ST-Pro

femoral nailing system

Surgical **Technique**

BIOMET Europe

www.biomet.co.uk

INTRODUCTION

design principals

Recent advances in imaging technology have enabled orthopaedic surgeons to extend closed treatment of femoral fractures to include more complicated, multiple and comminuted fractures. Concurrently, the number, and variety, of fracture fixation implant devices has expanded to include multiple pins or screws for femoral neck and intertrochanteric fractures, compression screws with side plates for neck fractures, and regular and interlocking intramedullary nails for simple and complex shaft fractures. As a result, the surgeon is faced with mastering a wide variety of implants, insertion instruments and surgical techniques, depending on the type of fracture encountered. In the case of multiple fractures, a combination of implants is often required.

The design philosophy of the Vari-Wall Nailing System was to develop a single system that could be used for the widest possible variety of femoral fractures. Based on a closed interlocking intramedullary rod, the system takes full advantage of contemporary understanding of the biology of fracture healing, combined with modern biomechanical design principles. Primary requirements of the system were that the number of instruments should be kept to a minimum and that they should be simple to use. It was also desirable to minimise the number of implants necessary for a complete size inventory.

For a given size of implant, the strength should be as high as possible to guard against implant failure. On the other hand, it is desirable to maximise the flexibility of the implant

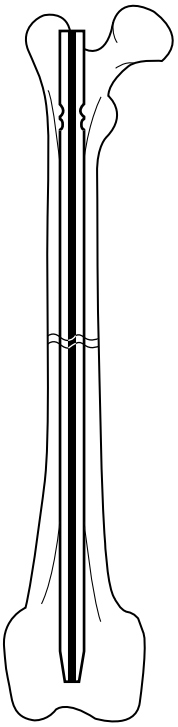
a). to facilitate insertion without comminution;

b). to transmit load to the bone to protect the implant while minimising stress protection resorbtion;

c). to stimulate the natural fracture healing mechanisms by allowing adequate motion at the fracture interface.
The fully-slotted Vari-Wall stainless steel rod provides the optimum combination of these properties.

INDICATIONS

standard intramedullary nailing

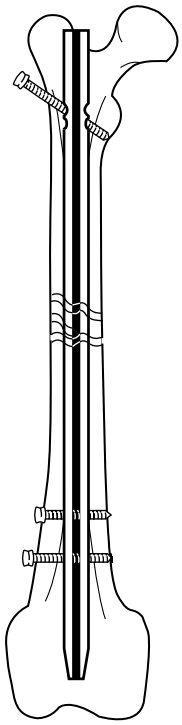


A

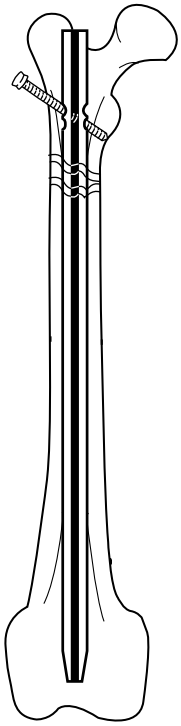
Standard Indications:

- Non-comminuted midshaft fractures (A).
  For non-comminuted midshaft fractures use either nail in either leg.

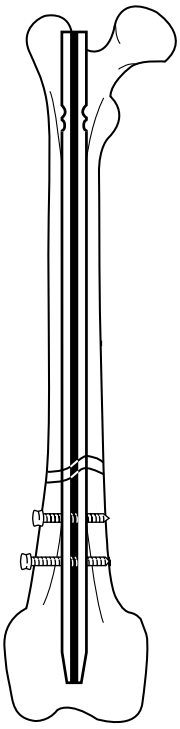
interlocking fixation



B



C

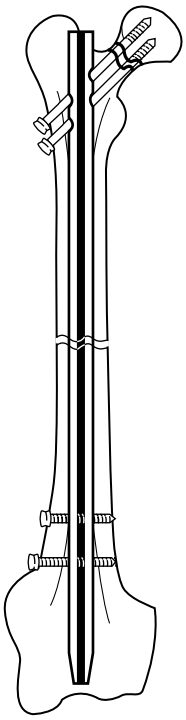


D

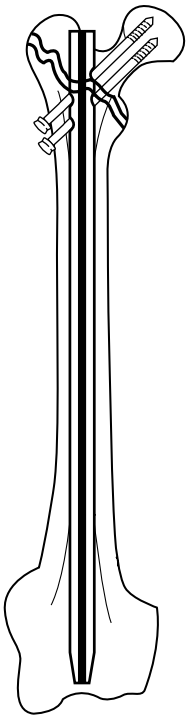
Interlocking Indications:

- Comminuted shaft fractures (B)
- Subtrochanteric fractures (C)
- Distal third fractures (D)

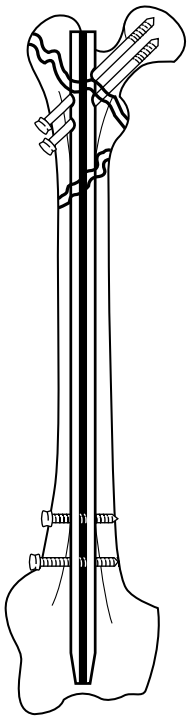
reconstructive fixation



E



F



G

Reconstructive Indications:

- Combination fractures of the shaft and neck (E).
- Intertrochanteric fractures (F).
- Combined intertrochanteric and subtrochanteric fractures (G).
- Reconstruction following tumour resection.

PREOPERATIVE PLANNING

estimation of nail size and diameter

To identify the correct diameter and length of the nail required, take A/P and lateral x-rays of the fractured femur at a distance of one metre with the cassette placed against the thigh. When possible, take A/P and lateral films of the uninjured leg for comparison.

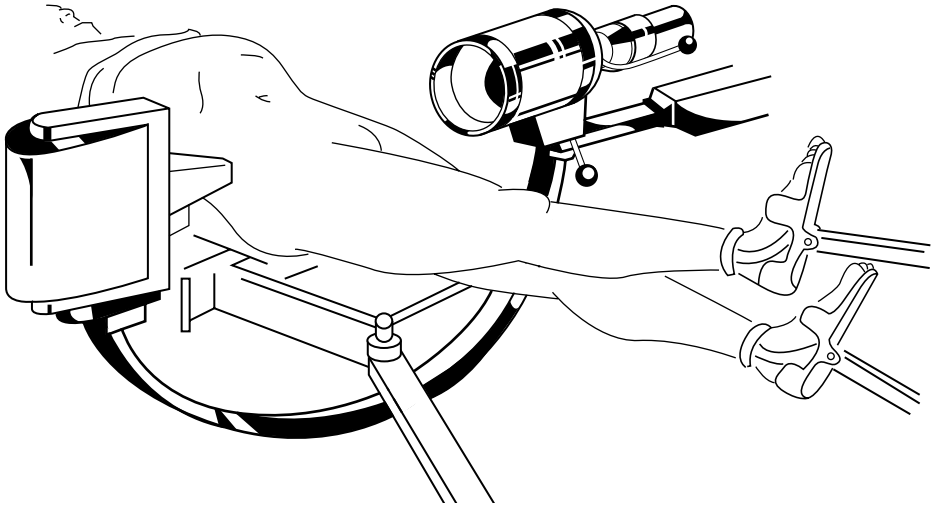
Estimate nail diameter and length by assessing medullary canal diameter and femur length on pre-operative radiographs by using the templates provided. The canal must be reamed to at least 11mm to accept the smallest Vari-Wall nail.

