



Zimmer® Natural Nail® System

Retrograde Femoral Nail
Surgical Technique



**Zimmer Natural Nail
System Retrograde Femur
Nail Surgical Technique****Table of Contents**

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Product Overview

The *Zimmer Natural Nail System* is a system of intramedullary (IM) nails, screws, instruments and other associated implants that are designed to provide stable internal fixation for fractured long bones. The nails have been designed for specific applications to help restore the shape of the fractured bone to its natural, pre-injured state.

The Retrograde Femur nail is designed to help treat various fractures of the femur. Screws are placed through the nail to secure the implant in place and maintain length and alignment while healing occurs. The nail has multiple screw holes in the distal body to allow surgeons to address different fracture types. The proximal slot allows for compression or dynamization across a fracture.

Several lengths and diameters are available to match the individual anatomy of the patient.

Implant Overview

Nail Diameters: 10, 11.5 and 13mm for short and long nails

Nail Lengths: 16, 20 and 24cm for short nails

28 to 44cm in 2cm increments for long nails

Distal Screw Diameter: 6.0mm for Oblique Interlocking and Transverse Interlocking Screws

Distal Screw Lengths: 30 to 110mm in 5mm increments.

Screw Type: Fixed Angle Screws

Proximal Screw Diameter: 5.0mm for all diameter nails

Proximal Screw Lengths: 20 to 60mm in 2.5mm increments

Screw Type: Fixed Angle Screws and Partially Threaded Screws

Further available: nail caps (0mm, 5mm, 10mm and 15mm height), cortical nut and washer

Materials: Ti-6Al-4V Alloy and UHMWPE (cortical nut only)

Precision instrumentation is provided to help implant the nail. Many of the instruments and implants feature a color coding system to help the surgical team use the system. Certain universal instruments are not color coded. The color coding system is referenced in the technique. A wall chart (97-2494-003-00) is also available to help explain the color coding system.

Indications

The *Zimmer Natural Nail System* is intended for temporary fracture fixation and stabilization of the bone.

Indications for use of the Retrograde Femur Nails in the femur including:

- Compound and simple shaft fractures
- Proximal, metaphyseal, and distal shaft fractures
- Segmental fractures
- Closed Supracondylar Fractures

- Severely comminuted supracondylar fractures with articular involvement
- Fractures involving femoral condyles
- Comminuted fractures
- Fractures involving osteopenic and osteoporotic bone
- Pathological fractures
- Fractures with bone loss
- Pseudoarthrosis, non-union, and mal-union
- Periprosthetic fractures
- Poly trauma patients

Contraindications

- A medullary canal obliterated by a previous fracture or tumor
- Bone shaft having excessive bow or deformity
- Lack of bone substance or bone quality which makes stable seating of the implant impossible
- All concomitant diseases that can impair the functioning and the success of the implant
- Infection
- Insufficient blood circulation
- Skeletally immature patients

Surgical Technique

Preoperative Planning

Preoperative planning is recommended before beginning the surgical procedure. A/P and Lateral x-rays of the injured femur should be taken preoperatively and evaluated for length, canal size and implant suitability. A/P and Lateral x-rays of the contralateral uninjured femur can also be taken preoperatively to provide insight into the characteristics of the pre-injured femur.

Patient Positioning

Place the patient in the supine position with the knee flexed approximately 30 - 60 degrees. Prep the hip limb free, circumferentially from the hemi pelvis to the toes, to ensure access to the lesser trochanter.



The use of a traction or fracture table can be beneficial to help during fracture reduction as well as to facilitate intraoperative imaging with a C-arm.

The use of image intensification is required. The image intensifier should be sterile-draped and may be positioned from either the contralateral or ipsilateral side of the operating table. Positioning from the contralateral side will facilitate insertion of the proximal locking screws. This will also allow the limb to be externally rotated when obtaining

a lateral view of the proximal femur for estimating the screw length. Confirm visualization of the hip as well as the shaft of the femur and knee using image intensification before prepping and draping.

Reduction

Nail insertion is facilitated by achieving fracture reduction before beginning any of the steps to place the IM Nail. Traction should be used as necessary to help achieve fracture reduction. Several instruments are available to assist in fracture reduction including clamps, reduction tongs, ball spike pushers and Steinman pins. Blocking screws are another option in facilitating fracture reduction and an ideal nail path.

Starting Point Location

Locating the entry portal is important to avoid anterior placement of the nail, involvement of the intercondylar notch, femoral trochlea, mediolateral mal-positioning, or posterior positioning involving the posterior cruciate ligaments.

Make a midline or medial parapatellar longitudinal incision in line with the femoral shaft. Incise the parapatellar reticulum or peritenon to expose the infrapatellar fat pad. It is not necessary to expose the femoral condyles as placement of the pin is determined under C-arm control.

Insert the guide pin in the starting point. Guide the pin to the notch region using gentle pressure to avoid scoring of the articular cartilage (Fig. 1).



Fig. 1

Use the C-arm to visualize the pin's position from an A/P, intercondylar notch and Lateral views. The starting point should be in line with the femoral canal on the A/P view, and just anterior to where Blumensaat's line intersects the anterior intercondylar notch on the lateral view. This can also be confirmed on the intercondylar notch view.

When the proper position is confirmed, apply firm pressure on the pin so the tip engages and maintains its position. Then adjust the angle of the pin so it is aligned collinearly, with the femoral canal on both AP and lateral images. Continue to monitor the pins alignment and progression (A/P and lateral C-arm views) as the pin is advanced.

Advance the pin proximally until reduced resistance is felt as the pin exits the metaphyseal region. Make a final check with A/P and lateral views.

As an option to insert the guide pin, assemble the STARTING POINT LOCATOR inside the ENTRY CANNULA. Place the tip of the STARTING POINT LOCATOR through the incision down to the intercondylar notch. Place the 3.0mm PIN through the center hole of the STARTING POINT LOCATOR. Use the steps indicated above to obtain the correct starting point using the C-arm (Fig. 2).



Fig. 2

Use the 8mm ENTRY REAMER to ream an entry portal over the guide pin into the distal femur through the starting point. Be sure to follow the path of the pin, allowing the reamer to advance through the metaphyseal bone without binding on the pin and pushing it up the femoral canal. Stop reaming when reduced resistance is felt. Remove the reamer and 3.0mm pin (Fig. 3).



Fig. 3

Alternatively, a 13.5mm TAPER REAMER or SHORT CANNULATED AWL can be used to initiate the entry portal. Do not place the SHORT CANNULATED AWL over the 3.0mm pin (Fig. 4).



Fig. 4

Place a 3.0mm x 100cm GUIDE WIRE through the ENTRY CANNULA, all the way into the proximal femur. To aid in manipulation, bend the tip of the guide wire at about a 10 degree angle 5cm from the end.

