GAMMA NAIL
Standart Gamma Nail:

- The nail is available in different diameters 11 – 16 mm and 17 mm proximal.
- 200 mm overall length.
- A tow distal screw is used to prevent rotation in complex fractures.
- Profile designed for rapid and secure fixation of fractures around the trochanter.
- Variations in femoral neck anatomy are accommodated by a range of neck angles available for the lag screw entry (125°, 130°, 135°, 140°).
- The nail incorporates proximal anteversion of 10°.
- In the majority of patients the standard 130° neck angle can be used without difficulty. The 125° neck angle may be needed in osteoarthritic coxa vara, and the 135° in coxa valga.

Indications:

- Intertrochanteric fractures.
- Pertrochanteric fractures.
- High sub-trochanteric fractures.
- Nonunion and malunion

Long Gamma Nail:

- The nail itself incorporates several important mechanical design features. The nail itself is unslotted and cannulated for guide wire controlled insertion. It has a 17 mm proximal diameter tapering to 11 mm distally in lengths from 340 mm to 440 mm in 20 mm steps.
- Variations in femoral neck anatomy are accommodated by a range of neck angles available for the lag screw entry (125°, 130°, 135°).
- Two distal locking screws are inserted through the distal end of the nail to control rotation and telescoping.

Indications:

- Spiralling subtrochanteric fractures
- Pertrochanteric fractures associated with shaft fractures
- Pathologic fractures in osteoporotic bone (including prophylactic use) in both trochanteric and diaphyseal areas
- Proximal or distal non-unions and malunions, revision procedures.

Contraindications:

- Medial neck fractures.

The Lag Screw:

- The lag screw, inserted through a small incision with the aid of a targeting device, incorporates a special sliding lock to provide dynamic compression with axial stability.
- After insertion, a set screw inserted through the proximal head of the nail engages in one of four grooves in the lag screw. As these are of asymmetrical depth profile, they allow the lag screw to slide in one direction, producing dynamic osteosynthesis by compression during early weight-bearing.
- The lag screw incorporates a rounded nose profile and self-tapping thread designed for easy insertion and resistance to cut-out.
Advantages:

- Early weight-bearing through superior strength and stability
- Reduced trauma through closed operating technique.
- Low blood loss, low level of wound problems and low risk of infection.
- More secure fractures fixation through better biomechanics.

The biomechanical advantage:

- As the load-bearing axis of the Gamma Nail is closer to the hip joint fulcrum, the effective lever on the implant and femur is significantly less than with an external plate, reduced by a factor equivalent to $d/D$ in the diagram (approximately 25%).
- The resultant force is transmitted directly down the centre of the femur rather than through the many bone-weakening screws used in the side-plate system, increasing both the strength and reliability of the mechanical repair.

The rehabilitation advantage:

- The extra strength effectively gained by the biomechanical advantage of the Gamma Nail, combined with improved control of axial telescoping and rotational instability, allows early weight-bearing even in complex or unstable proximal fractures.
- Earlier mobilization, combined with dynamic compression and less traumatic operative technique, increases the chance of successful patient recovery and reliable repair.

POSTOPERATIVE CARE AND REHABILITATION:

- After the wound is closed, elastic bandage is applied from the toes to the hip. Active and passive mobilization of the lower limbs should be started immediately. The injured limb is kept elevated. The drain is removed when the drainage stops and usually within the first 48 hours. Walking can be started on the third day.
- For stable fractures with dynamic locking, full weightbearing walking can 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 and large medial third fragment, partial weight-bearing walking is allowed for the first 6 to 8 weeks. Full weightbearing walking can be commenced when there is a bridging callus formed on the medial side as evident on the follow up X-ray.
- Dynamization of the fracture may be performed if delayed union is noted between four and six months after operation.
- If the implants are going to be removed after the fracture is healed, removal of the distal locking screw dynamization) six months prior to implant removal is recommended in order to further improve the quality of the medial cortical bone.
INCISION AND ENTRY POINT:

INCISION:

Determination of the soft tissue incision position:

- The tip of the greater trochanter can be located by palpation, and a horizontal skin incision of approximately 3-5 cm is made from the greater trochanter to the iliac crest.
- The incision is deepened through the fascia lata, splitting the abductor muscle for approximately 3 cm immediately above the tip of the greater trochanter, thus exposing its tip. A self-retractor is put in place.

Finding the bone entry point:

The correct entry point can be identified by touch; it 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.

