



M/DN® Femoral Interlocking & Recon Nail Intramedullary Fixation Surgical Technique



Surgical Techniques for Fixation of Femoral Fractures with an M/DN Nail

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Introduction

Closed intramedullary nailing has long been a common method of treating noncomminuted fractures of the femur and tibia. The interlocking nail has extended the indications of closed intramedullary nailing to include comminuted fractures, fractures with bone loss, and proximal and distal fractures of the femur.

The multi-point fixation provided by the cross-section of the *M/DN*® Nail makes it appropriate for use unlocked (Fig. A) as well as locked in either the dynamic (Fig. B) or static mode (Fig. C). It also makes it appropriate for reamed or unreamed applications.

The successful use of any intramedullary nail is technically demanding. Close attention to positioning, reduction, rod placement, and insertion of the proximal and distal locking screws is mandatory.



Fig A



Fig B



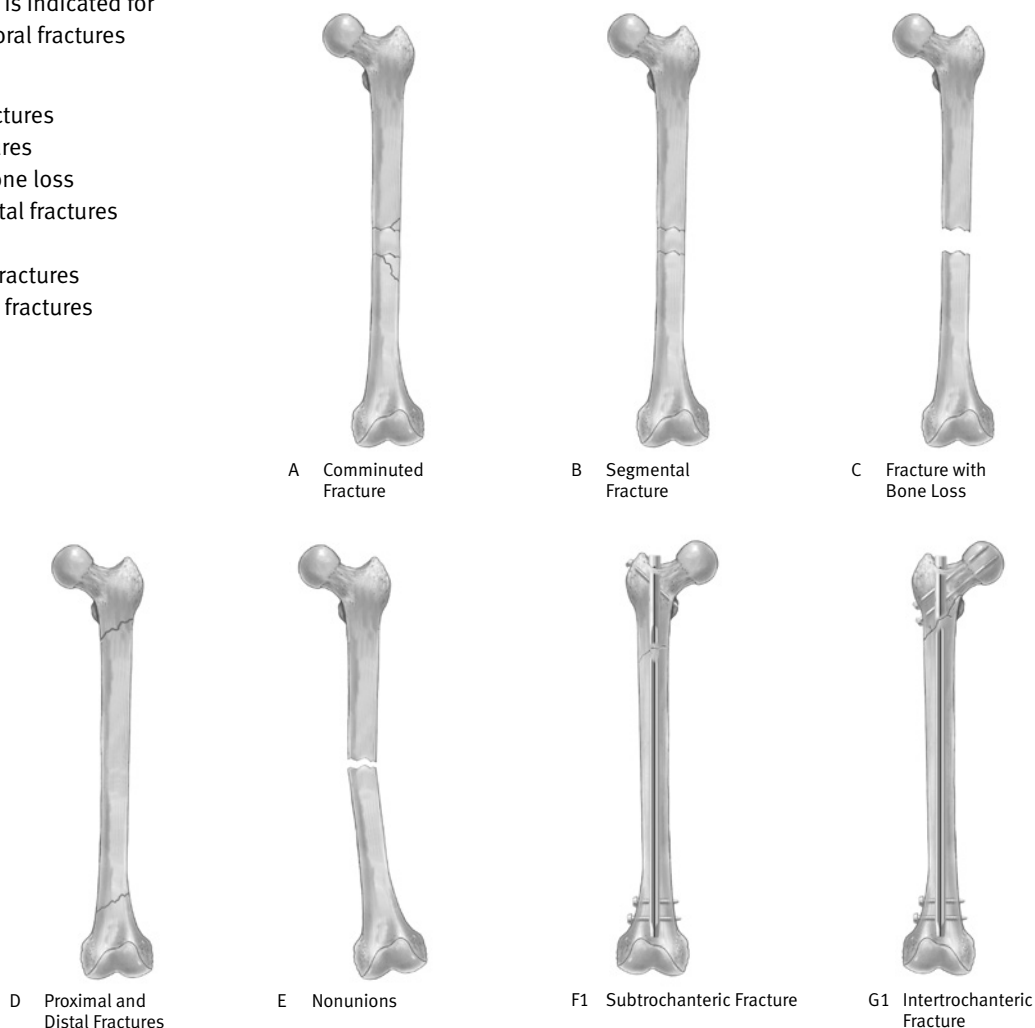
Fig C

Indications

The M/DN femoral nail is indicated for use in a variety of femoral fractures (Fig. 1), such as:

- A. Comminuted fractures
- B. Segmental fractures
- C. Fractures with bone loss
- D. Proximal and distal fractures
- E. Nonunions
- F. Subtrochanteric fractures
- G. Intertrochanteric fractures

Fig. 1



Surgical Technique

The M/DN Femoral Nail is designed for varied use. A single nail can be used for both right and left standard interlocking or recon procedures. The femoral nail is available in the most commonly used sizes. These nails range in diameters from 8.0mm to 16.0mm and lengths from 24cm to 50cm.

Preoperative Planning

Proper preoperative planning is essential to successful interlocking or recon nailing of the femur. To determine the appropriate nail size, an ossimeter, roentgenogram templates, and an x-ray film of the unaffected extremity are necessary for determining canal size at the isthmus and for measuring the length of the femur to aid in determining nail length.

The Nail Length Gauge or Harris/Galante Bulb-Tip Guide Wires (Sounds), available in diameters from 10mm-17mm, can be used as alternate techniques to determine nail diameter and length.

X-rays taken at a 36-inch distance from the x-ray source result in 10-15 percent magnification of bone. The ossimeter has both an actual size scale and one that takes into account this magnification. It should be used routinely to determine nail diameter and length.

The proper length of nail should extend from the tip of the greater trochanter to the epiphyseal scar. The diameter of the femoral nail should match the isthmus in the lateral x-ray projection.

The surgeon should review the x-ray to assure that there are no unusual anatomic variations.

Patient Positioning and Radiographic Control

The patient may be placed in either the supine or the lateral decubitus position (Fig. 2).

In multiple trauma patients, the supine position may be used for easier access to the airways as well as to facilitate the treatment of other injuries. The supine position also facilitates fracture reduction and rotational alignment of the femur. The disadvantage to the supine position is that it impairs access to the tip of the greater trochanter for insertion of the nail.

It is essential to obtain excellent A/P and lateral images of the femoral head and neck prior to beginning the surgery regardless of which patient position is used.

The use of image intensification or other x-ray imaging is required. The image intensifier should be sterile-draped and may be positioned from either the contralateral or ipsilateral side of the operating table. Confirm visualization of the hip as well as the shaft of the femur using image intensification before prepping and draping. Bend the patient's torso away from the affected extremity to improve access to the greater trochanter. If access to the greater trochanter is still inadequate, adduct the affected leg. However, to achieve proper alignment of the fracture, this adducted position must be corrected prior to insertion of the nail.

Reduction

It is important to reduce the fracture before beginning the surgical procedure.

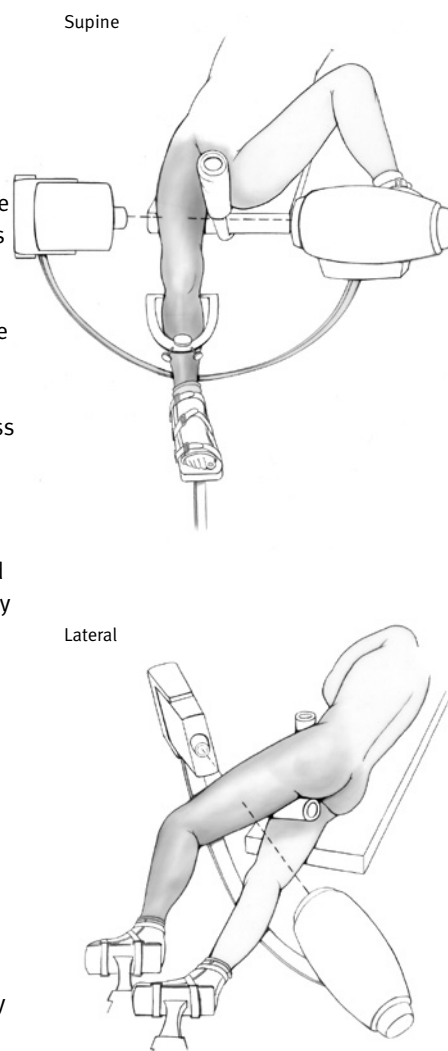


Fig. 2 Supine and lateral decubitus positions.

Incision and Exposure

Begin the skin incision 1cm proximal to the greater trochanter and carry it proximally about 5cm in line with the gluteus maximus muscle (Fig. 3). A larger incision may be desired for obese patients. Split the fascia of the gluteus maximus in line with its fibers. Identify the subfascial plane of the gluteus medius, and palpate the posterior tip of the greater trochanter. Retract the muscles to facilitate visualization of the piriformis fossa. This may be difficult in the obese patient, especially if flexion causes the tip of the trochanter to lie against the ilium. Positioning techniques used to expose the tip of the trochanter include adduction of the leg and positioning of the patient's torso away from the affected extremity.

Creating the Entry Portal

Locating the correct entry portal in the piriformis fossa is extremely important. For the interlocking procedure, place

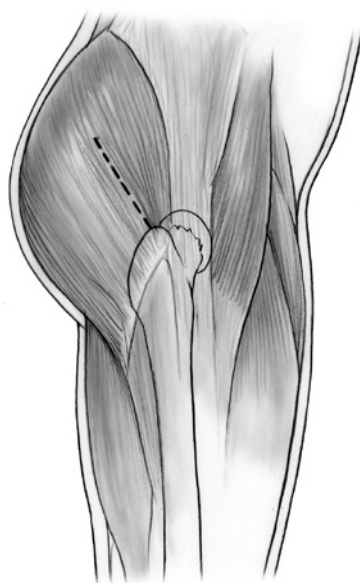


Fig. 3

the Awl at the piriformis fossa (Fig. 4) and check its position with A/P and lateral views.