CAUTION: If the guide wire is bent shorter than 5cm from the end of the wire and/or more than 10 degrees it



Fig. 5

may be difficult to remove from the nail. If the wire becomes lodged inside the nail, utilize the GUIDE WIRE GRIPPER and mallet to remove the guide wire from the nail.

The GUIDE WIRE must be placed through the fracture site. At the fracture site, manipulate the GUIDE WIRE under C-arm control. If you plan to ream the canal of the femur, the guide wire should be embedded in the proximal femur canal using the GUIDE WIRE GRIPPER and a MALLET (Fig. 5).

A REDUCTION FINGER is included in the set. The GUIDE WIRE can be fed retrograde through the REDUCTION FINGER. The REDUCTION FINGER can then be placed into the femur and used to help reduce the fracture from the inside as well as to help facilitate passage of the guide wire across the fracture site.

If a LONG NAIL is to be implanted, assemble the TWO PIECE NAIL LENGTH GAUGE. This step can be skipped if using a short nail (16cm, 20cm or 24cm in length).



Fig. 6

Fig. 6a



Slide the tube portion of the gauge over the 3.0mm x 100cm guide wire until the tip of the tube is at the level of the intercondylar notch (confirm position using fluoroscopy). The distal end of the GUIDE WIRE indicates the length of the wire in the canal. When determining nail length, consideration should be taken as to how deep the nail will be inserted into the femur based upon the shape of the patient's proximal femur. A ruler is also included in the set which can be used to radiographically determine nail length (Figs. 6 and 6a).



Fig. 7



Fig. 7a

Distal Reaming

Use the 13.5mm TAPER REAMER (PURPLE) through the ENTRY CANNULA to prepare the distal femur for the distal portion of the nail. The C-arm should be used to visualize the depth of the reamer in the distal femur. 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 (Figs. 7 and 7a).

The 13.5mm TAPER REAMER has a groove on it. The most proximal groove indicates the final position of the most distal portion of the nail.

NOTE: This corresponds to the measurement of the nail depth using the NAIL DEPTH GAUGE and CONNECTING BOLT. Also, the measurements correlate to the approximate height of the nail cap if desired.

Shaft Reaming

Reaming should be performed through the ENTRY CANNULA. Start with a small reamer. Increase the diameter of the reamer by 0.5 - 1.0mm depending on the amount of resistance felt while reaming. When cortical chatter occurs, stop reaming. Choose a nail that is 1.0 - 1.5mm smaller than the last shaft reamer used. If a short nail is to be used, it is only necessary to ream the distal portion of the canal (depending on intended nail length). If a long nail is planned, ream the full length of the canal. The GUIDE WIRE PUSHER can help prevent the GUIDE WIRE from coming out of the femur during reaming (Fig. 8).

NOTE: If the guide wire becomes lodged within the reamer, use the guide wire pusher to push the guide wire back into the IM Canal.



Fig. 8

Implant Selection

Choose the appropriate length and diameter of nail based on length and diameter measurement (fluoroscopic or based upon the last size reamer used).



Fig. 9

If the length indicated is between two available nail sizes, it is recommended that the shorter nail be chosen. The nail tip should not extend proximal to the intertrochanteric region.

Nail Assembly and Insertion

The color code for the retrograde femur nails is PURPLE. Ti-6Al-4V Alloy nails, the TARGETING GUIDE and the CONNECTING BOLT all have PURPLE colors on them, as well as the word PURPLE etched on them (Fig. 9).

Place the CONNECTING BOLT through the barrel of the TARGETING GUIDE. Begin threading the CONNECTING BOLT into the distal portion of the nail. Orient the distal portion of the nail so that the slots in the nail match up with the corresponding lines on the barrel of the TARGETING GUIDE. Completely tighten the CONNECTING BOLT using an 11mm WRENCH to secure the nail to the guide. The arrow on the nail will line up with the arrow on the barrel of the guide when the nail is correctly aligned. The bow of the nail should be anterior to match the bow in the femur (Fig. 10).



Fig. 10

Use a screw cannula, drill sleeve and drill bit to verify that the holes in the guide target the holes in the nail. If using a SHORT NAIL, the appropriate PROXIMAL TARGETING MODULE should be attached to verify that the drills line up with the proximal holes in the nail. Remove the PROXIMAL TARGETING MODULE before inserting the nail (Fig. 11).



Fig. 11

Insert the nail over the guide wire. Monitor the progression of the nail using the C-arm, especially as the nail is passing through or near the fracture site (Fig. 12).



Fig. 12

If the nail does not pass down the canal easily, attach the IMPACTION HEAD to the CONNECTING BOLT. Using the MALLET, impact gently on the IMPACTION HEAD (Fig. 13).



Fig. 13

CAUTION: Do not strike excessively as damage to the guide and the bone may result. Verify that the CONNECTING BOLT is tight while impacting. Do not impact on any other portion of the TARGETING GUIDE as this may break the guide or cause it to lose its accuracy.

If the nail will not advance with impaction, remove the nail and ream the canal to a larger diameter at additional 0.5 mm increments or consider using a smaller diameter nail.

Remove the GUIDE WIRE from the nail using the GUIDE WIRE GRIPPER. If possible, the guide wire should be removed before the nail is completely seated to reduce the potential for the wire to get caught in the nail or bone being impacted into the cannula of the nail (Fig. 14).



Fig. 14

Note: If guide wire gets stuck during removal, rotate wire 90 degrees as force is applied to remove. This can be accomplished by using the Guide Wire Gripper.

It is recommended that the distal tip of the nail be placed 3-5mm inside the distal surface of the femur. However, the nail can be placed deeper and nail cap used to fill femoral canal. To verify depth, advance the NAIL DEPTH GAUGE through the guide. The NAIL DEPTH GAUGE must be assembled before attaching the IMPACTION HEAD. To ensure the NAIL DEPTH GAUGE does not slide into the femoral canal opening, place a blue

PROTECTIVE CAP over the distal end of the NAIL DEPTH GAUGE. The IMPACTION HEAD must remain assembled to the CONNECTING BOLT in case the nail depth needs to be adjusted. Compare the distal tip of the RETROGRADE FEMUR NAIL DEPTH GAUGE with the calibrated etch lines on the CONNECTING BOLT to determine nail depth. Confirm the depth using a lateral x-ray. The nail depth is a result of the depth prepared with the 13.5MM TAPER REAMER. If oblique screws are to be used, verification of nail depth is critical. To facilitate observation of nail depth using fluoroscopy, the C-Arm can be tilted 5-15 degrees off of the true lateral plane to verify the end of the nail to the Blumensatt's Line. A perfect circle should be observed through the transverse hole to ensure proper orientation (Fig. 15).



