For Antegrade or Retrograde Insertion With Spiral Blade, Conventional and Compression Locking

Titanium Solid Humeral Nail System

Surgical Technique
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The Titanium Solid Humeral Nail System permits intramedullary fixation of a variety of humeral fractures using either an antegrade or retrograde approach. With the Titanium Spiral Blade for Humeral Nail, fractures of the humeral diaphysis with proximal involvement beyond the locking parameters of Locking Bolts or Locking Screws may be treated. For fractures confined to the proximal humerus, the 150 mm Titanium Proximal Humeral Nail enables fixation with the added advantage of targeted distal locking through guided drill and screw placement.

Titanium Solid Humeral Nail
The Titanium Solid Humeral Nail, available in 7.5 mm and 9.5 mm diameters and lengths from 190 mm to 325 mm, is the core of the system. Multiple proximal locking options are available using the Titanium Solid Humeral Nail: spiral blade locking, static locking through the transverse axial hole or 120° oblique locking hole, and compression locking.

Titanium Proximal Humeral Nail
The 150 mm Titanium Proximal Humeral Nail, available in 7.5 mm and 8.0 mm diameters, has distal locking holes placed 76 mm and 90 mm from the proximal end. An Extended Aiming Arm permits targeted distal locking. Multiple proximal locking options are available using the Titanium Proximal Humeral Nail: spiral blade locking or static locking through the 60° oblique locking hole.

Titanium Spiral Blade for Humeral Nail
The Titanium Spiral Blade for Humeral Nail is optimized for fixation in the humeral head. Increased surface area distributes load more broadly than conventional Locking Screws or Locking Bolts. It can be locked into either the Titanium Solid Humeral Nail or Titanium Proximal Humeral Nail with a spiral blade End Cap to create a locked, fixed-angle construct. Four 2.25 mm holes are arranged around the periphery of the Spiral Blade for suture anchoring in complex fractures.
Indications

Indications for the Titanium Solid Humeral Nail System include:

- Diaphyseal fractures of the humeral shaft
- Fractures of the proximal humerus
- Proximal humeral fractures with diaphyseal extension
- Impending pathologic fractures

Case Example

Preoperative X-ray: Two-part proximal humerus fracture of the surgical neck

Postoperative X-ray: Surgical neck fracture treated with Titanium Proximal Humeral Nail and Titanium Spiral Blade for Humeral Nail
AO Principles

In 1958, the AO formulated four basic principles, which have become the guidelines for internal fixation.\(^1\) \(^2\)

**Anatomic reduction**
Fracture reduction and fixation to restore anatomical relationships.

**Early, active mobilization**
Early and safe mobilization and rehabilitation of the injured part and the patient as a whole.

**Stable fixation**
Fracture fixation providing absolute or relative stability, as required by the patient, the injury, and the personality of the fracture.

**Preservation of blood supply**
Preservation of the blood supply to soft tissues and bone by gentle reduction techniques and careful handling.

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Features and Benefits

The Titanium Solid Humeral Nail System consists of all implants and instruments necessary for humeral fracture fixation.

Titanium Solid Humeral Nail

- Universal design for right or left humerus, antegrade or retrograde insertion
- Spiral Blade, conventional, and compression locking options
- 7.5 mm diameter nail has a solid round cross section; 9.5 mm diameter nail has a solid fluted cross section for increased flexibility
- Lengths from 190 mm to 325 mm
- 120° oblique locking hole for antegrade nailing
- Proximal locking holes (one slot and two holes) accept a Titanium Spiral Blade for Humeral Nail, 3.9 mm Locking Bolt or 4.0 mm Locking Screw in the slot and a 3.9 mm Locking Bolt or 4.0 mm Locking Screw in the holes for spiral blade and conventional locking
- Distal locking holes (two holes) accept 3.9 mm Locking Bolts or 4.0 mm Locking Screws
Features and Benefits (continued)

Titanium Proximal Humeral Nail

- Available in 7.5 mm or 8.0 mm midshaft diameter; proximal ends are 8.0 mm and 9.5 mm, respectively
- 150 mm length
- Distal taper design, from 8.0 mm/7.5 mm to 5.5 mm, dampens stress from the tip of the nail to the humeral shaft
- 5° bend located 55 mm from the proximal end allows an off-axis entry site to minimize damage to the articular surface
- Proximal locking holes (one slot and one 60° oblique hole) accept a Titanium Spiral Blade for Humeral Nail in the slot and 3.9 mm Locking Bolt or 4.0 mm Locking Screw in the oblique hole for spiral blade and oblique locking
- Two distal locking holes accept 3.9 mm Locking Bolts or 4.0 mm Locking Screws and permit locking through a safe anatomic window between the axillary and radial nerves
- Extended distal tip reduces stress below the Locking Screws or Locking Bolts in the distal locking holes
- Controlled distal targeting with an Extended Aiming Arm

Titanium Spiral Blade for Humeral Nail

- Cutting flutes on front edges facilitate insertion through cortical and cancellous bone
- Avoids drill penetration of the medial cortex and risk to adjacent neurovascular structures
- Increased surface area minimizes strain on trabecular bone
- Provides a fixed-angle construct when locked with the titanium spiral blade End Cap
- Humeral shaft and head may be reconstructed with minimal soft tissue stripping
- Proximal locking position avoids the axillary nerve
- Four 2.25 mm suture holes around the periphery of the spiral blade head accommodate suture needles up to 2.0 mm and provide multiple suture anchoring sites for soft tissue reconstruction and fixation of small bone fragments
Titanium Spiral Blade for Humeral Nail (continued)

- 3.9 mm core diameter with a 2.2 mm cannulation
- 10.5 mm blade width for use through 12 mm wide nail slot
- 13.0 mm head diameter provides a positive stop against the outer cortex
- Lengths from 34 mm to 54 mm in 2 mm increments for precise placement near subchondral bone

Titanium End Caps

Titanium End Caps for Humeral Nail with Spiral Blade (gold)

- 0 mm, 5 mm, 10 mm and 15 mm extensions
- Secures Titanium Spiral Blade in nail slot, creating a fixed-angle construct
- T15 StarDrive™ Recess (0 mm) or 3.5 mm hex recess (5 mm, 10 mm and 15 mm)
- 5 mm, 10 mm and 15 mm extensions extend nail height if nail is overinserted
- Protects nail threads from tissue ingrowth

Titanium End Caps for Solid Humeral Nail (blue)

- 0 mm, 5 mm, 10 mm and 15 mm extensions
- 2.5 mm hex recess (0 mm) or 3.5 mm hex recess (5 mm, 10 mm and 15 mm)
- 5 mm, 10 mm and 15 mm extensions extend nail height if nail is overinserted
- Protects nail threads from tissue ingrowth

Note: All Titanium Solid Humeral Nail System implants are made of titanium alloy (Ti-6Al-7Nb).
Locking Configurations

Titanium Solid Humeral Nail

ANTEGRADE

For multipart fractures or lesions from the humeral head to the distal humeral shaft, the Titanium Solid Humeral Nail may be inserted antegrade using one of four basic locking configurations.