Breaching the cortex:

- The medullary canal is opened, under image intensification using the awl. Care must be taken to ensure that the awl is not misplaced.
- The insertion point should be just on the tip of the greater trochanter. If it is very medial the nail will not go down the shaft properly, with the danger of fracturing the femur.
- When the entry point has been made, the reamer guide wire is placed in position so that the proximal femur may be prepared using flexible intramedullary reamers.
PREPARATION OF MEDULLARY CAVITY

REAMING TECHNIQUE:

- Pass the reamer guide wire from the tip of the greater trochanter into the shaft of the femur using the Jacob's chuck.
- Rotating the guide wire during insertion makes it easier to achieve the desired position in the middle of the medullary canal and avoid it coming out of a posterior fracture line.

- Flexible reamers are used to ream the shaft of the femur in stages starting with a small reamer. Increase the diameter of the reamer by 0.5 - 1.0mm depending on the amount of resistance felt while 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 of the wire, which in turn would lead to an offset position for the nail and a risk of fracturing the shaft.

- In order to accommodate the proximal end of the Gamma Nail, the trochanteric region MUST be reamed to 17 mm with the help of the proximal reamer to prepare the proximal femur for the proximal portion of the nail. Care should be taken to keep the reamer in line with the shaft of the femur to avoid reaming through the cortex of the femur.

Assembly of targeting device:

- The selected nail is now assembled onto the targeting device.
- The nail held by the nail holding bolt, and tightened using the socket wrench.
- Ensure that the target sleeve angle matches the corresponding nail chosen.
Nail and Lag Screw Positioning:

Anteversion Guide Insertion:

With the image intensifier C-arm in the inhorizontal position to provide a lateral view of the femoral neck and head, a 2 mm K-wire is inserted percutaneously, anterior to the shaft and parallel to the axis of the femoral neck and head. This provides a guide to the angle of anteversion of the femoral neck during later insertion of the nail, during which the targeting device is kept parallel to the K-wire in the coronal plane. Alternatively, the K-wire can be inserted after the lag screw guide sleeve has been positioned.

The nail inserted by hand using anterior-posterior screening. **Do not use undue force. Never use a hammer. As the Gamma Nail are very rigid implants, they must not be forced into the femur by hammering, as this may fracture the femur.**

Nail insertion is monitored with the image intensifier C-arm; the projected axis of the lag screw should be measured with a ruler on the monitor screen to ensure that the lag screw will be positioned in the ideal position.

- The Gamma Nail is inserted by hand until the axis of the lag screw holes (visible as crescent shapes on the screen) is lined up with the inferior half of the femoral neck.
- The objective of this is to ultimately position the lag screw tip just below the centre of the femoral head in the frontal plane.
- Check: When the Gamma Nail is inserted to its final depth the plane of the targeting device will be parallel to the percutaneous guide wire positioned earlier.
- This ensures the correct degree of rotation to align the lag screw holes with the angle of anteversion of the femoral neck.
- Remove the reaming guide wire using the Jacob's chuck, ensuring that the targeting device is supported to prevent rotational movement of the Gamma Nail.
- The targeting device may require support by an assistant, to prevent its weight from externally rotating the nail, until the next stage is completed.
- With the nail now inserted to the correct depth and the correct anteversion angle, slide the Gamma Nail targeting sleeve corresponding to the nail angle of the selected Gamma Nail onto the end of the targeting device.
Assemble the soft tissue protector and the guide sleeve for the lag screw, and pass them through the targeting device to the level of the skin.

This now indicates the position for the small incision to be made, which is developed down to the bone.

The guide sleeve and tissue protector assembly is now passed through the incision to press firmly against the lateral cortex. If the guide catches the fascia lata, twisting it will usually allow it to pass through to the bone.

The soft tissue protector is removed and the lag screw guide sleeve is firmly abutted to the lateral cortex of the femur to stabilize the targeting device.

With the guide sleeve firmly engaged in the cortex, the awl should be inserted and turned by hand in order to pierce the lateral cortex.

Check for correct positioning on both anterior-posterior and lateral intensifier views.

Before proceeding, check that the guide wire for the flexible reamer used earlier has been removed.

The soft tissue protector is now re-inserted to act as a guide sleeve for the lag screw guide wire, which is inserted using the Jacob’s chuck.

The guide wire should be screwed into the subchondral bone, checking for position on both the anterior-posterior and lateral intensifier views. Checking is essential if you are to ensure good lag screw positioning.

The tip of the guide wire must be placed in the inferior half of the femoral head in the frontal plane, and on the midline in the lateral plane. The objective is to place the lag screw below the centre of the femoral head on the anterior-posterior view and centrally on the lateral view, to decrease the risk of it cutting superiorly out of the femoral head.

If the guide wire is too anterior or posterior it must be repositioned; this should seldom be necessary if the anteversion-guiding percutaneous wire has been inserted correctly.