For the recon procedure, place the Awl in the anterior portion of the piriformis fossa approximately 5mm

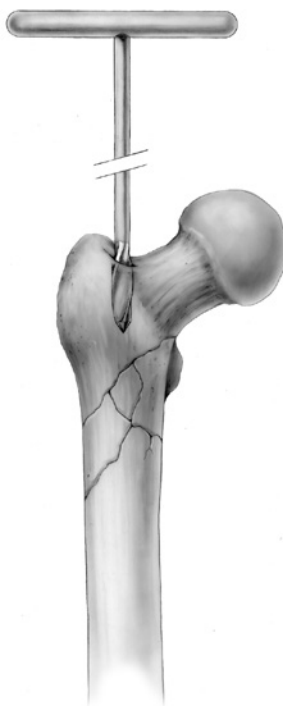


Fig. 4

anterior to the position you would choose when doing a standard femoral nailing (Fig. 5). This will facilitate screw placement in the center of the femoral neck.

Check the position of the awl with both A/P and lateral images before creating

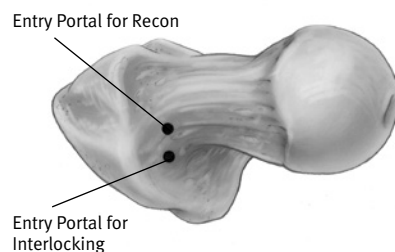


Fig. 5

the portal. On the A/P image, the awl should lie at the base of the femoral neck adjacent to the greater trochanter. On the lateral view, it should be oriented just posterior to the center of the femoral neck. When the correct position is achieved, rotate the Awl to create the entry portal for the Ball-Tip Guide Wire.

If using the Long Cannulated Awl, the 3.0mm Ball-Tip Guide Wire can be inserted through the Awl.

An alternative method is to insert a 3.2mm Steinmann Pin into the piriformis fossa while checking the position with A/P and lateral image intensification. The Steinmann Pin must lie at the base of the femoral neck just medial to the greater trochanter on the A/P view, and oriented just posterior to the center of the femoral neck on the lateral view. Seat the Steinmann Pin well into the proximal femur and use the optional 9mm Trochanteric Reamer to create the entry portal (Fig. 6).



Fig. 6

Guide Wire Replacement and Reaming

Conventional Guide Wire/ Exchange Tube Technique

Attach the 3.0mm Ball-Tip Guide Wire to the Wire-Grip T-Handle (Fig. 7) and tighten. The Ball-Tip Guide Wire may also be described as a Bulb-Tip or Bullet-Tip Guide Wire. To aid in manipulation, bend the tip of the Guide Wire at about a 10° angle 5cm from the end. Insert the Guide Wire through the entry hole and manipulate it down the proximal femur. At the fracture site, manipulate the Guide Wire under C-arm control (Fig. 8). Once in the distal canal, pass the wire to its final position in the epiphyseal scar (Fig. 9).

CAUTION: If the guide wire is bent shorter than 5cm from the end of the wire and/or more than 10 degrees it may be difficult to remove from the nail. If the wire becomes lodged inside the nail, utilize the WIRE GRIP T-HANDLE and mallet to remove the guide wire from the nail.

If reduction of the abducted and flexed hip is difficult, place pressure on the anterior aspect of the proximal fragment either with the hand or directly with an instrument.

The Reduction Finger can be used to assist in femoral fracture reduction. To use the Reduction Finger, advance the Ball-Tip Guide Wire and ream the proximal segment. Pass the Reduction Finger over the Ball-Tip Guide Wire. Manipulate the fracture externally while using the Reduction Finger internally to aid in fracture reduction. Once the Ball-Tip Guide Wire has passed through the fracture site, the Ball-Tip

Guide Wire is advanced to epiphyseal scar. If the Ball-Tip Guide Wire can not advance through the fracture site, the ball tip of the Guide Wire should be bent slightly and then reinserted to aid in internal reduction.

Determine the proper nail length by placing a second guide wire of equal length at the greater trochanter. The length of the wire that is not overlapping is the correct nail length (Fig. 10). The 50cm Ruler or ossimeter may be used for an accurate measurement.

Another way to measure the length is to use the C-arm to position the 0 mark on the metal ruler at the tip of the trochanter. Then read the correct length at the epiphyseal scar directly off the metal ruler.

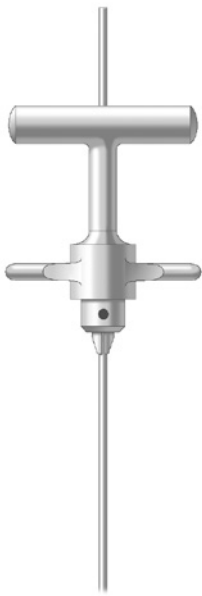


Fig. 7



Fig. 8



Fig. 9

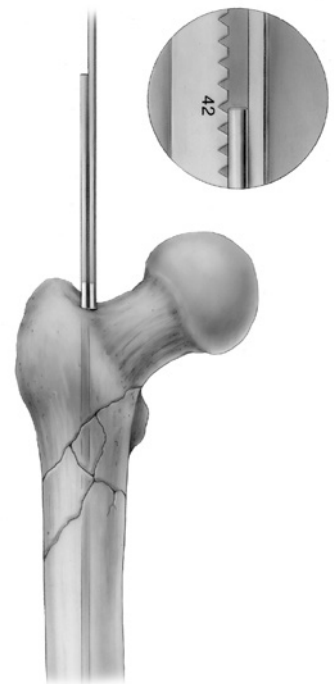


Fig. 10

Alternatively, the IM Nail Length Gauge can be used to measure the appropriate Nail length through measurement of one 100cm Guide Wire. To use, place a 100cm Ball-Tip Guide Wire down the medullary canal. Slide the IM Nail Length Gauge over the Guide Wire, ensuring that the distal portion of the gauge is resting on the piriformis fossa in order to determine correct nail length. Nail length is determined by noting the location of the remaining Guide Wire and reading the Nail Length Gauge at that particular location. If the length indicated is between two available nail sizes, it is recommended that the shorter nail be chosen.

NOTE: Nail Length Gauge can only be used with 100cm Guide Wire.

Remove the Wire-Grip T-Handle, and place a *Pressure Sentinel*® intramedullary reamer over the guide wire. The *Pressure Sentinel* Intramedullary Reaming System is a system of one-piece reamers ranging in size from 5mm diameter to 27mm diameter in half millimeter increments. Each reamer is composed of a fluted reamer head, a shaft and a quick-connect drive end. The quick-connect end can



Fig. 11

be connected to a manual or powered driver. The width of the isthmus of the medullary canal is determined by preoperative x-ray examination. The instrument with the smallest possible diameter is used for initial reaming into the medullary canal. Reamers with a diameter of 5mm to 7.5mm use a 2.4mm Ball-Tip Guide Wire while reamers with a diameter of 8mm to 27mm use a 3.0mm Ball-Tip Guide Wire. As reaming continues, the reamer size should be increased by 0.5mm or 1.0mm increments until an opening of the desired size is obtained (Fig. 11).

NOTE: To avoid reamer lodging during use, reaming should be immediately stopped and the reamers retracted when there is too much resistance. If the reamer becomes lodged, stop reaming immediately. Reverse the direction of rotation of the handpiece and back the reamer out of the canal. The reamer can also be extracted by snapping the T-Handle Extractor onto the reamer end and then gently tapping the Extractor with a small mallet or hammer.

CAUTION: Excessive blows to the T-Handle Extractor may damage the reamer or the Extractor.

NOTE: The proximal diameter of the 8mm and 9mm M/DN Femoral Nail is 12mm. Therefore, over ream the proximal femur to 13mm for these nail diameters. The proximal diameter of the 10mm, 11mm, and 12mm M/DN Femoral Nail is 13mm. Therefore, over ream the proximal femur to just below the level of the lesser trochanter to 14mm for these nail diameters.

NOTE: If the Guide Wire becomes lodged within the reamer, use the Wire-Grip T-Handle to push the Guide Wire back into the IM Canal.

New Guide Wire Technique Option

If using a Ball-Tip Guide Wire that does NOT have a gold coated end OR if using a nail less than 10mm:

When the reaming is complete and the final measurements are made, insert the plastic Exchange Tube over the Ball-Tip Guide Wire. Remove the Ball-Tip Guide Wire, and insert a Smooth Guide Wire (Fig. 12).

If using a Ball-Tip Guide Wire that DOES have a gold coated end and if using a nail equal to or greater than 10mm:

The Ball-Tip Guide Wire can remain in place. It is **NOT NECESSARY** to exchange the Ball-Tip Guide Wire for a Smooth Guide Wire.

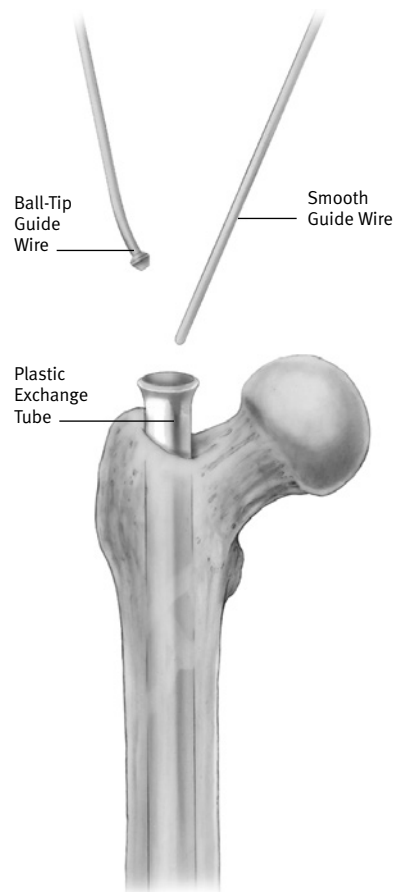


Fig. 12

Nail Insertion

Select the appropriate sized *M/DN* Femoral Nail (Table 1).

Attach the selected nail to the appropriate left or right Femoral Proximal Targeting Guide. Insert the Femoral Locking Bolt through the barrel of the Proximal Targeting Guide (Fig. 13). Using the thumb or finger to apply a steady downward pressure on the Locking Bolt, hand-tighten the Locking Bolt into the proximal end of the nail (Fig. 14). Use the Pin Wrench to ensure that the locking mechanism is tightened securely. A keyway in the proximal end of the nail will help ensure proper alignment of the Guide and nail (Fig. 15). The Lock Washer mechanism will prevent the Locking Bolt from loosening during the insertion of the nail. Tighten until the Lock Washer is flattened between the Guide and the Locking Bolt (Fig. 16).

