | 10.5 | 75 |
| 4060-0080S | 10.5 | 80 |
| 4060-0085S | 10.5 | 85 |
| 4060-0090S | 10.5 | 90 |
| 4060-0095S | 10.5 | 95 |
| 4060-0100S | 10.5 | 100 |
| 4060-0105S | 10.5 | 105 |
| 4060-0110S | 10.5 | 110 |
| 4060-0115S | 10.5 | 115 |
| 4060-0120S | 10.5 | 120 |

5mm fully threaded Locking Screws, StSt***



| Stainless Steel REF | Diameter mm | Length mm |
|---------------------|-------------|-----------|
| 1796-5025S | 5.0 | 25.0 |
| 1796-5027S | 5.0 | 27.5 |
| 1796-5030S | 5.0 | 30.0 |
| 1796-5032S | 5.0 | 32.5 |
| 1796-5035S | 5.0 | 35.0 |
| 1796-5037S | 5.0 | 37.5 |
| 1796-5040S | 5.0 | 40.0 |
| 1796-5042S | 5.0 | 42.5 |
| 1796-5045S | 5.0 | 45.0 |
| 1796-5050S | 5.0 | 50.0 |
| 1796-5055S | 5.0 | 55.0 |
| 1796-5060S | 5.0 | 60.0 |
| 1796-5065S | 5.0 | 65.0 |
| 1796-5070S | 5.0 | 70.0 |
| 1796-5075S | 5.0 | 75.0 |
| 1796-5080S | 5.0 | 80.0 |
| 1796-5085S | 5.0 | 85.0 |
| 1796-5090S | 5.0 | 90.0 |

* Nails are packed together with the Set Screw, sterile

** Longer Lag Screws are available on request.

*** Longer Locking Screws as well as partly threaded screws are available on request.

Ordering Information – Implants

Set Screw, StSt (available separately)



| Stainless Steel REF | Diameter mm | Length mm |
|---------------------|-------------|-----------|
| 4003-0822S | 8.0 | 17.5 |

End Caps, StSt



| Stainless Steel REF | Diameter mm | Length mm |
|---------------------|-------------|-----------|
| 4005-1100S | 11.0 | 0 |
| 4005-1105S | 15.5 | +5 |
| 4005-1110S | 15.5 | 10 |

Condyle Screws, StSt







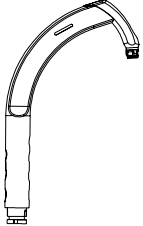


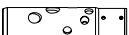

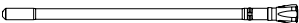
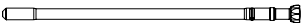





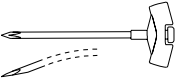




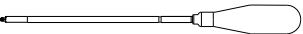


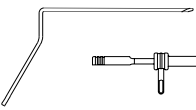




| Stainless Steel REF | Diameter mm | Length mm |
|---------------------|-------------|-----------|
| 1795-5040S | 5.0 | 40 |
| 1795-5045S | 5.0 | 45 |
| 1795-5050S | 5.0 | 50 |
| 1795-5055S | 5.0 | 55 |
| 1795-5060S | 5.0 | 60 |
| 1795-5065S | 5.0 | 65 |
| 1795-5070S | 5.0 | 70 |
| 1795-5075S | 5.0 | 75 |
| 1795-5080S | 5.0 | 80 |
| 1795-5085S | 5.0 | 85 |
| 1795-5090S | 5.0 | 90 |

Nut for Condyle Screw, StSt

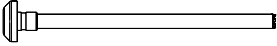
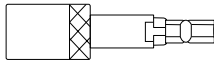

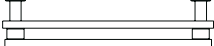








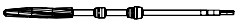








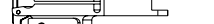




| Stainless Steel REF | Diameter mm | Length mm |
|---------------------|-------------|-----------|
| 1795-5001S | – | 17.0 |

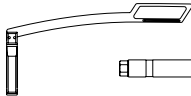





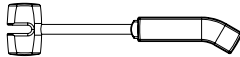
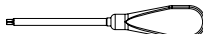
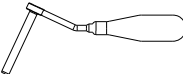



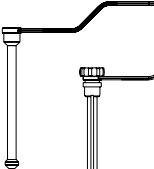
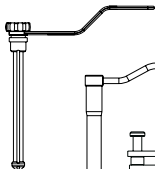
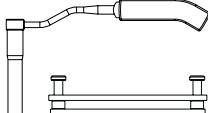



Ordering Information – Instruments

| | REF | Description |
|---|------------|--|
|  | 702628 | T-Handle, Quicklock |
|  | 1210-6450S | Kirschner wire, sterile |
|  | 1320-0065 | Screwdriver 8mm, Ball-Tip, T-handle |
|  | 1320-0090 | Nail Holding Screw |
|  | 1320-0100 | Gamma3 Targeting Arm |
|  | 1320-0105 | Knob for Targeting Sleeve |
|  | 1320-0110 | Clip for K-Wire |
|  | 1320-0118 | Targeting Sleeve 180, green coded |
|  | 1320-0130 | Lag Screw Guide Sleeve |
|  | 1320-0140 | Drill Guide Sleeve 4.2mm for Lag Screw, green |
|  | 1320-0150 | K-Wire Sleeve |
|  | 1320-0180 | Lag Screw Ruler |
|  | 1320-0190 | Lag Screw Step Drill |
|  | 1320-0200 | Lag Screw Driver |
|  | 1320-0231 | Flexible Set Screwdriver, 4mm, small shaft (silicon covered) |
|  | 1320-3042S | Drill Ø4,2 × 300mm, AO small, green, sterile |
|  | 1806-0041 | Awl, Curved |
|  | 1806-0095 | Guide Wire Handle |
|  | 1806-0096 | Guide Wire Handle Chuck |
|  | 1806-0185 | Tissue Protection Sleeve, Long |
|  | 1320-0215 | Gamma3 Drill Sleeve |
|  | 1806-0232 | Screwdriver, Long |
|  | 1320-0315 | Gamma3 Trocar |
|  | 1806-0325 | Screw Gauge, Long |
|  | 1806-0365 | Screw Scale, Long (for Long Nail) |
|  | 1806-0480 | Screw Gauge (for Long Nail) |
|  | 1320-3042 | Drill Ø4,2 × 300mm, AO small, green, unsterile |
|  | 1806-4270S | Drill Ø4,2 × 180mm, AO small, green, sterile (for Long Nail) |
|  | 1320-9000 | Instrument Tray, Basic, empty |
| | 1320-6000 | Instrument Set, Basic, completely filled |