If the guide wire is mispositioned, the first step is to withdraw the guide wire itself, and then to withdraw the nail. Rotate the nail in the appropriate direction and re-insert as before. The guide wire is then re-drilled and control screening is carried out as before.

LAG SCREW DRILLING

After achieving a satisfactory position for the guide wire, the lag screw length required is measured using the lag screw length measuring gauge.

Before starting to measure, ensure that the soft tissue protector and guide sleeve assembly is pressed firmly against the lateral cortex of the femur.
• Take the measuring gauge and place it directly under the guide wire and against the soft tissue protector.

• The measurement on the gauge is now transferred to the adjustable stop on the lag screw step drill. It should be noted that the adjustable stop is positioned with the chosen length next to the stop on the side towards the drill tip. The collar is used to lock the stop in position.

To ensure accurate lag screw length the soft tissue protector must remain within the guide sleeve when measuring the lag screw length.

LAG SCREW SELECTION & INSERTION

• The soft tissue protector is now removed and the lag screw step drill is passed over the guide wire, through the guide sleeve.
• The path for the lag screw is drilled using the Jacob’s chuck. If exceptional resistance is encountered, a power drill may be used with great care.
• Drilling should continue until the stop impacts against the guide sleeve.

• If you check on the image intensifier at this stage you should see the tip of the guide wire protruding slightly from the step drill. This is because the threaded portion of the guide wire is deliberately excluded from the drill measurement to prevent joint penetration by the drill.
• The correct length lag screw is chosen by selecting a size at least 5 mm longer than the measurement previously made on the lag screw gauge for drilling. It is important that the lag screw protrudes at least 5 mm from the lateral femoral cortex to retain rotational stability and to permit sliding.

• The correct size lag screw is now assembled with the lag screwdriver.
• The end thumbwheel must be pulled back, and the screw and driver connected. After pulling back and connecting, the end thumbwheel is tightened to secure the connection.
The lag screw is now passed over the guide wire, through the guide sleeve, and threaded up to the sub-chondral part of the head.

If the guide wire is inadvertently removed, then the screw may still be passed without it provided that the guide sleeve is still in contact with the cortex.

After tightening the screw ensure that the handle of the lag screw driver is either parallel or perpendicular to the axis of the targeting device so that the set screw will engage in one of the four lag screw grooves.

**COMPRESSION**

If compression is planned, thread the compression device onto the lag screw driver and twist it to the level of the handle. This may be done before or after attaching the lag screw. Insert the lag screw over the guide pin and into the femur. The handle on the lag screw driver must be parallel or perpendicular to the axis of the guide. Rotate the lag screw driver up to 90° in order to correctly orient the handle to the guide. If compression is desired, twist the compression device in a clockwise fashion. As the device presses against the lag screw cannula, it will generate compression across the fracture. Compress as needed to reduce the fracture.

**SET SCREW INSERTION**

- A set screw can be used to prevent the lag screw from rotating post-operatively.
- Insert the tip of the set screw driver into the hex end of the set screw through the connecting bolt into the proximal portion of the nail. It is then tightened fully using the set screwdriver and socket wrench.
- Ensure that the set screw is still engaged in the groove by checking that the lag screw cannot now be rotated with the lag screwdriver.
- If distal locking is not indicated, disconnect the lag screwdriver using the end thumbwheel, remove the lag screwdriver, guide sleeve, guide wire, targeting device and sleeve.
- If distal locking is indicated then leave the targeting device and sleeve in position and continue.
DISTAL LOCKING SCREW

The decision to use the distal locking screw must be made according to the pattern of the fracture.

It should be used:

- When the fracture is unstable
- To control the length of a comminuted fracture of the proximal femoral shaft
- When there is a great disparity between the diameter of the nail and the femoral cavity

Distal Screw targeting:

- Insert the distal guide sleeve through the hole in the targeting device.
- If required, the distal awl may be passed through the distal guide sleeve and turned gently to make a small impression in the lateral cortex of the femur.

- The awl, if used, is now removed and the 5 mm distal drill is used, making sure the distal guide sleeve is held firmly engaged in the cortex at all times during the drilling.
- Distal Screw length measurement After drilling, measurement of the distal screw length is made direct reading of the drill or by using the distal screw depth gauge.

- The gauge passes through the distal guide sleeve with its tip passing into the medial cortex.

- A measure of the distal screw length is taken from a direct reading of the depth gauge.
- 25 and 30 mm screws are the most commonly used lengths.
- The correct size of distal self-tapping screw is introduced through the distal guide sleeve and tightened using the distal screwdriver.

- A proximal plug is available to prevent ingrowth from becoming trapped in the proximal threads of the nail.
- This can be inserted after removal of the targeting device. Where used, this is tightened using the set screwdriver.