Table 1. *M/DN* Femoral Recon Nails Expanded Set

Nail Length (cm)	Nail Diameter (mm)								
	8	9	10	11	12	13	14	15	16
24	•	•	•	•	•	•			
26	•	•	•	•	•	•			
28	•	•	•	•	•	•	•		
30	•	•	•	•	•	•	•	•	•
32	•	•	•	•	•	•	•	•	•
34	•	•	•	•	•	•	•	•	•
36	•	•	•	•	•	•	•	•	•
38	•	•	•	•	•	•	•	•	•
40	•	•	•	•	•	•	•	•	•
42	•	•	•	•	•	•	•	•	•
44	•	•	•	•	•	•	•	•	•
46		•	•	•	•	•	•	•	•
48			•	•	•	•	•	•	•
50						•	•	•	•

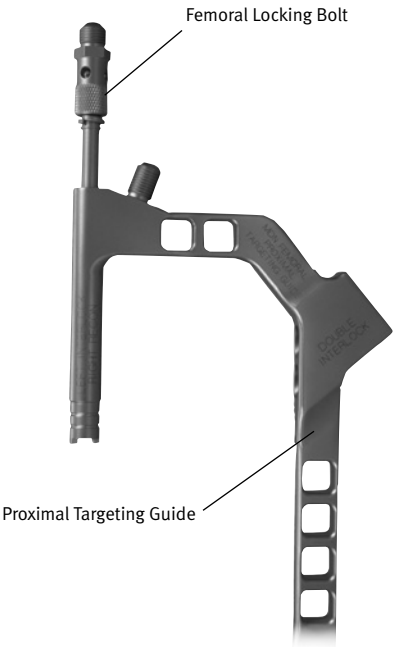


Fig. 13

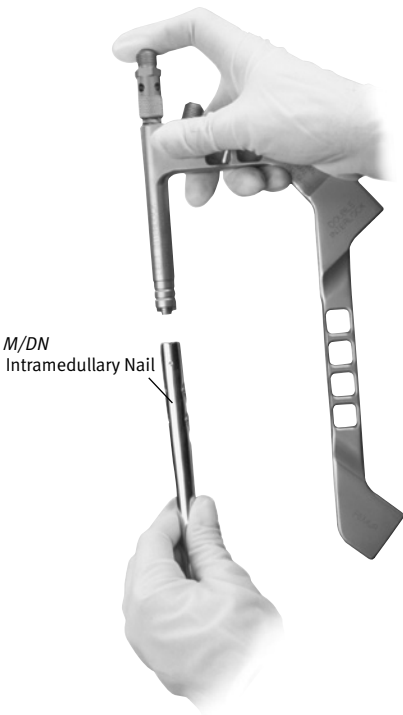


Fig. 14

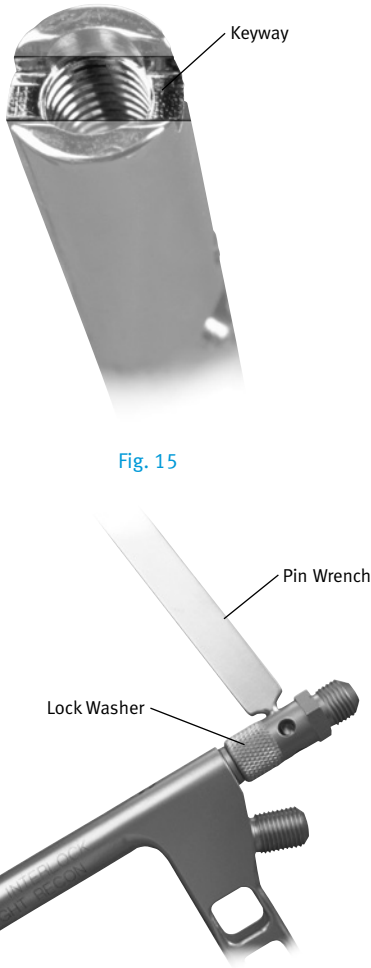


Fig. 15

Fig. 16

Interlocking Application

Verify proper alignment of the construct by inserting the 5mm Femoral Drill Bushing into the 8mm Femoral Screw Bushing (Fig. 17).

Insert the two nested bushings through the interlocking hole. Insert the 5mm Drill into the bushing and through the interlocking hole. When the device is properly aligned, the drill will pass through the proximal hole of the nail and will not contact the nail (Fig. 18).

Place the selected nail over the Ball-Tip Guide Wire and into the femur. **Do not strike the guide directly to seat the nail.** Screw the Threaded Driver or the Slaphammer into the back end of the Locking Bolt or onto the offset threaded drive. Begin seating the nail using gentle impaction.

The Slotted Mallet can be used with the Threaded Driver to make slight upward adjustments in depth (Fig. 19).

While impacting the nail, use the Femoral Proximal Guide to maintain the proper rotation during impaction. Use caution when crossing the fracture site. Visualize the fracture in two planes with image intensification to assure proper passage of the nail into the distal fragment. Reduce the force of impaction as the proximal end of the nail approaches the greater trochanter.

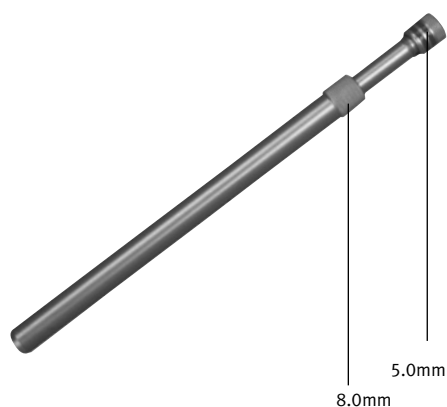


Fig. 17

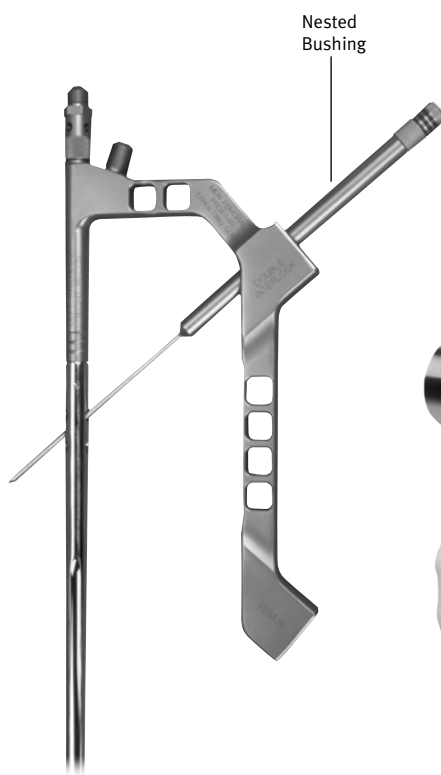


Fig. 18

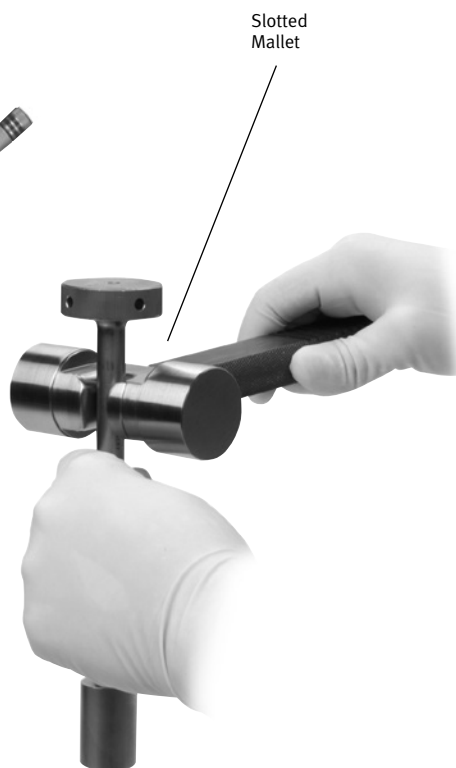


Fig. 19

Recon Application

When performing the recon procedure, slide a 14in. Steinmann Pin percutaneously along the anterior aspect of the trochanter, parallel to the femoral neck. Verify pin placement with the C-arm (Fig. 20). This will help to identify the anteversion of the neck. During the insertion, the Femoral Proximal Guide must remain parallel to this pin to ensure proper anteversion for the locking screws.

If excessive resistance is encountered during nail driving, remove the nail and check the size of both the reamer and the nail. Once proper sizing has been confirmed, the surgeon may choose to over ream the canal or select a smaller size nail.

Continue to seat the nail until it is flush with the trochanter. When the nail is fully seated, **REMOVE THE GUIDE WIRE** so that it does not get trapped in the bone. Remember, it might be concealed inside the driver or Slaphammer.

Reassess the integrity of the Locking Bolt – Nail connection and re-tighten with the Pin Wrench if necessary (Fig. 21).