Nail length can be approximated visually by holding the nail to the injured leg. The correctly sized nail will extend from the tip of the greater trochanter to the intercondylar notch. Final determination of nail size must be made intraopertatively.

patient positioning

Interlocking - Position Supine

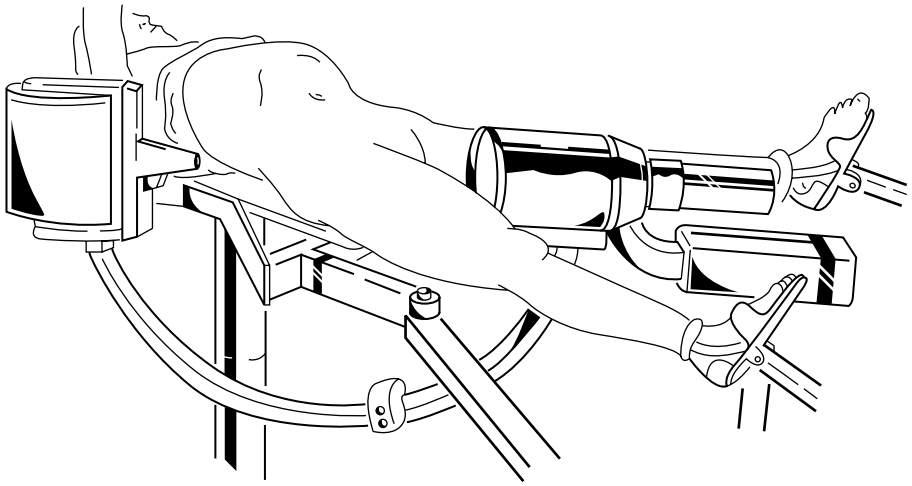
Supine positioning for interlocking or standard nailing.



Place patient supine on fracture table with the affected leg in neutral or slightly abducted. Either tibial or femoral pin traction is recommended. The unaffected leg is lowered to allow visualisation with the image intensifier in both A/P and lateral views.

PREOPERATIVE PLANNING
patient positioning

Reconstructive - Supine Position



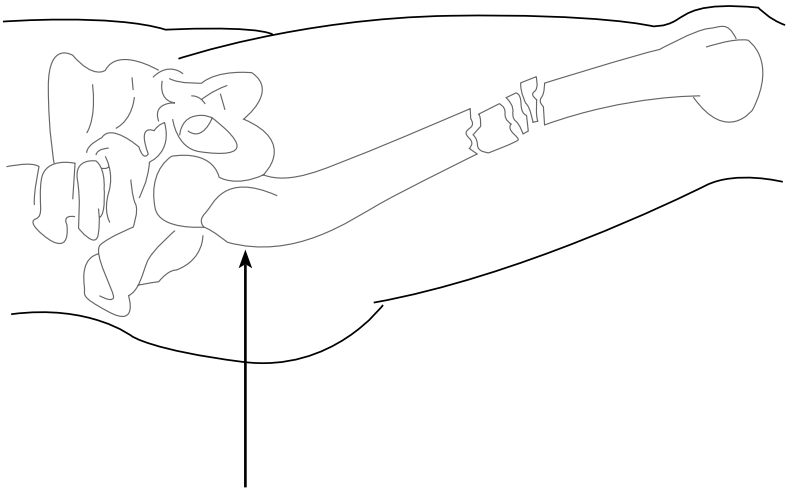
NOTE: This position is for reconstructive nailing only.

Place patient supine on fracture table with unaffected leg widely abducted.

Position image intensifier between the legs to allow for A/P and true lateral projections of the hip.

SURGICAL APPROACH

Supine approach is illustrated for this procedure.

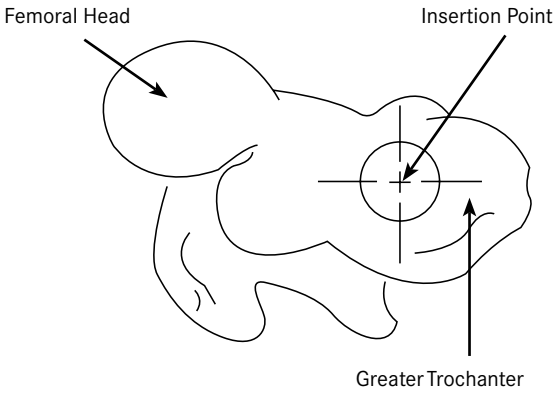


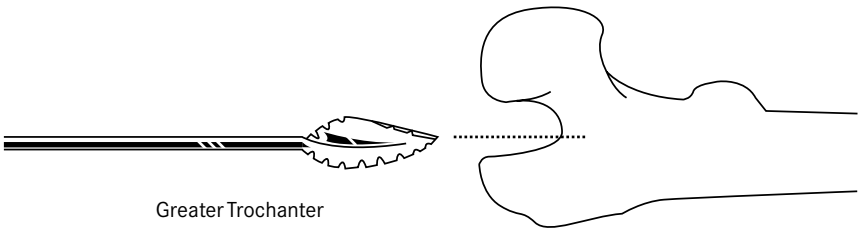
Start incision at the tip of the greater trochanter and extend it approximately 100mm proximally in line with the femoral shaft axis.