Fig. 15

Nail rotation is also critical with this nail and should be verified by placing 3.0mm PINS through the holes in the targeting guide on either side of the connecting bolt. Place the blue PROTECTIVE CAPS on the pointed end of the 3.0mm PINS before inserting into the Targeting Guide to prevent them from falling on the floor. Rotate the guide so that the pins are parallel with the tibia shaft (Fig. 16).



Fig. 16

Distal Screw Placement

Use only 6.0mm FIXED ANGLE screws through the appropriate distal holes in the nail.

A fixed angle construct is created by using 6.0mm fixed angle screws. The instruments needed to place screws through the distal portion of the nail are color coded according to the chart below. The retrograde femur guides use the PURPLE instruments.

<i>Instrument Type</i>	<i>Standard</i>
Screw Cannula	Purple
Trocar/Tri-Flute Trocar	Purple
4.9mm Drill Sleeve	Purple/Black
4.9mm Drill Bit (solid or cannulated)	Purple/Black
3.0mm Pin Sleeve	Purple
Screw Depth Gauge/ Cannulated Screw Depth Gauge	Purple
Screwdriver	Purple

Note: 6.0mm fixed angle screws contain the color/color name of BLACK on the label and screw case. These colors match the color rings on the drills.

If impaction was required, retighten the CONNECTING BOLT to the nail (Fig. 17).



Fig. 17

Only certain distal screw patterns should be used. Use of all other screw combinations may subject the device to increased stresses, which could lead to device failure. Please choose the appropriate screw pattern from the table below. These screw patterns are also depicted on the targeting guide (Fig. 18).



Fig. 18

Before placing any oblique screws, place 3.0mm PINS through the pin holes in the targeting arms. Use the blue pin caps to secure the pins in the holes. Place the blue pin caps on the pointed end of the 3.0mm PINS. Take a lateral x-ray. The position of the pins on the lateral x-ray represents where the oblique screws will be placed. If lateral imaging is difficult, incline the C-arm beam 5 – 15 degrees off the horizontal. The 3.0mm PINS must be contained in the metaphyseal region in any imaging in any plane. The most distal transverse hole has to be imaged as a perfect circle (Fig. 19).



Fig. 19

Two factors will primarily affect the location of the two oblique screws: nail insertion depth and nail rotation. It is recommended that nail insertion depth be adjusted first and then rotation of the nail/targeting guide.

If a WASHER (can be used at any distal hole) or CORTICAL NUT (used only at most distal transverse hole) is desired, please refer to the steps for placing these items below.

After confirming appropriate nail insertion depth and rotation, it is suggested that the 3.0mm PIN be placed in one of the transverse holes. This will stabilize the nail and targeting guide in the selected position.

Slide the TROCAR into the SCREW CANNULA. Slide the SCREW CANNULA through one of the transverse holes in the TARGETING MODULE. Incise the skin at the point the TROCAR touches it and dissect through the tissue down to the bone to make a path for the SCREW CANNULA. Advance the SCREW CANNULA until the tip of the TROCAR is against the bone (Fig. 20).



Fig. 20

CAUTION: Do not excessively impact the SCREW CANNULA. Use appropriate incision to seat the TROCAR/SCREW CANNULA as impaction may cause loss of accuracy (Fig. 21).



Fig. 21

Remove the TROCAR. Before drilling, use the PIN SLEEVE and drive in a guide pin to preview targeting via fluoroscopy. Confirm the rotational position of the nail and guide, in addition to the nail depth imaging the 3.0 pins in the targeting guide. Then refer to the steps listed below to insert the guide pin(s) in the oblique holes (Fig. 22).



Fig. 22

Returning to the transverse hole, remove the GUIDE PIN and PIN SLEEVE, and insert the appropriate sized DRILL SLEEVE through the CANNULA down to the bone. Place the appropriate sized solid DRILL BIT through the DRILL SLEEVE. Before the DRILL BIT contacts the bone, start the drill. (Cannulated technique is described below.)

It is suggested that the first screw be placed in one of the transverse holes prior to the oblique holes.

For Transverse Screws

Advance the spinning DRILL BIT through the bone bicortically. Use fluoroscopy to verify the appropriate location of the DRILL BIT in the bone. The tip of the drill should be no more than 5mm through the far cortex of the bone to reduce the risk of complications associated with screw protrusion.

With the DRILL BIT in place and the DRILL SLEEVE pressed against the bone, the length of screw needed is indicated by the etch marks on the DRILL BIT where it exits the DRILL SLEEVE. (Alternatively, the DRILL BIT and DRILL SLEEVE can be removed and the SCREW DEPTH GAUGE used to measure the length of screw.)

Alternatively, the cannulated technique, as described below for the oblique screws, can be used.

For Oblique Screws

The cannulated technique must be used for placement of the oblique screws. Slide the TROCAR into the SCREW CANNULA. Slide the SCREW CANNULA through one of the selected holes in the TARGETING MODULE. Incise the skin at the point the TROCAR touches it and dissect through the tissue down to the bone to make a path for the SCREW CANNULA. Advance the SCREW CANNULA until the tip of the TROCAR is against the bone.

Remove the TROCAR. Insert the 3.0mm PIN SLEEVE through the CANNULA down to the bone. Insert a 3.0mm PIN through the bone (bicortical for transverse screws, short of the far cortex for an oblique screw). Remove the PIN SLEEVE.

Insert the CANNULATED DEPTH GAUGE over the pin and observe the location of the end of the pin in relation to the etched calibration lines on the CANNULATED DEPTH GAUGE to determine length of screw. PLACE THE 4.9mm DRILL SLEEVE in the CANNULA. Drill using the 4.9mm CANNULATED DRILL BIT through the DRILL SLEEVE to the appropriate depth, which is recommended to be at least 10mm from the subchondral bone for bone that is less dense or severely osteoporotic. It is recommended to use a screw that would be at least 5mm from the subchondral bone (Fig. 23).



Fig. 23

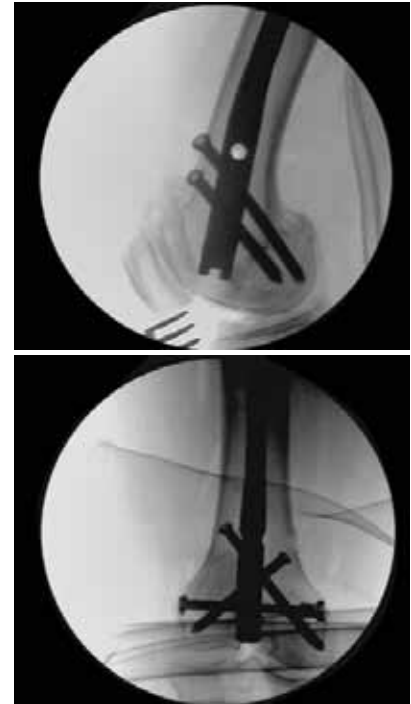
Measure the appropriate screw length using the marks on the calibrated drill or the depth gauge (ensure the tip of the shaft engages with the far cortex of the bone). The SCREW CANNULA must be seated on the bone for the calibration lines to be accurate.

