



Navy-S A/R Femoral Nail *Surgical Technique*

Get Better

Expertise and enthusiasm can be perfectly combined into a top-notch medical engineering company!

We contribute to the development of health services by providing superior technology products at competitive costs.

We envision a socially conscious business environment serving the health industry and patients get better.

Dunitech branded products are designed and engineered to keep our promise;

Easier Operation
Better Fixation

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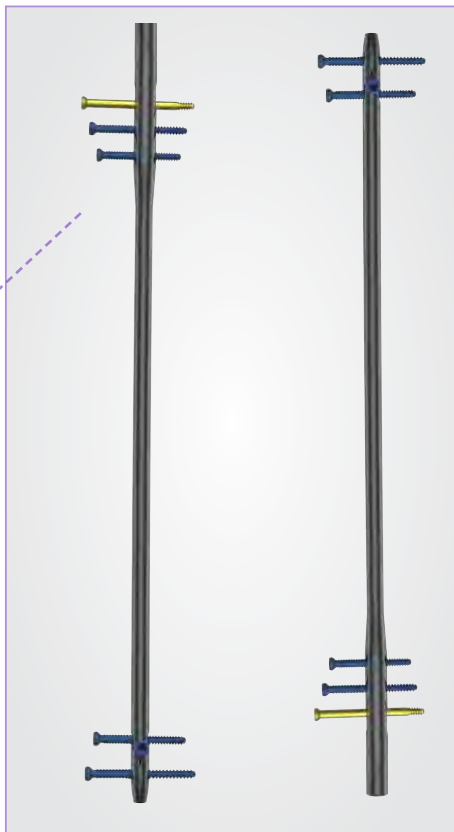
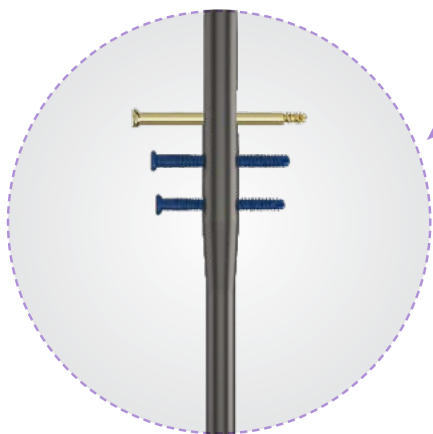
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Navy-S A/R Femoral Nail Specifications

Navy-S KEY FIGURES

- Nail length: 280 mm to 460 mm in 20 mm increment
- Proximal Diameter: 13 mm
- Distal Diameter: 10 mm to 13 mm in 1 mm increment
- Compression Range: 10 mm
- End Cap Length: 0 mm to 15 mm in 5 mm increments



COMPRESSION AND CORTICAL SCREWS' KEY FIGURES

- Length: 30 mm to 120 mm in 5 mm increment
- Diameter: 5 mm

Internal thread to secure the screw to the 5 mm Hex Driver

Compression Screw with threaded tip and 5 mm shaft to withstand compression load

Navy-S A/R Femoral Nail

INDICATIONS

- Femoral Shaft Fractures
- ipsilateral hip / shaft fractures
- Ipsilateral femur / tibia fractures (floating knee)
- Supracondylar fractures including those with intraarticular extension
- Fractures proximal to a knee implant
- Osteoporotic fractures
- Pathologic / impending pathologic fractures
- Malunions / nonunions

PRECAUTIONS

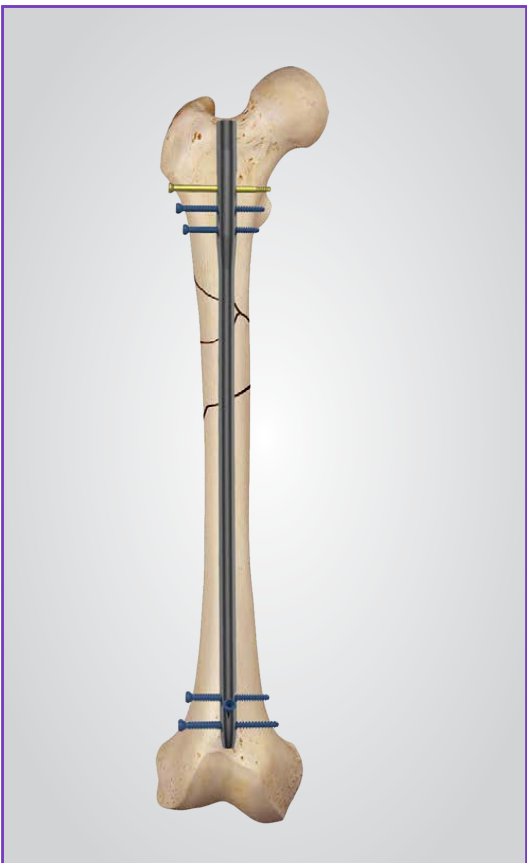
Navy-S A/R Femoral nails and accessories were not evaluated for safety and compatibility in magnetic resonance (MR) environment and no tests for heating or migration were conducted for this product in MR environment.

CONTRAINDICATIONS

- In a leg with a total knee implant (for retrograde technique)
- Femoral neck fractures

The following conditions may present an increased risk of implant failure. This list is not meant to be comprehensive. Physicians should use their clinical judgement when determining the appropriate implant and approach for a given patient.

- Infection
- Incomplete fusion of the epiphysis
- Cognitive and/or physical impairment that would lead to unacceptable risk of fixation failure
- Metal sensitivity or allergic reaction to foreign bodies
- Loss of bone stock or insufficient bone quality to support the device
- Obliterated or narrow medullary canal
- Obese patients
- In the same region as a pre-implanted screw plate
- In comminuted and/or intraarticular fractures
- In open fractures with inadequate soft tissue cover and/or with associated arterial injury



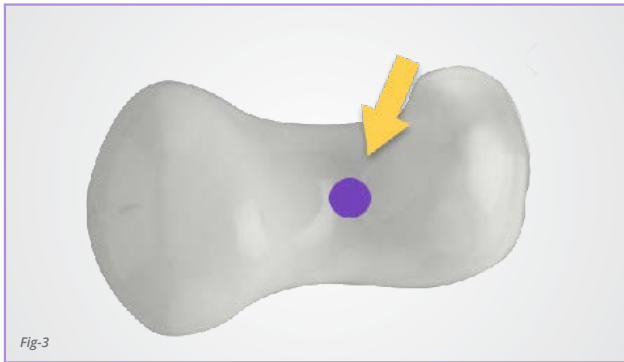
1. Patient Positioning and Fracture Reduction

- Place the patient in the supine or lateral decubitus position according to surgeon preference on a fracture or other radiolucent table.
- Apply traction to the affected leg and place it in slight adduction to ease access to the piriformis fossa and intramedullary canal. Alternatively, the torso can be abducted 10-15° towards the unaffected leg. The unaffected leg should be placed in a leg holder or extended away from the affected leg (Fig-1 and Fig-2). Position the image intensifier as to ensure that AP and lateral views of the entire femur can be easily obtained.
- Reduce the fracture as anatomically as possible through closed reduction before prepping and draping the patient with the help of image intensifier. Manual traction or a distraction device may be used to assist in fracture reduction.

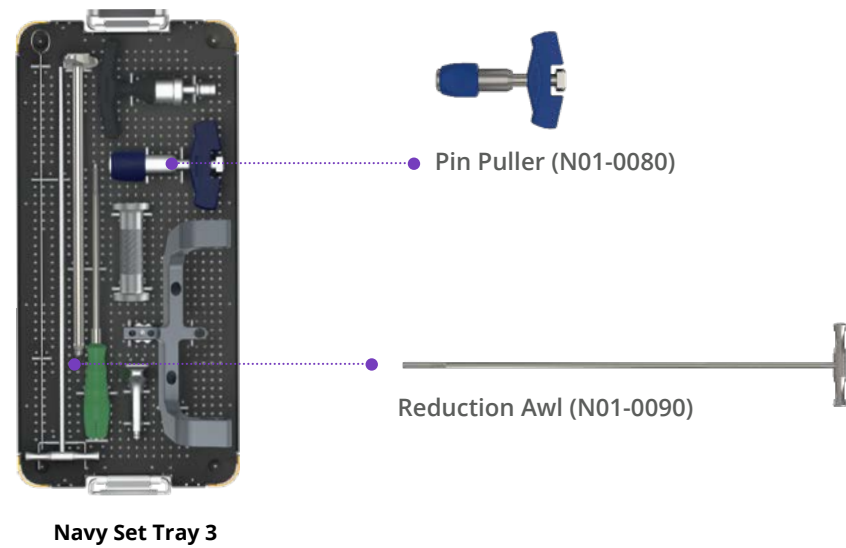
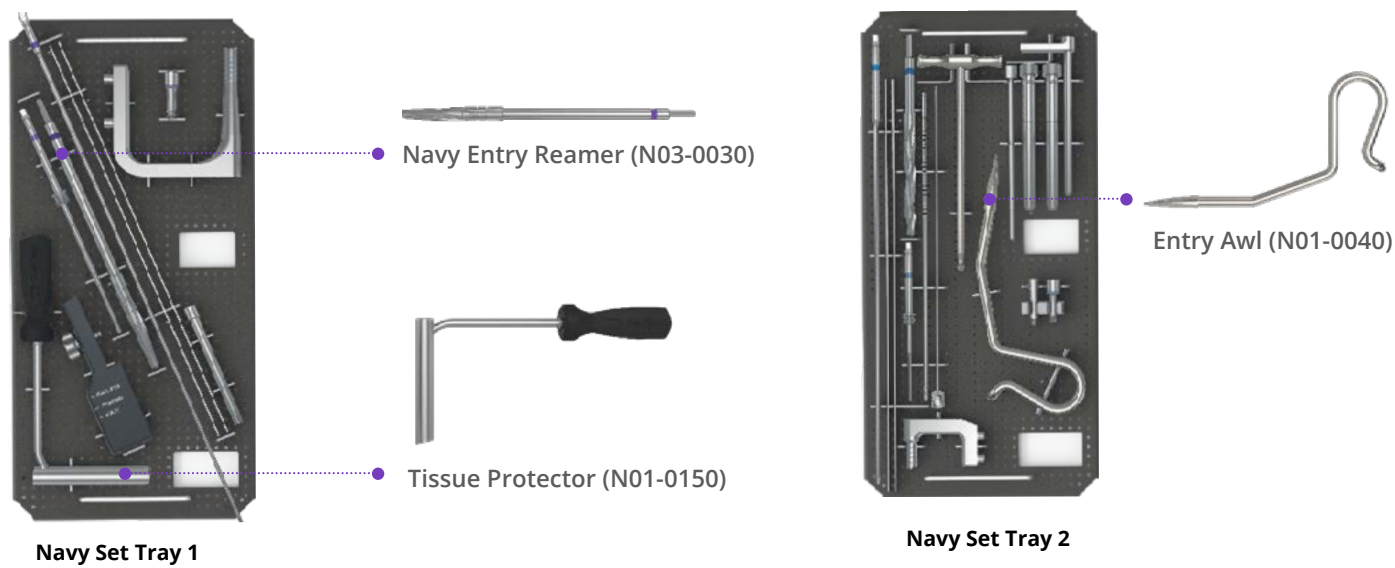


2. Incision and Entry Point

- Make a longitudinal incision proximal to the greater trochanter. Dissect down through the incision separating the gluteus medius in line with the fibers and palpate the proximal femur.
- The entry point is in line with the femoral medullary canal in both AP and lateral views. Typically, the entry point coincides with the piriformis fossa (Fig-3), but it may vary depending on the patient's anatomy.



INSTRUMENTS FOR ACCESSING THE CANAL AND PROXIMAL REAMING



Trocar Tip Guide Wire 3 mm x 600 mm (N01-0250)

Ball Tip Guide Wire 3 mm x 900 mm (N01-0270)

3 mm Guide Wire Sheath (N01-0280)

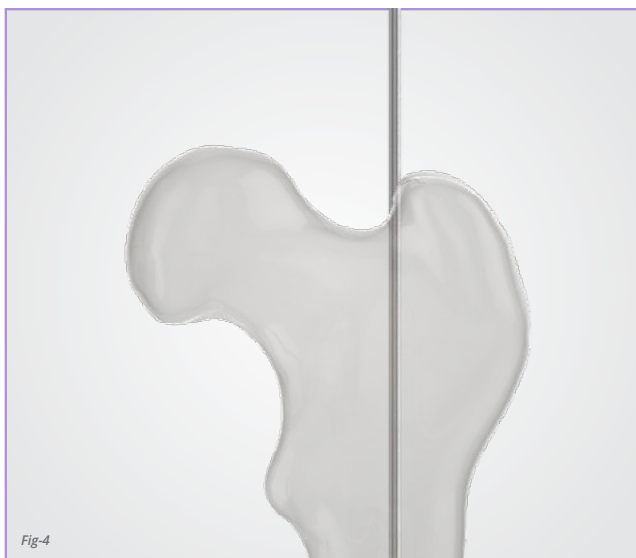
3. Accessing the Canal

Option 1: Trocar Tip Guide Wire

INSTRUMENTS:

- ✓ Trocar Tip Guide Wire 3 mm x 600 mm (N01-0250)

- Advance the 3 mm Trocar Tip Guide Wire through the entry point and into the proximal femur with the help of a powered driver.
- The wire should be centered in the canal on the AP and lateral views (Fig-4 and Fig-5).
- Withdraw and reposition the wire as necessary.



Option 2: Entry Awl and Trocar Tip Guide Wire

INSTRUMENTS:

- ✓ Entry Awl (N01-0040)
- ✓ Trocar Tip Guide Wire 3 mm x 600 mm (N01-0250)

- Insert the Entry Awl through the incision and down to the bone (Fig-6). Rotate the Entry Awl back and forth to penetrate the proximal femur. Care must be taken not to displace the fracture.
- Pass the 3 mm Trocar Tip Guide Wire through the Entry Awl and down to the bone. Withdraw and reposition the wire as necessary.