NAIL INSERTION POINT

canal location

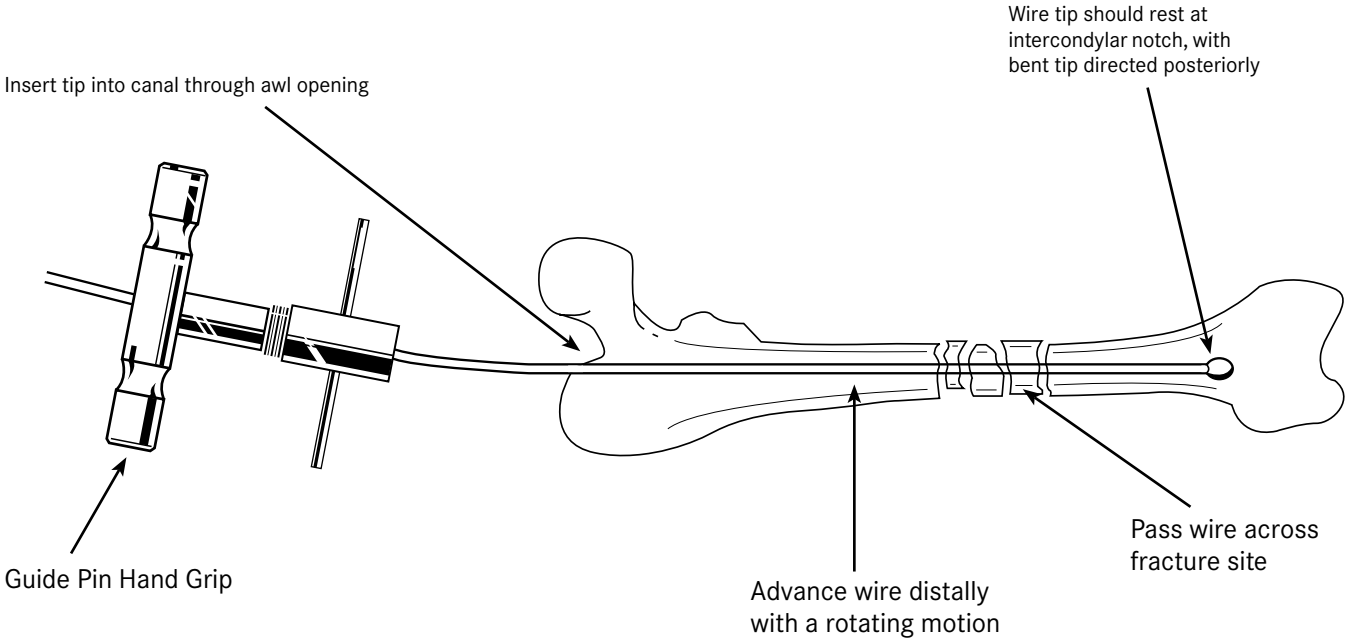
Split muscles and identify the A/P margins of the greater trochanter. Insert a sharp awl into the medullary canal through the region of the piriformis fossa. Check position with image intensifier. The insertion point is just medial to the greater trochanter and posterior to the central axis of the femoral neck. **Avoid anterior portals of entry.**





NAIL INSERTION

ball tip guide insertion



Bend the guide wire approximately 5-7 degrees 20mm from its tip to facilitate passage across the fracture. Advance the ball tipped guide wire to the fracture site with a rotating motion using a guide pin hand grip. Pass the wire across the fracture using bi-planar image control. The bent tip is turned posteriorly and advanced to the intercondylar notch. The guide wire should be located centrally in the canal. This can be verified by A/P and lateral x-rays.

In younger patients it may be appropriate to pierce the metaphyseal bone with a hand reamer before passage of the guide wire is possible.

Start bend 20mm from tip

Bend approximately 5-7°

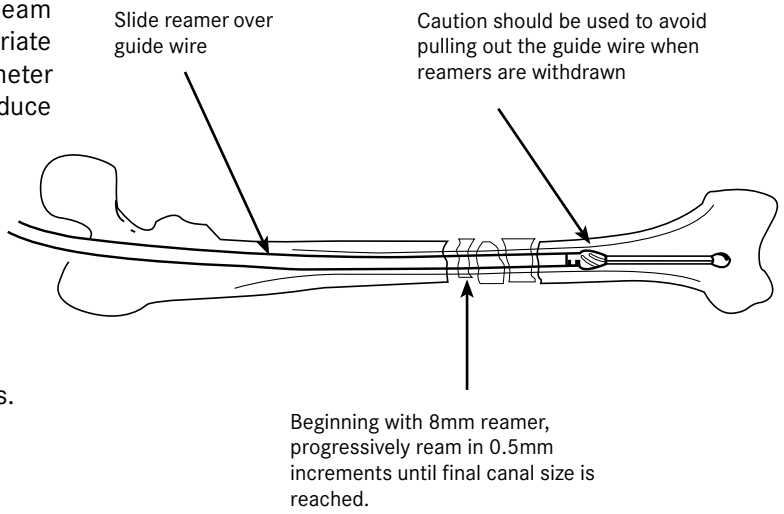
NAIL INSERTION

canal reaming

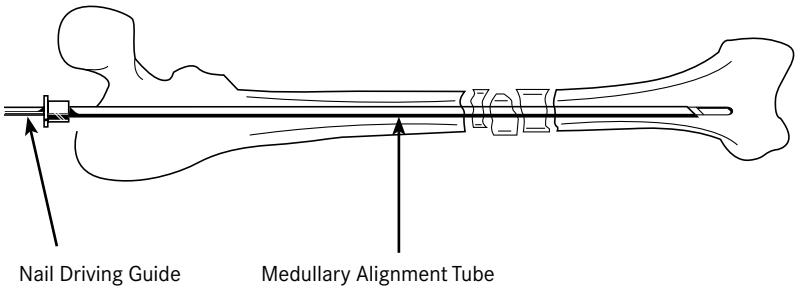
Start reaming with an 8mm end-cutting reamer. Ream progressively in 0.5mm increments until the appropriate canal diameter is reached. Reaming the canal diameter 1-1.5mm larger than the nail to be implanted will reduce the driving force on the nail, the potential risk of nail damage, and the chance of splitting the femur.

For reconstructive nailing, over-reaming by 2 full millimetres allows for later adjustment of anteversion without removal of the nail.

Surgeons should refer to the literature when faced with reaming segmental or very comminuted fractures.



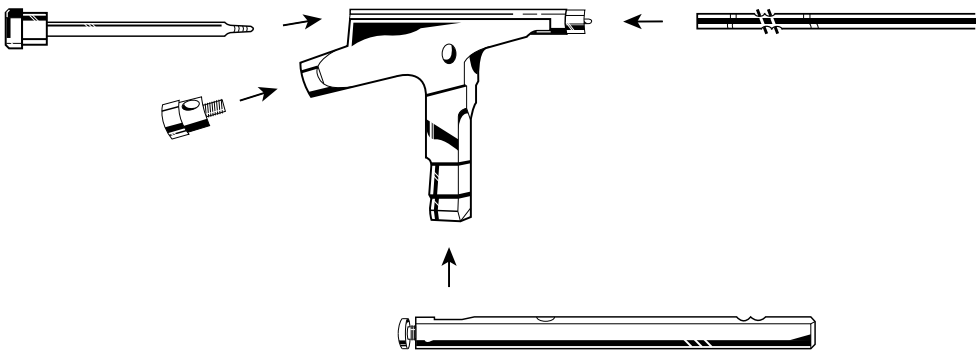
Following complete reaming, insert medullary alignment tube, remove guide wire and replace with nail driving guide.