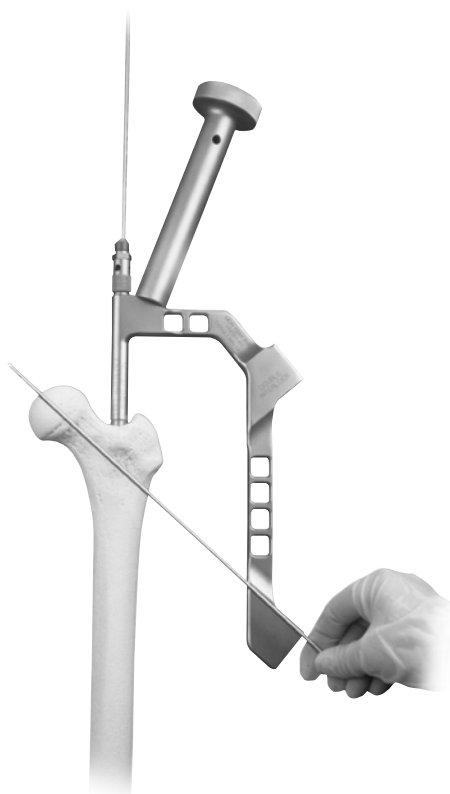


Fig. 20

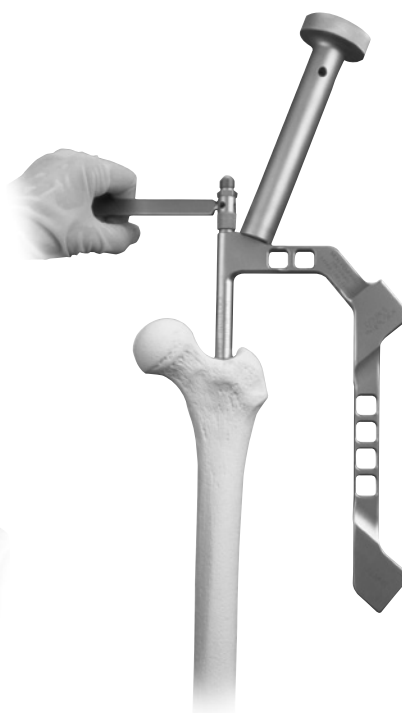


Fig. 21

Verify proper alignment by inserting the 3.2mm Femoral Pin/Drill Bushing into the 5mm Femoral Drill Bushing; then insert these two nested bushings into the 8mm Femoral Screw Bushing (Fig. 22). Place the three nested guide bushings through one of the recon holes in the Femoral Proximal Guide. Insert the 3.2mm, 14in. Steinmann Pin through the inner bushing. When the device is properly aligned, the Steinmann Pin will pass through the proximal hole of the nail and will not contact the nail (Fig. 23).



Fig. 22

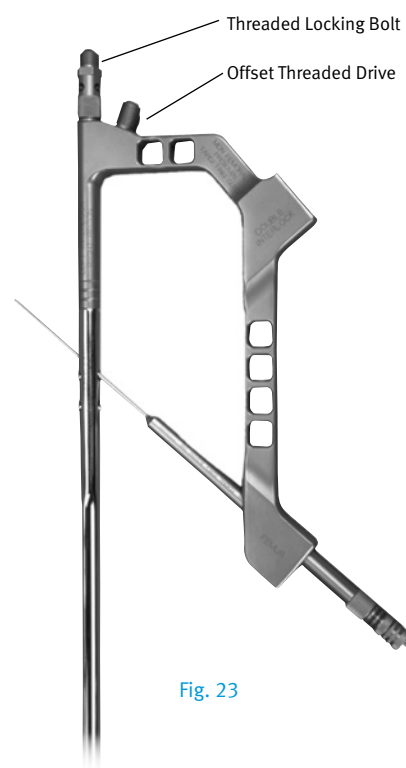


Fig. 23

Proximal Locking

For Interlocking Application
Screw the 5mm Femoral Drill Bushing (Color Code: Green), into the 8mm Femoral Screw Bushing (Fig. 24), and insert them into the Femoral Proximal Guide (Fig. 25). Insert the 5mm Femoral Drill (Color Code: Green), into the assembled bushings and drill until the medial femoral cortex is penetrated (Fig. 26).

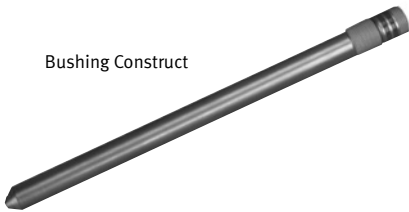


Fig. 24

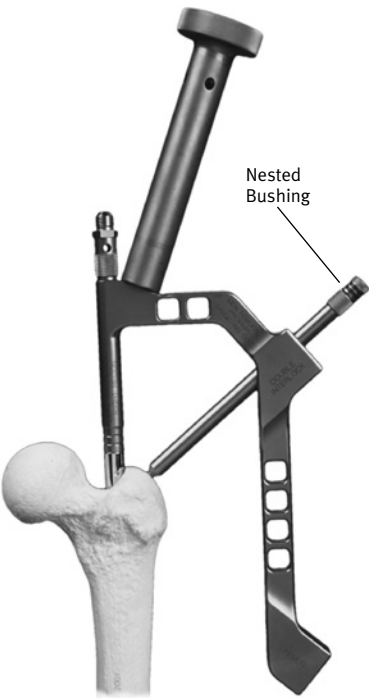


Fig. 25

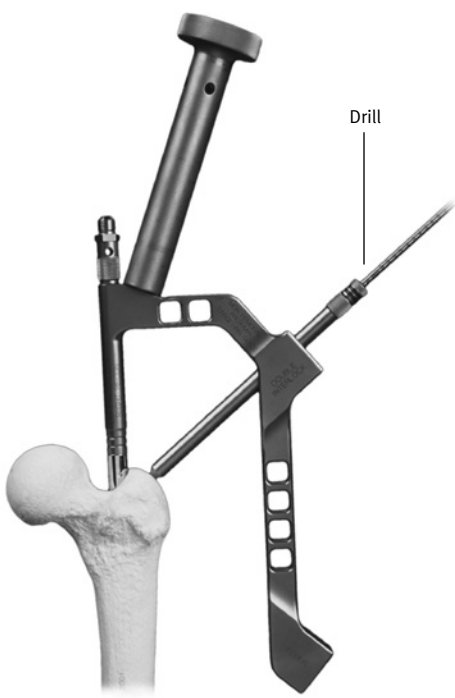


Fig. 26

Table 2. Implant / Instrumentation Specifications for Femoral Nails

Nail Diameter (mm)	8	9	10	11	12	13	14	15	16
Head Diameter (mm)	12	12	13	13	13	13	14	15	16
Guide Wire, Smooth (mm)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Proximal Screw Size (mm)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
	green	green	green	green	green	green	green	green	green
Drill Bushing Size (mm)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Proximal Drill Size (mm)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Distal Screw Size (mm)	3.7	4.2	4.2	4.2	5.5	5.5	5.5	5.5	5.5
	yellow	blue	blue	blue	green	green	green	green	green
Trocar Diameter (mm)	3.2	3.7	3.7	3.7	5.0	5.0	5.0	5.0	5.0
Distall Drill Size (mm)	3.2	3.7	3.7	3.7	5.0	5.0	5.0	5.0	5.0

Note: 4.5mm cortical interlocking screws are NOT indicated for use with the MDN system.

Remove the 5mm Femoral Drill Bushing, leaving the 8mm Femoral Screw Bushing in place.

Use the Proximal Screw Depth Gauge to determine screw length (Fig. 27 & 28). Use the T-Handle Screwdriver to insert the appropriate length 5.5mm screw (Color Code: Green) (Fig. 29), to the correct reference line on the T-Handle Screwdriver (Fig. 30). Use the C-arm to check the position of the screw and tighten it appropriately.

Remove the screwdriver and the 8mm Femoral Screw Bushing. Take A/P and lateral C-arm views to check for correct positioning. If using a second Proximal screw, repeat the previous technique. Disengage the Locking Bolt from the nail using the Pin Wrench.

NOTE: 5.5mm Screws (Color Code: Green), are used proximally for all Femoral Nails.

3.7mm screws (Color Code: Yellow), are used distally for 8mm Femoral Nails.

4.2mm screws (Color Code: Blue), are used distally for all 9mm – 11mm Femoral Nails.

5.5mm Screws (Color Code: Green), are used distally for all 12mm – 16mm Femoral Nails.

Note: 4.5mm cortical interlocking screws are NOT indicated for use with the MDN system.

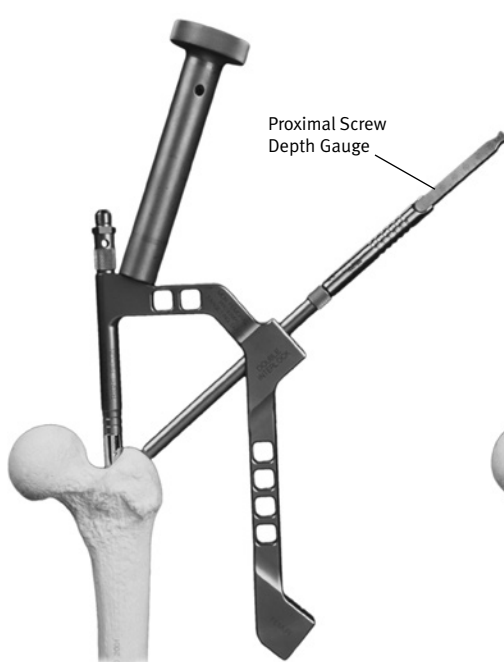


Fig. 27

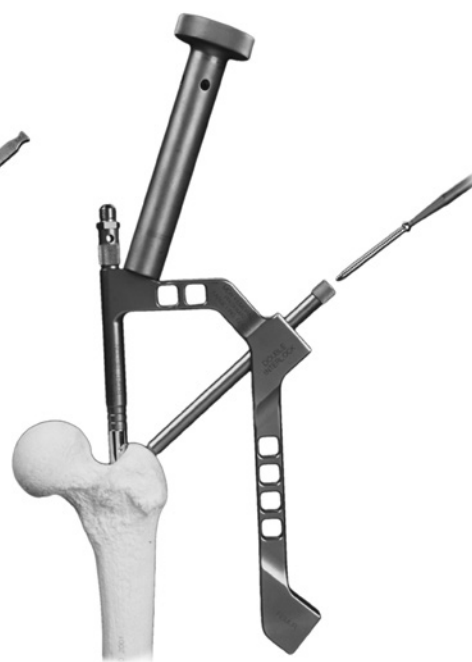


Fig. 29



Fig. 28

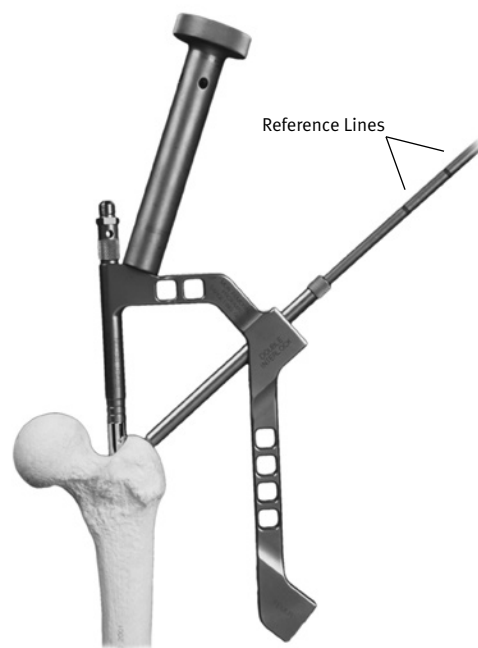


Fig. 30

For Recon Application

Correct rotation of the nail is imperative for retrograde insertion of the two screws through the nail and into the femur. Be sure that the nail is inserted to the correct depth to allow placement of both screws with the correct anteversion.