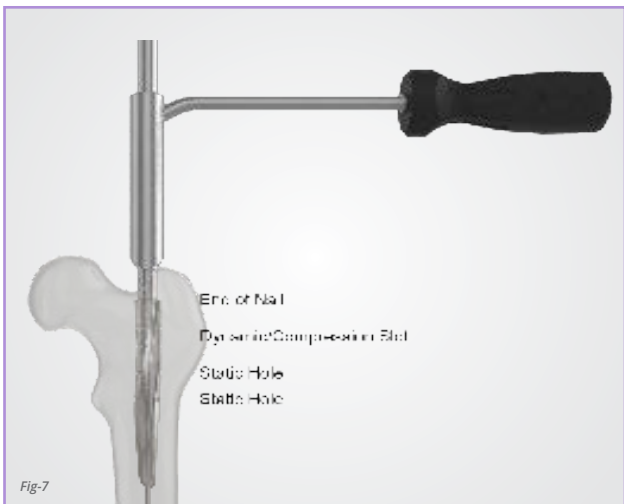


4. Proximal Reaming

INSTRUMENTS:

- ✓ Tissue Protector (N01-0150)
- ✓ Navy Entry Reamer (N03-0030)
- ✓ Ball Tip Guide Wire 3 mm x 900 mm (N01-0270)
- ✓ 3 mm Guide Wire Sheath (N01-0280)
- ✓ Pin Puller (N01-0080)
- ✓ Reduction Awl (N01-0090)

- Insert the Tissue Protector through the incision and down to the bone. Secure the Navy Entry Reamer to a powered driver. Pass it over the wire and through the Tissue Protector. Ream the proximal femur to the desired depth with the help of the image intensifier.
- The grooves on the cutting blade of the Navy Entry Reamer are templates that show the position of the screws (Fig-7). The step between the cutting blades and the shank represent the end of the nail.

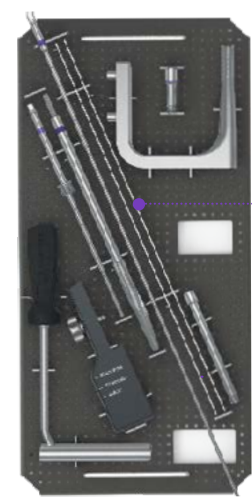


Note:

- ✓ If compression is necessary, the screws placement will be different than indicated during proximal reaming (e.g. if 5 mm compression is done, the static holes will be 5 mm more proximal than indicated by the Navy Entry Reamer).

- Exchange the 3 mm Trocar Tip Guide Wire to the Ball Tip Guide Wire and 3 mm Guide Wire Sheath. Loosen up the Pin Puller's lock and pass the Guide Wire through it. Lock the wire by rotating the Pin Puller's drum and move it to the desired depth (Fig-8). Ensure that the guide wire is in correct position with the help of image intensifier. Withdraw and reposition the wire as necessary.
- Confirm that the fracture is well reduced. If necessary use the Reduction Awl to assist with the fracture reduction or guide wire change.





Navy Set Tray 1



Navy-Nite Guide Wire Ruler (N06-0650)

5. Determining the Nail Length

INSTRUMENTS:

- ✓ Navy-Nite Guide Wire Ruler (N06-0650)
- Confirm that the fracture is well reduced and pass the Navy Nite Guide wire Ruler's hole from the Ball Type Guide Wire 3mm x 900 mm (N01-0270) and touch to the entry point of the bone.
- Top of the Guide Wire's location will show the length of the nail.

Note:

- ✓ If compression will be required, the final nail head position will be more proximal than what is read in the template. Consider the expected compression when choosing the nail's length.
- ✓ Using a different Guide Wire may give wrong results.

6. Distal Reaming

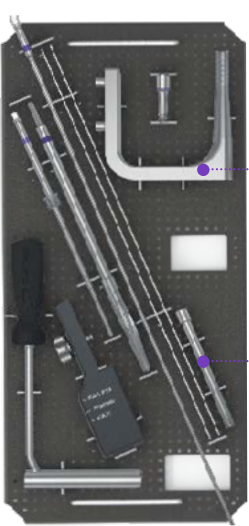
INSTRUMENTS:

✓ *Dunitech Intramedullary Reamer Set (INST-01-002)*

- Confirm that the fracture is well reduced. Starting from 8.5 mm Reamer Cutter Head, ream until the desired depth with a steady pressure. By each pass, increase the diameter of the Reamer Cutter Head in 0.5 mm increments. If the sheath comes out with the reamer, insert it back before starting the next pass.
- The canal should be reamed to at least 1 mm above the desired nail diameter. Ream to at least 11 mm (the nail with smallest diameter has 10 mm of distal diameter). If there's no resistance to reaming to 11 mm, increase the reaming diameter to fit the next size of nail to a maximum of 14 mm.
- To prevent accumulation of debris in the medullary canal, retract the reamer when necessary.
- After distal reaming, remove the sheath (Fig-11). The Sheath won't pass through the nail.



INSTRUMENTS FOR ATTACHING THE NAIL



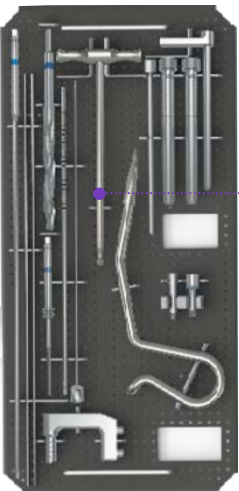
Navy Set Tray 1



● Navy Guide Handle (N03-0060)



● Navy Handle-Nail Connector Screw (N03-0070)



Navy Set Tray 2



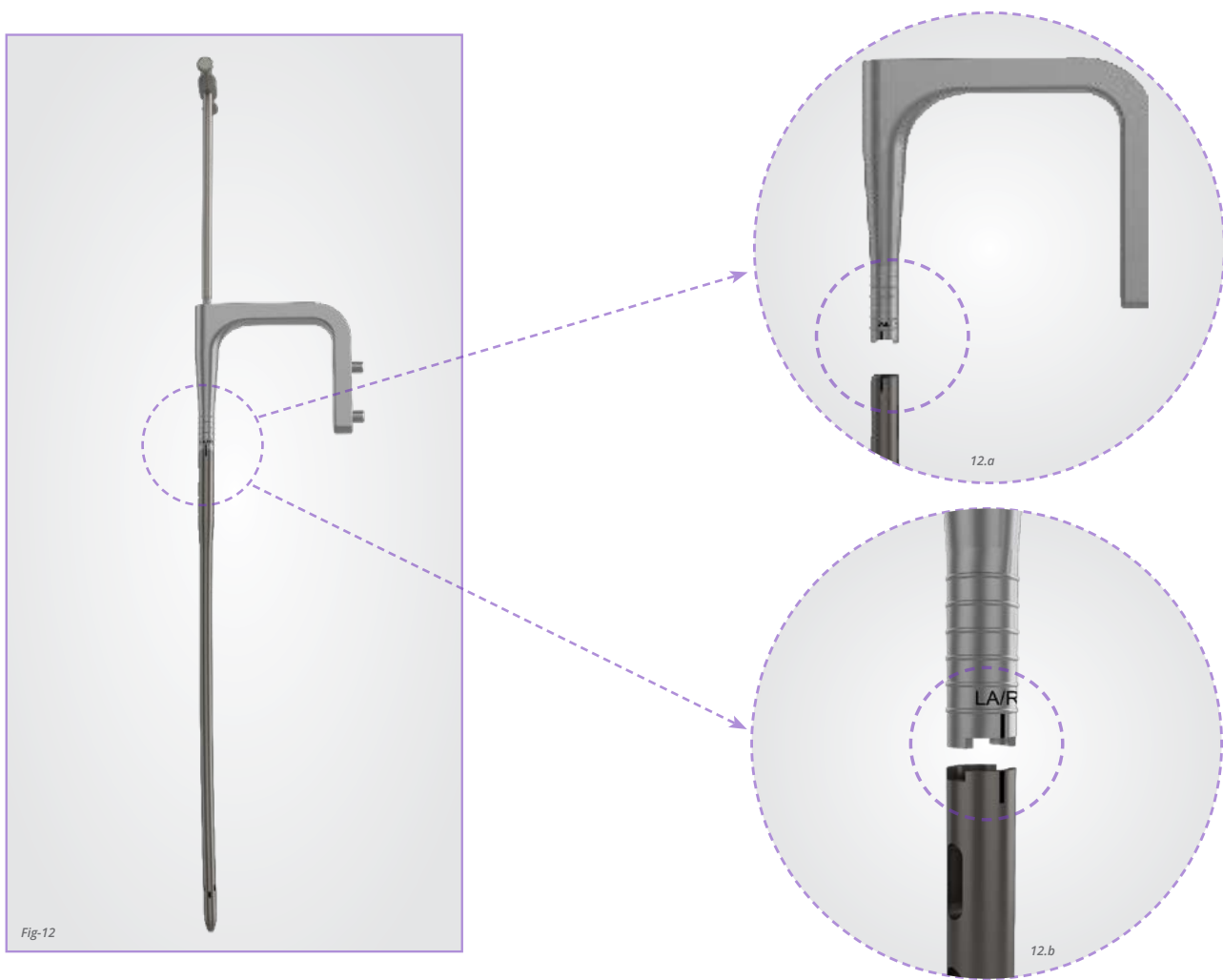
● 7 mm Hex Driver (N01-0030)

7. Attaching the Nail

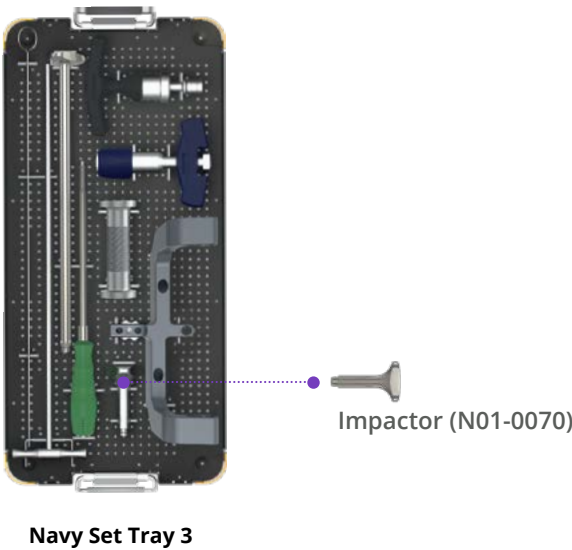
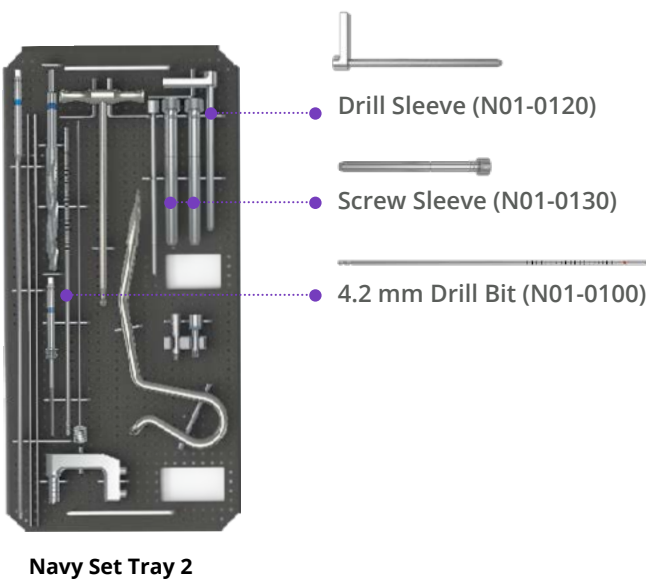
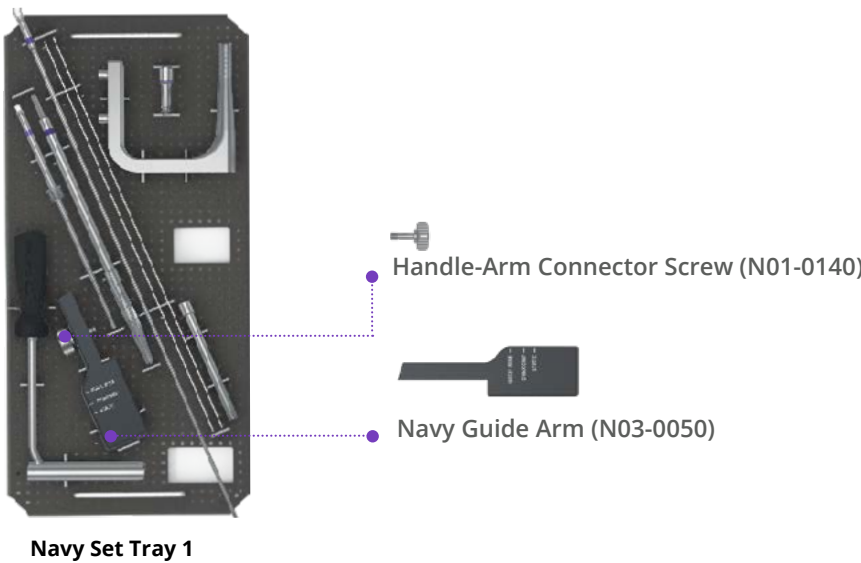
INSTRUMENTS:

- ✓ Navy Handle-Nail Connector Screw (N03-0070)
- ✓ 7 mm Hex Driver (N01-0030)
- ✓ Navy Guide Handle (N03-0060)

- The marks on the Guide Handle have the following meaning:
 - ✓ LA/RR for Left femur and Antegrade approach (LA) or Right femur and Retrograde approach (RR).
 - ✓ RA/LR for Right femur and Antegrade approach (RA) or Left femur and Retrograde approach (LR).
- For Antegrade approach, align the mark on the nail to the **LA/RR** mark on the Guide Handle for the **Left** leg or **RA/LR** for the **Right** leg.
- Mate the desired nail to the Navy Guide Handle and use the 7 mm Hex Driver (N01-0030) to tighten the Handle-Nail Connector Screw N03-0070 (Fig-12). Ensure that the reference line on the nail is aligned with the correct line on the Guide Handle. (N03-0060)
- Ensure that the connection is tight before proceeding.