Antegrade nail insertion with Spiral Blade locking
Antegrade nail insertion with oblique locking
Antegrade nail insertion with conventional locking
Antegrade nail insertion with compression locking
ANTEGRADE

Case Examples

Preoperative X-ray:
Grade II closed, midshaft humeral fracture in a multiple trauma patient with complex ankle injury

Postoperative X-ray:
An antegrade 7.5 mm Titanium Solid Humeral Nail was used to stabilize the fracture and permit ambulation
Titanium Solid Humeral Nail

For fractures or lesions of the mid- to proximal humeral shaft, the Titanium Solid Humeral Nail may be inserted retrograde using one of two basic locking configurations.
RETROGRADE

Case Example

Stabilization of an impending pathologic fracture with a retrograde 7.5 mm Titanium Solid Humeral Nail
Locking Configurations (continued)

Titanium Proximal Humeral Nail

For fractures of the proximal humerus, the Titanium Proximal Humeral Nail has two basic locking configurations.

Spiral Blade Locking

Oblique Locking
Case Example

Preoperative X-ray: Two-part proximal humerus fracture of the surgical neck

Postoperative X-ray: Surgical neck fracture treated with Titanium Proximal Humeral Nail and Titanium Spiral Blade for Humeral Nail
Preoperative implant selection

To estimate nail length preoperatively, place the preoperative planner template on the AP X-ray of the uninjured humerus and select a nail length that is 1 cm distal to the superior edge of the articular surface and at least 2.5 cm proximal to the superior edge of the olecranon fossa.

To determine nail diameter preoperatively, place the template on the AP X-ray of the uninjured humerus and measure the diameter at the narrowest part of the medullary canal that will contain the nail. When selecting nail size, consider medullary canal size, fracture pattern and postoperative protocol.

*Note:* There are two templates available for use: true size and 115% magnification. The template image is magnified 15% to account for average radiograph magnification; however, variations in magnification levels are common.
Patient positioning

- Place the patient in a modified lateral position.
- Use an OR table that is completely radiolucent.
- The table setup should permit full C-arm visualization of the entire humerus in the AP and lateral views.
- Place the C-arm opposite the surgeon and orient it perpendicular to the longitudinal axis of the humeral shaft in the AP view.
- Obtain the scapular “Y” lateral view by bringing the C-arm through a 90° arc and projecting the beam directly at the glenoid.
Antegrade Nail Insertion — 
Solid and Proximal Humeral Nails (continued)

Confirm nail length

The Radiographic Ruler [357.591] may be used on either arm pre- or intraoperatively. To use the ruler, position the C-Arm for an AP view of the proximal humerus. When measuring the fractured humerus, apply gentle traction to restore length.

With long forceps, hold the ruler along the lateral aspect of the arm, parallel to and at the level of the humerus. To prevent magnification errors, orient the X-ray beam perpendicular to the humerus and center it over the area to be measured. Adjust the ruler so that the top is approximately 1 cm distal to the cephalic notch. Mark the skin at the top of the ruler.

Move the image intensifier distally, replace the top of the ruler at the skin mark, and take an AP image of the distal humerus. Verify fracture reduction.

Read the nail length directly from the ruler image, selecting the measurement that is at least 2.5 cm proximal to the superior edge of the olecranon fossa.
**Confirm nail diameter**

To confirm nail diameter, position the image intensifier for a lateral view of the distal humerus. With long forceps, place the ruler against the arm so that the diameter gauge is centered over the narrowest part of the medullary canal that will contain the nail. The diameter gauge indicates the correct diameter nail to use and any necessity for reaming prior to nail insertion.
Antegrade Nail Insertion —
Solid and Proximal Humeral Nails (continued)

Instruments to Open the Proximal Humerus

Quick Coupling for drill bits
532.013

Quick Coupling for K-wires
532.022

Large Quick Coupling
532.015

Cannulated Awl with T-Handle
351.12

2.5 mm Kirschner Wire, trocar point, 285 mm
292.26

Also Available

Flexible Medullary Reamers, 385 mm

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Flexible Medullary Reamer</th>
</tr>
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<tbody>
<tr>
<td>6.0 mm</td>
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<td>359.114</td>
</tr>
<tr>
<td>10.5 mm</td>
<td>359.115</td>
</tr>
</tbody>
</table>

AO Reduction Drive Unit 532.017
Requires 14.4V Battery 532.033
and Battery Casing 532.032

Small Jacobs Chuck
with key 532.016

2.5 mm Titanium Calibrated Reaming Rod
359.083
Open the proximal humerus

The surgical approach to the proximal humerus should be considered carefully. The anterior acromial approach is recommended to minimize damage to the rotator cuff. The more traditional lateral acromial site is not suggested because it may transect the infraspinatus and teres minor. The lateral acromial approach will also position the entry site posterolateral resulting in varus displacement of a proximal fragment and the possible fracture of the entry site if the fracture is more distal.

Access the entry site through the raphe separating the anterior and middle third of the deltoid.

Insert 2.5 mm K-wires [292.26] using the Small Battery Drive [532.010] and Quick Coupling for K-wires [532.022] into the humeral head to enable manipulation. The head is maneuvered, using radiographic control, until the sulcus (cephalic notch) between the greater tuberosity and the margin of the articular cartilage is recognized.

Antegrade Nail Insertion —
Solid and Proximal Humeral Nails (continued)

Open the proximal humerus (continued)

The insertion point is in line with the medullary canal in the lateral view and at the margin of the articular surface in the AP view. After the entry site has been verified, incise the supraspinatus longitudinally and tag the margins with sutures. These sutures will help retract the edges of the supraspinatus during the procedure and assist in reapproximating the supraspinatus during final closure.

Insert another 2.5 mm K-wire [292.26] through the sulcus and into the medullary canal using the Small Battery Drive [532.010] and Quick Coupling for K-wires [532.022].

For three- and four-part fractures, the humeral head is reconstructed prior to insertion of the K-wire. For a three-part fracture involving the greater tuberosity, an open rotator cuff approach should be considered. Mobilize the greater tuberosity fragment and perforate it with a tuberosity punch or other suitable instrument. Secure the greater tuberosity fragment with heavy nonabsorbable suture and/or K-wires positioned to reapproximate the fragment. For a four-part fracture, a deltopectoral approach may be more useful.

Slide the Cannulated Awl with T-Handle [351.12] over the K-wire and use a twisting hand motion to create the portal into the medullary canal. Tighten the nut to secure the K-wire inside the awl and remove the assembly.
## Implants and Instruments for Antegrade Insertion of Solid and Proximal Humeral Nails

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Identification</th>
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<tbody>
<tr>
<td>Titanium Solid Humeral Nail</td>
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<tr>
<td>Titanium Proximal Humeral Nail</td>
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<tr>
<td>Insertion Handle</td>
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<tr>
<td>11 mm Combination Wrench</td>
<td>321.16</td>
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<td>4.5 mm Pin Wrench</td>
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<tr>
<td>Connecting Screw</td>
<td>358.54</td>
</tr>
<tr>
<td>Driving Head</td>
<td>355.18</td>
</tr>
<tr>
<td>Inserter/Extractor</td>
<td>358.699</td>
</tr>
<tr>
<td>Hammer, 350 grams</td>
<td>399.41</td>
</tr>
<tr>
<td>Slide Hammer</td>
<td>359.036</td>
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</tbody>
</table>
Antegrade Nail Insertion —
Solid and Proximal Humeral Nails (continued)

Assemble the insertion instruments

Insert the Connecting Screw [358.54] into the Insertion Handle [358.692] and manually turn the appropriate length Titanium Solid or Proximal Humeral Nail onto the connecting screw. Connect the nail to the insertion handle with the apex of the nail bend pointing away from the insertion handle. Thread the connecting screw fully into the nail and secure the assembly with the 11 mm Combination Wrench [321.16].