Remove the DRILL BIT and DRILL SLEEVE. Place the appropriate length and diameter screw through the SCREW CANNULA into the bone. Use the 3.5mm HEX SCREWDRIVER to advance the screw to achieve good thread purchase, care should be taken using fluoroscopy to prevent perforating the subchondral bone (the screw head should sit on the near cortex of the bone). An etch line on the SCREWDRIVER indicates when the screw head is at the bone surface (this is to be used as a reference and not the primary check for the screw head being seated on the bone). The screws are self tapping so tapping should not be necessary (Fig. 24).



Fig. 24

Repeat this technique to place additional distal screws as necessary.



CAUTION: When using any screwdriver do not torque it beyond the calibration line. Do not drive the screws into the bone under power, as damage to the bone, screws and nail could result. In addition, avoid any excessive torque or excessive force during final screw seating.

Washers and Cortical Nuts

Washers can be used at any distal hole, but CORTICAL NUTS may only be used with the most distal TRANSVERSE SCREW. (It is recommended to use the next longest screw to ensure full engagement with the cortical nut.) Follow the steps to drill and measure for these screws. If a washer and/or cortical nut will be used add at least 3mm to the screw length. Remove the DRILL SLEEVE after obtaining appropriate screw length and insert the 3.0mm PIN SLEEVE. Place a 3.0mm PIN through the PIN SLEEVE bicortically so that it causes the medial skin to bulge. Incise at the bulge and dissect down to the bone. Attach the COUNTERBORE to the T-HANDLE and advance through the hole on the medial side of the guide. Advance the COUNTERBORE over the 3.0mm PIN down to the bone.

Rotate the COUNTERBORE to remove bone for the placement of the CORTICAL NUT. The shoulder on the COUNTERBORE should be advanced to the level of the medial cortex (Fig. 25).



Fig. 25

NOTE: The corresponding COUNTERBORE and CORTICAL NUT DRIVER are marked with the color code PURPLE

CAUTION: Do not counterbore or drive the cortical nut into the bone under power, as damage to the bone, screws and nail could result. In addition, using the depth gauge after counterboring can lead to error in screw length measurement.

Remove the COUNTERBORE, 3.0mm PIN and PIN SLEEVE. The screw cannula can be inserted to help facilitate screw insertion, keep cannula outside of skin, insert screw into cannula, advance screw out of exit end of cannula, load washer, then insert cannula back into wound site before screw insertion. Before the screw enters the wound, insert a washer onto the screw. Then begin driving the screw into the bone and through the hole in the nail. Attach the CORTICAL NUT DRIVER to the T-HANDLE. Put a CORTICAL NUT into the CORTICAL NUT DRIVER and pass it through the hole on the medial side of

the guide over the screw until it seats onto the cortex. Tighten the CORTICAL NUT to the tip of the 6.0mm SCREW using the CORTICAL NUT DRIVER. Use an image intensifier to verify proper position.

CAUTION: Do not overtighten the nut.

Proximal Screw Placement – Short Nails:

Use 5.0mm FIXED ANGLE SCREWS or PARTIALLY THREADED SCREWS through the appropriate proximal holes in the nail.

There is no locking tab built in for short nails proximally. Therefore either screw type will result in a standard locking construct.

Color coded instruments are also used for proximal targeting of short nails. For the RETROGRADE FEMUR TARGETING GUIDE, instruments marked PURPLE are utilized to place the proximal screws. The chart below details the color coded instruments that are used for proximal targeting and screw placement.

Instrument Type	
8.0mm Screw Cannula	Purple
4.3mm Drill Bit	Purple-Red
4.3mm Drill Sleeve	Purple-Red
Screw Depth Gauge	Purple
Screwdriver	Purple
Screw Trocar	Purple

The TARGETING GUIDE is designed to target the proximal static (ST) and dynamic (DY) holes in SHORT nails. Assemble the appropriate TARGETING MODULE (16cm, 20cm, or 24cm correspond to SHORT nail length) to the TARGETING GUIDE laterally (Figs. 26 and 26a).



Fig. 26



Fig. 26a

Slide the TROCAR into the SCREW CANNULA. Slide the SCREW CANNULA through one of the selected holes in the TARGETING MODULE. Incise the skin at the point the TROCAR touches it and dissect through the tissue down to the bone to make a path for the SCREW CANNULA. Advance the SCREW CANNULA until the tip of the TROCAR is against the bone.

Remove the Screw Trocar and assemble the 4.3mm DRILL SLEEVE to the 8.0mm SCREW CANNULA. Pass the cannula through the appropriate hole in the targeting guide to target the distal hole or slot. The hole is labeled ST is for the Static Hole. The hole labeled DY is for the Dynamic Slot (Fig. 27).



Fig. 27

CAUTION: Do not impact on the cannula, as the tip of the cannula may skive along the bone and prevent accurate targeting.

Utilize the 4.3mm DRILL BIT to drill through both cortices of bone. The depth of the hole can be measured using calibrations on the DRILL BIT. Another option is to remove the drill bit and the drill sleeve and then use the SCREW DEPTH GAUGE to measure the depth of the hole.

The nail utilizes a 5.0mm screw proximally. The screw packages are labeled with the color RED.

Choose the appropriate length screw based on the DEPTH GAUGE or DRILL BIT reading. Use the 3.5mm HEX SCREWDRIVER to place the screw bicortically through the bone.

CAUTION: When using any screwdriver, do not torque it beyond the calibration line. Do not drive the screws into the bone under power, as damage to the bone, screws and nail could result.

Remove the screwdriver and cannula. If desired, repeat these steps to place another screw in the other hole or slot.

Proximal Screw Placement – Freehand Technique for Long Nails:

The chart below indicates the color coding for proximal screws and their associated drill bits for each nail diameter.

Nail Diameter	Screw Size	Drill Bit Size	Color Code
All diameters	5.0mm	4.3mm	Red

Insert the FREEHAND 4.3mm DRILL BIT (RED) into the FREEHAND TARGETING WAND. Finger tighten the SET SCREW. Position the C-arm in order to get an AP view of the proximal femur. Adjust the angle of the C-arm so that the hole through the nail appears as a perfect circle on the monitor. Bring the tip of the drill bit to the skin and use the C-arm to center it over the hole that you desire to place a screw through. Make a stab wound at this point and dissect down to the bone. Place the tip of the drill bit against the bone. Verify that the tip of the drill bit is in the centre of the hole. Align the drill bit with the C-arm beam. Tap the drill bit into the bone using the MALLET (Fig. 28).

Fig. 28



Remove the FREEHAND TARGETING WAND. Slide the FREEHAND TISSUE PROTECTION SLEEVE over the DRILL BIT. Attach the DRILL to the FREEHAND 4.3mm DRILL BIT and advance the drill bit through the bone. Verify that the drill bit has gone through the hole in the nail.