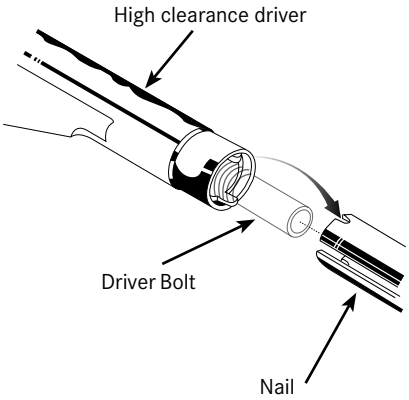
Insert the medullary alignment tube over the ball tipped guide wire. Remove the guide wire. Insert and advance the 4mm nail driving guide. Remove the alignment tube.

NAIL INSERTION

Insert the driver bolt into the driver handle. Slide the driver bushing over the end of the driver bolt until the flats line up. Lock the assembly together by pushing the tab on the driver handle.

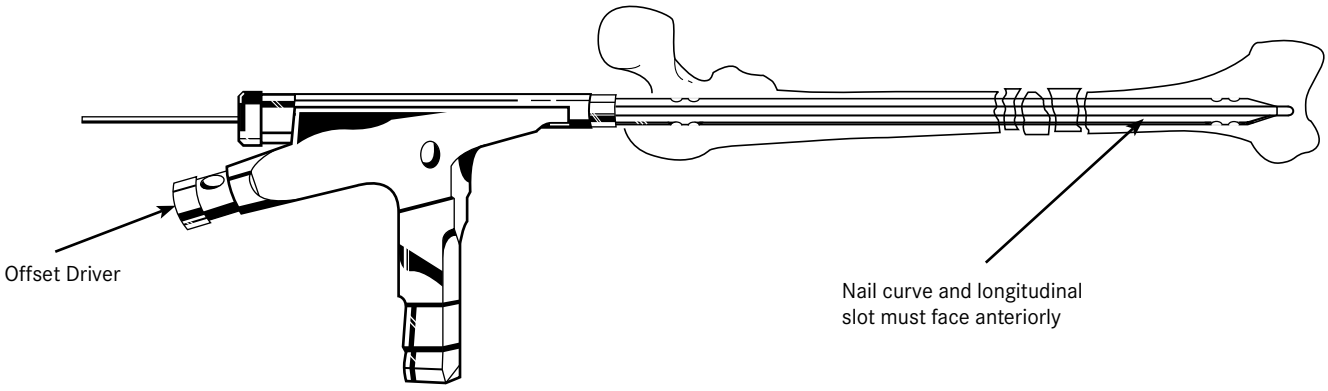


Engage nail slots with tangs on driver bushing to control nail rotation



Before threading the driver bolt into the nail, confirm the direction of the driver handle for right or left leg fixation. With the bow and longitudinal slot of the nail facing anteriorly, thread the driver bolt into the end of the nail using either an end wrench or universal socket wrench. Engage the nail slots with the tangs on the driver bushing to securely lock the assembly.

Note: It is essential that the nail locks securely into the handle because the nail alignment is controlled by this assembly.

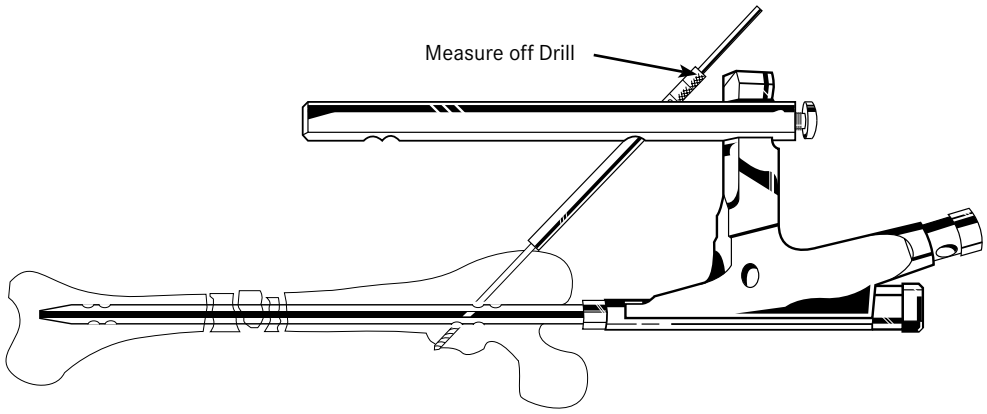


Thread the offset driver into the driver handle until fully seated. Place the nail over the nail driving guide. Drive the nail until the proximal end is even with the tip of the greater trochanter.

If the offset driver handle should loosen slightly during insertion, tighten it down before continuing. The distal nail tip should lie between the superior pole of the patella and the epiphyseal scar. Remove the nail driving guide. Unthread the offset driver using a lever bar.

SCREW INSERTIONS

proximal screw hole – interlocking application

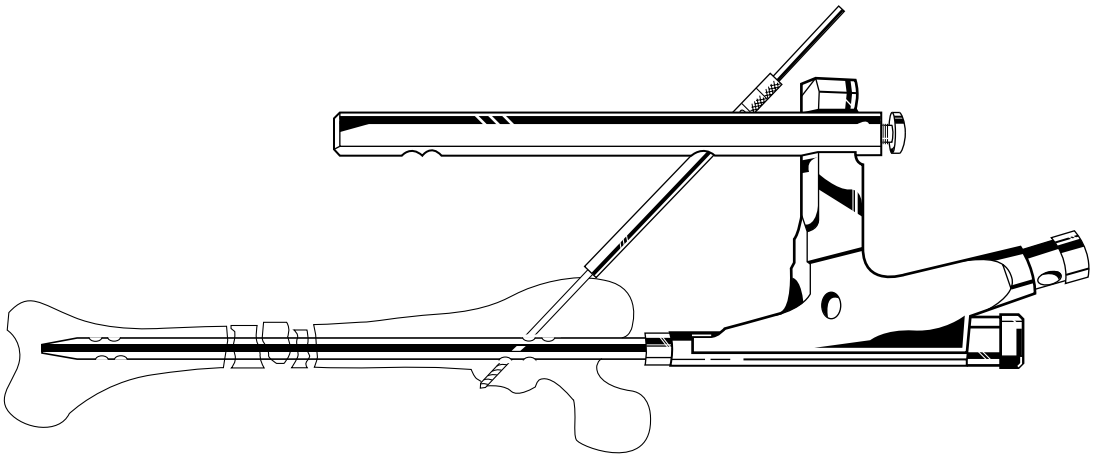


Thread the drill bushing A into the guide tube A. Insert the sleeves through the proximal target on the driver handle. Push the sleeves down to the femoral cortex via a stab incision. Tap lightly to rest against the bone.