**Note:** A different insertion assembly is required when locking in the compression mode (see page 50).
**Insert the nail**

Insert the nail into the humerus using a twisting hand motion. Verify fracture reduction and monitor nail passage across the fracture under image intensification. Use the nail as a reduction tool while keeping the patient’s elbow steady to counter any distraction forces.

If needed, thread the Driving Head [355.18] onto the connecting screw, using the 4.5 mm Pin Wrench [321.17] to secure the assembly. Use light, controlled blows of the Hammer [399.41] to seat the nail. **Do not strike the insertion handle.** Alternatively, the Inserter/Extractor [358.699] can be threaded onto the connecting screw, and the nail can be inserted using light, controlled blows of the Slide Hammer [359.036].

Insert the nail until the proximal end is slightly countersunk beneath the superior surface of the proximal humerus. If needed, the nail can be overinserted up to 15 mm and nail length can be extended with an End Cap. **Do not leave the nail proud because this may cause impingement.**

*Insert the nail manually as far as possible.*

*Use the hammer to seat the nail.*

*Insert the nail until the proximal end is slightly countersunk.*
Retrograde Nail Insertion — Solid Humeral Nail

Preoperative implant selection

To estimate nail length preoperatively, place the preoperative planner template on the AP X-ray of the uninjured humerus and select a nail length that is 2.5 cm proximal to the superior edge of the olecranon fossa and at least 1 cm distal to the superior articular surface of the humeral head.

To determine nail diameter preoperatively, place the template on the lateral X-ray of the uninjured humerus and measure the diameter at the narrowest part of the medullary canal that will contain the nail.

Note: There are two templates available for use: true size and 115% magnification. The template image is magnified 15% to account for average radiograph magnification; however, variations in magnification levels are common.

Measure canal diameter from the lateral X-ray.
Patient positioning

- Place the patient in the supine or lateral decubitus position.

- Use a radiolucent table.

- The elbow should be free to flex 120° to facilitate reduction and permit access to the retrograde insertion site.

- The table setup should permit full C-arm visualization of the entire humerus in the AP and lateral views.

For supine positioning, place the patient so that the affected arm is draped freely to hang beyond the edge of the table. Flex the elbow and place the patient’s arm across the chest.

Alternatively, place the patient in the lateral decubitus position. With the elbow flexed 45° to 60°, apply manual traction and use gentle manipulation to ensure that the fracture can be reduced before proceeding.

Or place the arm on a radiolucent arm rest.
If desired, the arm can be flexed, positioned in neutral rotation and placed in traction using an olecranon screw.
Retrograde Nail Insertion—Solid Humeral Nail

Confirm nail length

The Radiographic Ruler [357.591] may be used on either arm pre- or intraoperatively. To use the ruler, position the C-arm for an AP view of the distal humerus. When measuring the fractured humerus, apply gentle traction to restore length.

With long forceps, hold the ruler along the lateral aspect of the arm, parallel to and at the level of the humerus. To prevent magnification errors, orient the X-ray beam perpendicular to the humerus and center it over the area to be measured. Adjust the ruler so that the top is approximately 2.5 cm proximal to the superior edge of the olecranon fossa. Mark the skin at the top of the ruler.

Move the image intensifier proximally, replace the top of the ruler at the skin mark and take an AP image of the proximal humerus. Verify fracture reduction.

Read the nail length directly from the ruler image, selecting the measurement that is at least 1 cm distal to the superior articular surface of the humeral head.

Place ruler along lateral aspect.

Read nail length.
**Confirm nail diameter**

To confirm nail diameter, position the image intensifier for a lateral view of the distal humerus. With long forceps, place the ruler against the arm so the diameter gauge is centered over the narrowest part of the medullary canal that will contain the nail. The diameter gauge indicates the correct diameter nail to use and any necessity for reaming prior to nail insertion.

*Use the Radiographic Ruler to determine nail diameter.*

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**Radiographic Ruler**

357.591
Retrograde Nail Insertion — Solid Humeral Nail

Instruments to open the distal humerus

- 4.5 mm Drill Bit 310.44
- Router 332.06
- Conical Burr 358.68
- Quick Coupling for drill bits 532.013
- Large Quick Coupling 532.015
- Small Battery Drive 532.010
- Battery Casing 532.002

Also Available

Flexible Medullary Reamers, 385 mm

<table>
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Flexible Medullary Reamer

- Large Jacobs Chuck with key 532.014
- AO Reduction Drive Unit 532.017
  Requires 14.4V Battery 532.033 and Battery Casing 532.032

Ball tip

2.5 mm Titanium Calibrated Reaming Rod 359.083
Open the distal humerus

If traction is not used, flex the elbow approximately 120° and place the arm across the patient’s chest with an assistant holding the arm in this position. Expose the distal humerus with a triceps-splitting incision that begins approximately 1 cm proximal to the olecranon fossa and ends well distal to the spiral groove and radial nerve. Retract the triceps.

Identify the starting point approximately 2.5 cm proximal to the superior edge of the olecranon fossa and in line with the axis of the medullary canal. Open the near cortex at this starting point with the 4.5 mm Drill Bit [310.44]. Do not penetrate the far cortex. Continue drilling and progressively lower the drill until the drill bit is in line with the medullary canal in the lateral view.
Open the distal humerus (continued)

Alternatively, drill three holes through the near cortex along the axis of the medullary canal and connect the holes with the 4.5 mm Drill Bit to form an opening that is approximately 15 mm long by 5 mm wide.

Further enlarge the opening with the Router [332.06]. Use the 8.5 mm/3.5 mm Conical Burr [358.68] to shape the opening into a “trough” that leads directly into the medullary canal.
Open the distal humerus (continued)

The trough must be large enough to accommodate the head of the nail and must be at least 2 cm long by 1 cm wide.* This is done by carving away the inner aspect of the posterior cortex as well as the medial and lateral cortical walls and creating a distal bevel.

If desired, pass a Flexible Medullary Reamer [359.1xx] through the insertion site to ensure passage of the nail.

* The proximal end of the 7.5 mm Titanium Solid Humeral Nail is 8.0 mm in diameter.
Retrograde Nail Insertion — Solid Humeral Nail

Implants and Instruments for Retrograde Insertion of Titanium Solid Humeral Nail

- Titanium Solid Humeral Nail 462.xxx
- Connecting Screw 358.54
- Insertion Handle 358.692
- 11 mm Combination Wrench 321.16
- 4.5 mm Pin Wrench 321.17
- Driving Head 355.18
- Hammer, 350 grams 399.41
- Inserter/Extractor 358.699
- Slide Hammer 359.036
Assemble the insertion instruments

Insert the Connecting Screw [358.54] into the Insertion Handle [358.692] and manually turn the appropriate length Titanium Solid Humeral Nail onto the connecting screw. Couple the nail to the insertion handle with the apex of the nail bend pointing away from the insertion handle. Thread the connecting screw fully into the nail and secure the assembly with the 11 mm Combination Wrench [321.16].
Retrograde Nail Insertion — Solid Humeral Nail

Insert the nail

Insert the nail into the humerus using a twisting hand motion. If the nail does not pass through the insertion site, remove the nail and enlarge the trough with the router or conical burr until the nail can be inserted with relative ease. Forcing a nail through a retrograde insertion site may increase the risk of fracture.