Remove the drill bit. Measure the depth of the hole using the FREEHAND SCREW DEPTH GAUGE. Choose a fixed angle or partially threaded screw and insert the appropriate length screw using the screwdriver.

CAUTION: When using any screwdriver do not torque it beyond the calibration line. Do not drive the screws into the bone under power, as damage to the bone, screws and nail could result. In addition, avoid any excessive torque or excessive force during final screw seating.

Repeat these steps to insert additional proximal screws.

Finalize Implant Placement

Observe the depth of the nail in distal femur. Ridges in the targeting guide barrel indicate 5 and 10mm of depth. Using the nail depth gauge technique described earlier will also indicate the nail depth.

Disconnect any TARGETING MODULES from the TARGETING GUIDE and set aside. Choose the appropriate height cannulated NAIL CAP. If a NAIL CAP 5mm or longer is chosen place a 2.0MM GUIDE PIN through the CONNECTING BOLT down to the level of the distal screws. Loosen and remove the CONNECTING BOLT from the nail. Remove the TARGETING GUIDE HANDLE and set aside.

If a 0mm height NAIL CAP is used insert using the CONNECTION BOLT INSERTER. If a 5, 10 or 15mm height cap is used, secure the selected NAIL CAP to the NAIL CAP INSERTER using the NAIL CAP RETAINING SHAFT. Ensure an unobstructed pathway exists to the distal end of nail to facilitate NAIL CAP insertion. Slide the cannulated NAIL CAP over the 2.0MM GUIDE PIN and tighten to the nail. Using the C-arm, verify that the cap is completely seated to the top of the nail.

Disengage the NAIL CAP INSERTER from the NAIL CAP. Remove the 2.0MM GUIDE PIN.

Close all wounds and apply the appropriate dressings.

Postoperative Care

Early range of motion exercises of the knee and ankle are encouraged. Allow toe-touch weight bearing to progress to full weight bearing as fracture callus increases on the x-ray films.

It is the responsibility of the surgeon to determine what is the most suitable postoperative care depending on each patient's health condition.

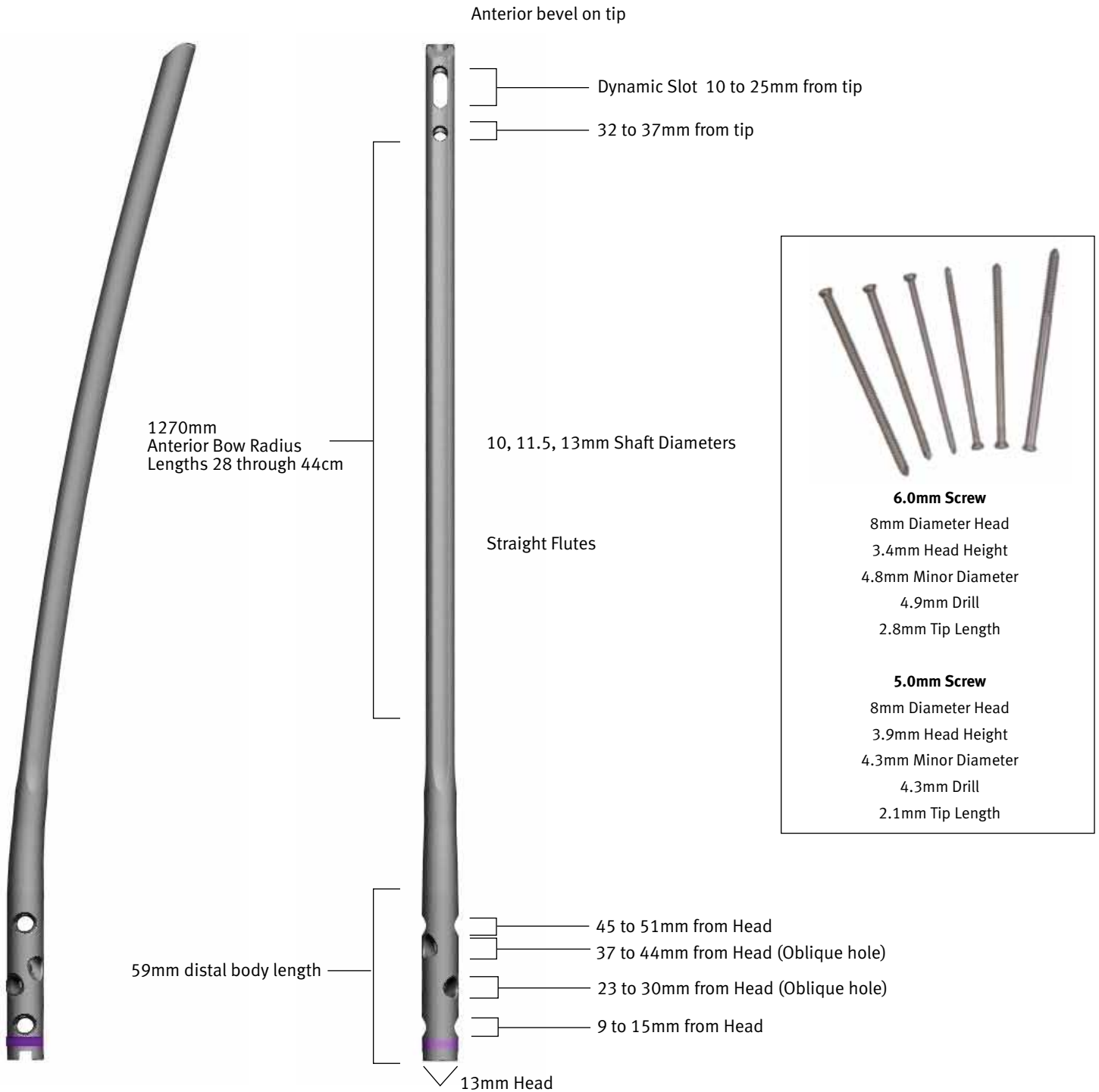
Nail Extraction

Use the C-arm to locate any proximal screws. Remove the proximal screws using a 3.5mm HEX SCREWDRIVER. Remove the nail cap (if one was inserted) with a 5.0mm HEX SCREWDRIVER. Expose the distal screws and use a 3.5mm HEX SCREWDRIVER to remove them. If bone has grown into any of the screws, nail cap or nail that would inhibit implant removal, use instruments such as rongeurs, dental picks or drills to remove bone in-growth before attempting implant removal. Take care not to damage the implant itself while removing ingrown bone.