INSTRUMENTS FOR CHECKING ALIGNMENT AND INSERTING THE NAIL

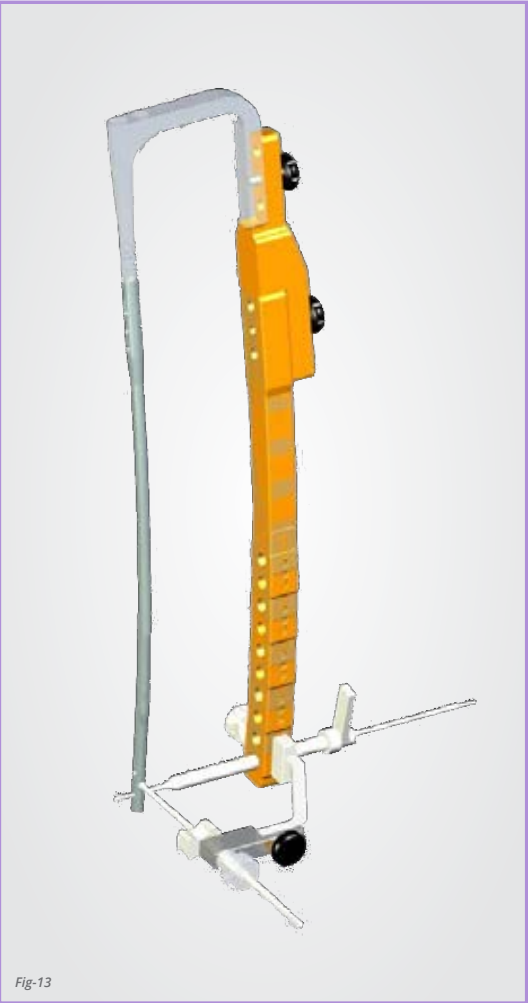


8. Checking Alignment

INSTRUMENTS:

- ✓ Navy Guide Arm (N03-0050)
- ✓ Handle - Arm Connector Screw (N01-0140)
- ✓ Screw Sleeve (N01-0130)
- ✓ Drill Sleeve (N01-0120)
- ✓ 4.2 mm Drill Bit (N01-0100)
- ✓ Navy-S Handle-Bar Connector (N06-0010)
- ✓ Navy-S Distal Guide Bar 280-440 Left/right (N06-0020)
- ✓ Navy-S Distal Guide Bar 300-460 Left/right (N06-0030)
- ✓ Navy-S Distal Targeting Arm (N06-0040) Dia X (X = 9-10-11-12-13) Block
- ✓ Locking Bolt (N06-0560) X 3
- ✓ Locking Bolt (N06-0570)
- ✓ Locking Bolt for distal Targeting Device (N06-0580)
- ✓ Positioning Rod (N06-0590)

- Before inserting the nail check the nail's holes are correctly aligned to the holes of the Guide Arm .
- Mate the Navy Guide Arm with the Navy Guide Handle and secure them with the Handle-Arm Connector Screw.
- Insert the Drill Sleeve into the Screw Sleeve and insert this assembly into the most distal hole of the Guide Arm. Insert the 4.2 mm Drill bit through the Drill Sleeve and advance until it passes through the corresponding nail hole (Fig-13).
- Repeat the process in the other holes.
- Prior to inserting the nail, remove the Navy Guide Arm.
- Mate the Navy-S Handle-Bar Connector with the Navy Guide Handle and secure them with the locking bolt (N06-0560).
- Mate the Navy-S Distal Guide Bar 280-440 left/right(N06-0020) with N06-0010 if you are using nails 280-320-360-400-440 with the locking bolt(N06-0560).
- Mate the Navy-S Distal Guide Bar 300-460 left/right(N06-0030) with N06-0010 if you are using nails 300-340-380-420-460 with the locking bolt(N06-0560).
- Connect Navy-S Distal Targeting Arm (N06-0040) with Navy-S Distal Guide Bar using N06-0570 Locking Bolt.
- Connect Positioning Rod (N06-0590) inside the Navy-S Distal Targeting Arm (N06-0220).
- Fix Dia X Block (X chosen according to the distal diameter of the nail) to the positioning rod.
- Screw and fix the position of the positioning Rod with Locking Bolt Distal Targeting Device (N06-0580).
- Insert the Drill Sleeve (N01-0100) into the Screw Sleeve and insert this assembly into the most distal hole of the Guide Arm. Insert the 4.2 mm Drill bit through the Drill Sleeve and advance until it passes through the corresponding nail hole (Fig-13).
- Repeat the process in the other hole.
- Remove the Navy-S Handle-Bar Connector (N06-0010).
- Prior to inserting the nail, remove the Navy-S Distal Guide Bar (N06-0020/30).



9. Inserting the Nail

INSTRUMENTS:

- ✓ Impactor (N01-0070) - Optional

Note:

- ✓ If a traditional ball tip guide wire was used, it must be exchanged for a smooth guide wire. Its tip won't pass through the nail.

- Pass the nail over the guide wire, through the incision and into the bone. With steady pressure and gentle rotation movements, advance the nail (Fig-14). Monitor closely with the help of image intensifier the passage of the nail across the fracture site.
- If needed, the Impactor can be assembled in the Guide Handle for light hammer blows. If considerable resistance is encountered, do not use strong hammer strikes. It may cause loss of reduction or perioperative fracture. Instead, remove the nail, replace the sheath and further enlarge the medullary canal.
- The rings in the handle are spaced 5 mm from each other, they indicate the depth of the nail's head.

Note

- ✓ Do not strike the Guide Handle with a slap hammer or any other mallet.

- Once the nail is in its final position, remove the guide wire.



10. Distal Locking

INSTRUMENTS:

- ✓ Navy Guide Arm (N03-0050)
- ✓ Navy-S Handle-Bar Connector (N06-0010)
- ✓ Navy-S Distal Guide Bar 280-440 left/right (N06-0020)
- ✓ Navy-S Distal Guide Bar 300-460 left/right (N06-0030)
- ✓ Navy-S Distal Targeting Arm (N06-0040)
- ✓ Dia X Block (N06-0510/520/530/540/550)
- ✓ Locking Bolt (N06-0560) x3
- ✓ Locking Bolt (N06-0570)
- ✓ Locking Bolt for Distal Targeting device (N06-0580)
- ✓ Positioning Rod (N06-0590)
- ✓ Impactor (N06-0600) (Optional)
- ✓ Drill Sleeve (N06-0610)
- ✓ Cannulated Drill Bit (N06-0620)
- ✓ Guidewire dia 2.5 (N06-0630)
- ✓ Hammer (N06-0640) (Optional)



Fig-16

- Mate the Navy-S Distal Guide Bar 280-440 left/right (N06-0020) with N06-0010 if you are using Nails 280-320-36-400-440 with the Locking Bolt (N06-0560).
- Mate the Navy-S Distal Guide Bar 300-460 left/right (N06-0030) with N06-0010 if you are using Nails 300-340-380-420-460 with the Locking Bolt (N06-0560).
- Connecting Navy-S Distal targeting Arm (N06-0040) with Navy-S Distal Guide Bar using N06-0570 Locking Bolt.
- The hole in the Navy-S Distal Targeting Arm has two o-rings to enable it to be centered to the nail. With radiographic view, two rings should be seen as one ring. If the rings are not centered over the nail hole, Navy-S Distal Targeting Arm has to be moved until they are centered.
- Insert the Drill Sleeve (N06-0610) into the Navy-S Distal Targeting Arm (N06-0040).
- Advance it until the skin and make a small incision. Advance it until the Drill Sleeve touches the cortical bone.
- Send the Cannulated Drill Dia 6/Dia 2.5 into the Drill Sleeve until it touches the first cortex. Then send the Guide wire 2.5 inside the Cannulated Drill Dia 6/Dia 2.5.
- Guide wire Dia 2.5 should be sent into the first cortex. This can be done by using a motor or with the help of impactor (N06-0600) and Hammer (N06-0640).
- Drill the first cortex with Cannulated Drill Dia 6/Dia 2.5. Be careful not to continue on drilling after the cortex is passed. This might damage the nail.
- Remove the Drill Sleeve, Cannulated Drill and Guide Wire Dia 2.5.
- Send the Positioning Rod (N06-0590) into the hole on the Navy-S Distal Targeting Arm ((N06-0040). Turn it clockwise in order to be locked into the nail. To check whether if it is in right position, a radiographic image can be taken or a guide wire can be send into the nail until it touches to the positioning rod.
- Dia X Block should be chosen accordingly to the diameter of the distal diameter of the nail. As in example of the Navy-S11-380 Nail, Dia 11 Block (N06-0530) has to be used. Assemble the Dia X Block on the positioning rod.
- Screw the Locking bolt (N06-0560) for Distal Targeting Device to the Positioning Rod.

11. Distal Locking - Drilling for Locking Screw

INSTRUMENTS:

- ✓ Screw Sleeve (N01-0130)
 - ✓ Drill Sleeve (N01-0120)
 - ✓ Trocar (N01-0110)
 - ✓ 4.2mm Drill Bit (N01-0100)
- Insert the trocar into the Drill Sleeve and insert them into the Screw Sleeve.
 - Pass the assembly through the Navy-S Distal Guide Bar, advance it until the skin and make a small incision. Advance the assembly until the drill sleeve touched the cortical bone. Apply pressure with the trocar over the bone to create a dingle in the lateral cortex.
 - Remove the trocar and pass the 4.2mm Drill Bit through the Drill Sleeve. Drill through both cortices. With the Drill Bit in the far cortex and drill Sleeve touching the lateral cortex, read the measurement in line with the Drill Sleeve. Measurement will indicate the screw length to be used.
 - Optionally, you can drill first cortex and stop when the drill touches the second cortex. With the drill bit touching far cortex, send the measurement in line with the Drill Sleeve. Add 5mm to the measurement. This will indicate the screw length to be used.

12. Distal Locking - Inserting the Locking Screw

- Mate the 5 mm Hex Driver with the selected screw and secure with the 5 mm Hex Driver Connector Screw (Fig-21). Remove the Drill Sleeve.
- Insert the screw/driver assembly through the Screw Sleeve until it contacts the bone. Rotate the driver to thread up the screw until its head seats against the lateral cortex (Fig-22). Do not over tighten the screw as it may lead to screw stripping.
- Rotate the connector screw counterclockwise to disengage the driver from the screw (Fig-23).
- Remove the Screw Sleeve.
- Tighten the Locking bolt for Distal Targeting Device and remove it from the positioning and together with the Dia X Block.
- Rotate the Positioning Rod counter clockwise and remove it.
- Optionally, you can insert a third screw into the samehole with following the steps used for inserting other screw.
- Remove the Navy-S Handle Bar Connector from the Guide Handle.

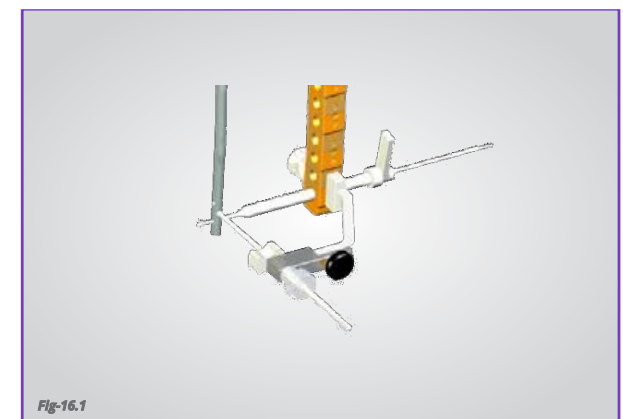
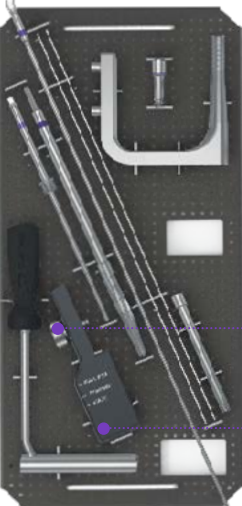
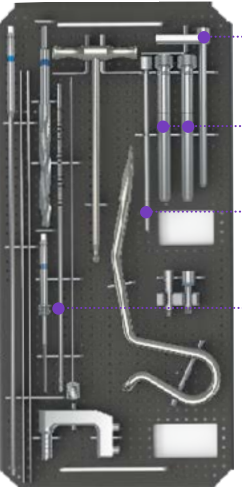


Fig-16.1



Navy Set Tray 1

- Handle-Arm Connector Screw (N01-0140)
- Navy Guide Arm (N03-0050)



Navy Set Tray 2

- Drill Sleeve (N01-0120)
- Screw Sleeve (N01-0130)
- Trocar (N01-0110)
- 4.2 mm Drill Bit (N01-0100)

13. Proximal Locking – Drilling for Locking Screw

INSTRUMENTS:

- ✓ Navy Guide Arm (N03-0050)
- ✓ Handle - Arm Connector Screw (N01-0140)
- ✓ Screw Sleeve (N01-0130)
- ✓ Drill Sleeve (N01-0120)
- ✓ Trocar (N01-0110)
- ✓ 4.2 mm Drill Bit (N01-0100),
- ✓ 5.0 mm Drill Bit (N01-0460)

Note

- ✓ The process for inserting any cortical screw is the same.
- ✓ This document will use the Compression Cortical Screw placement as an example.