Verify fracture reduction and monitor nail passage across the fracture under image intensification. Use the nail as a reduction tool while keeping the patient’s elbow steady to counter any distraction forces. Consider the proximity of the radial nerve to the humerus and use a limited open reduction if necessary.

If needed, thread the Driving Head onto the connecting screw using the 4.5 mm Pin Wrench to secure the assembly. Use light, controlled blows of the Hammer to seat the nail. **Do not strike the insertion handle.** Alternatively, the Inserter/Extractor can be threaded onto the connecting screw and the nail can be inserted using light, controlled blows of the Slide Hammer. Insert the nail flush with the entry site.
Locking Options—Spiral Blade Locking
Solid and Proximal Humeral Nails

Implants and Instruments for Spiral Blade Locking

Titanium Spiral Blades 462.6xx

14.0 mm/4.5 mm Drill Sleeve [358.688]

4.5 mm/2.0 mm Wire Sleeve 358.694

2.0 mm Trocar 358.686

2.0 mm Non-Threaded Guide Wire, 230 mm 292.656

Spiral Blade Measuring Device 358.698

Spiral Blade Inserter 358.696

Hammer, 350 Grams 399.41

Extended Aiming Arm 358.679

Quick Coupling for K-wires 532.022

Small Battery Drive 532.010

Battery Casing 532.002

4.5 mm Cannulated Drill Bit 358.691

Large Jacobs Chuck with key 532.014

Spiral Blade Connecting Screw 358.697
Insert Spiral Blade

Assemble the 14.0 mm/4.5 mm Drill Sleeve [358.688], 4.5 mm/2.0 mm Wire Sleeve [358.694] and 2.0 mm Trocar [358.686]. Pass the sleeves through the hole marked “SPIRAL BLADE” in the Extended Aiming Arm [358.679]. Create a lateral incision through the skin adjacent to the tip of the trocar and bluntly spread the fibers of the deltoid muscle. Bring the sleeves into contact with the bone, remove the trocar and insert a 2.0 mm Non-Threaded Guide Wire [292.656] through the wire sleeve. The final placement of the Spiral Blade tip should be at or slightly below the equator of the humeral head and in the inferior hemisphere.

Advance the guide wire to a position approximately 5 mm from the articular surface of the humeral head. Verify that the position of the guide wire is correct in both AP and lateral views. Confirm that the sleeves are in contact with the bone. Determine the length of the Spiral Blade by placing the Spiral Blade Measuring Device [358.698] over the guide wire and advancing it until the nose rests against the collar of the drill sleeve. Read the graduation of the Spiral Blade Measuring Device at the end of the guide wire.
Locking Options—Spiral Blade Locking
Solid and Proximal Humeral Nails (continued)

Insert Spiral Blade (continued)

Remove the wire sleeve and perforate the lateral cortex using the 4.5 mm Cannulated Drill Bit [358.691]. Remove the drill sleeve.

Attach the selected Spiral Blade to the Spiral Blade Inserter [358.696] using the Spiral Blade Connecting Screw [358.697]. The T-handle of the Spiral Blade Inserter should be parallel to the Extended Aiming Arm.

Perforate the lateral cortex using the 4.5 mm Cannulated Drill Bit.

Attach the selected Spiral Blade to the Spiral Blade Inserter.

The T-Handle of the Spiral Blade Inserter should be parallel to the Extended Aiming Arm.
Locking Options—Spiral Blade Locking Solid and Proximal Humeral Nails (continued)

**Insert Spiral Blade (continued)**

Pass the cannulated tip of the Spiral Blade over the Guide Wire. Advance the Spiral Blade Inserter through the Extended Aiming Arm and the longitudinal split in the deltoid muscle until the tip of the Spiral Blade rests in the perforation of the lateral cortex created with the 4.5 mm Cannulated Drill Bit.

Advance the Spiral Blade through the nail using light, controlled blows of the Hammer [399.41]. Advancement of the Spiral Blade should be monitored radiographically. If using tension sutures, pause approximately 1.5 cm to 2.0 cm before seating the Spiral Blade so that the suture ends can be provisionally placed through the suture portals. After the Spiral Blade is seated and locked with a spiral blade End Cap (gold), tie the sutures to the Spiral Blade.

**Precaution:** Use only the Titanium End Cap for Humeral Nail with Spiral Blade to lock the Spiral Blade in the slot of the nail.

**Note:** Failure to secure the Spiral Blade with a spiral blade End Cap prior to tying the sutures will cause the Spiral Blade to displace. For End Cap insertion, see page 56.

If there is lateral incompetence because of tumor, fracture pattern, or bone loss (gunshot wound, etc.), heavy sutures can be placed through the supraspinatus muscle insertion and secured to the fixed-angle Spiral Blade. This will transpose the supraspinatus muscle to the Spiral Blade and minimize the possibility of fixation failure by lateral translation.
Locking Options—Conventional Locking
Solid Humeral Nail

Implants and Instruments for Transverse Locking
with Locking Bolts or Locking Screws

- 3.9 mm Titanium Locking Bolts 458.xx
- 4.0 mm Titanium Locking Screws 458.8xx
- Large Quick Coupling 532.015
- Quick Coupling for drill bits 532.013
- Standard Aiming Arm 358.689
- 11.0 mm/8.0 mm Protection Sleeve 355.70
- 8.0 mm/3.2 mm Drill Sleeve 355.722
- 8.0 mm Trocar 355.75
- 3.2 mm Three-Fluted Drill Bit, 68 mm Calibration 315.330
- Holding Sleeve 314.11
- Holding Sleeve Locking Device 360.253
- Locking Bolt Measuring Device 357.792
- Large Hexagonal Screwdriver 314.75
- Small Battery Drive 532.010
- Battery Casing 532.002
Locking Options—Conventional Locking Solid Humeral Nail (continued)

Lock proximally

Confirm fracture reduction, keeping the insertion handle oriented laterally. Determine the proximal locking configuration for the Solid Humeral Nail.

Place the arm in neutral rotation to minimize tension on the axillary nerve. Consider an open approach to help avoid injury to the surrounding neurovascular structures and soft tissues. Insert the 11.0 mm/8.0 mm Protection Sleeve [355.70] and 8.0 mm Trocar [355.75] through the “STAT” or “OBLIQUE” hole in the Standard Aiming Arm [358.689].

Note: The “COMP” slot in the nail should not be used to lock the fracture in the dynamic mode due to the risk of nail migration.

Insertion of the static, transverse Locking Bolt ( ) or Locking Screw prohibits insertion of a second Locking Bolt or Locking Screw through the oblique hole ( ), although an additional transverse Locking Bolt or Locking Screw may be inserted through the compression slot for added rotational control ( ).
Lock proximally (continued)

Replace the trocar with the 8.0 mm/3.2 mm Drill Sleeve [355.722] and drill through both cortices with the 3.2 mm Calibrated Drill Bit [315.330], stopping the drill immediately after penetrating the far cortex. Careful attention to drill bit and Locking Bolt or Locking Screw length is important to prevent neuro-vascular injury.