Notes: For accurate screw length readings, the drill sleeve must be tight against the greater trochanter.

Place the 5mm calibrated twist drill through the sleeves and advance through both cortices. Read the screw length off the calibrated drill shaft. Remove the drill and bushing A.

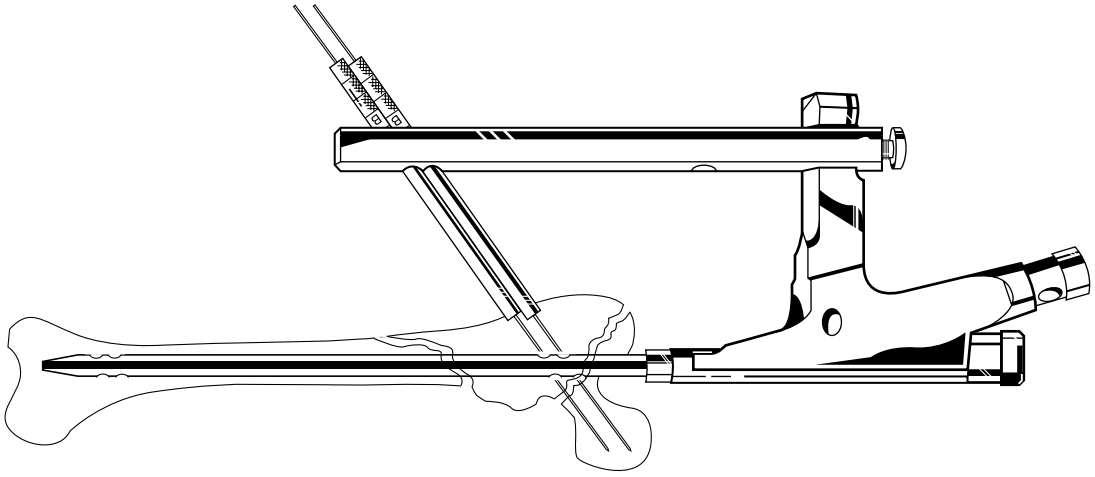
Note: The interlocking method uses the most distal of the proximal screw holes. This ensures maximum strength at the point of peak stress just distal to the screw hole



Insert the screw through the guide tube A and advance with the T-wrench until seated. Confirm screw placement with x-ray before removing the T-wrench and guide tube A.

SCREW INSERTIONS

proximal screw hole – reconstructive application



Prior to drilling holes, both guide pins should be inserted through the guide bushings and advanced into the bone to confirm placement.

Slide the proximal target over the driver handle until it is resting against soft tissue. Slide the proximal target back and either extend the initial incision or make separate proximal screw incisions. Split the skin, incise the fascia lata and carefully elevate the soft tissue from the bone. Slide the proximal target into position against the soft tissue and tighten by turning the thumbscrew or using the T-wrench. The driver handle is parallel to the angle of screw insertion (patent pending).

Insert the 3 sleeves labelled B into each other and lock by turning clockwise. Insert the sleeve assembly through the proximal target.

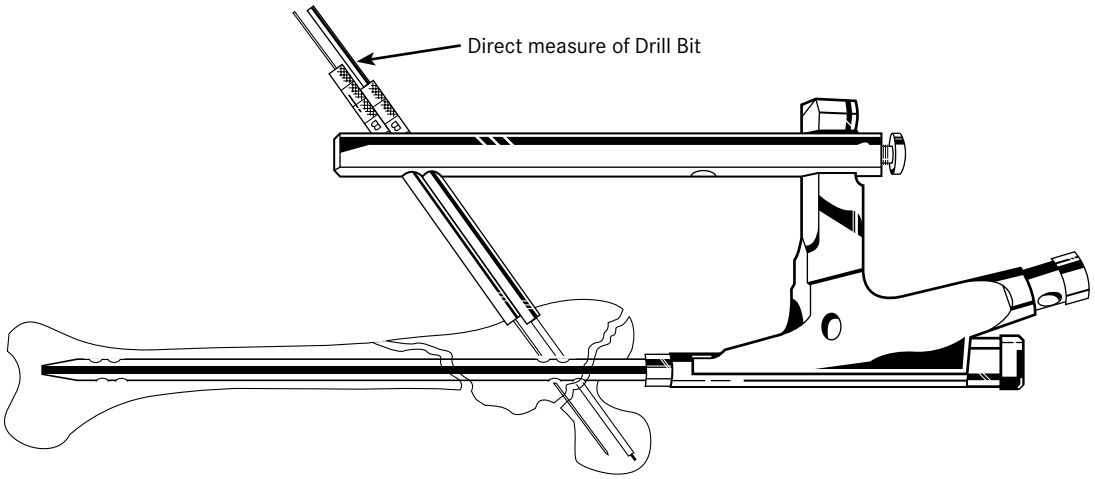
Note: Tap lightly to rest against the lateral femoral cortex for accurate screw length readings. Repeat with the other sleeve assembly.

Insert guide pins (3.2mm x 640mm) into the femoral head and take A/P and lateral x-rays to confirm guide pin positioning. The pins should be centrally located in the head. If the pins are not oriented correctly, the nail may require adjustment. Remove the guide pins before adjusting.

To advance the nail, attach the offset driver; to back out the nail, attach the extractor. A second verification is then required by reinserting guide pins to check the nail position. **Do not proceed until the guide pins are correctly positioned.**