- Mate the Navy Guide Arm with the Navy Guide Handle and secure them with the Handle-Arm Connector Screw (Fig-17). Insert the Trocar into the Drill Sleeve and insert them into the Screw Sleeve.
- Pass the assembly through the Dyn/Comp hole in the guide arm, advance it until the skin and make a small incision. Advance the assembly until the Drill Sleeve touches the cortical bone. Tighten the Screw Sleeve to the guide arm if possible. Apply pressure with the Trocar over the bone to create a dimple in the lateral cortex (Fig-18).
- Remove the Trocar and pass the 4.2 mm Drill Bit through the Drill Sleeve. Drill through both cortices (Fig-19). With the drill bit in the far cortex and Drill Sleeve touching the lateral cortex, read the graduation in line with the Drill Sleeve (Fig-20). The measurement will indicate the screw length to be used.
- In order to use cortical compression screw first cortex has to be drilled with 5 mm Drill Bit (N01-0460). Drill Sleeve has to be removed from the screw sleeve before using the 5mm drill bit (N01-0460). You should not drill the second cortex with 5 mm drill bit (N01-0460)



Fig-17



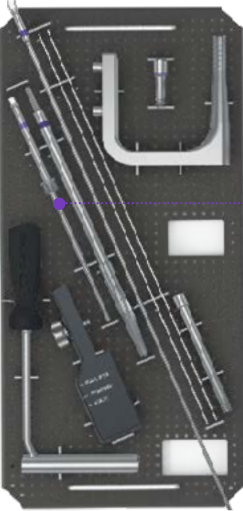
Fig-18



Fig-19



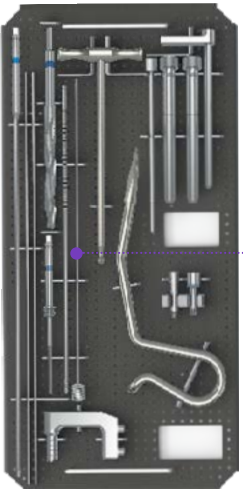
Fig-20



Navy Set Tray 1



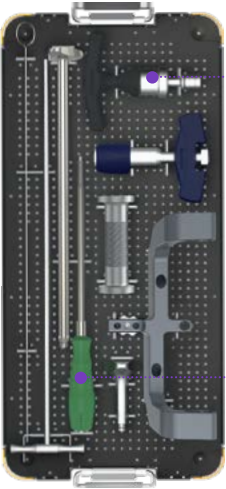
Navy Compressor (N03-0010)



Navy Set Tray 2



5 mm Hex Driver Connector Screw (N01-0010)



Navy Set Tray 3



Torque Limiting Handle (N01-0170)



5 mm Hex Driver (N01-0020)

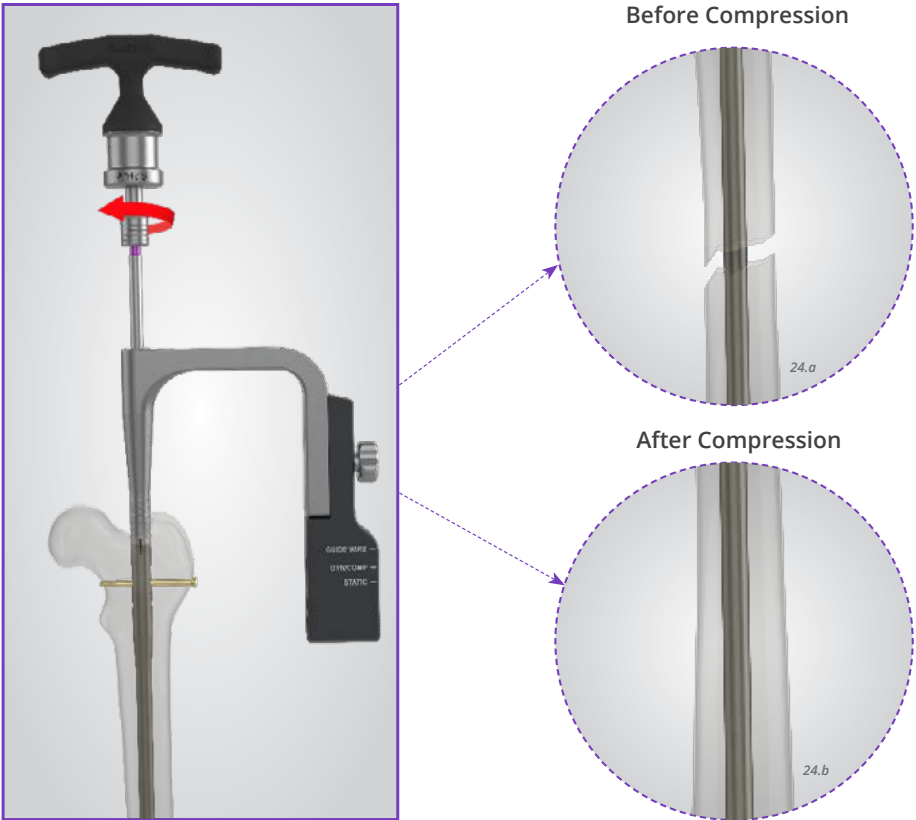
14. Proximal Locking – Compression

INSTRUMENTS:

- ✓ *Torque Limiting Handle (N01-0170)*
- ✓ *Navy Compressor (N03-0010)*
- Mate the Navy Compressor with the Torque Limiting Handle. Insert the compressor into the Guide Handle and through the nail. Rotate until the compressor engages the thread in the guide handle (Fig-24). Monitor the process with the help of image intensifier.
- As the compressor is rotated, the Compression Cortical Screw is pushed down the dynamic slot and the distal fragment is drawn towards the proximal fragment. Up to 10 mm of compression can be applied.
- Before releasing the compressor, insert one screw in one of the static holes to ensure that the compression will be maintained.

Note

- ✓ Do not over compress as it may cause the screw to fail.
- ✓ Do not backslap the nail against the deployed Claws to achieve compression.



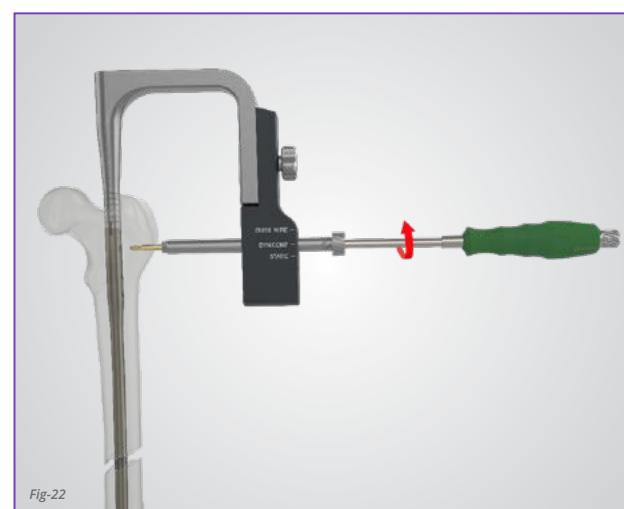
15. Proximal Locking – Inserting the Screw

INSTRUMENTS:

- ✓ 5 mm Hex Driver (N01-0020)
- ✓ 5 mm Hex Driver Connector Screw (N01-0010)
- Mate the 5 mm Hex Driver with the selected screw and secure with the 5 mm Hex Driver Connector Screw (Fig-21). Remove the Drill Sleeve.
- Insert the screw/driver assembly through the Screw Sleeve until it contacts the bone. Rotate the driver to thread up the screw until its head seats against the lateral cortex (Fig-22). Do not over tighten the screw as it may lead to screw stripping.
- Rotate the connector screw counterclockwise to disengage the driver from the screw (Fig-23).
- Remove the Screw Sleeve.

Note

- ✓ If compression is needed, make sure to use a Compression Cortical Screw. It is designed to withstand the compression loads.



The use of Cortical and Compression Screws are at the discretion of the surgeon, and should be tailored to the patient's needs. The common proximal locking configurations are presented below:

1. Static locking after fracture compression



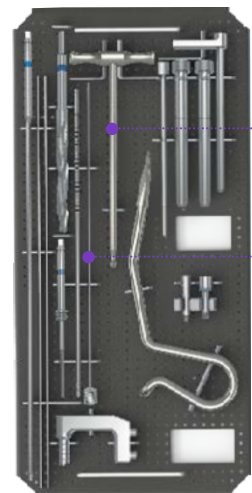
2. Dynamic configuration for postoperative compression



3. Static configuration with possibility of future dynamization.



INSTRUMENTS FOR INSERTING END CAP



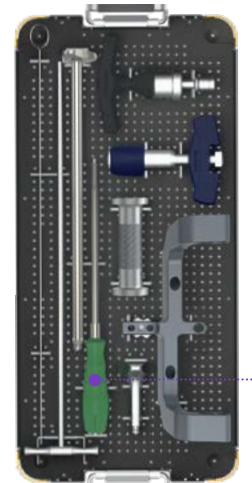
Navy Set Tray 2



7 mm Hex Driver (N01-0030)



5 mm Hex Driver Connector Screw (N01-0010)



Navy Set Tray 3



5 mm Hex Driver (N01-0020)

16. Inserting End Cap

INSTRUMENTS:

✓ 7 mm Hex Driver (N01-0030)

✓ 5 mm Hex Driver (N01-0020)

✓ 5 mm Hex Driver Connector Screw (N01-0010)

- Check the final nail head position, it may have changed if compression was applied. The rings in the handle are spaced 5 mm from each other, they indicate the depth of the nail's head.
- If satisfied with the final implant's position, remove the Screw Sleeve and use the 7 mm Hex Driver to release the nail from the Guide Handle.
- Mate the 5 mm Hex Driver to the chosen end cap and secure with the 5 mm Hex Driver Connector Screw (Fig-29). Pass the end cap/driver assembly through the incision and mate with the proximal end of the nail, rotating clockwise with the driver until it is fully threaded (Fig-30).
- Rotate the connector screw counterclockwise to disengage the driver from the end cap.



Retrograde Approach

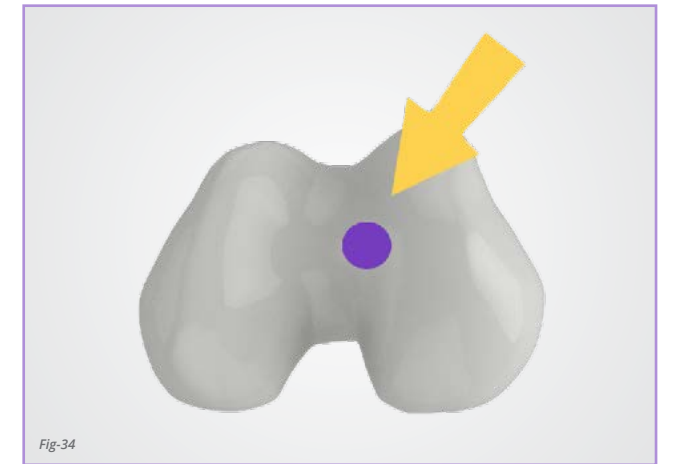
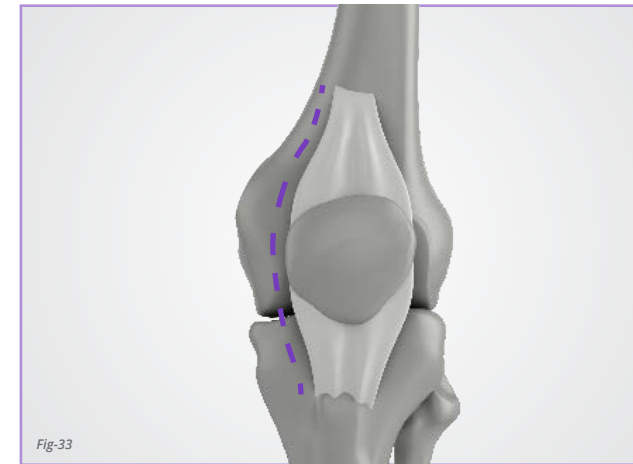
1. Patient Positioning and Fracture Reduction

- Place the patient in the supine position according to surgeon preference on a fracture or other radiolucent table.
- With the knee over a bolster or a leg roll, flex the leg to 30-40°. This should assist in fracture reduction and limb stabilization (Fig-31 and Fig-32).
- Position the image intensifier as to ensure that AP and lateral views of the entire femur can be easily obtained.
- Reduce the fracture as anatomically as possible through closed reduction before prepping and draping the patient with the help of image intensifier. Manual traction or a distraction device may be used to assist in fracture reduction.



2. Incision and Entry Point

- Perform a midline skin incision extending from the inferior pole of the patella to the tibial tubercle.
- Make a medial parapatellar capsular incision to expose the articular surface (Fig-33).



Note

- ✓ In distal fractures presenting intra-articular complications, reduce and secure the fracture with interfragmentary screws prior to nail placement. Care should be taken to keep the nail's path clear.

- The entry point is in line with the femoral medullary canal in both AP and lateral views.
- Typically, the entry point coincides with the top of the intercondylar notch slightly anterior and lateral to the femoral origin of the posterior cruciate ligament (Fig-34), but it may vary depending on the patient's anatomy.

3. Accessing the Canal

Option 1: Trocar Tip Guide Wire

INSTRUMENTS:

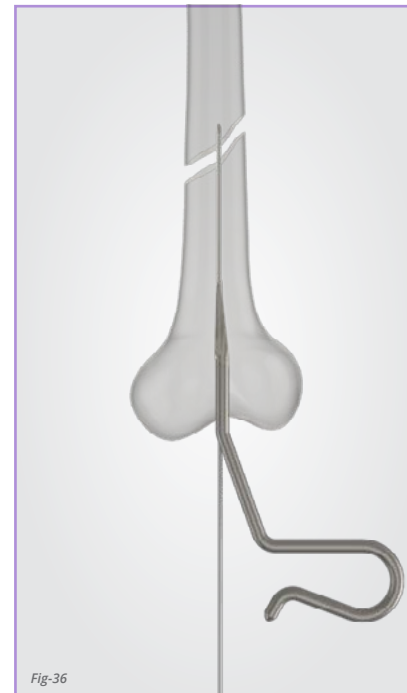
- ✓ *Trocar Tip Guide Wire 3 mm x 600 mm (N01-0250)*
- Advance the 3 mm Trocar Tip Guide Wire through the entry point and into the distal femur with the help of a powered driver (Fig-35). The wire should be centered in the canal on the AP and lateral views.
- Withdraw and reposition the wire as necessary.



Option 2: Entry Awl and Trocar Tip Guide Wire

INSTRUMENTS:

- ✓ *Entry Awl (N01-0040)*
- ✓ *Trocar Tip Guide Wire 3 mm x 600 mm (N01-0250)*
- Insert the Entry Awl through the incision and down to the bone (Fig-36). Rotate the Entry Awl back and forth to penetrate the distal femur. Care must be taken not to displace the fracture.
- Pass the 3 mm Trocar Tip Guide Wire through the Entry Awl and down to the bone. Withdraw and reposition the wire as necessary.



