Gamma3
Operative Technique

Hip Fracture Systems
Trochanteric Nail 180
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

The Gamma3™ Locking Nail System is based on more than 15 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.
Implant Features

Design Features of the Gamma3™ System

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

- In the following, the Trochanteric Nail 180 is called:
  Gamma3™ Nail 180

All nails* use the same Lag Screws, Set Screw, distal Locking Screws and End Caps.

Gamma3 Nail 180

The anatomical shape of the nail is universal for all indications involving the treatment of trochanteric fractures. The nail is cannulated for Guide-Wire-controlled insertion and features a conical tip for optimal alignment with inner part of the cortical bone.

A range of three different neck-shaft angles are available for Lag Screw entry to accommodate variations in femoral neck anatomy.

A single distal Locking Screw is provided to stabilize the nail in the medullary canal and to prevent rotation in complex fractures. The oblong hole allows static or dynamic locking.

Technical Specifications:

- **Material:**
  Titanium alloy with anodized type II surface treatment or Orthinox® High Strength Stainless Steel

- **Nail length:**
  180mm

- **Nail diameter:**
  proximal 15.5mm, distal: 11.0mm

- **Proximal Nail angle range:**
  120°, 125°, 130°

- **M-L bend for valgus curvature:**
  4 degrees

- **End Caps in lengths of**
  0mm, +5mm and +10mm

- **Distal oblong hole for**
  5mm screws; up to 5mm dynamization is possible

Distal Locking Options

- Locking in the distal part of the oblong hole creates a dynamic locking mechanism (see Figure 1).
- Locking in the proximal part of the oblong hole allows static locking of the nail (see Figure 2).

* Each nail is supplied sterile packaged together with a Set Screw in one box.
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 Figure 4).
- Patented self-retaining Set Screw to protect the Lag Screw against rotation and simultaneously allowing sliding of the Lag Screw laterally.
Implant 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 (Figure 5).

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 (Figure 5a).

Length Definition of the Distal Locking Screw

The distal Locking Screw is measured from head to tip (Figure 5b).

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 tTreaded 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.
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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 \( \frac{D}{d} \) as shown in Figure 6 (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. This increases both the strength and reliability of the biomechanical 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 fractures. Early mobilization, dynamic compression, and a less traumatic operative technique increase the chance for rapid recovery and reliable bone union.

Indications/Contraindications

Indications

The indications for the Gamma3 Nail 180 are the same of those for the Gamma™ Trochanteric Locking Nail (Figure 7).

- Intertrochanteric fractures
- Pertrochanteric fractures
- Nonunion and malunion

Contraindications

Contraindications are medial neck fractures and sub-trochanteric fractures.

Important 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.
Implant Selection

X-ray templates are very helpful during preoperative planning. Use the X-ray Templates 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 Figure 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.

Important 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

The patient is placed in a supine position on the fracture table and closed reduction of the fracture is recommended. Reduction should be achieved as anatomically as possible. If this is not achievable in a closed procedure, open reduction may be necessary.

Traction is applied to the fracture, keeping the leg straight. The unaffected leg is abducted as far as possible to make room for the image intensifier (Figure 10).

Maintaining traction, the leg is internally rotated 10–15 degrees to complete fracture reduction; the patella should have an either horizontally or slightly inward position (Figure 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 (Figure 12).

It is important to ensure that a view of both the distal and proximal ends 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 proximal.

Fracture Reduction

Important 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 Nail during insertion.
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 (Figure 13) and a horizontal skin incision of approximately 2–3cm is made from the greater trochanter in the direction of the iliac crest (Figure 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 (Figure 16a). A line is drawn on the skin (Figure 16).
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 Figure 17 and 17a.

A vertical line is drawn onto the skin (Figure 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 Figure 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 2cm’s.

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

Using a finger, the tip of the trochanter should be felt easily (Figure 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 (Figure 22).

Preparation of the Medullary Canal

In order to prepare the medullary canal for the Gamma3 Nail 180, 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 (Figure 23) is recommended if conventional reaming or the One Step Conical Reamer will be used to prepare the canal for the nail.
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 (Figure 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 (Figure 25). The canal should be reamed at least 2mm larger than the distal diameter of the nail, 13mm for the Gamma3 Nail 180. In some narrow medullary canals, reaming may be necessary to achieve this (Figure 26).

When reaming is performed, the entire femoral canal should be overreamed down through the isthmus, in order to avoid stress riser in the bone.