Screw the 3.2mm Proximal Pin/Drill Bushing, into the 5mm Femoral Drill Bushing (Color Code: Green). Screw this construct into the 8mm Femoral Screw Bushing (Fig. 31), and insert the assembled three bushings into the inferior recon hole of the Femoral Proximal Guide to the level of the skin, (Fig. 32). Make an incision in the skin and fascia at this point and continue to insert the bushings until contact is made with the lateral femoral cortex. Drill a 14in. Steinmann Pin into the femoral head to the required level to achieve fracture fragment stability, without penetrating the femoral head cortex (Fig. 33). Verify the proper position and anteversion of the pin with A/P and lateral C-arm views.

Avoid excessive twisting or torquing of the Femoral Guide to ensure proper targeting. If the position is not correct, remove the pin and adjust the nail rotation and/or nail depth. **Verify the new pin placement with the C-arm.**



Fig. 31

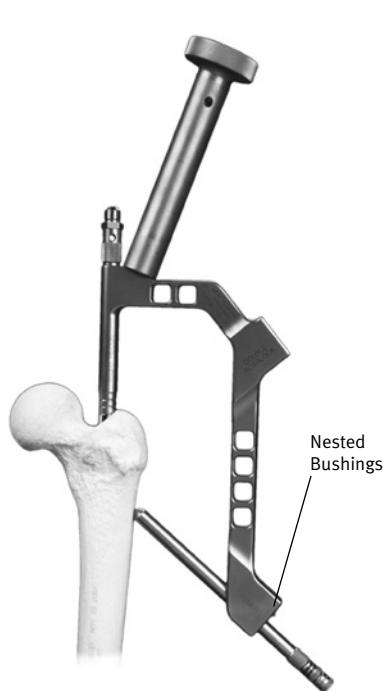


Fig. 32

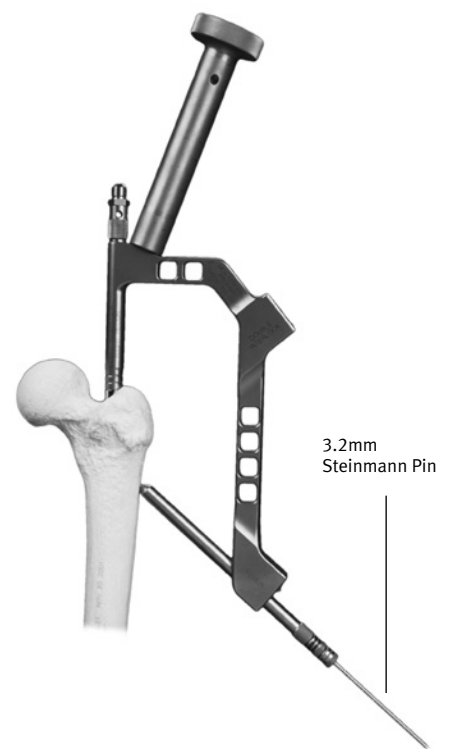


Fig. 33

Assemble the second set of three bushings in the same fashion and place them into the superior hole of the Femoral Proximal Guide. Drill the second 14in. Steinmann Pin in to the bone and verify its position with the C-arm (Fig. 34 & 35). If the position is unacceptable, remove both Steinmann Pins and reposition the nail. If the correct position is obtained, remove the Threaded Driver or Slaphammer. Also remove the inferior Steinmann Pin and the 3.2mm Proximal Pin/Drill Bushing.

Insert the 5mm Femoral Drill (Color Code: Green), into the 5mm Femoral Drill Bushing (Color Code: Green). Drill the inferior proximal screw hole while monitoring image intensification to prevent penetration of the femoral head (Fig. 36). Read the appropriate screw length directly from the calibrated Femoral Drill (Fig. 37). Remove the 5mm Drill and Femoral Drill Bushing. Insert the Recon Screw Counterbore through the outer 8mm Femoral Screw Bushing and counterbore. The blunt end of the Counterbore serves as a stop.

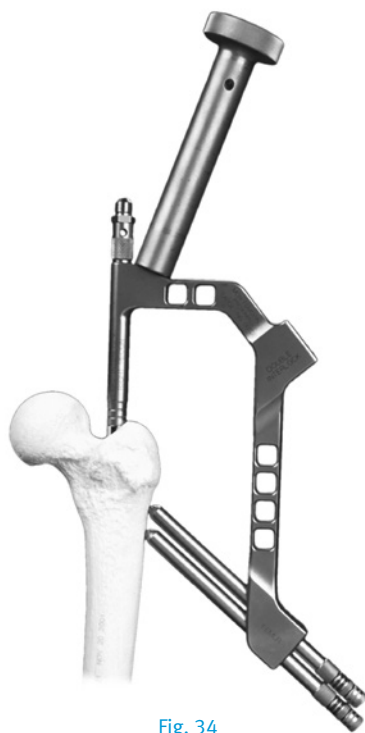


Fig. 34

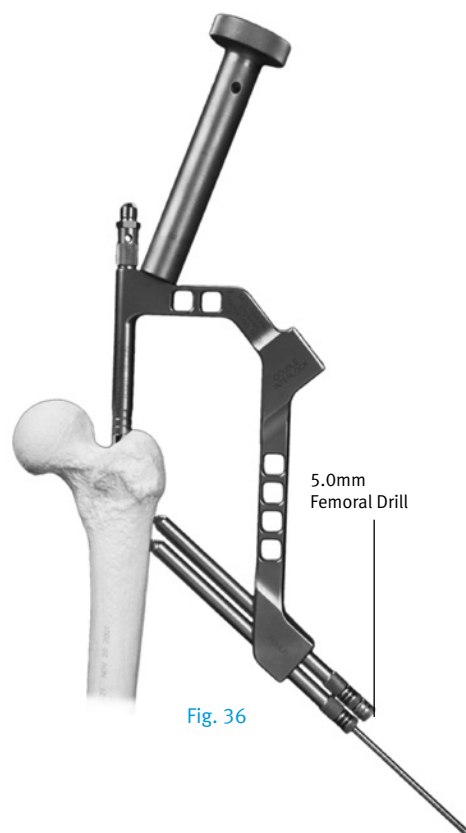


Fig. 36



Fig. 35

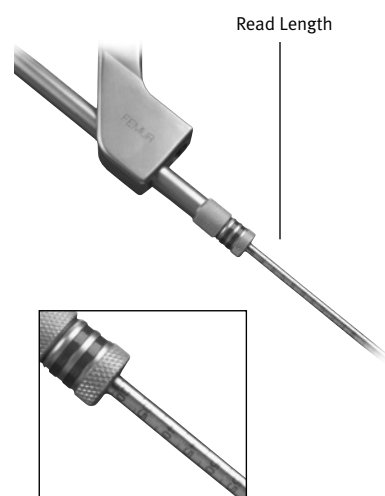


Fig. 37

Screw length may alternatively be measured using the Proximal Screw Depth Gauge. Select a screw equal to the measured length to avoid penetration of the joint (Fig. 38).

Another gauge that can be used to measure screw length is the Cannulated Depth Gauge. Slide the Cannulated Depth Gauge over the Steinmann Pin, i.e., the inferior of the two Steinmann Pins if two pins are used, until the gauge contacts the bone using the C-arm. Read and record the length of the Steinmann Pin from the calibrated depth gauge.

NOTE: This measurement designates the correct length of the screw to be implanted.

Remove the counterbore using the T-Handle Screwdriver, insert the appropriate length 5.5mm Partially Threaded Recon Screw (Fig. 39) through the outer bushing to the level of the correct reference line on the T-Handle Screwdriver (Fig. 40). Use the C-arm to ensure proper seating of the locking screw well within the femoral head. Tighten it appropriately.

The first screw should lie in the inferior neck to allow room for the second screw to be placed. This may be difficult in small patients or in patients with varus hips. Be certain to seat the inferior screw tightly against the medial cortex to prevent varus deformity and to allow for placement of the proximal screw.

Remove the T-Handle Screwdriver and the Femoral Bushing. Take A/P and lateral C-arm views to check for correct positioning. Repeat the same