4. Distal Reaming

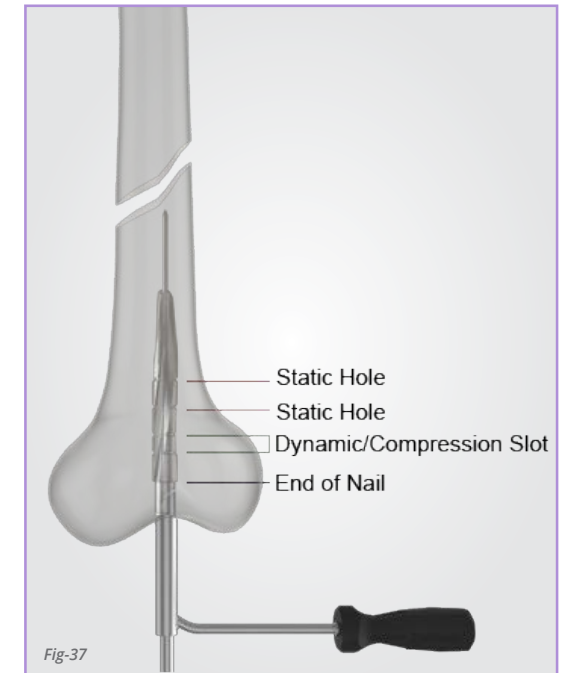
INSTRUMENTS:

- ✓ *Tissue Protector (N01-0150)*
- ✓ *Navy Entry Reamer (N03-0030)*
- ✓ *Ball Tip Guide Wire 3 mm x 900 mm (N01-0270)*
- ✓ *3 mm Guide Wire Sheath (N01-0280)*
- ✓ *Pin Puller (N01-0080)*
- ✓ *Reduction Awl (N01-0090)*

- Insert the Tissue Protector through the incision and down to the bone. Secure the Navy Entry Reamer to a powered driver. Pass it over the wire and through the Tissue Protector. Ream the distal femur to the desired depth with the help of the image intensifier.
- The grooves on the cutting blade of the Navy Entry Reamer are templates that show the position of the screws (Fig-37). The step between the cutting blades and the shank represent the end of the nail.
- Ream until the nail head position is deep enough with respect to the articular surface. Consider any need for compression or dynamization because this will cause the nail to migrate in the direction of the articulation.

Note

- ✓ If compression is necessary, the screws placement will be different than indicated during proximal reaming (e.g. if 5 mm compression is done, the static holes will be 5 mm more distal than indicated by the Navy Entry Reamer).



- Exchange the 3 mm Trocar Tip Guide Wire to the Ball Tip Guide Wire and 3 mm Guide Wire Sheath. Loosen up the Pin Puller's lock and pass the Guide Wire through it. Lock the wire by rotating the Pin Puller's drum and move it to the desired depth (Fig-38). Ensure that the guide wire is in correct position with the help of image intensifier. Withdraw and reposition the wire as necessary.
- Confirm that the fracture is well reduced. If necessary use the Reduction Awl to assist with the fracture reduction or guide wire change.

5. Determining the Nail Length

INSTRUMENTS:

✓ **Navy-Nite Guide Wire Ruler (N01-0270)**

- Confirm that the fracture is well reduced and pass the Navy Nite Guide wire Ruler's hole from the Ball Type Guide Wire 3mm x 900 mm (N01-0270) and touch to the entry point of the bone.
- Top of the Guide Wire's location will show the length of the nail.

Note:

- ✓ If compression will be required, the final nail head position will be more proximal than what is read in the template. Consider the expected compression when choosing the nail's length.
- ✓ Using a different Guide Wire may give wrong results.

6. Proximal Reaming

INSTRUMENTS:

✓ **Dunitech Intramedullary Reamer Set (INST-01-002)**

- Confirm that the fracture reduction has been maintained. Starting from 8.5 mm Reamer Cutter Head, ream until the desired depth with a steady pressure. By each pass, increase the diameter of the Reamer Cutter Head in 0.5 mm increments. If the sheath comes out with the reamer, insert it back before starting the next pass.
- The canal should be reamed to at least 1 mm above the desired nail diameter. Ream to at least 11 mm (the nail with smallest diameter has 10 mm of distal diameter). If there's no resistance to reaming to 11 mm, increase the reaming diameter to fit the next size of nail to a maximum of 14 mm.
- To prevent accumulation of debris in the medullary canal, retract the reamer when necessary.
- After distal reaming, remove the sheath (Fig-41). The Sheath won't pass through the nail.



7. Attaching the Nail

INSTRUMENTS:

- ✓ Navy Handle - Nail Connector Screw (N03-0070)
- ✓ 7 mm Hex Driver (N01-0030)
- ✓ Navy Guide Handle (N03-0060)

- The marks on the Guide Handle have the following meaning:
 - ✓ LA/RR for Left femur and Antegrade approach (LA) or Right femur and Retrograde approach (RR).
 - ✓ RA/LR for Right femur and Antegrade approach (RA) or Left femur and Retrograde approach (LR).
- For Retrograde approach, align the mark on the nail to the **LA/RR** mark on the Guide Handle for the **Right** leg or **RA/LR** for the **Left** leg.
- Mate the desired nail to the Navy Guide Handle and use the 7 mm Hex Driver to tighten the Handle-Nail Connector Screw (Fig-42). Ensure that the reference line on the nail is aligned with the correct line on the Guide Handle.
- Ensure that the connection is tight before proceeding.

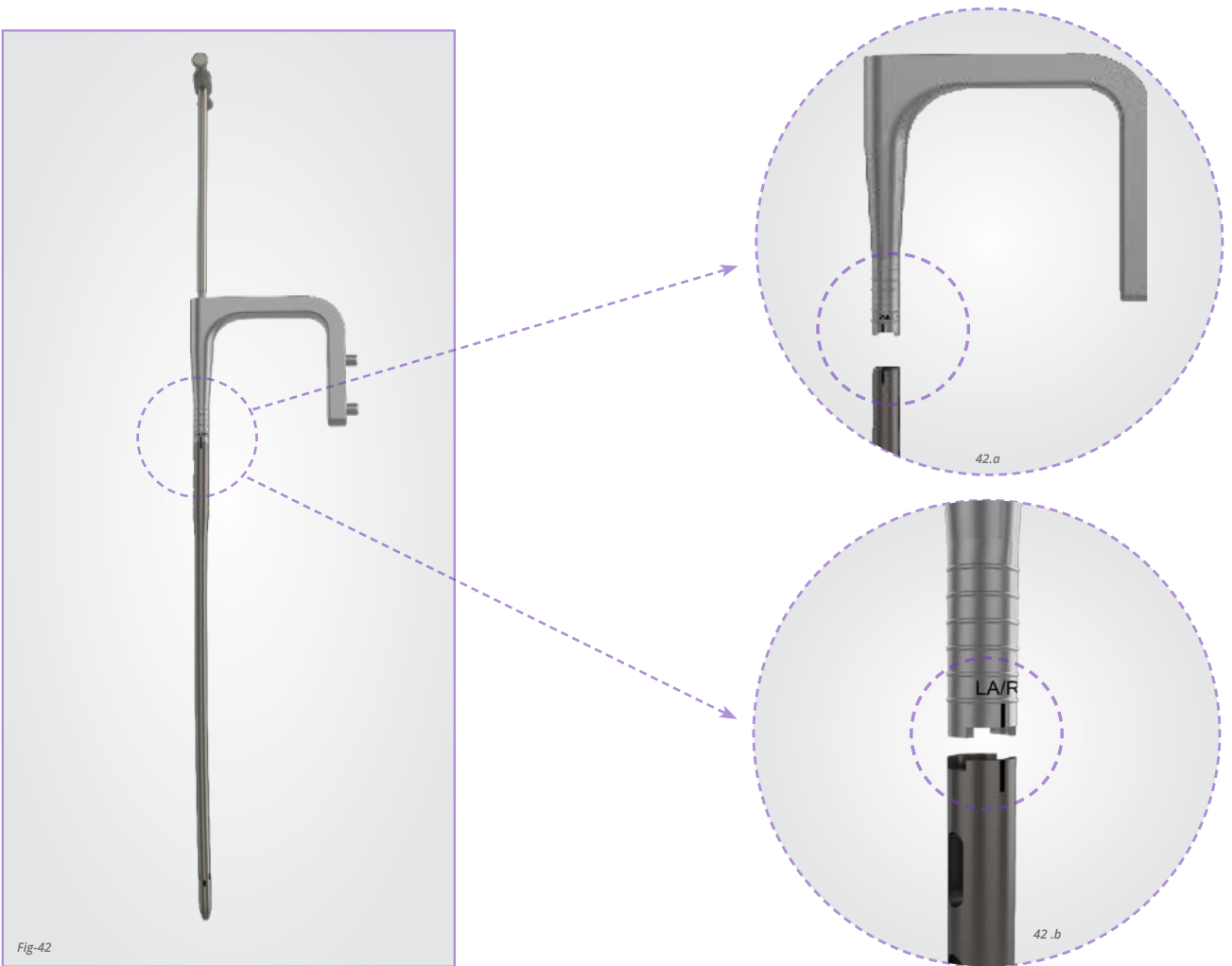


Fig-42

8. Checking Alignment

INSTRUMENTS:

- ✓ Navy Guide Arm (N03-0050)
- ✓ Handle - Arm Connector Screw (N01-0140)
- ✓ Screw Sleeve (N01-0130)
- ✓ Drill Sleeve (N01-0120)
- ✓ 4.2 mm Drill Bit (N01-0100)
- ✓ Navy-S Handle-Bar Connector (N06-0010)
- ✓ Navy-S Distal Guide Bar 280-440 Left/right (N06-0020)
- ✓ Navy-S Distal Guide Bar 300-460 Left/right (N06-0030)
- ✓ Navy-S Distal Targeting Arm (N06-0040) Dia X (X = 9-10-11-12-13) Block
- ✓ Locking Bolt (N06-0560) X 3
- ✓ Locking Bolt (N06-0570)
- ✓ Locking Bolt for distal Targeting Device (N06-0580)
- ✓ Positioning Rod (N06-0590)

- Before inserting the nail check the nail's holes are correctly aligned to the holes of the Guide Arm .
- Mate the Navy Guide Arm with the Navy Guide Handle and secure them with the Handle-Arm Connector Screw.
- Insert the Drill Sleeve into the Screw Sleeve and insert this assembly into the most distal hole of the Guide Arm. Insert the 4.2 mm Drill bit through the Drill Sleeve and advance until it passes through the corresponding nail hole (Fig-13).
- Repeat the process in the other holes.
- Prior to inserting the nail, remove the Navy Guide Arm.
- Mate the Navy-S Handle-Bar Connector with the Navy Guide Handle and secure them with the locking bolt (N06-0560).
- Mate the Navy-S Distal Guide Bar 280-440 left/right(N06-0020) with N06-0010 if you are using nails 280-320-360-400-440 with the locking bolt(N06-0560).
- Mate the Navy-S Distal Guide Bar 300-460 left/right(N06-0030) with N06-0010 if you are using nails 300-340-380-420-460 with the locking bolt(N06-0560).
- Connect Navy-S Distal Targeting Arm (N06-0040) with Navy-S Distal Guide Bar using N06-0570 Locking Bolt.
- Connect Positioning Rod (N06-0590) inside the Navy-S Distal Targeting Arm (N06-0220).
- Fix Dia X Block (X chosen according to the distal diameter of the nail) to the positioning rod.
- Screw and fix the position of the positioning Rod with Locking Bolt Distal Targeting Device (N06-0580).
- Insert the Drill Sleeve (N01-0100) into the Screw Sleeve and insert this assembly into the most distal hole of the Guide Arm. Insert the 4.2 mm Drill bit through the Drill Sleeve and advance until it passes through the corresponding nail hole (Fig-13).
- Repeat the process in the other hole.
- Remove the Navy-S Handle-Bar Connector (N06-0010).
- Prior to inserting the nail, remove the Navy-S Distal Guide Bar (N06-0020/30).

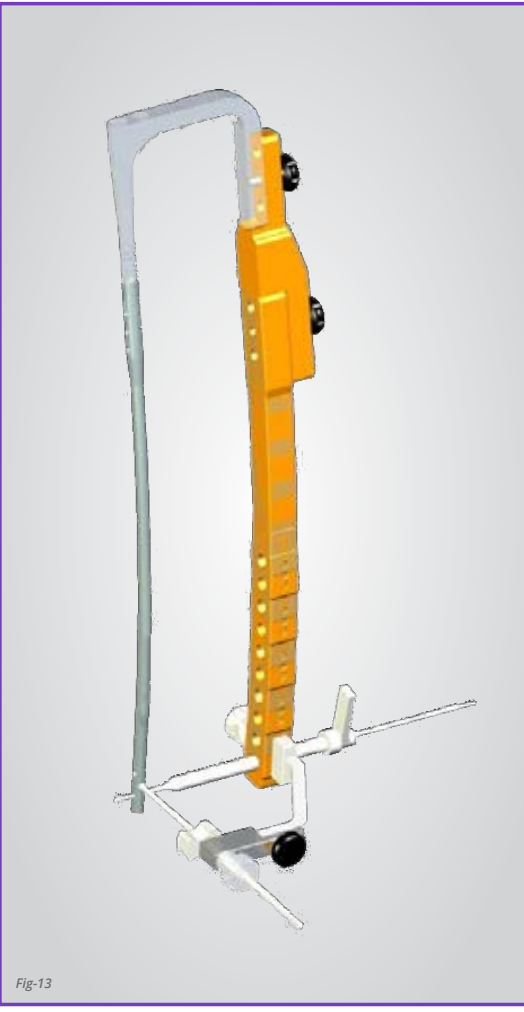


Fig-13

9. Inserting the Nail

INSTRUMENTS:

- ✓ Impactor (N01-0070) - Optional

Note

- ✓ If the Guide Wire Sheath has not been removed, it has to be removed in before the insertion of the nail (Fig-41). The Sheath will not pass through the nail.
 - ✓ If a traditional ball tip guide wire was used, it must be exchanged for a smooth guide wire. Its tip won't pass through the nail.
- Pass the nail over the guide wire, through the incision and into the bone. With steady pressure and gentle rotation movements, advance the nail (Fig-44). Monitor closely with the help of image intensifier the passage of the nail across the fracture site.
 - If needed, the Impactor can be assembled in the Guide Arm for light hammer blows. If considerable resistance is encountered, do not use strong hammer strikes. It may cause loss of reduction or perioperative fracture. Instead, remove the nail, replace the sheath and further enlarge the medullary canal.
 - The rings in the handle are spaced 5 mm from each other, they indicate the depth of the nail's head.