Monitor the drill bit insertion radiographically because the position of the drill bit tip directly represents Locking Bolt or Locking Screw tip position in the bone. Read the Locking Bolt or Locking Screw length directly from the drill bit at the back of the drill sleeve. To avoid measurement errors, press the drill sleeve firmly to the cortex.

Alternatively, use the Locking Bolt Measuring Device [357.792]. Remove the scaled probe portion from its outer housing and remove the drill sleeve from the protection sleeve. Insert the scaled probe through the protection sleeve. The hook of the Locking Bolt Measuring Device grasps the far cortex of the bone. Read the scale against the edge of the protection sleeve to determine the appropriate Locking Bolt or Locking Screw length.
Locking Options—Conventional Locking Solid Humeral Nail (continued)

Lock proximally (continued)

Insert the Locking Bolt or Locking Screw through the protection sleeve using the Large Hexagonal Screwdriver [314.75] and Holding Sleeve [314.11] with Holding Sleeve Locking Device [360.253]. If a transverse Locking Bolt or Locking Screw is used, a second transverse Locking Bolt or Locking Screw may be inserted by repeating this procedure through the hole in the Standard Aiming Arm [358.689] marked “COMP.”

Remove the insertion assembly and insert an End Cap. See “End Cap Insertion” on page 56.
## Locking Options—Distal Locking (Freehand)

### Solid Humeral Nail

**Implants and Instruments for Distal Locking (Freehand)**

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.9 mm Titanium Locking Bolts</td>
<td>458.xx</td>
</tr>
<tr>
<td>4.0 mm Titanium Locking Screws</td>
<td>458.8xx</td>
</tr>
<tr>
<td>Quick Coupling for drill bits</td>
<td>532.013</td>
</tr>
<tr>
<td>Large Quick Coupling</td>
<td>532.015</td>
</tr>
<tr>
<td>Radiolucent Drive</td>
<td>511.30</td>
</tr>
<tr>
<td>Locking Bolt Measuring Device</td>
<td>357.792</td>
</tr>
<tr>
<td>Holding Sleeve</td>
<td>314.11</td>
</tr>
<tr>
<td>Holding Sleeve Locking Device</td>
<td>360.253</td>
</tr>
<tr>
<td>3.2 mm Three-Fluted Drill Bit for Radiolucent Drive, Brad Point</td>
<td>511.414</td>
</tr>
<tr>
<td>Small Battery Drive</td>
<td>532.010</td>
</tr>
<tr>
<td>Battery Casing</td>
<td>532.002</td>
</tr>
<tr>
<td>Large Hexagonal Screwdriver</td>
<td>314.75</td>
</tr>
</tbody>
</table>
Locking Options—Distal Locking (Freehand)
Solid Humeral Nail

Lock distally (freehand)

While maintaining fracture reduction, orient the image intensifier for an AP view of the distal humerus and make a longitudinal skin incision over the superior distal locking hole being targeted. Bluntly dissect through the biceps muscle to the bone.

Confirm reduction. Align the image intensifier with the hole in the nail until a perfect circle is visible in the center of the screen. Place a scalpel blade on the skin to determine the incision point and make an incision using open technique. Under image intensification, insert the top of the 3.2 mm Three-Fluted Drill Bit for Radiolucent Drive [511.414] through the incision. Place the drill bit oblique to the X-ray beam until the tip is centered in the locking hole. Be sure to use a sharp drill bit to prevent slippage and ensure accuracy.
Lock distally (freehand) (continued)

Tilt the Small Battery Drive until the drill bit is in line with the beam and appears as a radiopaque solid circle in the center of the outer ring. The drill bit will nearly fill the locking hole image. Hold the drill in this position and drill through both cortices.

Measure for Locking Bolt or Locking Screw length using the Locking Bolt Measuring Device [357.792]. Pressing the sleeve to the bone, grasp the far cortex with the hook of the Locking Bolt Measuring Device. Read the scale against the top of the measuring device sleeve to determine the appropriate Locking Bolt or Locking Screw length.

Insert the Locking Bolt or Locking Screw in a freehand fashion using the Large Hexagonal Screwdriver [314.75] and Holding Sleeve [314.11] with Holding Sleeve Locking Device [360.253]. Verify Locking Bolt or Locking Screw length under image intensification. If needed (e.g., osteopenia, short distal fragment), a second distal Locking Bolt or Locking Screw may be inserted using the same technique.

Note: Distal locking from lateral to medial in the Solid Humeral Nail is not recommended.
Locking Options—Spiral Blade Locking Proximal Humeral Nails

The technique for Spiral Blade locking of Proximal Humeral Nails is found in the Solid Humeral Nail section beginning on page 35.
Locking Options—Oblique Locking
Proximal Humeral Nails

Implants and Instruments for Oblique Locking

- 3.9 mm Titanium Locking Bolts
  458.xx

- 4.0 mm Titanium Locking Screws
  458.8xx

- Quick Coupling for drill bits
  532.013

- Large Quick Coupling
  532.015

- Small Battery Drive
  532.010

- Battery Casing
  532.002

- 11.0 mm/8.0 mm Protection Sleeve
  355.70

- 8.0 mm/3.2 mm Drill Sleeve
  355.722

- 8.0 mm Trocar
  355.75

- 3.2 mm Three-Fluted Drill Bit, 68 mm Calibration
  315.330

- Extended Aiming Arm
  358.679

- Holding Sleeve
  314.11

- Holding Sleeve Locking Device
  360.253

- Large Hexagonal Screwdriver
  314.75

- Locking Bolt Measuring Device
  357.792
Locking Options—Oblique Locking Proximal Humeral Nails (continued)

Lock proximally

Confirm fracture reduction, keeping the Insertion Handle oriented laterally.

Place the arm in neutral rotation to minimize tension on the axillary nerve. Insert the 11.0 mm/8.0 mm Protection Sleeve [355.70] and 8.0 mm Trocar [355.75] through the “OBLIQUE” hole in the Extended Aiming arm [358.679].

Replace the trocar with the 8.0 mm/3.2 mm Drill Sleeve [355.722] and drill through the lateral cortex with the 3.2 mm Calibrated Drill Bit [315.330], stopping the drill without penetrating the far cortex. Careful attention to drill bit and Locking Bolt or Locking Screw length is important to prevent damage to the articular surface.

Monitor the drill bit insertion radiographically, since the position of the drill bit tip directly represents Locking Bolt or Locking Screw tip position in the bone. Read the Locking Bolt or Locking Screw length directly from the drill bit at the back of the drill sleeve. To avoid measurement errors, press the drill sleeve firmly to the cortex.

Insert the Locking Bolt or Locking Screw through the Protection Sleeve using the Large Hexagonal Screwdriver [314.75] and Holding Sleeve [314.11] with Holding Sleeve Locking Device [360.253].

Remove the insertion assembly and insert an End Cap. See page 56 for “End Cap Insertion.”
Locking Options— Distal Locking Proximal Humeral Nails

Lock distally

The Extended Aiming Arm must remain connected to the Insertion Handle. Confirm fracture reduction, keeping the Insertion Handle oriented laterally.