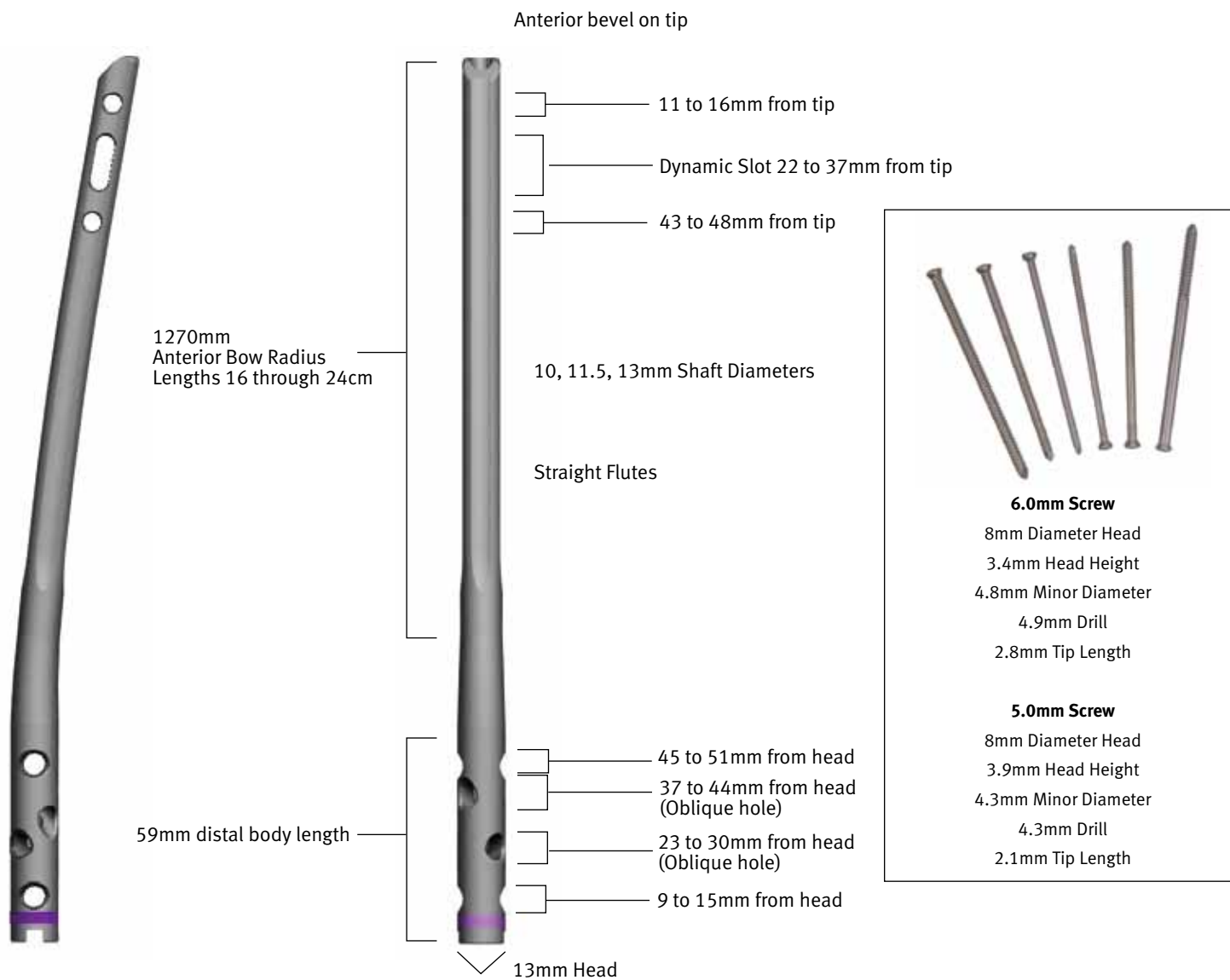
To remove the nail, slide a 2.0mm PIN through the nail. Insert the CANNULATED EXTRACTION ADAPTER over the wire into the top of the nail. Tighten the adapter to the nail. Attach a SLAPHAMMER or other impaction device and impact to back out the nail. The nail should move with each impaction. Periodically retighten the adapter and/or SLAPHAMMER during extraction as needed.

Zimmer also offers a Universal Extraction System should one be required.

Retrograde Femur Long Nail Details



Retrograde Femur Short Nail Details



NOTE: There is no locking tab for retrograde femur short nails proximally.

Product Information

Retrograde Femur Nails

Short Nails

Part Number	Description
47-2494-160-10	Retrograde Short Femoral Nail 10mm X 16cm Universal Ti-6Al-4V Alloy
47-2494-200-10	Retrograde Short Femoral Nail 10mm X 20cm Universal Ti-6Al-4V Alloy
47-2494-240-10	Retrograde Short Femoral Nail 10mm X 24cm Universal Ti-6Al-4V Alloy
47-2494-160-11	Retrograde Short Femoral Nail 11.5mm X 16cm Universal Ti-6Al-4V Alloy
47-2494-200-11	Retrograde Short Femoral Nail 11.5 mm X 20cm Universal Ti-6Al-4V Alloy
47-2494-240-11	Retrograde Short Femoral Nail 11.5 mm X 24cm Universal Ti-6Al-4V Alloy
47-2494-160-13	Retrograde Short Femoral Nail 13mm X 16cm Universal Ti-6Al-4V Alloy
47-2494-200-13	Retrograde Short Femoral Nail 13mm X 20cm Universal Ti-6Al-4V Alloy
47-2494-240-13	Retrograde Short Femoral Nail 13mm X 24cm Universal Ti-6Al-4V Alloy

Long Nails

Part Number	Description
47-2494-280-10	Retrograde Femoral Nail 10mm X 28cm Universal Ti-6Al-4V Alloy
47-2494-300-10	Retrograde Femoral Nail 10mm X 30cm Universal Ti-6Al-4V Alloy
47-2494-320-10	Retrograde Femoral Nail 10mm X 32cm Universal Ti-6Al-4V Alloy
47-2494-340-10	Retrograde Femoral Nail 10mm X 34cm Universal Ti-6Al-4V Alloy
47-2494-360-10	Retrograde Femoral Nail 10mm X 36cm Universal Ti-6Al-4V Alloy
47-2494-380-10	Retrograde Femoral Nail 10mm X 38cm Universal Ti-6Al-4V Alloy
47-2494-400-10	Retrograde Femoral Nail 10mm X 40cm Universal Ti-6Al-4V Alloy
47-2494-420-10	Retrograde Femoral Nail 10mm X 42cm Universal Ti-6Al-4V Alloy
47-2494-440-10	Retrograde Femoral Nail 10mm X 44cm Universal Ti-6Al-4V Alloy
47-2494-280-11	Retrograde Femoral Nail 11.5 mm X 28cm Universal Ti-6Al-4V Alloy