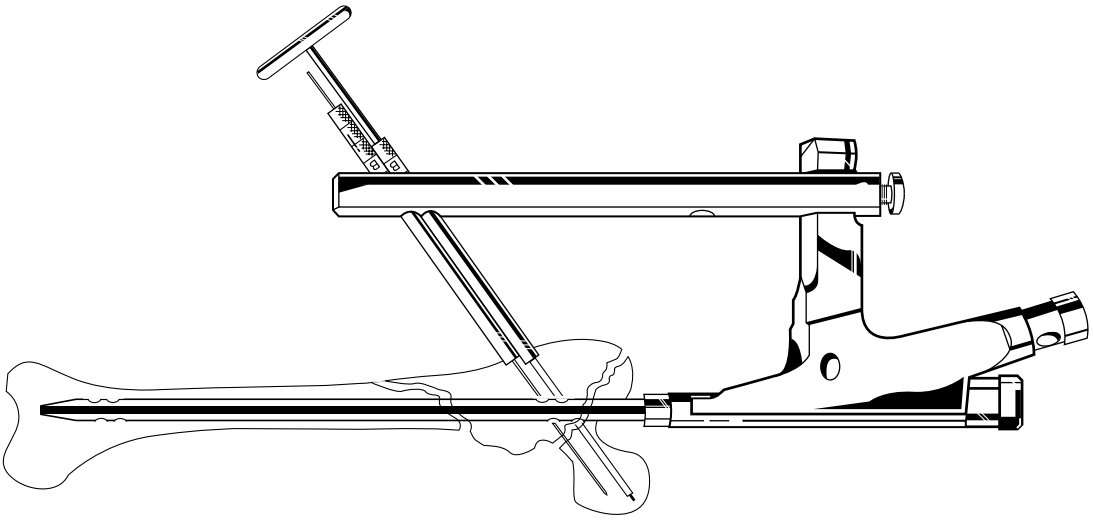
SCREW INSERTIONS

proximal screw hole – reconstructive application



Remove one guide pin and sleeve. Leave the other guide pin and sleeves in place to secure the position during drilling. Place the calibrated step drill through the drill bushing, advance to the lateral cortex and into the femoral neck and head. Use image-intensifier control to protect against femoral head perforation. Read the screw length from the calibrated drill shaft.

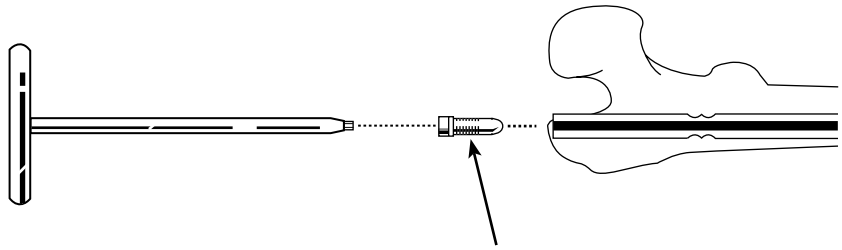
For accurate screw length readings, the drill sleeves must be against the lateral femoral cortex. Remove the step drill and drill sleeve.



Insert the partially-threaded screw through guide tube B and advance with the T-wrench until seated. Confirm screw placement with x-ray. Repeat for the other screw placement. Remove T-wrench, guide sleeves and proximal target.

Lateral x-ray view indicates approximately 9° anteversion with screws centrally positioned in the femoral head.

END CAP PLACEMENT

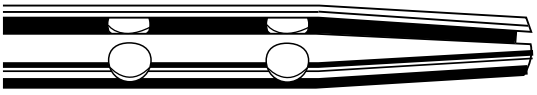


Screw protective end cap
into proximal end of nail.

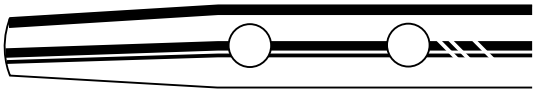
Following successful intramedullary nailing, the driver handle is removed using the universal socket wrench. The end cap can then be inserted with the T-wrench into the proximal end of the nail.

DISTAL SCREW HOLES

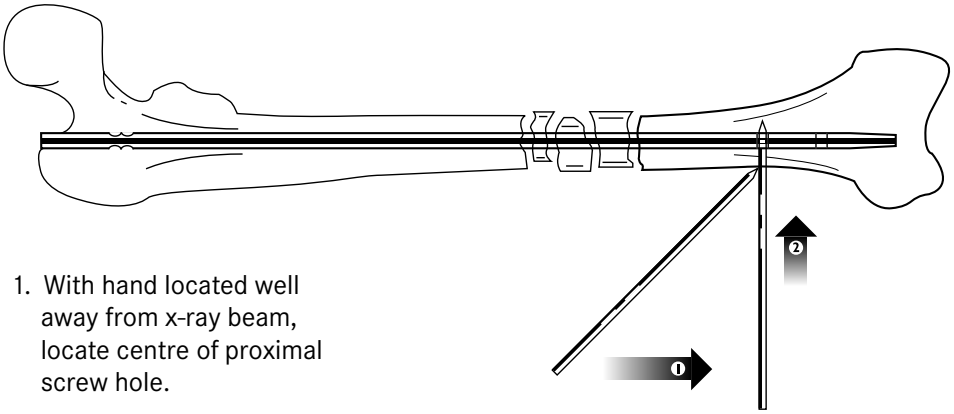
Incorrect



Correct



Position the C-arm about the distal femur so that the distal screw holes appear as concentric circles under fluoroscopic view. (see illustrations).

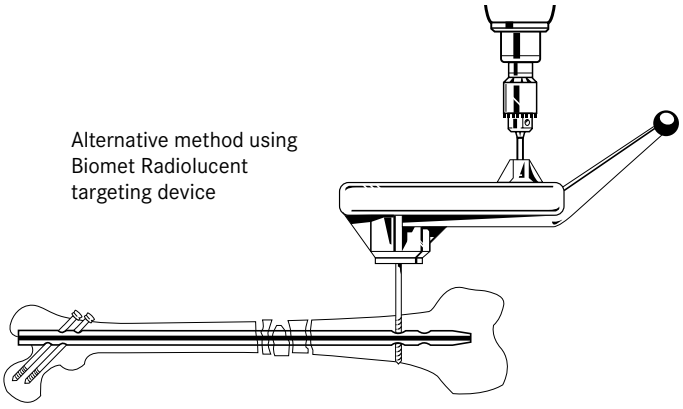


1. With hand located well away from x-ray beam, locate centre of proximal screw hole.

2. Turn beam off and bring aw or pin in line with the screw hole.

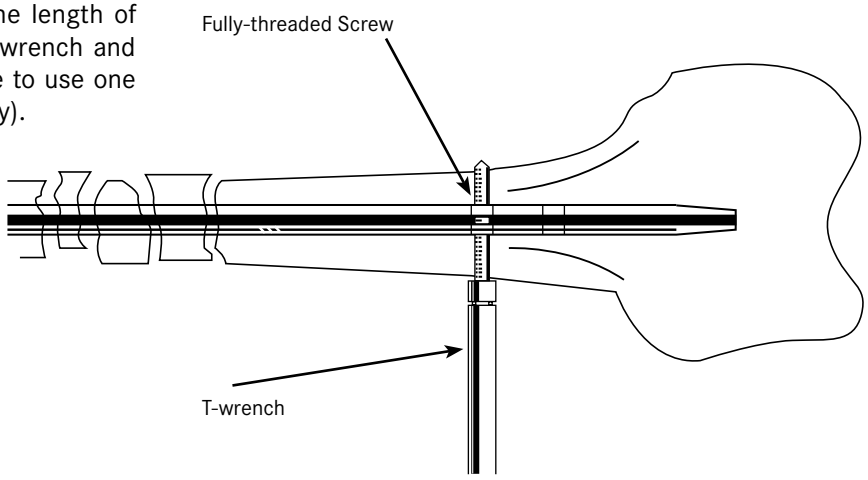
Achieve access to the bone and distal screw holes through a 50-60mm incision, or a pair of stab incisions. Elevate soft tissue from the bone. Locate the centre of one of the holes with an awl or Steinmann pin, keeping hands well out of the x-ray beam. Turn off the beam and bring the instrument in line with the C-arm. Tap the awl or pin through the lateral cortex and advance it through the screw hole. Do not advance through the medial cortex, as this may compromise screw fixation. Confirm engagement of the instrument radiographically. Remove the awl or pin.