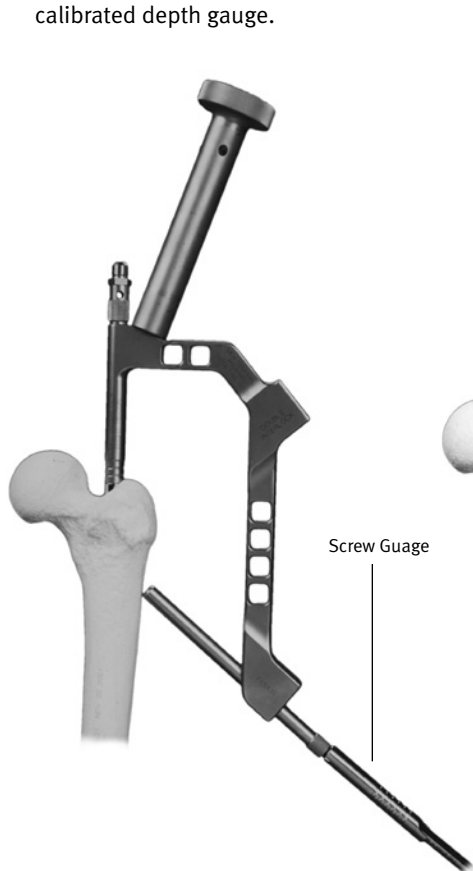


Fig. 38

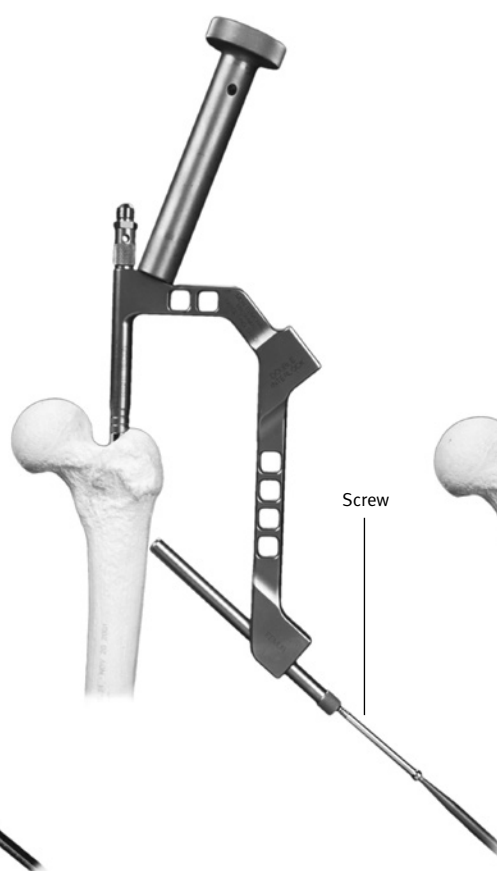


Fig. 39

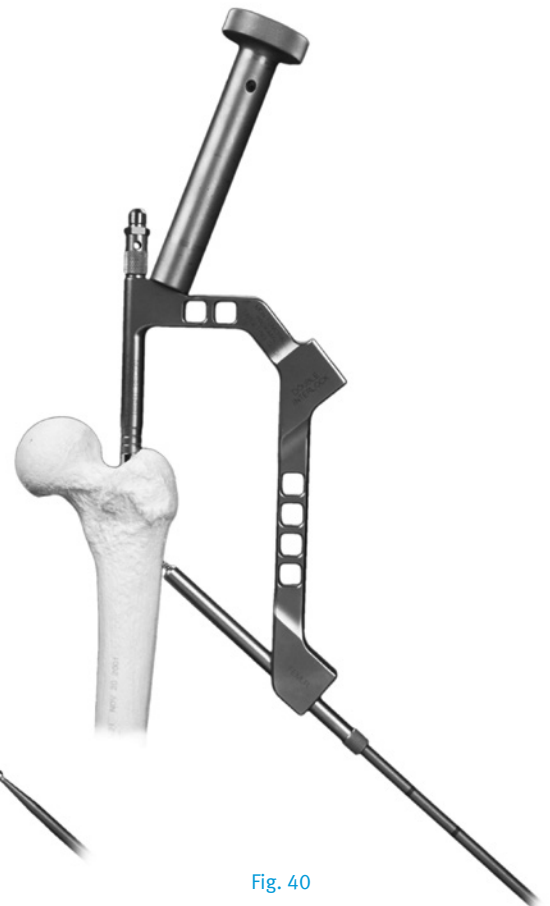


Fig. 40

procedures for insertion of the superior locking screw (Fig. 41). Again, observe A/P and lateral C-arm views to ensure proper seating within the femoral head and neck. Using the Pin Wrench, loosen and remove the Locking Bolt and Femoral Proximal Guide.

NOTE: 5.5mm Recon Screws (Color Code: Candy Stripe Green) are used proximally for all recon procedures.

3.7mm screws (Color Code: Yellow), are used distally for 8mm Femoral Nails.

4.2mm screws (Color Code: Blue), are used distally for all 9mm – 11mm Femoral Nails.

5.5mm Screws (Color Code: Green), are used distally for all 12mm – 16mm Femoral Nails.

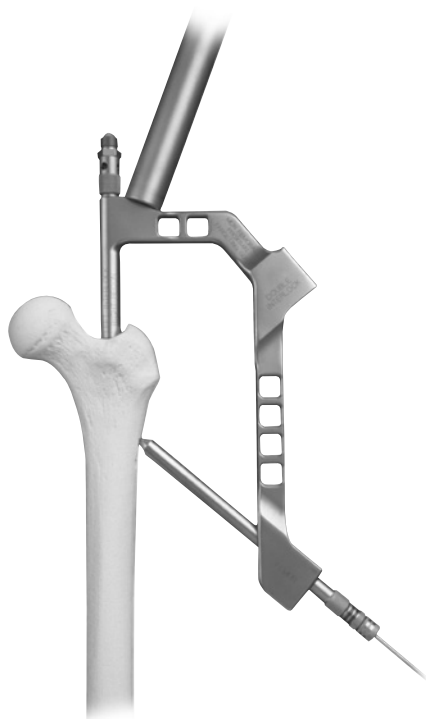


Fig. 41

End Cap Placement

If desired, insert an *M/DN* End Cap of the appropriate length (0mm, 5mm, 10mm, 15mm) in the proximal end of the nail. These caps help protect the internal threads of the nail, facilitate future extraction, and allow the surgeon to adjust the length of the nail.

Distal Locking

Technique for Using Freehand Targeting Device

The distal locking screws may be inserted with a freehand technique using the Freehand Targeting Device. Insert an appropriate size Trocar 3.2mm (Color Code: Yellow) for 3.7mm screw, 3.7mm (Color Code: Blue) for 4.2mm screw, 5.0mm (Color Code: Green) for 5.5mm screw] (Fig. 42) into the Freehand Targeting Device. Finger tighten the set screw.



Fig. 42

Choose the appropriate locking hole based on the need for dynamization. The superior locking hole on the *M/DN* Nail is used for static locking, while the distal locking hole is used for dynamic locking. If static locking is preferred, but there is a potential need for later dynamization, insert screws in both locking holes. The locking screw in the static hole can then be removed to achieve later dynamization.

For success with this technique, proper placement of the lateral x-ray beam is critical. Position the C-arm so the locking hole of the nail appears perfectly round on the monitor (Fig. 43).

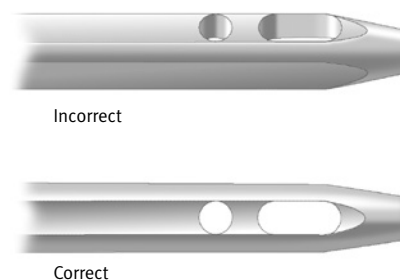


Fig. 43

Note: 4.5mm cortical interlocking screws are NOT indicated for use with the MDN system.

When this is achieved, bring the tip of the Trocar to the skin and use the C-arm to center it over the hole. Make a lateral stab wound opposite the appropriate locking hole, and dissect down to bone. Bring the tip of the Trocar to the bone and center it over the locking hole using the C-arm (Fig. 44a).

Align the Trocar with the axis of the x-ray beam (Fig. 44b and c). Drive the Trocar into the bone and across the hole in the nail in line with the lateral x-ray beam, but do not penetrate the medial cortex.

Remove the Targeting Device by loosening the set screw. Verify Trocar placement in both the A/P and lateral planes (Fig. 45).

After it has been correctly placed, remove the Trocar. The path of the Trocar in the bone acts as a pilot hole for the appropriate size drill (Fig. 46). Attach the appropriate drill (same size as the Trocar) to the Freehand Targeting Device. Insert the drill into the pilot hole made by the Trocar. Before drilling through the medial cortex, check the A/P and lateral C-arm image to assure that the drill is in the hole in the nail. Then drill through the medial cortex.

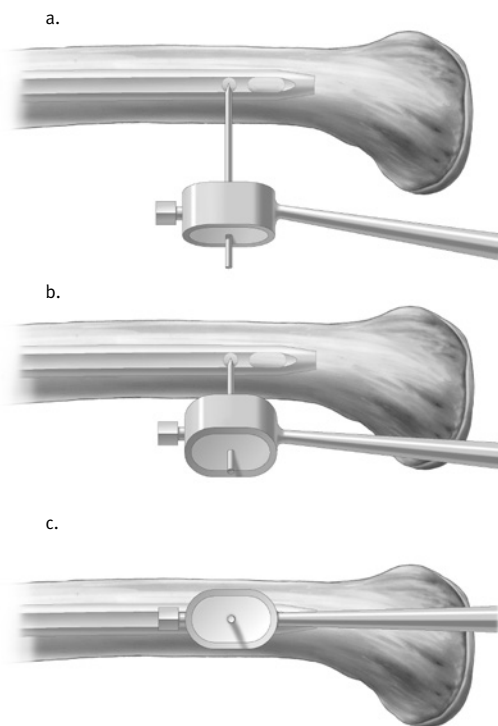


Fig. 44

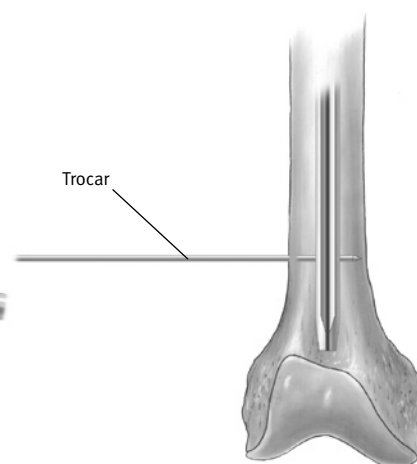


Fig. 45

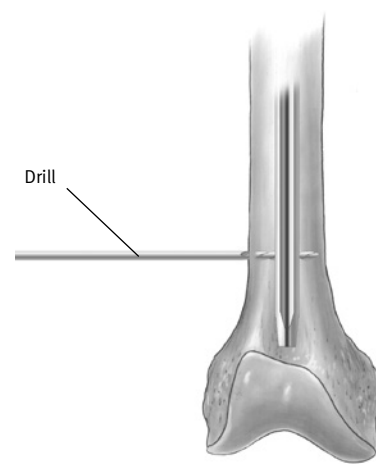


Fig. 46

Remove the drill and insert the Distal Screw Depth Gauge (Fig. 47). The length of the screw is determined by reading it directly off the Distal Screw Depth Gauge. Select an appropriate length screw to ensure adequate engagement of the medial cortex. Insert the appropriate size *M/DN* Screw using the Distal Screwdriver (Fig. 48).