47-2494-300-11	Retrograde Femoral Nail 11.5 mm X 30cm Universal Ti-6Al-4V Alloy
47-2494-320-11	Retrograde Femoral Nail 11.5 mm X 32cm Universal Ti-6Al-4V Alloy
47-2494-340-11	Retrograde Femoral Nail 11.5 mm X 34cm Universal Ti-6Al-4V Alloy
47-2494-360-11	Retrograde Femoral Nail 11.5 mm X 36cm Universal Ti-6Al-4V Alloy
47-2494-380-11	Retrograde Femoral Nail 11.5 mm X 38cm Universal Ti-6Al-4V Alloy
47-2494-400-11	Retrograde Femoral Nail 11.5 mm X 40cm Universal Ti-6Al-4V Alloy
47-2494-420-11	Retrograde Femoral Nail 11.5 mm X 42cm Universal Ti-6Al-4V Alloy
47-2494-440-11	Retrograde Femoral Nail 11.5 mm X 44cm Universal Ti-6Al-4V Alloy
47-2494-280-13	Retrograde Femoral Nail 13mm X 28cm Universal Ti-6Al-4V Alloy
47-2494-300-13	Retrograde Femoral Nail 13mm X 30cm Universal Ti-6Al-4V Alloy
47-2494-320-13	Retrograde Femoral Nail 13mm X 32cm Universal Ti-6Al-4V Alloy
47-2494-340-13	Retrograde Femoral Nail 13mm X 34cm Universal Ti-6Al-4V Alloy
47-2494-360-13	Retrograde Femoral Nail 13mm X 36cm Universal Ti-6Al-4V Alloy
47-2494-380-13	Retrograde Femoral Nail 13mm X 38cm Universal Ti-6Al-4V Alloy
47-2494-400-13	Retrograde Femoral Nail 13mm X 40cm Universal Ti-6Al-4V Alloy
47-2494-420-13	Retrograde Femoral Nail 13mm X 42cm Universal Ti-6Al-4V Alloy
47-2494-440-13	Retrograde Femoral Nail 13mm X 44cm Universal Ti-6Al-4V Alloy

6.0mm Screws (for distal screw holes)

Part Number	Description
47-2484-030-60	6.0mm Cancellous Screw 30mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-035-60	6.0mm Cancellous Screw 35mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-040-60	6.0mm Cancellous Screw 40mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-045-60	6.0mm Cancellous Screw 45mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-050-60	6.0mm Cancellous Screw 50mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-055-60	6.0mm Cancellous Screw 55mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head

47-2484-060-60	6.0mm Cancellous Screw 60mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-065-60	6.0mm Cancellous Screw 65mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-070-60	6.0mm Cancellous Screw 70mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-075-60	6.0mm Cancellous Screw 75mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-080-60	6.0mm Cancellous Screw 80mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-085-60	6.0mm Cancellous Screw 85mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-090-60	6.0mm Cancellous Screw 90mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-095-60	6.0mm Cancellous Screw 95mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-100-60	6.0mm Cancellous Screw 100mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-105-60	6.0mm Cancellous Screw 105mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-110-60	6.0mm Cancellous Screw 110mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head

5.0mm Screws (for proximal screw holes)

Part Number	Description
47-2483-020-50	5.0mm Cortical Screw 20mm Length Ti-6Al-4V Partially Threaded 3.5mm Hex Head
47-2483-022-50	5.0mm Cortical Screw 22.5mm Length Ti-6Al-4V Partially Threaded 3.5mm Hex Head
47-2483-025-50	5.0mm Cortical Screw 25mm Length Ti-6Al-4V Partially Threaded 3.5mm Hex Head
47-2483-027-50	5.0mm Cortical Screw 27.5mm Length Ti-6Al-4V Partially Threaded 3.5mm Hex Head
47-2483-030-50	5.0mm Cortical Screw 30mm Length Ti-6Al-4V Partially Threaded 3.5mm Hex Head
47-2483-032-50	5.0mm Cortical Screw 32.5mm Length Ti-6Al-4V Partially Threaded 3.5mm Hex Head
47-2483-035-50	5.0mm Cortical Screw 35mm Length Ti-6Al-4V Partially Threaded 3.5mm Hex Head
47-2483-037-50	5.0mm Cortical Screw 37.5mm Length Ti-6Al-4V Partially Threaded 3.5mm Hex Head
47-2483-040-50	5.0mm Cortical Screw 40mm Length Ti-6Al-4V Partially Threaded 3.5mm Hex Head
47-2483-042-50	5.0mm Cortical Screw 42.5mm Length Ti-6Al-4V Partially Threaded 3.5mm Hex Head
47-2483-045-50	5.0mm Cortical Screw 45mm Length Ti-6Al-4V Partially Threaded 3.5mm Hex Head

47-2483-047-50	5.0mm Cortical Screw 47.5mm Length Ti-6Al-4V Partially Threaded 3.5mm Hex Head
47-2483-050-50	5.0mm Cortical Screw 50mm Length Ti-6Al-4V Partially Threaded 3.5mm Hex Head
47-2483-052-50	5.0mm Cortical Screw 52.5mm Length Ti-6Al-4V Partially Threaded 3.5mm Hex Head
47-2483-055-50	5.0mm Cortical Screw 55mm Length Ti-6Al-4V Partially Threaded 3.5mm Hex Head
47-2483-057-50	5.0mm Cortical Screw 57.5mm Length Ti-6Al-4V Partially Threaded 3.5mm Hex Head
47-2483-060-50	5.0mm Cortical Screw 60mm Length Ti-6Al-4V Partially Threaded 3.5mm Hex Head
47-2484-020-50	5.0mm Cortical Screw 20mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-022-50	5.0mm Cortical Screw 22.5mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-025-50	5.0mm Cortical Screw 25mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-027-50	5.0mm Cortical Screw 27.5mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-030-50	5.0mm Cortical Screw 30mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-032-50	5.0mm Cortical Screw 32.5mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-035-50	5.0mm Cortical Screw 35mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-037-50	5.0mm Cortical Screw 37.5mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-040-50	5.0mm Cortical Screw 40mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-042-50	5.0mm Cortical Screw 42.5mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-045-50	5.0mm Cortical Screw 45mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-047-50	5.0mm Cortical Screw 47.5mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-050-50	5.0mm Cortical Screw 50mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-052-50	5.0mm Cortical Screw 52.5mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-055-50	5.0mm Cortical Screw 55mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-057-50	5.0mm Cortical Screw 57.5mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head
47-2484-060-50	5.0mm Cortical Screw 60mm Length Ti-6Al-4V Fixed Angle 3.5mm Hex Head

Nail Caps

Part Number	Description
47-2487-008-00	Retrograde Femoral Nail Cap 0mm Height Ti-6Al-4V
47-2487-008-05	Retrograde Femoral Nail Cap 5mm Height Ti-6Al-4V
47-2487-008-10	Retrograde Femoral Nail Cap 10mm Height Ti-6Al-4V
47-2487-008-15	Retrograde Femoral Nail Cap 15mm Height Ti-6Al-4V

Cortical Nuts and Washers

Part Number	Description
47-2488-000-01	Cortical Nut Ti-6Al-4V for the 6.0mm Cancellous Screw (Sterile)
47-2488-000-02	Washer Ti-6Al-4V (sterile)

Non sterile Screws and Washers are also available. Please contact your Sales Representative.