Alternative method using Biomet Radiolucent targeting device



DISTAL SCREW HOLES

Use the 5mm calibrated twist drill to drill through the lateral cortex. As the drill advances, engaging the nail, it is advisable to either reverse or stop the drill and push it across the nail. Once the cutting edge is past the nail forward drilling is resumed until the medial cortex is drilled. Using the depth gauge, determine the length of screw required. Insert the screw onto the T-wrench and advance into the bone. (It is quite acceptable to use one distal screw for stability in bone of good quality).

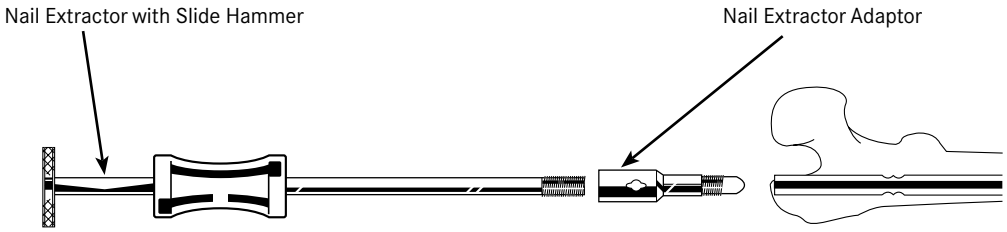


POST OPERATIVE CARE

Patients are started on gentle range of motion exercises of the knee and hip within 24 hours, and as tolerated, non-weight bearing ambulation on crutches is begun. Obvious limitations to this occur with extremely comminuted fractures or with multi-injured patients who are not capable of ambulation.

Generally, patients are discharged from 5 to 7 days post-operatively, depending on associated injuries, and are non-weight bearing for a minimum of 6 to 8 weeks.

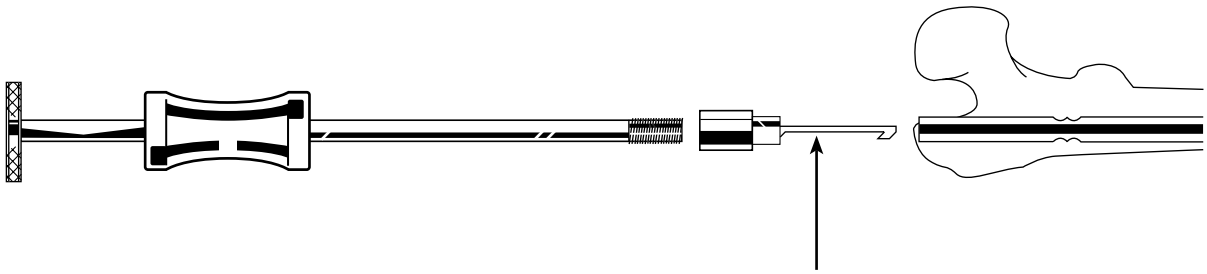
NAIL REMOVAL



Remove the distal and the proximal screws with the 5mm T-wrench. Make an incision at the nail insertion point. Remove the end cap with the T-wrench. Use the universal socket wrench to thread the nail extractor adaptor into the end of the nail.

The extractor adaptor encapsulates the nail end, preventing splaying. Thread the nail extractor with the slide hammer into the extractor adaptor and remove the nail.

Note: The nail should remain in place at least 12-18 months before removing.



If an end cap was not used and the threads are damaged use the hook adaptor. Catch the hook in the proximal screw hole on the side with a positive slope. Attach the nail extactor to the slide hammer and remove the nail.

Hook Adaptor catches proximal screw hole and attaches to nail extactor with slide hammer.

ORDERING INFORMATION

FEMORAL NAILS – LEFT INTERLOCKING, RIGHT RECONSTRUCTIVE

10mm Diameter

347226	Vari Wall Femoral Nail	10x260mm
347228		10x280mm
347230		10x300mm
347232		10x320mm
347234		10x340mm
347236		10x360mm
347238		10x380mm
347240		10x400mm
347242		10x420mm
347244		10x440mm
347246		10x460mm
347248		10x480mm
347250		10x500mm
347252		10x520mm

11mm Diameter

347326	Vari Wall Femoral Nail	11x260mm
347328		11x280mm
347330		11x300mm
347332		11x320mm
347334		11x340mm
347336		11x360mm
347338		11x380mm
347340		11x400mm
347342		11x420mm
347344		11x440mm
347346		11x460mm
347348		11x480mm
347350		11x500mm
347352		11x520mm

12mm Diameter

347426	Vari Wall Femoral Nail	12x260mm
347428		12x280mm
347430		12x300mm
347432		12x320mm
347434		12x340mm
347436		12x360mm
347438		12x380mm
347440		12x400mm
347442		12x420mm
347444		12x440mm
347446		12x460mm
347448		12x480mm
347450		12x500mm
347452		12x520mm

13mm Diameter

347526	Vari Wall Femoral Nail	13x260mm
347528		13x280mm
347530		13x300mm
347532		13x320mm
347534		13x340mm
347536		13x360mm
347538		13x380mm
347540		13x400mm
347542		13x420mm
347544		13x440mm
347546		13x460mm
347548		13x480mm
347550		13x500mm
347552		13x520mm

14mm Diameter

347626	Vari Wall Femoral Nail	14x260mm
347628		14x280mm
347630		14x300mm
347632		14x320mm
347634		14x340mm
347636		14x360mm
347638		14x380mm
347640		14x400mm
347642		14x420mm
347644		14x440mm
347646		14x460mm
347648		14x480mm
347650		14x500mm
347652		14x520mm