Note

- ✓ Do not strike the Guide Handle with a slap hammer or any other mallet.
- ✓ Once the nail is in its final position, remove the guide wire.



10. Proximal Locking

INSTRUMENTS:

- ✓ Navy Guide Arm (N03-0050)
 - ✓ Navy-S Handle-Bar Connector (N06-0010)
 - ✓ Navy-S Distal Guide Bar 280-440 left/right (N06-0020)
 - ✓ Navy-S Distal Guide Bar 300-460 left/right (N06-0030)
 - ✓ Navy-S Distal Targeting Arm (N06-0040)
 - ✓ Dia X Block (N06-0510/520/530/540/550)
 - ✓ Locking Bolt (N06-0560) x3
 - ✓ Locking Bolt (N06-0570)
 - ✓ Locking Bolt for Distal Targeting device (N06-0580)
 - ✓ Positioning Rod (N06-0590)
 - ✓ Impactor (N06-0600) (Optional)
 - ✓ Drill Sleeve (N06-0610)
 - ✓ Cannulated Drill Bit (N06-0620)
 - ✓ Guidewire dia 2.5 (N06-0630)
 - ✓ Hammer (N06-0640) (Optional)
- Mate the Navy-S Distal Guide Bar 280-440 left/right (N06-0020) with N06-0010 if you are using Nails 280-320-36-400-440 with the Locking Bolt (N06-0560).
 - Mate the Navy-S Distal Guide Bar 300-460 left/right (N06-0030) with N06-0010 if you are using Nails 300-340-380-420-460 with the Locking Bolt (N06-0560).
 - Connecting Navy-S Distal targeting Arm (N06-0040) with Navy-S Distal Guide Bar using N06-0570 Locking Bolt.
 - The hole in the Navy-S Distal Targeting Arm has two o-rings to enable it to be centered to the nail. With radiographic view, two rings should be seen as one ring. If the rings are not centered over the nail hole, Navy-S Distal Targeting Arm has to be moved until they are centered.
 - Insert the Drill Sleeve (N06-0610) into the Navy-S Distal Targeting Arm (N06-0040).
 - Advance it until the skin and make a small incision. Advance it until the Drill Sleeve touches the cortical bone.
 - Send the Cannulated Drill Dia 6/Dia 2.5 into the Drill Sleeve until it touches the first cortex. Then send the Guide wire 2.5 inside the Cannulated Drill Dia 6/Dia 2.5.
 - Guide wire Dia 2.5 should be sent into the first cortex. This can be done by using a motor or with the help of impactor (N06-0600) and Hammer (N06-0640).
 - Drill the first cortex with Cannulated Drill Dia 6/Dia 2.5. Be careful not to continue on drilling after the cortex is passed. This might damage the nail.
 - Remove the Drill Sleeve, Cannulated Drill and Guide Wire Dia 2.5.
 - Send the Positioning Rod (N06-0590) into the hole on the Navy-S Distal Targeting Arm ((N06-0040). Turn it clockwise in order to be locked into the nail. To check whether if it is in right position, a radiographic image can be taken or a guide wire can be send into the nail until it touches to the positioning rod.
 - Dia X Block should be chosen accordingly to the diameter of the distal diameter of the nail. As in example of the Navy-S11-380 Nail, Dia 11 Block (N06-0530) has to be used. Assemble the Dia X Block on the positioning rod.
 - Screw the Locking bolt (N06-0560) for Distal Targeting Device to the Positioning Rod.



11. Proximal Locking - Drilling for Locking Screw

INSTRUMENTS:

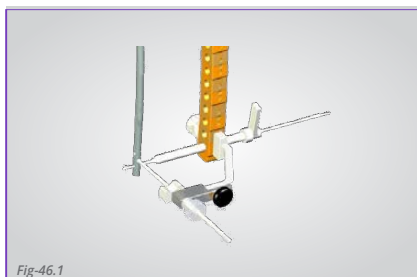
- ✓ Screw Sleeve (N01-0130)
- ✓ Drill Sleeve (N01-0120)
- ✓ Trocar (N01-0110)
- ✓ 4.2mm Drill Bit (N01-0100)

- Insert the trocar into the Drill Sleeve and insert them into the Screw Sleeve.
- Pass the assembly through the Navy-S Distal Guide Bar, advance it until the skin and make a small incision. Advance the assembly until the drill sleeve touched the cortical bone. Apply pressure with the trocar over the bone to create a dingle in the lateral cortex.
- Remove the trocar and pass the 4.2mm Drill Bit through the Drill Sleeve. Drill through both cortices. With the Drill Bit in the far cortex and drill Sleeve touching the lateral cortex, read the measurement in line with the Drill Sleeve. Measurement will indicate the screw length to be used.
- Optionally, you can drill first and stop when the drill touches the second cortex. With the drill bit touching far cortex, send the measurement in line with the Drill Sleeve. Add 5mm to the measurement. This will indicate the screw length to be used.



12. Proximal Locking - Inserting the Locking Screw

- Mate the 5 mm Hex Driver with the selected screw and secure with the 5 mm Hex Driver Connector Screw (Fig-21). Remove the Drill Sleeve.
- Insert the screw/driver assembly through the Screw Sleeve until it contacts the bone. Rotate the driver to thread up the screw until its head seats against the lateral cortex (Fig-22). Do not over tighten the screw as it may lead to screw stripping.
- Rotate the connector screw counterclockwise to disengage the driver from the screw (Fig-23).
- Remove the Screw Sleeve.
- Tighten the Locking bolt for Distal Targeting Device and remove it from the positioning and together with the Dia X Block.
- Rotate the Positioning Rod counter clockwise and remove it.
- Optionally, you can insert a third screw into the same hole with following the steps used for inserting other screw.
- Remove the Navy-S Handle Bar Connector from the Guide Handle.



13. Distal Locking – Drilling for Locking Screw

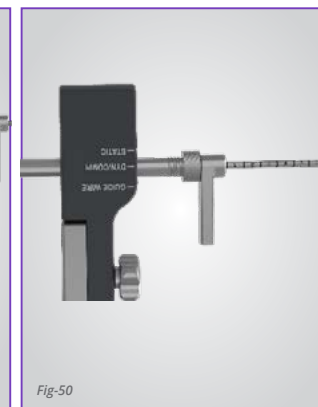
INSTRUMENTS:

- ✓ Navy Guide Arm (N03-0050)
- ✓ Handle - Arm Connector Screw (N01-0140)
- ✓ Screw Sleeve (N01-0130)
- ✓ Drill Sleeve (N01-0120)
- ✓ Trocar (N01-0110)
- ✓ 4.2 mm Drill Bit (N01-0100),
- ✓ 5.0 mm Drill Bit (N01-0460)

Note

- ✓ The process for inserting any cortical screw is the same.
- ✓ This document will use the Compression Cortical Screw placement as an example.

- Mate the Navy Guide Arm with the Navy Guide Handle and secure them with the Handle-Arm Connector Screw (Fig-17). Insert the Trocar into the Drill Sleeve and insert them into the Screw Sleeve.
- Pass the assembly through the Dyn/Comp hole in the guide arm, advance it until the skin and make a small incision. Advance the assembly until the Drill Sleeve touches the cortical bone. Tighten the Screw Sleeve to the guide arm if possible. Apply pressure with the Trocar over the bone to create a dimple in the lateral cortex (Fig-18).
- Remove the Trocar and pass the 4.2 mm Drill Bit through the Drill Sleeve. Drill through both cortices (Fig-19). With the drill bit in the far cortex and Drill Sleeve touching the lateral cortex, read the graduation in line with the Drill Sleeve (Fig-20). The measurement will indicate the screw length to be used.
- In order to use cortical compression screw first cortex has to be drilled with 5 mm Drill Bit (N01-0460). Drill Sleeve has to be removed from the screw sleeve before using the 5mm drill bit (N01-0460). You should not drill the second cortex with 5 mm drill bit (N01-0460)



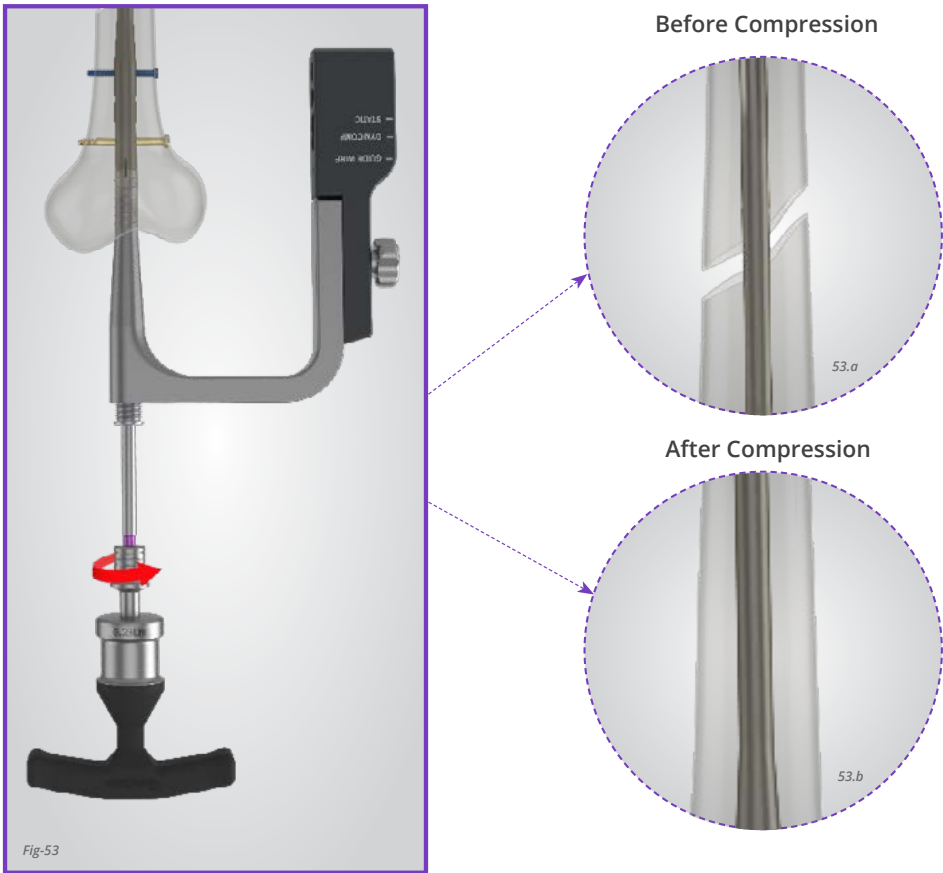
14. Distal Locking – Compression

INSTRUMENTS:

- ✔ Torque Limiting Handle (N01-0170)
 - ✔ Navy Compressor (N03-0010)
- Mate the Navy Compressor with the Torque Limiting Handle. Insert the compressor into the Guide Handle and through the nail. Rotate until the compressor engages the thread in the guide handle (Fig-53). Monitor the process with the help of image intensifier.
 - As the compressor is rotated, the Compression Cortical Screw is pushed down the dynamic slot and the proximal fragment is drawn towards the distal fragment. Up to 10 mm of compression can be applied.
 - Before releasing the compressor, insert one screw in one of the static holes to ensure that the compression will be maintained.

Note

- ✔ Do not over compress as it may cause the screw to fail.
- ✔ Do not backslap the nail against the deployed Claws to achieve compression.



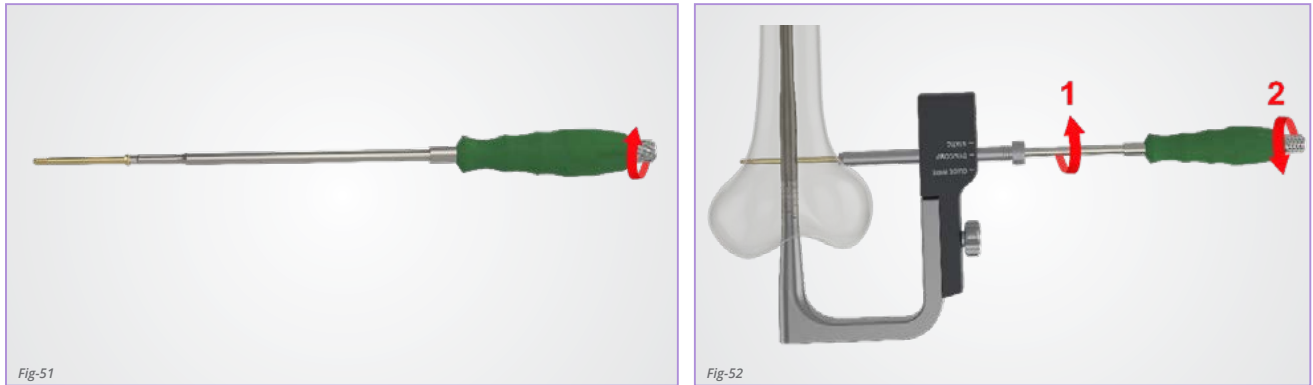
15. Distal Locking – Inserting the Cortical Screw

INSTRUMENTS:

- ✔ 5 mm Hex Driver (N01-0020)
 - ✔ 5 mm Hex Driver Connector Screw (N01-0010)
- Mate the 5 mm Hex Driver with the selected screw and secure with the 5 mm Hex Driver Connector Screw (Fig-51). Remove the Drill Sleeve.
 - Insert the screw/driver assembly through the Screw Sleeve until it contacts the bone. Rotate the driver to thread up the screw until its head seats against the lateral cortex (Fig-52). Do not over tighten the screw as it may lead to screw stripping.
 - Rotate the connector screw counterclockwise to disengage the driver from the screw.
 - Remove the Screw Sleeve.