Insert the 11.0 mm/8.0 mm Protection Sleeve [355.70] with the 8.0 mm Trocar [355.75] through one of the distal holes in the Extended Aiming Arm. Dimple the skin with the trocar tip. Slightly retract the trocar and protection sleeve to permit skin incision. Bluntly dissect the soft tissues to the bone. Bring the trocar and protection sleeve into contact with the bone.

Withdraw the trocar and insert the 8.0 mm/3.2 mm Drill Sleeve [355.722] into the protection sleeve. Use the 3.2 mm Calibrated Drill Bit [315.330] to perforate both cortices.

Monitor the drill bit insertion radiographically because the position of the drill bit tip directly represents Locking Bolt or Locking Screw tip position in the bone. Read the Locking Bolt or Locking Screw length directly from the drill bit at the back of the drill sleeve. To avoid measurement errors, press the drill sleeve firmly to the cortex.

Alternatively, use the Locking Bolt Measuring Device [357.792]. Remove the scaled probe portion from its outer housing and remove the drill sleeve from the protection sleeve. Insert the scaled probe through the protection sleeve. The Locking Bolt Measuring Device hook grasps the far cortex of the bone. Read the scale against the edge of the protection sleeve to determine the appropriate Locking Bolt or Locking Screw length.

Insert the correct Locking Bolt or Locking Screw using the Large Hexagonal Screwdriver [314.75] and Holding Sleeve [314.11] with Holding Sleeve Locking Device [360.253]. Repeat the process for the second distal Locking Bolt or Locking Screw.
Locking Options—Compression Locking Solid and Proximal Humeral Nails

Preoperative considerations

Compression locking can help close a transverse or short oblique fracture gap that is up to 8 mm wide. It may also be used to create a limited amount of interfragmentary compression to increase the torsional stiffness and bending strength of the nail-bone construct.

Compression locking should be planned preoperatively to address the following considerations before and during surgery:

• A special nail insertion assembly is required.

• Compression locking may be used for transverse and short oblique fractures.

• Compression locking is not indicated for patients with poor bone quality because a secure bolt-cortex interface is needed.

• Compression locking should be used with great care when radial nerve impingement is suspected or possible. In these cases, the nerve should be explored and isolated prior to nailing or locking.

• The nail must be overinserted by the same amount of interfragmentary travel that is anticipated because, as compression is applied, the nail will back out at the insertion site.

• When the antegrade approach is used, nail overinsertion may also help obtain bicortical purchase with the compression Locking Bolt or Locking Screw.

• When the retrograde approach is used, slight nail overinsertion may also be required to obtain bicortical purchase of the compression Locking Bolt or Locking Screw.
Locking Options—Compression Locking
Solid and Proximal Humeral Nails

Implants and Instruments for Compression Locking

- 3.9 mm Titanium Locking Bolts 458.xx
- 4.0 mm Titanium Locking Screws 458.8xx
- Quick Coupling for drill bits 532.013
- Large Quick Coupling 532.015
- Driving Head 355.18
- Inserter/ Extractor 358.699
- 11 mm Combination Wrench 321.16
- 4.5 mm Pin Wrench 321.17
- Small Battery Drive 532.010
- Battery Casing 532.002
- Compression Connecting Screw 358.61
- Compression Sleeve 358.60
Locking Options—Compression Locking
Solid and Proximal Humeral Nails

Implants and Instruments for Compression Locking (continued)

- Insertion Handle
  - 358.692

- Standard Aiming Arm
  - 358.689

- 11.0 mm/8.0 mm Protection Sleeve
  - 355.70

- 8.0 mm/3.2 mm Drill Sleeve
  - 355.722

- 8.0 mm Trocar
  - 355.75

- Locking Bolt Measuring Device
  - 357.792

- 3.2 mm Three-Fluted Drill Bit, 68 mm Calibration
  - 315.330

- Holding Sleeve
  - 314.11

- Holding Sleeve Locking Device
  - 360.253

- Large Hexagonal Screwdriver
  - 314.75
Locking Options—Compression Locking Solid and Proximal Humeral Nails

Open the humerus

Open the humerus using standard technique. See page 18 to open the proximal humerus or page 28 to open the distal humerus.

Assemble the insertion instruments

Insert the Compression Connecting Screw [358.61] into the Compression Sleeve [358.60] until the instruments snap together. Insert this assembly through the Insertion Handle [358.692]. Manually turn the appropriate length humeral nail onto the connecting screw. Couple the nail to the insertion handle with the apex of the nail bend pointing away from the insertion handle.

Use the 11 mm Combination Wrench [321.16] to advance the connecting screw into the nail until the “0” mark on the connecting screw aligns with the shoulder of the compression sleeve. Do not overtighten.
Locking Options—Compression Locking Solid and Proximal Humeral Nails

Insert the nail

Continue with standard nail insertion technique and overinsert the nail as determined preoperatively. See page 14 for antegrade nail insertion technique or page 24 for retrograde nail insertion technique.

After nail insertion, confirm fracture reduction and minimize fracture distraction as much as possible. The maximum amount of interfragmentary travel produced by the compression device is 8 mm.

Lock through the nail tip

Determine Locking Bolt or Locking Screw length. Insert one or two Locking Bolts or Locking Screws through the nail tip. See page 43 for “Freehand Distal Locking of Titanium Solid Humeral Nails” or see page 49 for “Distal Locking of Titanium Proximal Humeral Nails.”

Insert the compression bolt

Insert the Locking Bolt or Locking Screw through the hole in the Standard Aiming Arm [358.689] marked “COMP” and into the nail slot following standard insertion technique.
Compress the fracture

Advance the connecting screw with the combination wrench. The tip of the connecting screw will contact the Locking Bolt or Locking Screw and advance into the nail, pulling the interlocked far fragment toward the near fragment.

Continue to advance the connecting screw, noting the amount of interfragmentary travel at the fracture site and on the compression scale until the desired amount of travel is achieved. It is important to monitor both the fracture site and the compression Locking Screw or Locking Bolt during the procedure. If the fragments do not compress and/or the compression Locking Screw or Locking Bolt migrates or deforms excessively, discontinue the compression locking procedure.

Once interfragmentary apposition is achieved, the device may be used to apply a slight amount of additional compression, although that is not the primary function of the device.

To maintain compression, a second Locking Bolt or Locking Screw must be inserted through the static hole. Insert the 11.0 mm/8.0 mm Protection Sleeve [355.70] and 8.0 mm Trocar [355.75] through the Aiming Arm hole marked “STAT” and insert the static Locking Bolt or Locking Screw following standard insertion technique.

Note: The “COMP” slot in the nail should not be used to lock the fracture in dynamic mode due to the risk of nail migration.

