Multiple options

MultiLoc Humeral Nailing System

Surgical Technique

DePuy Synthes

PART OF THE Johnson & Johnson FAMILY OF COMPANIES

AO approved by AO Technical Commission


Image intensifier control

This description alone does not provide sufficient background for direct use of DePuy Synthes products. Instruction by a surgeon experienced in handling these products is highly recommended.

Processing, Reprocessing, Care and Maintenance
For general guidelines, function control and dismantling of multi-part instruments, as well as processing guidelines for implants, please contact your local sales representative or refer to:
http://emea.depuysynthes.com/hcp/reprocessing-care-maintenance
For general information about reprocessing, care and maintenance of DePuy Synthes reusable devices, instrument trays and cases, as well as processing of DePuy Synthes non-sterile implants, please consult the Important Information leaflet (SE_023827) or refer to:
http://emea.depuysynthes.com/hcp/reprocessing-care-maintenance

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System Overview

The modular implant system consists of a short and a long nail with multiple locking options.

- Straight nail design for central insertion point

Short and long nails are available in left and right versions.

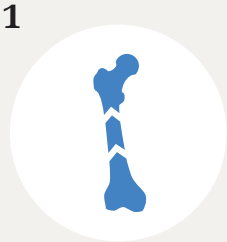
Intended Use, Indications and Contraindications can be found in the corresponding system Instructions for Use.

The AO Principles of Fracture Management

Mission
The AO's mission is promoting excellence in patient care and outcomes in trauma and musculoskeletal disorders.

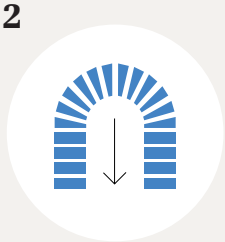
AO Principles [1,2]

1



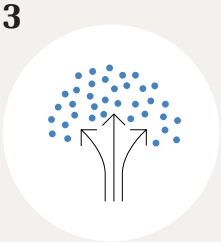
Fracture reduction and fixation to restore anatomical relationships.

2



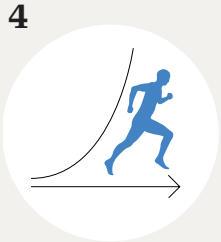
Fracture fixation providing absolute or relative stability, as required by the "personality" of the fracture, the patient, and the injury.

3



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

4



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

1 Müller ME, M Allgöwer, R Schneider, H Willenegger. Manual of Internal Fixation.
3rd ed. Berlin, Heidelberg, New York: Springer. 1991
2 Buckley RE, Moran CG, Apivatthakakul T. AO Principles of Fracture Management: 3rd ed. Vol. 1: Principles, Vol. 2: Specific fractures. Thieme; 2017.

Screw Configuration
MultiLoc Proximal Humeral Nail (short)

Levels A to D

Proximal locking
The three **lateral screws** (greater tuberosity, levels A, B, and D) **must** be used in any fracture situation.