If desired, insert the second screw in the second locking hole of the nail in an identical manner (Fig. 49). Check the position of both screws with the C-arm in the A/P and lateral planes (Fig. 50).

Bushings are available that can be used with the Freehand Targeting Device. A separate radiolucent Bushing Insert is available to aid in targeting.

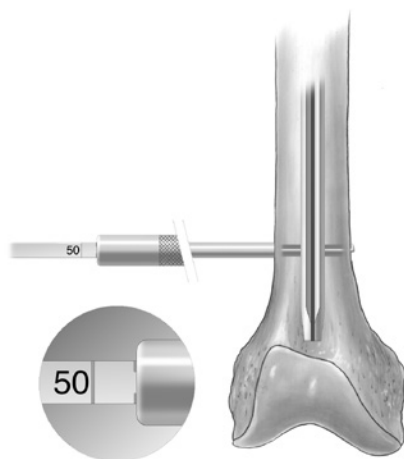


Fig. 47

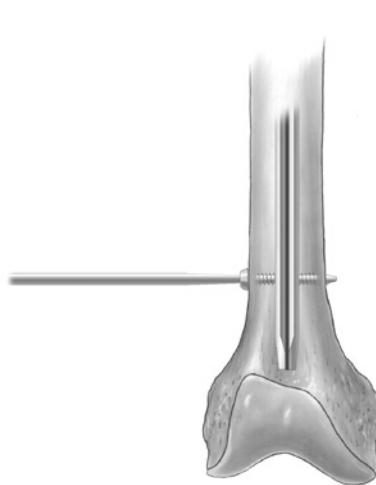


Fig. 48

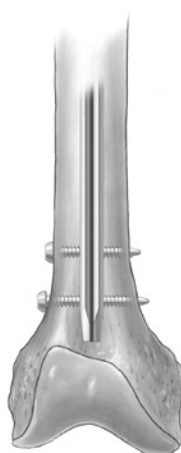


Fig. 49

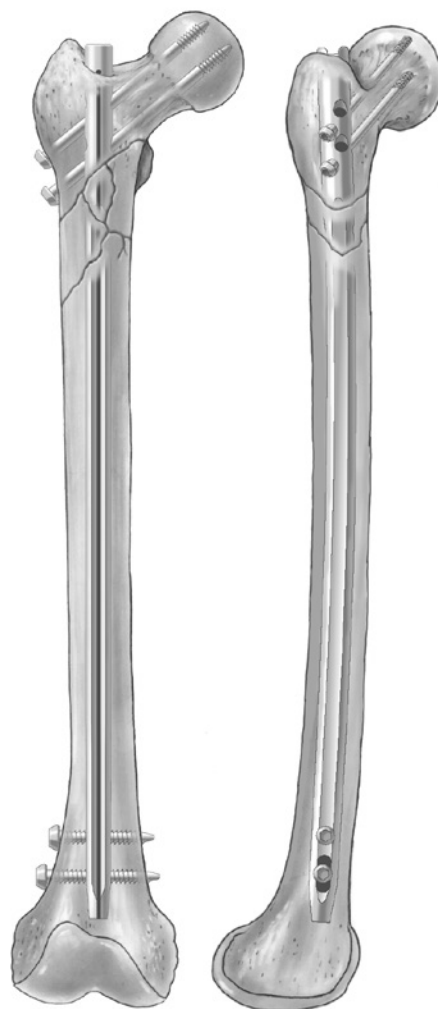


Fig. 50

Table 3. Distal Screw Sizes for *M/DN* Femoral Recon Nails

Nail Diameter (mm)	Screw Diameter		
	Distal 3.7mm Cortical	Distal 4.2mm Cortical	Distal 5.5mm Cortical
8	•		
9		•	
10		•	
11		•	
12			•
13			•
14			•
15			•
16			•

Note: 4.5mm cortical interlocking screws are NOT indicated for use with the MDN system.

Closure and Postoperative Care

Close the proximal wound over suction drains, and apply a soft compression dressing.

Nail Cap

If desired, a nail cap can be placed into the proximal threaded portion of the *M/DN* Nail (Fig. 51). Nail Caps are available in 0mm, 5mm, 10mm, and 15mm heights.

Extraction

Should extraction of the nail become necessary, attach the Threaded Extractor to the end of the nail and use the Slaphammer to extract the nail (Fig. 52).

NOTE: The cannulated Locking Bolt should not be used for nail removal. Extraction of the nail should be accomplished by using the Threaded Extractor.



Fig. 51



Fig. 52

Instrument Case Options

M/DN Instruments

Option A (Metal Femoral/MIS Femoral/Retrograde)

Set Number 00-2255-000-17 (includes case/tray/lid + instruments)

Case Set Number 00-2237-090-00 (includes trays and lid)

Metal Femoral Guides/Instruments (top tray holds the following)

Prod. No.	Description	
00-2255-001-03	Locking Bolt Assembly	2
00-2255-002-10	Fem. Prox. Targeting Guide	1
00-2255-002-11	Fem. Prox. Targeting Guide	1
00-2255-004-32	3.2mm Pin Bushing	2
00-2255-004-50	5.0mm Drill Bushing	2
00-2255-004-80	8.0mm Screw Bushing	2
00-2255-011-00	Recon Screw Counterbore	1
00-2258-067-00	<i>ITST</i> ® Threaded Guide Pin 355mm	3
00-2255-028-00	Pin Wrench	1
00-2255-035-50	5.0mm Femoral Drill, Large	3

MIS Guides (middle tray holds the following; must be used with above tray)

Prod. No.	Description	
00-2255-003-03	Perc. Recon Arm Set Screw	2
00-2255-028-00	Pin Wrench	1
00-2255-050-01	Fem. Perc. Targeting Guide	1
00-2255-050-02	Fem. Perc. Targeting Guide	1
00-2255-051-00	Perc. Recon Arm	1
00-2255-053-00	Perc. Cannula	1
00-2255-054-00	Perc. Centering Bushing	1
00-2255-058-00	Per. Locking Bolt	2

Retrograde Femoral Instruments (base of case holds the following)

Prod. No.	Description	
00-2241-001-00	Retro. Targ. Guide Assembly (4 pcs.)	1
00-2241-001-01	Adj. Targ. Arm Assembly (5 pcs.)	1
00-2241-006-00	Cortical Nut Screwdriver	1
00-2241-008-37	3.7mm Drill Bushing	2
00-2241-008-50	5.0mm Drill Bushing	2
00-2258-067-00	<i>ITST</i> ® Threaded Guide Pin 355mm	3
00-2255-001-00	Locking Bolt	2
00-2255-004-80	8.0mm Screw Bushing	2
00-2255-028-00	Pin Wrench	1
00-2255-031-37	3.7mm Drill	1
00-2255-035-50	5.0mm Drill, Large	1
00-2255-059-00	Nail Cap Inserter (captured screwdriver)	1

M/DN Instruments**Option B (Metal Femoral/Tibial/Humeral/Retrograde)**

Set Number 00-2255-000-18 (includes case/tray/lid + instruments)

Case Set Number 00-2237-068-00 (includes trays and lid)

Metal Femoral Guides/Instruments (top tray holds the following)

Prod. No.	Description	
00-2255-001-03	Locking Bolt Assembly	2
00-2255-002-10	Fem. Prox. Targeting Guide	1
00-2255-002-11	Fem. Prox. Targeting Guide	1
00-2255-004-32	3.2mm Pin Bushing	2
00-2255-004-50	5.0mm Drill Bushing	2
00-2255-004-80	8.0mm Screw Bushing	2
00-2255-011-00	Recon Screw Counterbore	1
00-2258-067-00	<i>ITST</i> Threaded Guide Pin 355mm	3
00-2255-028-00	Pin Wrench	1
00-2255-035-50	5.0mm Femoral Drill, Large	3

Plastic Tibial/Humeral Instruments (middle tray holds the following)

Prod. No.	Description	
00-2255-001-00	Locking Bolt	2
00-2255-003-00	Tibial Proximal Targeting Guide	1
00-2255-003-01	Tibial Oblique Hole Adapter	1
00-2255-003-03	Set Screw	2
00-2255-004-00	Humeral Proximal Targeting Guide	1
00-2255-004-01	Humeral Oblique Hole Adapter	1
00-2255-036-37	Tib./Hum. 3.7mm Drill Bushing	2
00-2255-036-80	Tib./Hum. 8.0mm Screw Bushing	2
00-2255-028-00	Pin Wrench	1
00-2255-032-37	Tib./Hum. 3.7mm Drill	2

Retrograde Femoral Instruments (base of case holds the following)

Prod. No.	Description	
00-2241-001-00	Retro. Targ. Guide Assembly (4 pcs.)	1
00-2241-001-01	Adj. Targ. Arm Assembly (5 pcs.)	1
00-2241-006-00	Cortical Nut Screwdriver	1
00-2241-008-37	3.7mm Drill Bushing	2
00-2241-008-50	5.0mm Drill Bushing	2
00-2258-067-00	<i>ITST</i> Threaded Guide Pin 355mm	3
00-2255-001-00	Locking Bolt	2
00-2255-004-80	8.0mm Screw Bushing	2
00-2255-028-00	Pin Wrench	1
00-2255-031-37	3.7mm Drill	1
00-2255-035-50	5.0mm Drill, Large	1
00-2255-059-00	Nail Cap Inserter (captured screwdriver)	1

General Instrument Set

Set Number 00-2255-000-16 (includes case/tray/lid + instruments)
Case Set Number 00-2237-095-00 (includes trays and lid)

General Instruments (top tray holds the following)

Prod. No.	Description	
00-2237-053-00	Wire Grip T-Handle	1
00-2237-061-00	Long T-Handle Cannulated Awl	1
00-2237-066-00	Short T-Handle Cannulated Awl	1
00-2255-016-00	7mm Angled Femoral Awl*	1
00-2255-034-00	Reduction Finger	1
00-2255-052-00	9mm/14mm Perc. Tapered Reamer	1
00-2255-060-00	8mm Trochanteric Reamer	1
00-2258-067-00	ITST Threaded Guide Pin 355mm	3
00-2255-038-00	T-Handle	1
00-4816-060-00	Ball-Spiked Pusher	1
00-4817-011-00	Shoulder Hook	1