Ordering Information – Instruments

| | REF | Description |
|---|------------|---|
| Basic Instruments | | |
| Not stored on the Tray | | |
|  | 1320-0131 | Lag Screw Guide Sleeve, navigated |
| | 1806-0085S | Guide Wire, Ball Tip, Ø3 × 1000, Sterile |
|  | 702634 | Large AO Coupling Hall Fitting |
|  | 1320-0112 | Gamma3 U-Wire |
|  | 1320-9002 | Insert for Bixcut Reamer Heads for Diameter 11, 12, 13, 14, 15.5mm |
|  | 1806-0032 | Trocar for Curved Awl, (Awl Plug) |
|  | 1320-0210 | Straight Screwdriver, 4mm for Set Screw |
|  | 1320-3042 | Drill 4.2 × 300mm, AO small, green, unsterile |
|  | 1320-3045S | Drill 4.2 × 300mm, Tri-Flat Fitting, sterile |
| Optional Instruments | | |
|  | 0152-0218 | K-Wire 1,8×310mm, for Condyle Screws |
|  | 1320-0041 | Cannulated Cutter, use with 4mm Pin only |
|  | 1320-0042 | Sleeve for Cannulated Cutter |
|  | 1213-9091S | Guide Pin 4×400mm, sterile |
|  | 1320-0011 | One Step Conical Reamer, working with Conical Reamer Sleeve short and long |
|  | 1320-0021 | Conical Reamer Trocar, short |
|  | 1320-0026 | Multihole Trocar, short |
|  | 1320-0031 | Conical Reamer Sleeve, short |
|  | 1320-0066 | Spreading Screwdriver |
|  | 1320-0070 | Screwdriver Strike Plate |
|  | 1320-0080 | Universal Joint Socket Wrench |
|  | 1320-0135 | Adaptor for One Shot Device, Gamma |
|  | 1320-0160 | Fragment Control Clip |
|  | 1320-0170 | Fragment Control Sleeve |
|  | 1320-3030S | Drill 3,0×300mm, AO small, sterile, white (for Fragment Control Clip) |
|  | 1320-3045S | Drill 3,0×300mm, Tri-Flat Fitting, sterile, white (for Fragment Control Clip) |

Ordering Information – Instruments

| | REF | Description |
|---|------------|--|
| Optional Instruments | | |
|  | 1320-3010 | One Shot Device, Gamma3 |
|  | 1407-4006 | Nail Extraction Adapter |
|  | 1806-0020 | Guide Wire Ruler (for Long Nail) |
|  | 1806-0110 | Universal Rod |
|  | 1806-0125 | Reduction Spoon |
|  | 1806-0130 | Wrench, 8mm / 10mm |
|  | 1806-0170 | Slotted Hammer |
|  | 1806-0255 | Condyle Screwdriver (for Condyle Screws) |
|  | 1806-0450 | Tissue Protection Sleeve |
|  | 1806-0460 | Drill Sleeve Ø4.2mm |
|  | 1806-4290S | Drill 4,2×230mm, AO small, sterile, green (Long Nail) |
|  | 1806-5000S | Drill, 5×230mm, AO small, sterile, black (for Condyle or Shaft Screws) |
|  | 1320-0022 | Conical Reamer Trocar, long |
|  | 1320-0027 | Multihole Trocar, long |
|  | 1320-0032 | Conical Reamer Sleeve, long |
|  | 1320-9002 | Insert for Bixcut Reamer Heads for Diameter 11, 12, 13, 14, 15.5mm |
|  | 1320-0210 | Straight Screwdriver, 4mm for Set Screw |
| | 1320-6010 | Extraktion Set |
| | 1320-9400 | Extraktion Tray |
|  | 1320-9005 | Instrument Tray, Optional |

X-Ray Template

| | |
|-----------|---|
| 1320-0002 | X-Ray Template, Gamma3 Nail 180 |
| 1320-0005 | X-Ray Template, Gamma3 Long Nail, R 2.0 |

References

Publications

More than 1.000.000 Gamma Nail implantations have been performed world wide over the last 17 years. Extensive clinical experience has been published with the Gamma™ Locking Nail.

We recommend the following publications:

- The Gamma Locking Nail, Ten Years Surgical Experience
Gahr, R.H.; Leung, K.-S.; Rosenwasser, M.P.; Roth, W. (eds.),
Einhorn-Press Verlag, ISBN 3-88756-808-7
- Patients treated with the Long Gamma Nail,
R. van Doorn,
Bedrijfsnaam: Castellum Drukwerk Vof.

These books contain almost 300 clinical reports available on request.

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