Remove the insertion assembly and insert an End Cap. For “End Cap Insertion,” see page 56.
Locking Options—End Cap Insertion
Solid and Proximal Humeral Nails

Implants and Instruments for End Cap Insertion

- Titanium End Cap for Solid Humeral Nail (blue)
  462.9xx

- Titanium End Cap for Humeral Nail with Spiral Blade (gold)
  462.66x

- 2.5 mm Kirschner Wire, Trocar Point, 285 mm
  292.26

- Standard Aiming Arm
  358.689

- Extended Aiming Arm
  358.679

- Small Hexagonal Screwdriver with Holding Sleeve
  314.02

- T15 StarDrive Screwdriver
  314.115

- Holding Sleeve
  314.11

- Large Hexagonal Screwdriver
  314.75
Locking Options—End Cap Insertion
Solid and Proximal Humeral Nails

The Titanium Solid Humeral Nail Set contains two types of End Caps: Titanium End Caps for the Solid Humeral Nail (blue) and Titanium End Caps for Humeral Nail with Spiral Blade (gold). **Use of the correct End Cap for the application is critical to the success of the procedure.**

Leaving the Spiral Blade insertion assembly, if used, attached to the Spiral Blade, and the Large Hexagonal Screwdriver attached to the Locking Bolt or Locking Screw, carefully remove the Connecting Screw from the nail. Keeping the Spiral Blade insertion assembly attached to the Spiral Blade and the Large Hexagonal Screwdriver engaged in the head of the Locking Bolt or Locking Screw helps maintain alignment of the Insertion Handle with the nail.

Titanium End Caps for Solid Humeral Nail (blue)

The Titanium End Caps for the Solid Humeral Nail (blue) are for use without the Spiral Blade and are available with extensions of 0 mm, 5 mm, 10 mm and 15 mm. The Titanium End Caps for the Solid Humeral Nail protect nail threads from tissue ingrowth and extend the nail height if the nail is overinserted. The Titanium End Cap for the Solid Humeral Nail with 0 mm extension is inserted with a Small Hexagonal Screwdriver [314.02]. The Titanium End Caps with 5 mm, 10 mm or 15 mm extension are inserted with a Large Hexagonal Screwdriver [314.75].

Titanium End Caps for Humeral Nail with Spiral Blade (gold)

The Titanium End Caps for Humeral Nail with Spiral Blade (gold) must be used to securely lock the Spiral Blade. They are available with extensions of 0 mm, 5 mm, 10 mm and 15 mm, securely lock the Spiral Blade, protect nail threads from tissue ingrowth, and extend the nail height if the nail is overinserted. The titanium spiral blade End Caps have detented threads that will provide some resistance upon insertion. The End Cap with 0 mm extension is inserted using a T15 StarDrive Screwdriver [314.115]. The End Caps with 5 mm, 10 mm or 15 mm extension are inserted using a Large Hexagonal Screwdriver [314.75] and have a suture hole that will hold a tethering suture to minimize inadvertent loss.
Locking Options—End Cap Insertion
Solid and Proximal Humeral Nails

Insert the End Cap

0 mm extension End Cap insertion

If the nail has not been overinserted, use an End Cap with a 0 mm extension. Align the End Cap with the nail axis to prevent cross-threading. Fully seat the End Cap and insert using the Small Hexagonal Screwdriver or the T15 StarDrive Screwdriver. The 0 mm extension End Cap can be inserted through the Insertion Handle for additional control.

5 mm, 10 mm, 15 mm extension End Cap insertion

If the nail has been overinserted, insert a 2.5 mm K-wire [292.26] through one of the small holes in the Standard or Extended Aiming Arm [358.689 or 358.679] and estimate End Cap extension length using an AP image intensification view of the nail end. The End Cap should not protrude beyond the insertion site.

Align the End Cap with the nail axis to prevent cross-threading. Fully seat the End Cap using the Large Hexagonal Screwdriver [314.75].

Remove all nail insertion instrumentation.

Note: Moving the patient’s arm before the End Cap is completely seated may translate the nail from the entry site. This displaced alignment may cause difficulty in placing the End Cap.
Implant Removal—
Solid and Proximal Humeral Nails

Instruments for End Cap, Locking Screws or Locking Bolt Removal

- T15 StarDrive Screwdriver
  - 314.115
- Holding Sleeve
  - 314.11
- Small Hexagonal Screwdriver with Holding Sleeve
  - 314.02
- Large Hexagonal Screwdriver
  - 314.75

Instruments for Spiral Blade Removal

- Spiral Blade Inserter
  - 358.696
- Spiral Blade Connecting Screw
  - 358.697
- Hammer, 350 Grams
  - 399.41

Instruments for Solid Humeral Nail or Proximal Humeral Nail Removal

- Connecting Screw
  - 358.54
- Insertion Handle
  - 358.692
- Inserter/ Extractor
  - 358.699
- Slide Hammer
  - 359.036
Implant Removal —
Solid and Proximal Humeral Nails

Remove the End Cap

Use the T15 StarDrive Screwdriver [314.115] to remove the 0 mm extension spiral blade End Cap. Use the Small Hexagonal Screwdriver [314.02] to remove the 0 mm extension End Cap for Solid Humeral Nail. Use the Large Hexagonal Screwdriver [314.75] to remove the 5 mm, 10 mm and 15 mm extension spiral blade End Caps or End Caps for Solid Humeral Nail.

Remove the Spiral Blade

Connect the Spiral Blade Inserter [358.696] and Spiral Blade Connecting Screw [358.697] to the Spiral Blade. Manually turn the Spiral Blade Inserter counterclockwise or, using light, controlled blows of the Hammer [399.41], remove the Spiral Blade.
**Remove the locking bolts or locking screws**

Connect the Connecting Screw [358.54] and Insertion Handle [358.692] to the nail before removing the last Locking Bolt or Locking Screw. This will prevent the nail from rotating in the medullary canal during assembly of the instruments to the nail.

Use the Large Hexagonal Screwdriver [314.75] with the Holding Sleeve [314.11] and Holding Sleeve Locking Device [360.253] to remove the Locking Bolts or Locking Screws.

**Remove the nail**

Thread the Inserter-Extractor [358.699] onto the end of the connecting screw. Remove the nail using the Slide Hammer [399.41].

*Remove the Locking Screw.*

*Remove the nail.*
Titanium Solid Humeral Nail (blue)

Universal design for the left or right humerus

Material:
Titanium-6% aluminum-7% niobium alloy

Diameters:
7.5 mm and 9.5 mm (8.0 mm diameter proximal end)

Lengths:
190 mm to 325 mm:
- 190 mm – 220 mm in 15 mm increments
- 220 mm – 280 mm in 10 mm increments
- 280 mm – 325 mm in 15 mm increments

Cross Section (Solid):
- Round (7.5 mm diameter nail)
- Fluted for increased flexibility (9.5 mm diameter nail)
Titanium Solid Humeral Nail System Surgical Technique DePuy Synthes

Titanium Proximal Humeral Nail (gold)

Universal design for the left or right humerus

Material:
Titanium-6% aluminum-7% niobium alloy

Diameter:
7.5 mm and 8.0 mm (8.0 mm diameter proximal end)

Length:
150 mm

Cross Section (Solid):
- Round (7.5 mm and 8.0 mm diameter nail)

Countersunk locking holes accept 3.9 mm locking bolts or 4.0 mm locking screws.
Implant Specifications (continued)

Titanium Spiral Blades for Solid Humeral Nails (gold)

Material:
Titanium-6% aluminum-7% niobium alloy

Dimensions:
• 34 mm – 54 mm lengths in 2 mm increments
• 3.9 mm core diameter with a 2.2 mm cannulation
• 10.5 mm blade circumscribed diameter
• 3.9 mm blade thickness and 13.0 mm head diameter