In order to accommodate the proximal part of the Gamma3 Nail, the subtrochanteric region must be opened up to 15.5mm (Figure 27). This can be done either by reaming with the Stryker BIXCUT™ Reaming System (Figure 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.
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.

When the Gamma3 Nail 180 is used, reaming of the subtrochanteric and diaphyseal region of the femoral cavity may not be required, particularly in elderly patients with wide medullary canals.

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 (Figure 28 and 29).

Entry Point Optimization

The Entry Point 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 (Figure 29) to easily revise insertion of the guiding K-Wire in the proper position (Entry Point).
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 (Figure 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.

**Important 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 now.
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 Nail 180.

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.

It 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.

Its detailed operative technique is described separately (see Brochure “Cannulated Cutter” REF NO. B0300011).
Operative Technique

Assembly of Targeting Device

1. Targeting Sleeve and Knob Assembly

First assemble the Knob to the Targeting Sleeve (Figure 34a) and adjust the point on the Knob to be in line with the arrow on the Target Sleeve. Push the knob hard against the sleeve. The Knob moves approximately 5mm to the sleeve and has to be turned clockwise by approximately 30 degrees. Now 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 Target Arm (Figure 34c).

2. Target Arm and Targeting Sleeve Assembly

Push the Sleeve assembly over the Target 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 Knob has only one function, this is to lock either the Lag Screw Guide Sleeve or the Tissue Protection Sleeve.
3. Assembly of the Targeting Device and the Gamma3™ Nail 180

The selected Gamma3 Nail is now assembled to the Carbon Fibre Target Device as shown in Figure 35. The nail connecting part of the Target 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.

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

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

1. Secure fixation between Nail and Target Device
2. Lag Screw Guide Sleeve matches the selected nail angle.
3. Distal locking position of the Tissue Protection Sleeve, for required “Static” or “Dynamic” locking.
Before checking the function of the Lag Screw Guide Sleeve or Tissue Protection Sleeve for the distal locking, the Knob must be positioned in the counter clockwise position. Pass the Lag Screw Guide Sleeve gently through the hole of the Target 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).

Removal of the Lag Screw Guide Sleeve in the opposite order; turn the Knob counter clockwise and remove the Lag Screw Guide Sleeve by pulling it back.

Before the distal locking function can be checked, the Target Sleeve has to be positioned in either the “Static” or “Dynamic” mode.

Pull the Target Sleeve back and turn the sleeve until the required distal locking position is reached. Now push the sleeve against the Target Arm until a “snap in” is felt.

The distal Tissue Protection Sleeve is passed through the Target Sleeve until its final position is achieved. Lock the distal Tissue Protection Sleeve by gently turning the Knob clockwise. Check position with the Drill Sleeve and 4.2mm Drill (Fig 36a).

**Important Note:**
Before starting surgery, the implant and instrument assembly must be checked. Ensure that the Sleeve angle matches the corresponding nail angle chosen, e.g. a 125° Target Sleeve for a 125° nail, and the distal Sleeve matches either for “Dynamic” or “Static” locking as required (Fig 36 and 36a).
Nail Insertion

Insert the Gamma3 Nail by hand (Figure 37).

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

The final Nail depth position is monitored with the image intensifier C-arm; the projected 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 (Figure 38). The objective of this is to ultimately position the Lag Screw centrally or slightly inferior in femoral head in the frontal plane.

Note:
Remove Guide Wire for the flexible reamer and nail insertion using Guide Wire Handle. (Fig. 39a).

When the Gamma3 Nail has been inserted to its final depth, check the anteversion of the nail. Use of the K-Wire Clip (Figure 39) or the “One Shot Device” is recommended (see next page).

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

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

The Lag Screw should be placed in the central position of the femoral head in the lateral view (Figure 40).
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 establishing whether the Lag Screw is in the optimum 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. Detailed steps are described in the separated Operative Technique of the “One Shot Device” (see Brochure “One Shot Device” REF NO. B0300010).
Lag Screw Insertion

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

Next, assemble the Lag Screw Guide Sleeve with the green coded 4.2mm Lag Screw Drill Guide Sleeve and pass them through the Targeting Sleeve to the level of the skin. This indicates the position for a small incision down to the bone (Figure 43). The Guide Sleeve assembly is now advanced through the incision. If the guide catches the fascia lata, twisting it will usually allow it to pass through to the bone.