15mm Diameter

347726	Vari Wall Femoral Nail	15x260mm
347728		15x280mm
347730		15x300mm
347732		15x320mm
347734		15x340mm
347736		15x360mm
347738		15x380mm
347740		15x400mm
347742		15x420mm
347744		15x440mm
347746		15x460mm
347748		15x480mm
347750		15x500mm
347752		15x520mm

16mm Diameter

347826	Vari Wall Femoral Nail	16x260mm
347828		16x280mm
347830		16x300mm
347832		16x320mm
347834		16x340mm
347836		16x360mm
347838		16x380mm
347840		16x400mm
347842		16x420mm
347844		16x440mm
347846		16x460mm
347848		16x480mm
347850		16x500mm
347852		16x520mm

ORDERING INFORMATION

FEMORAL NAILS – RIGHT INTERLOCKING, LEFT RECONSTRUCTIVE

10mm Diameter

346226	Vari Wall Femoral Nail	10x260mm
346228		10x280mm
346230		10x300mm
346232		10x320mm
346234		10x340mm
346236		10x360mm
346238		10x380mm
346240		10x400mm
346242		10x420mm
346244		10x440mm
346246		10x460mm
346248		10x480mm
346250		10x500mm
346252		10x520mm

11mm Diameter

346326	Vari Wall Femoral Nail	11x260mm
346328		11x280mm
346330		11x300mm
346332		11x320mm
346334		11x340mm
346336		11x360mm
346338		11x380mm
346340		11x400mm
346342		11x420mm
346344		11x440mm
346346		11x460mm
346348		11x480mm
346350		11x500mm
346352		11x520mm

12mm Diameter

346426	Vari Wall Femoral Nail	12x260mm
346428		12x280mm
346430		12x300mm
346432		12x320mm
346434		12x340mm
346436		12x360mm
346438		12x380mm
346440		12x400mm
346442		12x420mm
346444		12x440mm
346446		12x460mm
346448		12x480mm
346450		12x500mm
346452		12x520mm

13mm Diameter

346526	Vari Wall Femoral Nail	13x260mm
346528		13x280mm
346530		13x300mm
346532		13x320mm
346534		13x340mm
346536		13x360mm
346538		13x380mm
346540		13x400mm
346542		13x420mm
346544		13x440mm
346546		13x460mm
346548		13x480mm
346550		13x500mm
346552		13x520mm

14mm Diameter

346626	Vari Wall Femoral Nail	14x260mm
346628		14x280mm
346630		14x300mm
346632		14x320mm
346634		14x340mm
346636		14x360mm
346638		14x380mm
346640		14x400mm
346642		14x420mm
346644		14x440mm
346646		14x460mm
346648		14x480mm
346650		14x500mm
346652		14x520mm

15mm Diameter

346726	Vari Wall Femoral Nail	15x260mm
346728		15x280mm
346730		15x300mm
346732		15x320mm
346734		15x340mm
346736		15x360mm
346738		15x380mm
346740		15x400mm
346742		15x420mm
346744		15x440mm
346746		15x460mm
346748		15x480mm
346750		15x500mm
346752		15x520mm

16mm Diameter

346826	Vari Wall Femoral Nail	16x260mm
346828		16x280mm
346830		16x300mm
346832		16x320mm
346834		16x340mm
346836		16x360mm
346838		16x380mm
346840		16x400mm
346842		16x420mm
346844		16x440mm
346846		16x460mm
346848		16x480mm
346850		16x500mm
346852		16x520mm

FIXATION SCREWS – FULLY THREADED

348130	Stainless Steel Full Threaded Screw ø	6x30mm
348135		6x35mm
348140		6x40mm
348145		6x45mm
348150		6x50mm
348155		6x55mm
348160		6x60mm
348165		6x65mm
348170		6x70mm
348175		6x75mm
348180		6x80mm
348185		6x85mm
348190		6x90mm
348195		6x95mm
348200		6x1000mm

FOR 10MM/11MM NAILS

348325	Stainless Steel Full Threaded Screw ø	5x25mm
348330		5x30mm
348335		5x35mm
348340		5x40mm
348345		5x45mm
348350		5x50mm
348355		5x55mm
348360		5x60mm
348365		5x65mm
348370		5x70mm

FIXATION SCREWS – PARTIALLY THREADED (reconstructive only)

348270	Stainless Steel Part Thread Screw ø	6.4x70mm
348275		6.4x75mm
348280		6.4x80mm
348285		6.4x85mm
348290		6.4x90mm
348295		6.4x95mm
348300		6.4x100mm
348305		6.4x105mm
348310		6.4x110mm
348315		6.4x115mm
348320		6.4x120mm

END CAPS – LOW PROFILE

348710	End Cap (12mm-16mm Nails)
348709	End Cap (10mm & 11mm Nails)

INTRAMEDULLARY NAILING

FEMORAL INSTRUMENTATION

for use with Uniflex and Vari-Wall Intramedullary Nails

INSTRUMENTATION

401127	Driver Bolt (HC) 10mm-11mm
471710	Driver (HC)
471712	Driver Bolt (HC) 12mm-16mm
471714	Offset Driver
471716	Prox. Target
471731	Plain Bar
471756	Universal Hex Socket Wrench
471758	Titanium End Wrench
471760	Hex Drive T-wrench
471765	Nail Extractor Slide Hammer
471768	Nail Extractor Adaptor
471770	Nail Extractor Hook with Adaptor
471795	Distal Tragetting Awl
469390	Medullary Alignment Tube pack/6
34-513646	Screw Depth Gauge
472254	Twist Drill 4mm x 180mm
401196	Universal Nail Sterilisation Box (all sizes)
401191	Instrument Case No. 1
401192	Instrument Case No. 2
401193	Insturment Case No. 1 c/w instr
401194	Insturment Case No. 2 c/w instr

INTERLOCKING ONLY

471732	Guide Tube A
471734	Drill Bushing A-5mm
471736	Callibrated Drill 5 x 254mm

RECONSTRUCTIVE ONLY

27-361681	3.2x305mm Guide Pins Pack/6
471740	Proximal Target
471742	Guide Tube B (2 each)
471744	Drill Bushing B 6.2mm (2 each)
471746	Guide Bushing B 3.2mm (2 each)
471748	Callibrated Step Drill 6.2mm x 330mm

ADDITIONAL INSTRUMENTATION FOR SMALL NAILS

471771	Small Driver Bolt (10mm & 11mm)
471773	Nail Extractor Adaptor (10mm & 11mm)
471772	Nail Extractor Hook with Adaptor (10mm & 11mm)

NOTES

FLT001 08/04

Waterton Industrial Estate,
Bridgend, South Wales,
CF31 3XA,
United Kingdom
Tel: +44 (0) 1656 655221
Fax: +44 (0) 1656 645454

Email: contact@biometeurope.com
www.biomet.co.uk