KT-2490-004-00 Retrograde Femoral Instrument Set

Part Number	Description	Qty.
00-2490-004-02	RETROGRADE FEMUR CONNECTING BOLT	2
00-2490-031-05	11MM HEX / PIN WRENCH	2
00-2490-046-20	2.0MM PIN	2
00-2490-071-80	RETROGRADE FEMUR SCREW CANNULA 8.0MM	3
00-2490-072-80	RETROGRADE FEMUR TROCAR 8.0MM	2
00-2490-073-80	RETROGRADE FEMUR TRI-FLUTE TROCAR 8.0MM	2
00-2490-063-40	RETROGRADE FEMUR GUIDE PIN SLEEVE 3.0MM	3
00-2490-000-33	RULER	1
00-2490-000-34	NAIL LENGTH GAUGE	1
00-2490-004-00	RETROGRADE FEMUR TARGETING GUIDE	1
00-2490-004-16	RETROGRADE FEMUR TARGETING MODULE 16CM	1
00-2490-004-20	RETROGRADE FEMUR TARGETING MODULE 20CM	1

00-2490-004-24	RETROGRADE FEMUR TARGETING MODULE 24CM	1
00-2490-010-01	SHORT CANNULATED AWL	1
00-2490-012-00	GUIDE WIRE GRIPPER	1
00-2490-013-14	RETROGRADE FEMUR TAPER REAMER 13.5MM	1
00-2490-014-80	ENTRY REAMER 8MM	1
00-2490-017-00	GUIDE WIRE PUSHER	1
00-2490-031-00	CONNECTING BOLT INSERTER	1
00-2490-032-02	RETROGRADE FEMUR IMPACTION HEAD	1
00-2490-032-05	SLOTTED MALLET	1
00-2490-035-75	FREEHAND MODULAR 3.5MM HEX SCREWDRIVER	2
00-2490-046-32	GUIDE PIN INSERTER/EXTRACTOR	1
00-2490-049-00	RETROGRADE FEMUR NUT COUNTERBORE	1
00-2490-050-02	MODULAR T-HANDLE - HALL CONNECTION	1
00-2490-065-85	RETROGRADE FEMUR SCREW DEPTH GAUGE 8.0MM	1
00-2490-070-00	FREEHAND TARGETING WAND	1
00-2490-073-00	FREEHAND TARGETING DEPTH GAUGE	1
00-2490-074-00	FREEHAND TISSUE PROTECTION SLEEVE	1
00-2490-080-00	NAIL CAP INSERTER	1
00-2237-008-00	SKIN PROTECTOR	1
02.00020.049	RATCHET WRENCH 11	1
00-2490-090-25	RETROGRADE FEMUR CANNULATED EXTRACT ADAPTER 5/16 INCH	2
00-2490-035-80	RETROGRADE FEMUR MODULAR SCREWDRIVER 3.5MM HEX	2
00-2490-050-00	MODULAR T-HANDLE AO CONNECTION	1
00-2490-065-43	RETROGRADE FEMUR DRILL SLEEVE 4.3MM	2
00-2490-065-49	RETROGRADE FEMUR DRILL SLEEVE 4.9MM	3
00-2490-034-43	RETROGRADE FEMUR CALIBRATED DRILL 4.3MM	2
00-2490-034-49	RETROGRADE FEMUR CALIBRATED DRILL 4.9MM	1

00-2490-034-50	RETROGRADE FEMUR CALIBRATED DRILL 4.9MM CANNULATED	2
00-2490-072-43	FREEHAND TARGETING DRILL 4.3MM	2
00-2490-047-30	3.0MM NON-THREADED PIN BY 355MM	4
00-2490-024-00	REDUCTION FINGER	1
00-2490-004-22	RETROGRADE FEMUR NAIL DEPTH GAUGE	2
00-2490-047-81	RETROGRADE FEMUR CANNULATED DEPTH GAUGE	1
00-4452-092-25	PROTECTIVE CAP (2.5-3.0MM)	1
00-2490-035-90	RETROGRADE FEMUR CORTICAL NUT DRIVER	1
00-2490-013-00	ENTRY CANNULA	1
00-2490-013-01	ENTRY CANNULA STARTING POINT LOCATER	1
00-2490-080-03	NAIL CAP RETAINING SHAFT	1
00-2490-035-62	CAPTURING HEX SCREWDRIVER 3.5MM SHORT	1
00-2490-035-72	CAPTURING HEX SCREWDRIVER 3.5MM FREEHAND	1
00-5900-099-00	CASE LID	

Instruments (Select both “Stainless Steel” or both “Stainless Steel and Aluminum” Cases)

Part Number	Description
00-2490-011-00	Retrograde Femur Case 1 of 2 – Stainless Steel
00-2490-023-00	Retrograde Femur Case 2 of 2 – Stainless Steel
00-2490-070 -50	Retrograde Femur Case 1 of 2 – Stainless Steel and Aluminum
00-2490-073-50	Retrograde Femur Case 2 of 2 – Stainless Steel and Aluminum

Optional Instruments

Part Number	Description
00-2490-048-50	LONG 5.0MM TAP
00-2255-009-00	SLAPHAMMER
00-0409-003-00	IM NAIL EXTRACTION SET #2
00-0409-004-00	IM NAIL EXTRACTION PIN WIRE SET
00-0409-006-00	IM NAIL EXTRACTION COMPLETE SET
00-2490-014-30	3.0MM THREADED PIN BY 355MM

Tear Drop Guide Wire (available separately)

Part Number	Description
47-2490-097-00	3.0mm x 100 cm Tear Drop Guide Wire sterile
47-2490-097-01	2.4mm x 100 cm Tear Drop Guide Wire sterile
47-2490-098-00	3.0mm x 70 cm Tear Drop Guide Wire sterile
47-2490-098-01	2.4mm x 70 cm Tear Drop Guide Wire sterile

Ball Tip Guide Wire (available separately)

Part Number	Description
00-2255-008-00	Guide Wire 2.4mm, Ball-Tip, 70cm box
47-2255-008-01	Guide Wire 3.0mm, Ball-Tip, 100cm Sterile
00-2255-008-01	Guide Wire 3.0mm, Ball-Tip, 100cm non sterile

Surgical Technique Part Number - 97-2494-002-00

Wall Chart Part Number - 97-2494-003-00

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Contact your Zimmer representative or visit us at www.zimmer.com

The CE mark is valid only if it is also printed on the product label.