General Instruments (middle tray holds the following)

Prod. No.	Description	
00-2228-097-00	Diameter Gauge	1
00-2237-055-00	Ruler	1
00-2255-057-00	Flexible Reamer Extension	2
00-2305-024-00	Screwdriver, Small Hexhead	1
00-2237-060-00	Slotted Mallet	1
00-2237-062-00	Threaded Driver	1
00-2237-063-00	Screw Depth Gauge, Long	1
00-2255-013-00	Screwdriver 3.5mm Hex, Long	1
00-2255-017-00	Flared Exchange Tube	1
00-2237-064-00	Nail Length Gauge	1
00-2258-057-00	Cannulated Depth Gauge	1

General Instruments (base of case holds the following)

Prod. No.	Description	
00-2255-009-00	Slaphammer	1
00-2255-028-00	Pin Wrench	1
00-2237-065-00	Threaded Extractor (17cm)	1
00-2237-065-01	Threaded Extractor (32cm)	1
00-2255-012-33	3.2mm Trocar	3
00-2255-012-37	3.7mm Trocar	3
00-2255-012-50	5.0mm Trocar	3
00-2255-033-32	3.2mm Drill	3
00-2255-033-37	3.7mm Drill	3
00-2255-033-50	5.0mm Drill	3
00-2255-018-00	Distal Screw Depth Gauge	1
00-2255-013-01	Distal Screwdriver 3.5mm Hex	1
00-2255-015-03	Wand Handle	1
00-2255-015-01	Wand Insert	1
00-2255-015-02	Wand Set Screw	1

* The 7mm Straight Awl (00-2237-001-07) OR the 7mm Angled Femoral Awl (00-2255-016-00) will fit in the case. However, when you order the set number (00-2255-000-16), you will get the Angled Awl.

See Sales representative for optional instruments.

Pressure Sentinel Intramedullary Reaming System
Order Information

Prod. No.	Description
00-2218-000-00	Long Pressure Sentinel Reamers Tray/Case/Lid
Includes the following instruments & case:	
00-2218-008-00	8.0mm Long Flexible PS Reamer
00-2218-008-05	8.5mm Long Flexible PS Reamer
00-2218-009-00	9.0mm Long Flexible PS Reamer
00-2218-009-05	9.5mm Long Flexible PS Reamer
00-2218-010-00	10.0mm Long Flexible PS Reamer
00-2218-010-05	10.5mm Long Flexible PS Reamer
00-2218-011-00	11.0mm Long Flexible PS Reamer
00-2218-011-05	11.5mm Long Flexible PS Reamer
00-2218-012-00	12.0mm Long Flexible PS Reamer
00-2218-012-05	12.5mm Long Flexible PS Reamer
00-2218-013-00	13.0mm Long Flexible PS Reamer
00-2218-013-05	13.5mm Long Flexible PS Reamer
00-2218-014-00	14.0mm Long Flexible PS Reamer
00-2218-014-05	14.5mm Long Flexible PS Reamer
00-2218-015-00	15.0mm Long Flexible PS Reamer
00-2218-015-05	15.5mm Long Flexible PS Reamer
00-2218-016-00	16.0mm Long Flexible PS Reamer
00-2218-016-05	16.5mm Long Flexible PS Reamer
00-2218-017-00	17.0mm Long Flexible PS Reamer
00-2218-017-05	17.5mm Long Flexible PS Reamer
00-2218-018-00	18.0mm Long Flexible PS Reamer
00-2228-030-00	T-Handle Extractor
00-2228-097-00	Diameter Gauge
00-5044-012-00	Adapter 3 Jaw Chuck
00-2228-098-10	Soak Tray
00-2218-025-00	Long Cleaning Brush
00-2218-030-00	Torque Limiter
00-2237-075-00	Long Reamer/Instrument Case Assembly
00-2237-076-00	Long Reamer/Instrument Case Base
00-2237-077-00	Long Reamer/Instrument Case Lid
00-2237-078-00	Long Reamer/Instrument Top Tray (8mm-13.5mm)
00-2237-079-00	Long Reamer/Instrument Middle Tray

00-2228-000-00 Pressure Sentinel Reamer Full Set
Includes the following instruments & case:

00-2228-005-00	5.0mm Flexible Reamer
00-2228-005-05	5.5mm Flexible Reamer
00-2228-006-00	6.0mm Flexible Reamer
00-2228-006-05	6.5mm Flexible Reamer
00-2228-007-00	7.0mm Flexible Reamer
00-2228-007-05	7.5mm Flexible Reamer
00-2228-008-00	8.0mm Flexible Reamer
00-2228-008-05	8.5mm Flexible Reamer
00-2228-009-00	9.0mm Flexible Reamer
00-2228-009-05	9.5mm Flexible Reamer
00-2228-010-00	10.0mm Flexible Reamer
00-2228-010-05	10.5mm Flexible Reamer
00-2228-011-00	11.0mm Flexible Reamer
00-2228-011-05	11.5mm Flexible Reamer
00-2228-012-00	12.0mm Flexible Reamer
00-2228-012-05	12.5mm Flexible Reamer
00-2228-013-00	13.0mm Flexible Reamer
00-2228-013-05	13.5mm Flexible Reamer
00-2228-014-00	14.0mm Flexible Reamer
00-2228-014-05	14.5mm Flexible Reamer
00-2228-015-00	15.0mm Flexible Reamer
00-2228-015-05	15.5mm Flexible Reamer
00-2228-016-00	16.0mm Flexible Reamer
00-2228-016-05	16.5mm Flexible Reamer
00-2228-017-00	17.0mm Flexible Reamer
00-2228-017-05	17.5mm Flexible Reamer
00-2228-018-00	18.0mm Flexible Reamer
00-2228-018-05	18.5mm Flexible Reamer
00-2228-019-00	19.0mm Flexible Reamer
00-2228-019-05	19.5mm Flexible Reamer
00-2228-020-00	20.0mm Flexible Reamer
00-2228-020-05	20.5mm Flexible Reamer
00-2228-021-00	21.0mm Flexible Reamer
00-2228-021-05	21.5mm Flexible Reamer
00-2228-022-00	22.0mm Flexible Reamer
00-2228-030-00	T-Handle Extractor
00-2228-097-00	Diameter Gauge
00-2228-098-00	Soak Tray
00-5044-012-00	1/4in. Jacob's Chuck to Zimmer Adapter, Qty=2
00-2228-090-00	Sterilization Case

Optional Reamer Sizes

Prod. No.	Description
00-2228-022-05	22.5mm Flexible Reamer
00-2228-023-00	23.0mm Flexible Reamer
00-2228-023-05	23.5mm Flexible Reamer
00-2228-024-01	24.0mm Flexible Reamer
00-2228-024-05	24.5mm Flexible Reamer
00-2228-025-01	25.0mm Flexible Reamer
00-2228-025-05	25.5mm Flexible Reamer
00-2228-026-01	26.0mm Flexible Reamer
00-2228-026-05	26.5mm Flexible Reamer
00-2228-027-01	27.0mm Flexible Reamer

Pressure Sentinel Sets

Prod. No.	Description
00-2228-000-01	Pressure Sentinel Reamer Trauma Set Includes the following instruments & case: 5.0mm, 6.0mm, 7.0mm & 8.00mm-17.5mm Flexible Reamers in .5mm increments (1ea.)
00-2228-030-00	T-Handle Extractor
00-5044-012-00	1/4in. Jacob's Chuck to Zimmer Adapter, Qty=2
00-2228-090-00	Sterilization Case
00-2228-000-02	Pressure Sentinel Reamer Hip Set Includes the following instruments & case: 8.0mm-18.0mm Flexible reamers in 1mm increments (1ea.)
00-2228-030-00	T-Handle Extractor
00-5044-012-00	1/4in. Jacob's Chuck to Zimmer Adapter, Qty=1
00-2228-090-00	Sterilization Case

00-2228-000-03	Pressure Sentinel Reamer Expanded Hip Set Includes the following instruments & case: 8.0mm-18.0mm Flexible reamers in .5mm increments (1ea.)
00-2228-030-00	T-Handle Extractor
00-5044-012-00	1/4in. Jacob's Chuck to Zimmer Adapter, Qty=1
00-2228-090-00	Sterilization case
00-2228-90-00	Sterilization Case Includes the following components:
00-2228-091-00	Base
00-2228-092-00	18.0mm to 22.0mm Reamer Tray
00-2228-093-00	12.0mm to 17.5mm Reamer Tray
00-2228-094-00	5.0mm to 11.5mm Reamer Tray
00-2228-096-00	Case Lid
00-9975-011-00	Pressure Sentinel Reamer ZMR® Hip Set Includes the following components: 8.0mm-27.0mm Flexible reamers in .5mm increments (1ea.)
00-9965-081-10	ZMR Flexible Reamer Diameter Gauge
00-9975-099-00	Case Lid
00-2228-040-00	ZMR Flexible Reamer Metal Case
* Set includes case and contents without the 00-9975-099-00 Case Lid. The Case Lid must be ordered separately.	

Optional Instruments

Prod. No.	Description
00-2255-008-00	Guide Wire 2.4mm, Ball-Tip, 70cm box (required for 5.0mm-7.5mm Pressure Sentinel Reamers)
47-2255-008-01	Guide Wire 3.0mm, Ball-Tip, 100cm Sterile/box (required for 8.0mm and larger Pressure Sentinel Reamers)
00-2255-008-01	Guide Wire 3.0mm, Ball-Tip, 100cm Non-sterile/box (required for 8.0mm and larger Pressure Sentinel Reamers)

DISCLAIMER:

This documentation is intended exclusively for physicians and is not intended for laypersons. Information on the products and procedures contained in this document is of a general nature and does not represent and does not constitute medical advice or recommendations. Because this information does not purport to constitute any diagnostic or therapeutic statement with regard to any individual medical case, each patient must be examined and advised individually, and this document does not replace the need for such examination and/or advise in whole or in part.

Please refer to the package inserts for important product information, including, but not limited to, indications, contraindications, warnings, precautions, and adverse effects.

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.