In order for an accurate Lag Screw length measurement, the outer Guide Sleeve must be in good contact to the lateral cortex of the femur. The Knob of the Target Sleeve must be turned gently clockwise to lock the Guide Sleeve in place and further stabilize the targeting assembly (Figure 44 and 44a).
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 (Figure 45).

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).

**Important 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 (Figure 46), using the Guide Wire Handle. Check that the K-wire is placed either central or in the lower half of the femoral head in the frontal plane and on the midline in the lateral plane (Figure 46a).

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

The objective is to position the Lag Screw either in the center or 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 (Figure 47a).

Place the Lag Screw Ruler directly under the K-wire (Figure 48).

The recommended value for the Step Drill depth and the Lag Screw length can be read directly from 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.

Important 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 become lodged in the drill and could be advanced into the pelvis, and may damage large blood vessels or cause other serious injuries.
The value of the measurement (Figure 48) is now transferred to the adjustable stop on the Lag Screw Step Drill (Figure 49).

The value e.g. 100 must be visible in the window (Figure 49a).

The K-wire Sleeve is now removed and the adjusted Lag Screw Step Drill is passed over the K-wire (Figure 50), 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 (Figure 51). Ensure that the Targeting Device is well supported to prevent it from slipping back or rotating.

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

**Important 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.
Lag Screw Insertion

Check on the image intensifier during drilling to monitor the depth of the drill near the subchondral bone. At this stage, you should see the tip of the K-wire protruding about 6 to 10mm out of the step drill. This is 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 (Figure 52) 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 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 (Figure 53).

In a case where compression is to be applied, a shorter Lag Screw length should be chosen to avoid the end of it sticking out too far in to the lateral cortex (see chapter Compression/ Apposition below). Ensure that the pins of the Lag Screwdriver are in the slots of the Lag Screw. The end thumbwheel must be turned clockwise and 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 of 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 when it reached the end of the Lag Screw Guide Sleeve.
Lag Screw Fixation

The handle of the Lag Screwdriver must be either parallel or perpendicular (90°) to the Target Arm (Figure 55 on next page) to ensure that the Set Screw is able to fit into one of the 4 Grooves of the Lag Screw shaft.

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

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

Important 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.

Compression/Apposition

If compression or apposition of the fracture gap is required, this can be achieved by gently turning the thumb-wheel of the Lag Screwdriver clockwise against the Guide Sleeve (Figure 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 has to be turned counter clockwise. 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.
Lag Screw Fixation

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 Bolt using the Set Screwdriver. While the Set Screw is passing the cannulated Nail Holding Bold, the Set Screw Driver has to be brought into proximal nail axis to allow a smooth push down of the Set Screw.

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. Turn the Set Screw until you feel contact in one of the grooves of the Lag Screw.

On slightly tightening the Set Screw, make sure that the handle of the Lag Screwdriver is either parallel or at right angles (90°) to the target arm (Figure 55). The Set Screw alignment indicator will help to find the right position of the handle.
Operative Technique

This ensures that the Set Screw will engage in one of the four Lag Screw grooves (Figure 57). To verify the correct position of the Set 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 moves, recorrect the handle position and tighten the Set Screw again until it engages in one of the four grooves.

After slightly tightening the Set Screw it should then be unscrewed by one quarter (¼) 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.

Important Note:
Do not unscrew the Set Screw more than ¼ to ½ 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 Bolt is now removed using the ball tip Screw Driver or Universal Socket Wrench and turning it counter clockwise. Remove the Nail Holding Bolt. Insert the End Cap (size 0) using the Socket Wrench or the Ball Tip Screwdriver. The End Cap should be tightened slightly.

Please see chapter „End Cap Insertion“.

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

Disconnect the Lag Screwdriver by loosening the end thumbwheel, remove the Lag Screwdriver, Lag Screw Guide Sleeve and the K-wire. The nature of the fracture determines whether the distal Locking Screw is used.

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

Gamma3 nails offer the possibility to be locked distally either dynamically or statically. The fracture pattern determines the method of distal locking.

The Carbon Fibre Targeting Device offers the options of guided distal locking in a dynamic or static position of the nail. The green coded Targeting Sleeve of the Target arm has to be adjusted in the required position. In the following description, a dynamic locking will be described. Turn the Targeting Sleeve until you reach the dynamic position with the point on the Target Sleeve is in line with the arrow on the target arm. Push the sleeve up in the cranial direction. Now assemble the Distal Tissue Protector, Drill Guide Sleeve and Trocar and advance it through the hole of the target arm down to the skin.