Note

- ✔ If compression is needed, make sure to use a Compression Cortical Screw. It is designed to withstand the compression loads.



The use of Cortical and Compression Screws are at the discretion of the surgeon, and should be tailored to the patient's needs. The common proximal locking configurations are presented below:

1. Static locking after fracture compression



2. Dynamic configuration for postoperative compression



3. Static configuration with possibility of future dynamization.



16. Inserting End Cap

INSTRUMENTS:

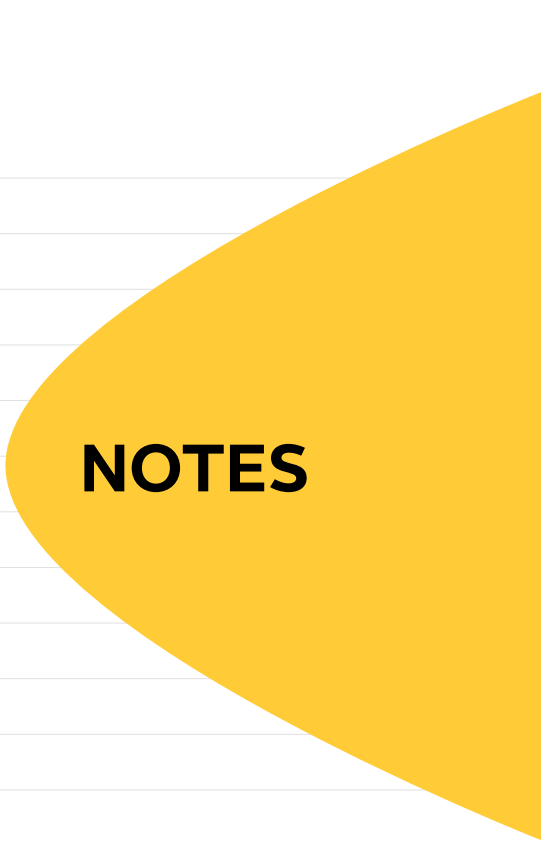
- ✓ 7 mm Hex Driver (N01-0030)
- ✓ 5 mm Hex Driver (N01-0020)
- ✓ 5 mm Hex Driver Connector Screw (N01-0010)

- Check the final nail head position, it may have changed if compression was applied. The rings in the handle are spaced 5 mm from each other, they indicate the depth of the nail's head.
- If satisfied with the final implant's position, remove the Screw Sleeve and use the 7 mm Hex Driver to release the nail from the Guide Handle.
- Mate the 5 mm Hex Driver to the chosen end cap and secure with the 5 mm Hex Driver Connector Screw (Fig-58). Pass the end cap/driver assembly through the incision and mate with the proximal end of the nail, rotating clockwise with the driver until it is fully threaded (Fig-59).
- Rotate the connector screw counterclockwise to disengage the driver from the end cap.





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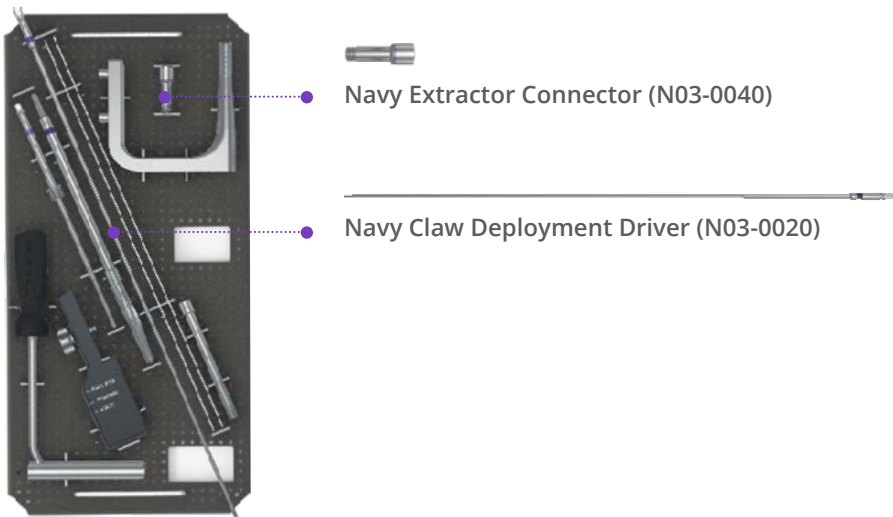


NOTES

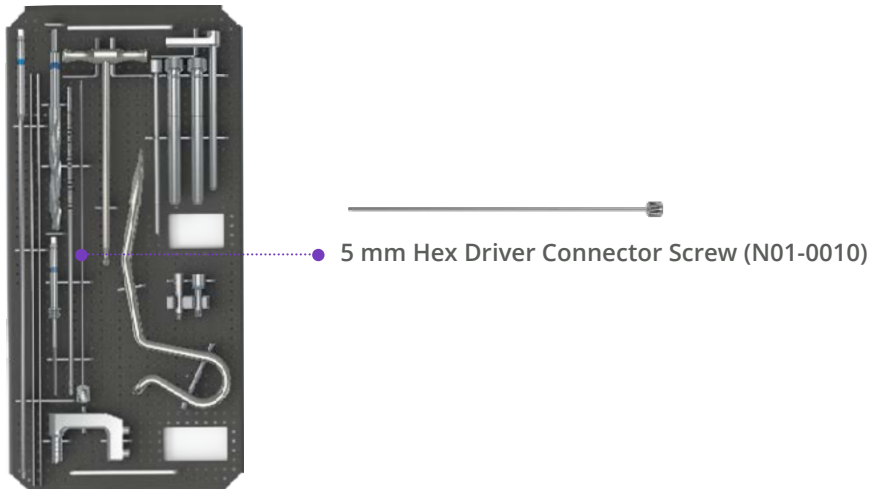
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Nail Removal

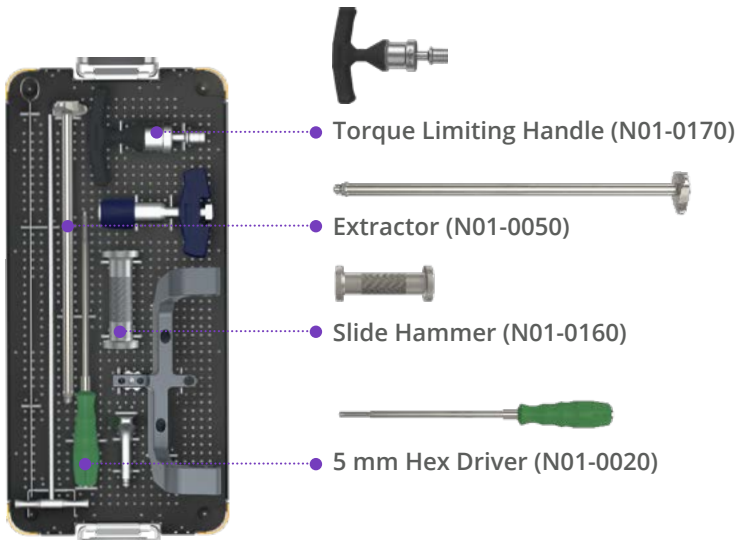
INSTRUMENTS FOT REMOVING THE NAIL



Navy Set Tray 1



Navy Set Tray 2



Navy Set Tray 3

1. Removing Nail End Cap

INSTRUMENTS:

- ✓ 5 mm Hex Driver (N01-0020)
- ✓ 5 mm Hex Driver Connector Screw (N01-0010)

Note

- ✓ The nail removal is an optional procedure.
- ✓ The steps for removing the nail are the same whether it has been inserted through a retrograde or antegrade approach.
- ✓ The removal of a nail inserted through retrograde approach is demonstrated.

- Insert the 5 mm Hex Driver Connector screw into the 5 mm Hex Driver and mate the driver to the nail end cap.
- Rotate the connector screw clockwise to secure the end cap to the driver.
- Rotate the driver counterclockwise until the end cap it is fully released (Fig-60).



Fig-60

2. Removing the Cortical Screws

INSTRUMENTS:

- ✓ 5 mm Hex Driver (N01-0020)
- ✓ 5 mm Hex Driver Connector Screw (N01-0010)

- Insert the 5 mm Hex Driver Connector screw into the 5 mm Hex Driver and mate the driver to the cortical screw.
- Rotate the connector screw clockwise to secure the cortical screw to the driver.
- Remove the cortical screw by rotating the driver counterclockwise (Fig-61).
- Ensure all screws have been removed before proceeding.

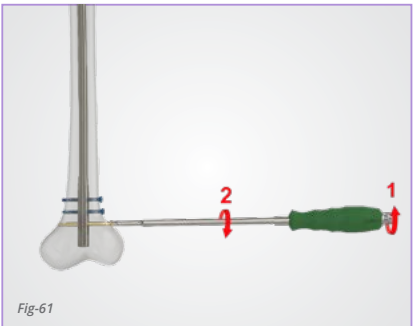
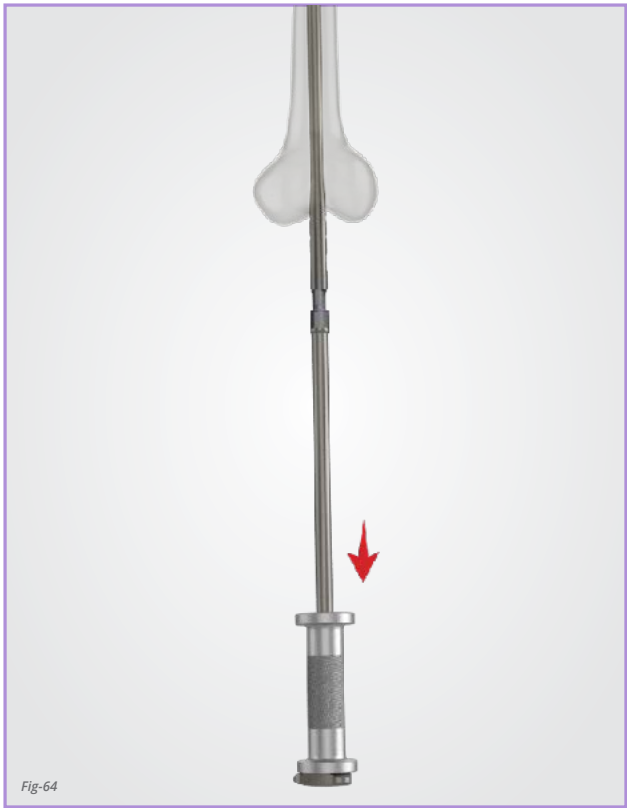
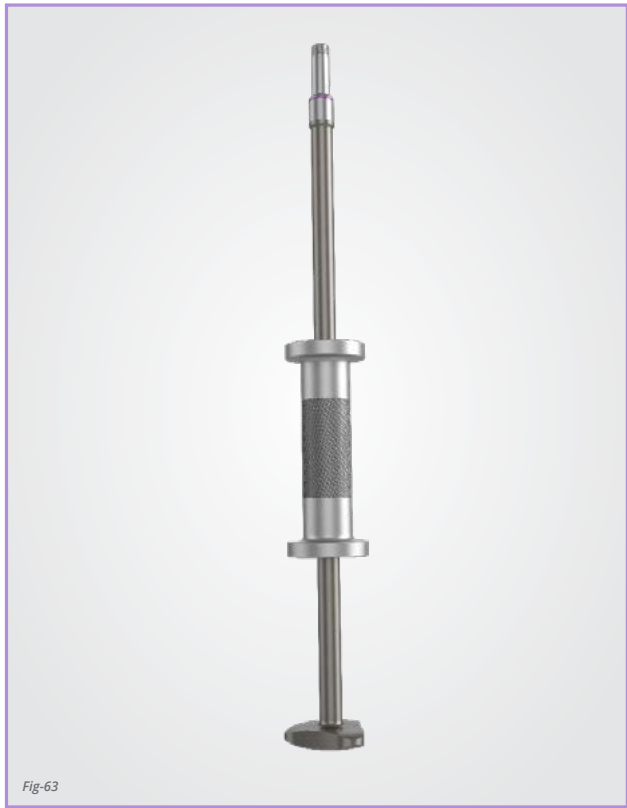


Fig-61

4. Removing the Nail

INSTRUMENTS:

- ✓ *Extractor (N01-0050)*
- ✓ *Slide Hammer (N01-0160)*
- ✓ *Navy Extractor Connector (N03-0040)*
- Attach the Navy Extractor Connector into Extractor and pass the Slide Hammer over the assembly (Fig-63).
- Mate the Navy Extractor Connector with the nail and rotate the Extractor clockwise to secure the assembly to the nail.
- With gentle blows of the Slide Hammer, remove the nail from the femur (Fig-64).