3.9 mm Titanium Locking Bolts (blue)

Material:
Titanium-6% aluminum-7% niobium alloy

Dimensions:
• 18 mm – 60 mm lengths in 2 mm increments
• 3.3 mm core diameter
• Self-cutting trocar tip
• 3.5 mm hex recess

4.0 mm Titanium Locking Screws (blue)

Material:
Titanium-6% aluminum-7% niobium alloy

Dimensions:
• 18 mm – 60 mm lengths in 2 mm increments
• 3.3 mm core diameter
• Self-cutting trocar tip
• 3.5 mm hex recess
Titanium Solid Humeral Nail End Caps (blue)

Material:
Titanium-6% aluminum-7% niobium alloy

0 mm extension:
• Protects nail threads from tissue ingrowth
• 2.5 mm hex recess

5 mm, 10 mm and 15 mm extensions:
• Extends nail height if nail is overinserted
• Protects nail threads from tissue ingrowth
• 3.5 mm hex recess

Titanium End Caps for Humeral Nail with Spiral Blade (gold)

Material:
Titanium-6% aluminum-7% niobium alloy

0 mm extension:
• Securely locks spiral blade
• Protects nail threads from tissue ingrowth
• T15 StarDrive Recess

5 mm, 10 mm and 15 mm extensions:
• Securely locks spiral blade
• Extends nail height if nail is overinserted
• Protects nail threads from tissue ingrowth
• 3.5 mm hex recess
• Suture holes hold tethering suture
Titanium Solid Humeral Nail Insertion and Locking Sets [105.690/105.691]

**Instruments**

- **292.26**  2.5 mm Kirschner Wire, 285 mm, trocar point, pkg. of 10
- **292.656**  2.0 mm Non-Threaded Guide Wire, spade point, 230 mm, 3 ea.
- **310.44◊**  4.5 mm Drill Bit, quick coupling, 145 mm
- **314.11**  Holding Sleeve
- **314.02**  Small Hexagonal Screwdriver with Holding Sleeve
- **314.115**  T15 StarDrive Screwdriver
- **314.75**  Hexagonal Screwdriver
- **315.31◊**  3.2 mm Three-Fluted Drill Bit, quick coupling, 145 mm
- **315.330◊**  3.2 mm Three-Fluted Drill Bit, quick coupling, 210 mm/68 mm calibration
- **319.97**  Screw Forceps, 2 ea.
- **321.16**  Combination Wrench, 11 mm width across flats, 2 ea.
- **321.17**  4.5 mm Pin Wrench 120 mm
- **332.06**  Router, quick coupling
- **351.12**  Cannulated Awl with T-Handle
- **355.18**  Driving Head
- **355.70**  11.0 mm/8.0 mm Protection Sleeve
- **355.722**  8.0 mm/3.2 mm Drill Sleeve, 110 mm
- **355.75**  8.0 mm Trocar
- **357.591**  Radiographic Ruler for Titanium Solid Humeral Nails
- **357.792**  Locking Bolt Measuring Device, 16 mm to 80 mm

- **358.54**  Connecting Screw for Titanium Solid Humeral Nails
- **358.679**  Extended Aiming Arm for Titanium Solid Humeral Nails
- **358.68**  8.5 mm/3.5 mm Conical Burr with quick coupling
- **358.686**  2.0 mm Trocar
- **358.688**  14.0 mm/4.5 mm Drill Sleeve
- **358.689**  Standard Aiming Arm for Titanium Solid Humeral Nails
- **358.691◊**  4.5 mm Cannulated Drill Bit with 102 mm Stop, 170 mm, Jacobs chuck
- **358.692**  Insertion Handle for Titanium Solid Humeral Nails
- **358.694**  4.5 mm/2.0 mm Wire Sleeve
- **358.696**  Spiral Blade Inserter for Titanium Solid Humeral Nails
- **358.697**  Spiral Blade Connecting Screw for Titanium Solid Humeral Nails
- **358.698**  Spiral Blade Measuring Device for Titanium Solid Humeral Nails
- **358.699**  Inserter/Extractor for Titanium Solid Humeral Nails
- **359.036**  Slide Hammer
- **360.253**  Holding Sleeve Locking Device
- **399.41**  Hammer, 350 grams

◊ Available nonsterile or sterile-packed.
Add "S" to catalog number to order sterile product.
## Implants

### Titanium Spiral Blades for Solid Humeral Nails

<table>
<thead>
<tr>
<th>Diameter (mm)</th>
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### 3.9 mm Titanium Locking Bolts

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### 4.0 mm Titanium Locking Screws

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### Titanium End Caps for Solid Humeral Nail

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### Titanium End Caps for Humeral Nail with Spiral Blade

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### Also Available

#### Titanium Solid Humeral Nails

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<th>Diameter (mm)</th>
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#### Titanium Proximal Humeral Nails

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◊ Available nonsterile or sterile-packed.
Add “S” to catalog number to order sterile product.
## Also Available

### Instruments

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<th>Item Description</th>
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<tr>
<td>105.596</td>
<td>Humeral Medullary Reamer Set</td>
</tr>
<tr>
<td>314.03</td>
<td>Small Hexagonal Screwdriver Shaft</td>
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<tr>
<td>314.116</td>
<td>3.5 mm StarDrive Screwdriver Shaft, T15, quick coupling</td>
</tr>
<tr>
<td>351.29–.33</td>
<td>Flexible shafts with front-cutting reamers, 7.0 mm–9.0 mm</td>
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<tr>
<td>351.76</td>
<td>3.0 mm Reaming Rod, 950 mm, with straight ball tip</td>
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<tr>
<td>351.93–.96</td>
<td>Hand Reamers, 7.0 mm–10 mm</td>
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<tr>
<td>358.60*</td>
<td>Compression Sleeve for Titanium Solid Humeral Nails</td>
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<td>358.61*</td>
<td>Compression Connecting Screw for Titanium Solid Humeral Nails</td>
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<tr>
<td>359.083◊</td>
<td>2.5 mm Titanium Calibrated Reaming Rod, 850 mm</td>
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<tr>
<td>690.334.60</td>
<td>Spiral Blade Rack for Graphic Case</td>
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<td>Spiral Blade Rack Lid for Graphic Case</td>
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### Power Equipment

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<td>105.955</td>
<td>Small Battery Drive Set</td>
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<tr>
<td>511.30</td>
<td>Radiolucent Drive</td>
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<td>511.414</td>
<td>3.2 mm Three-Fluted Drill Bit for Radiolucent Drive, brad point, 150 mm</td>
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<td>532.002</td>
<td>Battery Casing</td>
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<td>Battery for Small Battery Drive</td>
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<td>532.013</td>
<td>Quick Coupling for Drill Bits</td>
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<td>532.022</td>
<td>Quick Coupling for K-wires</td>
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For more information, refer to the Small Battery Drive User's Manual.

For detailed cleaning and sterilization instructions, please refer to [www.synthes.com/cleaning-sterilization](http://www.synthes.com/cleaning-sterilization) or sterilization instructions, if provided.

◊ Available nonsterile or sterile-packed.
  Add “S” to catalog number to order sterile product.

* Location available in graphic case.
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