A small incision is started at the tip of the Trocar, and is extended down to the lateral cortex. The Trocar will extend back of the sleeve by approx. 3mm when the Tissue Protection Sleeve has reached the lateral cortex (Figure 59).

Before locking the sleeve, gently turn the Knob clockwise, making sure that the Tissue Protection Sleeve is in good contact to the bone (Figure 59).
The Trocar is now removed and replaced by the calibrated green coded 4.2mm × 300mm drill. Drill through the first cortex and as the second cortex is reached read off the measurement on the drill scale. Add the thickness of the cortex, which is approximately 5mm, to this measurement to select the correct screw length (Figure 60a).

Alternatively, the drill can be drilled through the second cortex and monitored by X-ray or image intensifier. The screw length can then be read directly from the scale on the drill Figure 60a). Proceed to drill the second cortex.

It is also possible to measure the correct screw length using the Screw Gauge after drilling through the second cortex. The Drill Guide Sleeve must be removed and the Screw Gauge may be advanced through the Tissue Protection Sleeve. Put the small hook behind the medial cortex and read the required locking screw length from the scale.

Insert the 5mm distal Locking Screw (Figure 61) through the Distal Tissue Protector by using the 3.5mm Screwdriver until the mark on the Screwdriver shaft approaches the Protector; advance the screw head carefully until it is slightly in direct contact with the cortex (Figure 60a).

**Important Note:**
When the mark on the Screwdriver shaft reaches the Tissue Protection Sleeve, this indicates that the screw head is near the cortex (Figure 60a). Take care not to overscrew. The screw head should come just into contact with the cortex and resistance should be felt.
End Cap Insertion

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

Leave the Screwdriver for the distal locking in place and remove the Nail Holding Bolt using the Ball Tip 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, the distal Screwdriver and the distal sleeves and remove the Targeting Device in cranial direction.

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

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

The elongation End Caps are assembled using the Strike Plate with the self retaining ring or Ball Tip Screwdriver. This can only be done if the Target 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 with dynamic locking, 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.
Extraction of the Gamma3™ Implants

Where implant extraction is indicated, please proceed as follows:

**Step I (Figure 65)**

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

**Step II (Figure 66)**

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, if end cap was placed.

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 (Figure 67)**

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

**Step IV (Figure 68)**

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.

**Step V (Figure 69a&b)**

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

**Note:**

It is a useful to turn the Lag Screw Screwdriver clockwise slightly first to loosen the possibly bony ingrowth into the screw threads before turning it counter clockwise.
Dealing with Special Cases

Posterior Displacement

In the case of a comminuted fracture, there is a tendency for 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 (Figure 70).

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

### Instruments

#### Basic Instruments

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**Ordering Information**

**Instruments**

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**Optional Instruments**

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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 29).

The Nail and the Set Screw are therefore supplied together in the same blister pack (see Figure 71).

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 (Figure 72).

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.
## Ordering Information

### Titanium Implants

#### Trochanteric Nail Kit 180, Ti *

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#### 5mm fully threaded Locking Screw, Ti **

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#### Lag Screw, Ti ***

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#### Set Screw, Ti (available separately)

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* Nails are packed together with the Set Screw, sterile
** Longer Locking Screws as well as partly threaded screws are available on request.
*** Longer Lag Screws are available on request.
Ordering Information

**Stainless Steel Implants**

### Trochanteric Nail Kit 180, StSt *

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### Lag Screw, StSt ***

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### 5mm fully threaded Locking Screws, StSt **

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<th>Diameter</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>4003-0822S</td>
<td>ø8</td>
<td>17.5mm</td>
</tr>
</tbody>
</table>

* Nails are packed together with the Set Screw, sterile
** Longer Locking Screws as well as partly threaded screws are available on request.
*** Longer Lag Screws are available on request.
Publications

More than 750,000 Gamma Nail implantations have been performed worldwide over the last 15 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.
Notes
The information presented in this brochure is intended to demonstrate a Stryker product. Always refer to the package insert, product label and/or user instructions before using any Stryker product. Products may not be available in all markets. Product availability is subject to the regulatory or medical practices that govern individual markets. Please contact your Stryker representative if you have questions about the availability of Stryker products in your area.

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