NOTES

Catalogue Information

Navy-S A/R Femoral Nail

Distal Diameter	Lenght (mm)	Catalogue Code
10	280	NAVY-S-10-280
10	300	NAVY-S-10-300
10	320	NAVY-S-10-320
10	340	NAVY-S-10-340
10	360	NAVY-S-10-360
10	380	NAVY-S-10-380
10	400	NAVY-S-10-400
10	420	NAVY-S-10-420
10	440	NAVY-S-10-440
10	460	NAVY-S-10-460
11	280	NAVY-S-11-280
11	300	NAVY-S-11-300
11	320	NAVY-S-11-320
11	340	NAVY-S-11-340
11	360	NAVY-S-11-360
11	380	NAVY-S-11-380
11	400	NAVY-S-11-400
11	420	NAVY-S-11-420
11	440	NAVY-S-11-440
11	460	NAVY-S-11-460
12	280	NAVY-S-12-280
12	300	NAVY-S-12-300
12	320	NAVY-S-12-320
12	340	NAVY-S-12-340
12	360	NAVY-S-12-360
12	380	NAVY-S-12-380
12	400	NAVY-S-12-400
12	420	NAVY-S-12-420
12	440	NAVY-S-12-440
12	460	NAVY-S-12-460
13	280	NAVY-S-13-280
13	300	NAVY-S-13-300
13	320	NAVY-S-13-320
13	340	NAVY-S-13-340
13	360	NAVY-S-13-360
13	380	NAVY-S-13-380
13	400	NAVY-S-13-400
13	420	NAVY-S-13-420
13	440	NAVY-S-13-440
13	460	NAVY-S-13-460



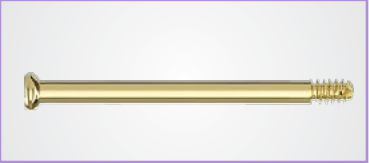
End Caps

Extension (mm)	Catalogue Code
0 (flush)	NAVY-13-000
5	NAVY-13-005
10	NAVY-13-010
15	NAVY-13-015



Cortical Screws

Diameter (mm)	Length (mm)	Catalogue Code
5	30	CORS-05-030
5	35	CORS-05-035
5	40	CORS-05-040
5	45	CORS-05-045
5	50	CORS-05-050
5	55	CORS-05-055
5	60	CORS-05-060
5	65	CORS-05-065
5	70	CORS-05-070
5	75	CORS-05-075
5	80	CORS-05-080
5	85	CORS-05-085
5	90	CORS-05-090
5	95	CORS-05-095
5	100	CORS-05-100
5	105	CORS-05-105
5	110	CORS-05-110
5	115	CORS-05-115
5	120	CORS-05-120



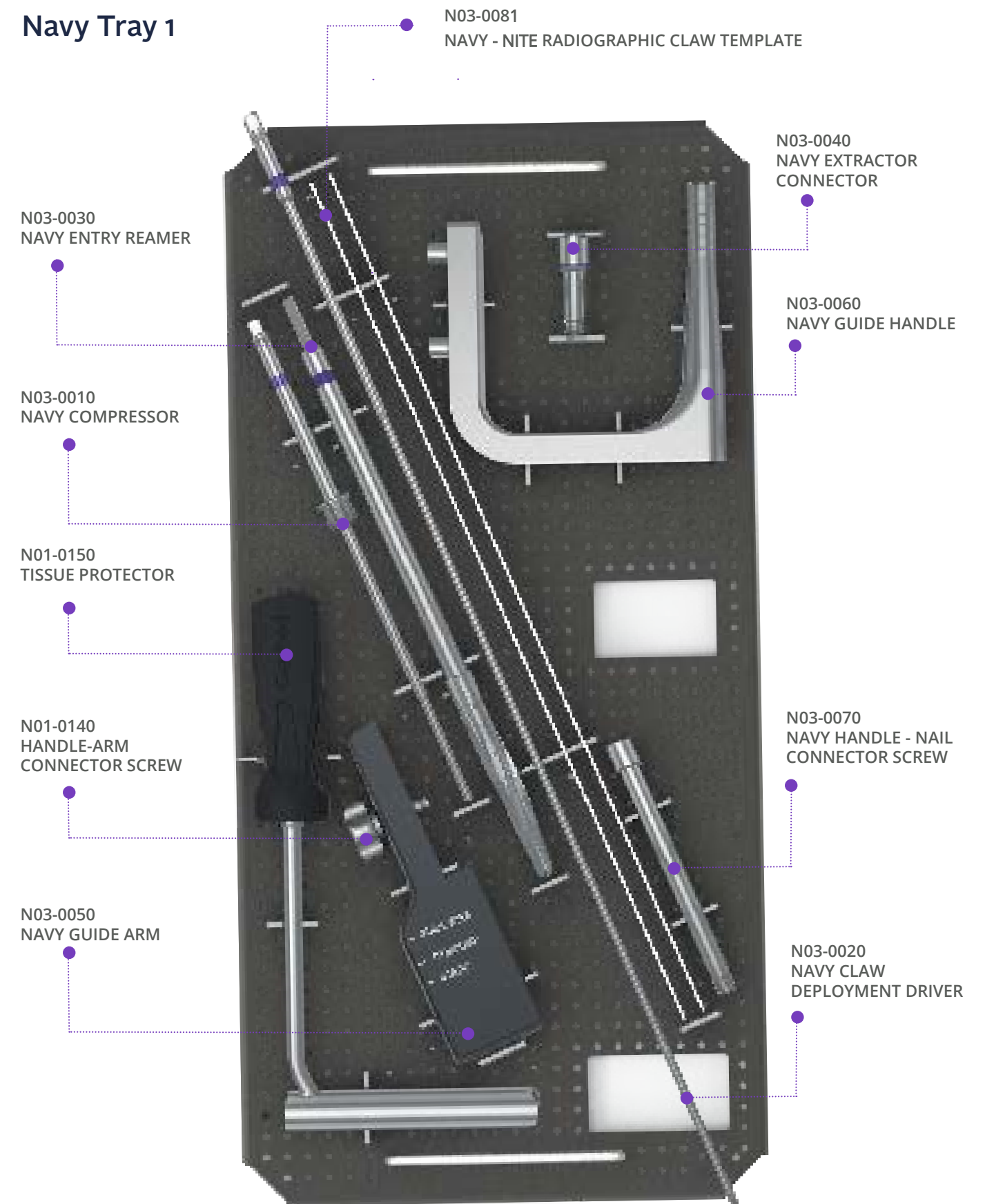
Compression Cortical Screws

Diameter (mm)	Length (mm)	Catalogue Code
5	30	COMS-05-030
5	35	COMS-05-035
5	40	COMS-05-040
5	45	COMS-05-045
5	50	COMS-05-050
5	55	COMS-05-055
5	60	COMS-05-060
5	65	COMS-05-065
5	70	COMS-05-070
5	75	COMS-05-075
5	80	COMS-05-080
5	85	COMS-05-085
5	90	COMS-05-090
5	95	COMS-05-095
5	100	COMS-05-100
5	105	COMS-05-105
5	110	COMS-05-110
5	115	COMS-05-115
5	120	COMS-05-120

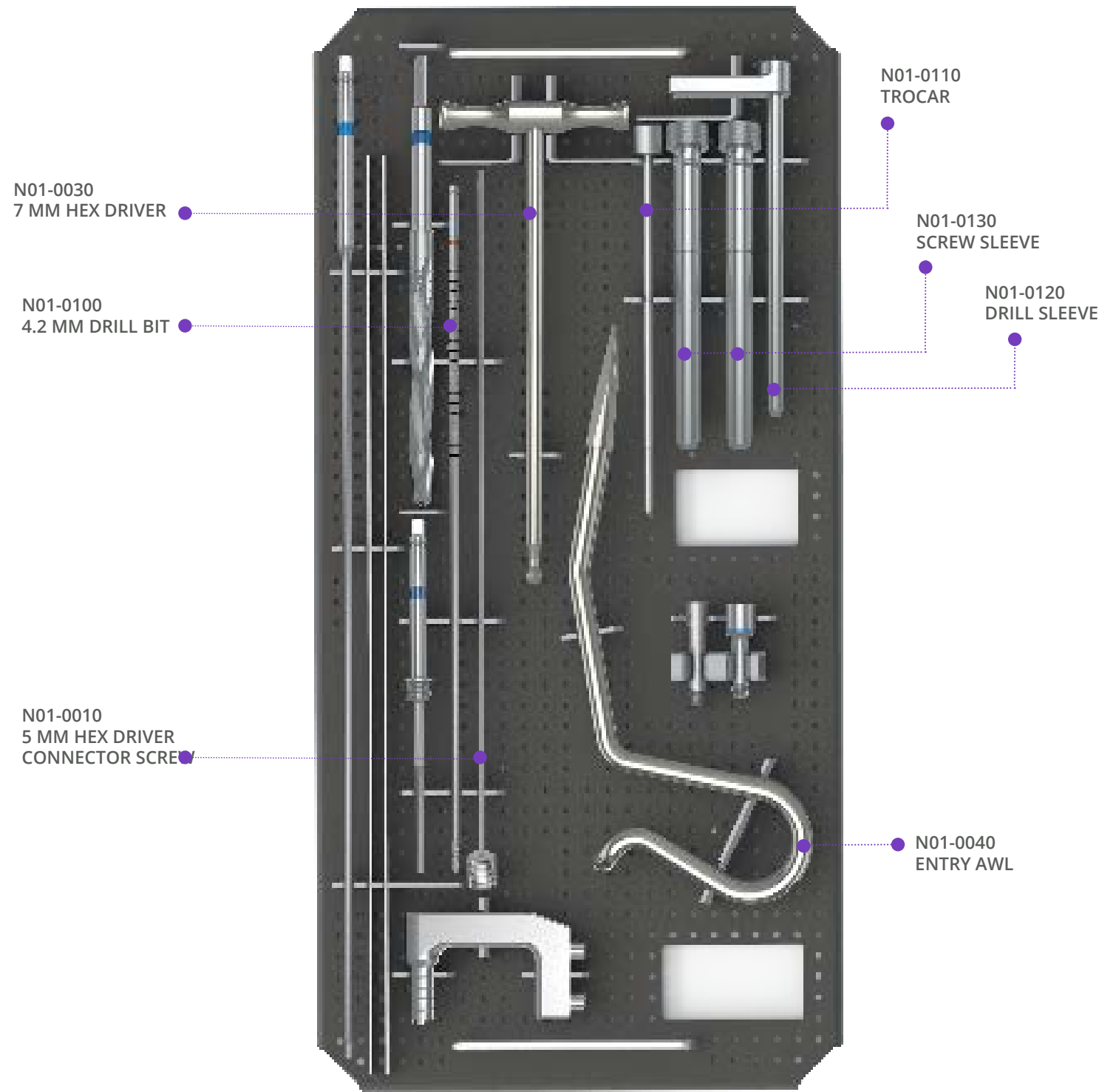
Navy Tool Set

- Navy Tray 1
- Navy Tray 2
- Navy Tray 3

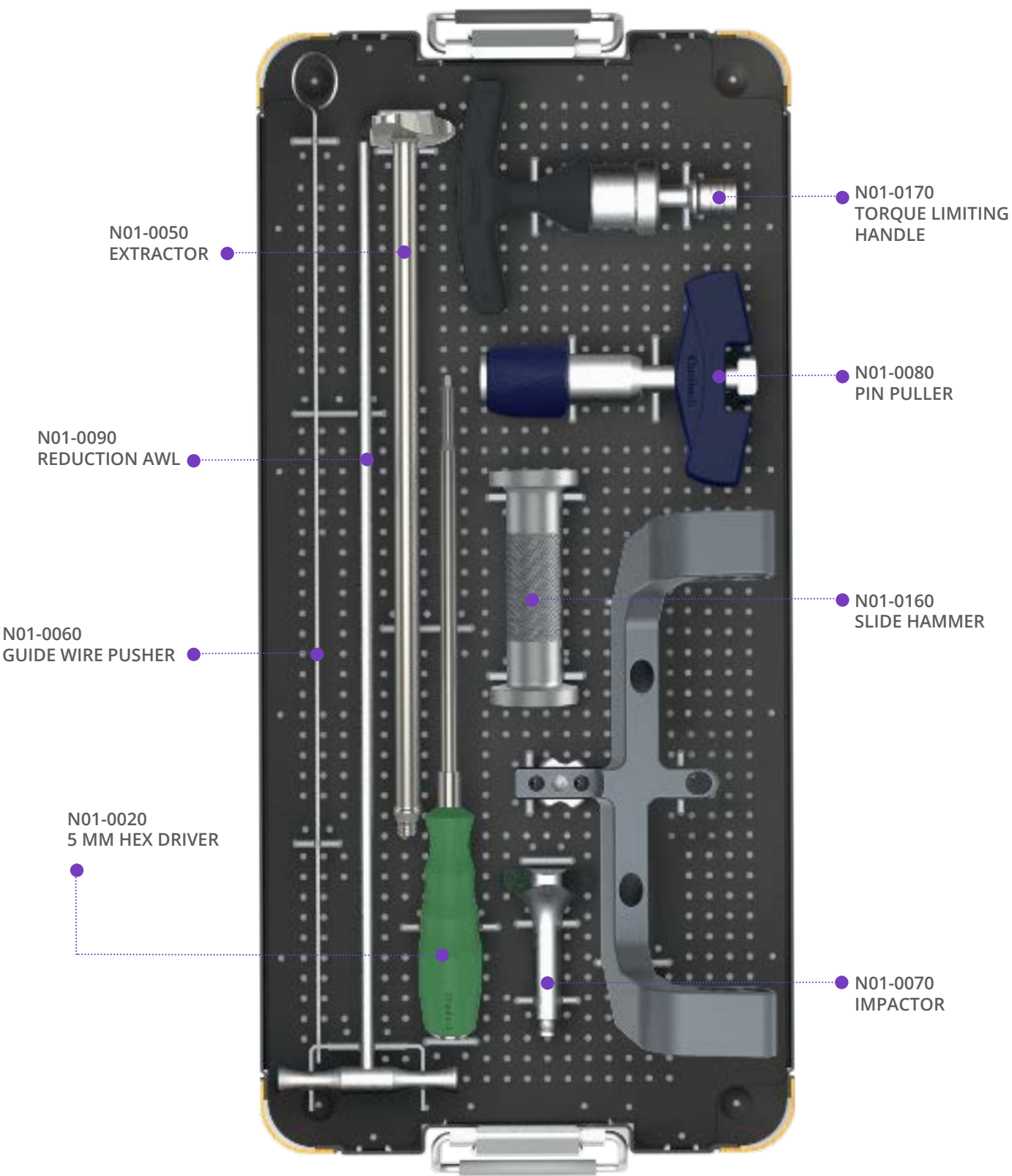
Navy Tray 1



Navy Tray 2



Navy Tray 3



NOTES

The 9mm and 14 mm diameter sizes are not kept in stock and are manufactured against order. Furthermore, product availability is subject to the regulatory and/or medical practices in individual markets. Some or all products described in those documents may not be available in your region. Please contact your Dunitech representative for information regarding product availability in your area.

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