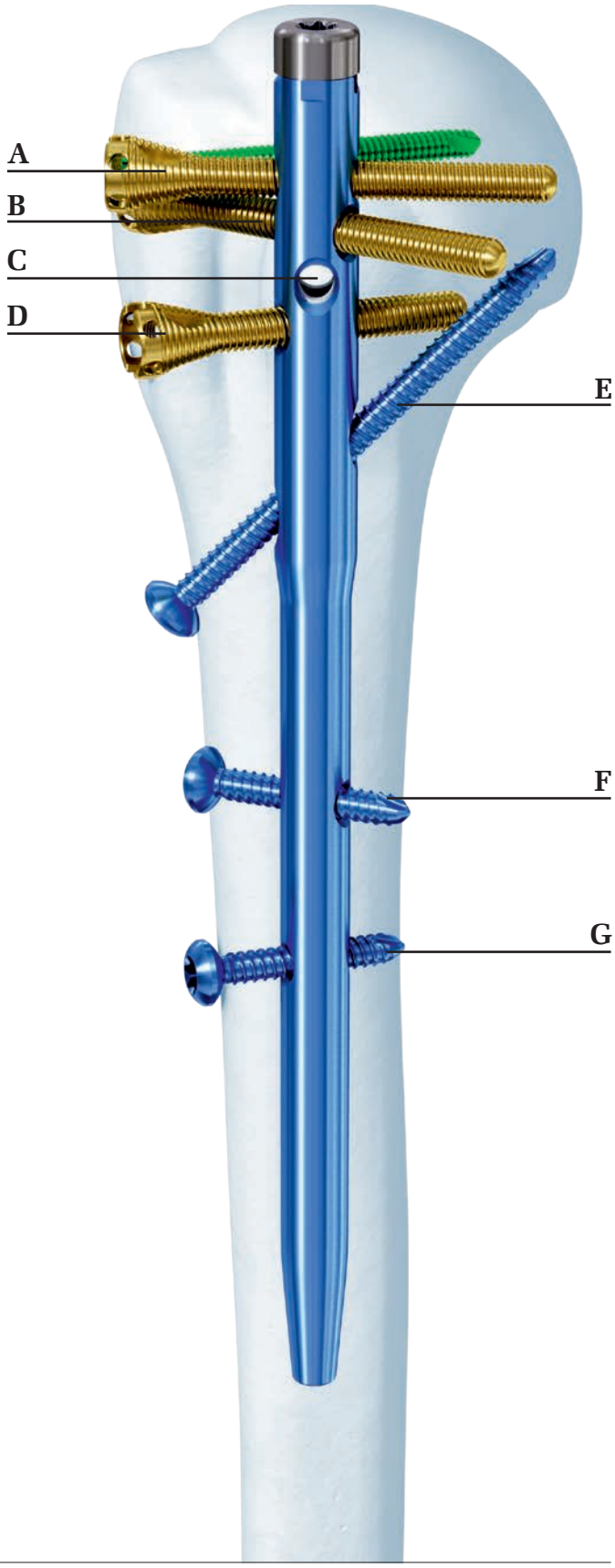
Screw type:
• MultiLoc screw ∅ 4.5 mm (gold)

The **anterior screw** (minor tuberosity, level C) may be used in fractures with a minor tuberosity fragment if the fragment is large enough to accommodate the screw head. Do not insert a 3.5 mm locking screw in this location.

Screw type:
• MultiLoc screw ∅ 4.5 mm (gold)

Additional locking screws **(screw-in-screw)** (greater tuberosity, levels A, B, and D) may be inserted through the screw heads of the lateral screws. These additional screws may be useful in poor bone quality, i.e. osteoporosis.

Screw type (optional):
• Locking screw ∅ 3.5 mm (green)



Level E

Ascending screw
The ascending screw supports the medial calcar region.

Screw type:
• Locking screw ∅ 4.0 mm (blue)

Levels F and G

Distal locking
The two distal locking screws are located in different planes.

Screw type:
• Locking screw ∅ 4.0 mm (blue)

Screw Configuration

MultiLoc Humeral Nail (long)

Levels A to D

Proximal locking:
For fractures of the proximal humerus with diaphyseal extension and combined fractures of the proximal humerus and the humeral diaphysis, the three **lateral screws** (greater tuberosity, levels A, B and D) **must** be used.

For fractures of the humeral diaphysis, two of the three **lateral screws** (greater tuberosity, levels A, B or D) may be sufficient.

Screw type:
- MultiLoc screw ∅ 4.5 mm (gold)

The **anterior screw** (minor tuberosity, level C) may be used in fractures with a minor tuberosity fragment if the fragment is large enough to accommodate the screw head. Do not insert a 3.5 mm locking screw in this location.

Screw type:
- MultiLoc screw ∅ 4.5 mm (gold)

Additional locking screws **(screw-in-screw)** (greater tuberosity, levels A, B, and D) may be inserted through the screw heads of the lateral screws. These additional screws may be useful in poor bone quality, i.e. osteoporosis.

Screw type (optional):
- Locking screw ∅ 3.5 mm (green)

Level E

Option 1: Ascending screw
The ascending screw supports the medial calcar region.

Screw type:
- Locking screw ∅ 4.0 mm (blue)

Option 2: Compression screw
The compression screw may be used for the compression of transverse or short oblique fractures.

Screw type:
- Locking screw ∅ 4.0 mm (blue)

Precaution: **The ascending screw should not be used in combination with the compression feature.**

Note: **Ascending screw and compression screw cannot be used at the same time.**

Levels F to H

Distal locking
The three distal locking screws are located in two different planes. The locking planes are situated in anatomical anteroposterior (Levels F and H) and lateral oblique direction (Level G).

Screw type:
- Locking screw ∅ 4.0 mm (blue)

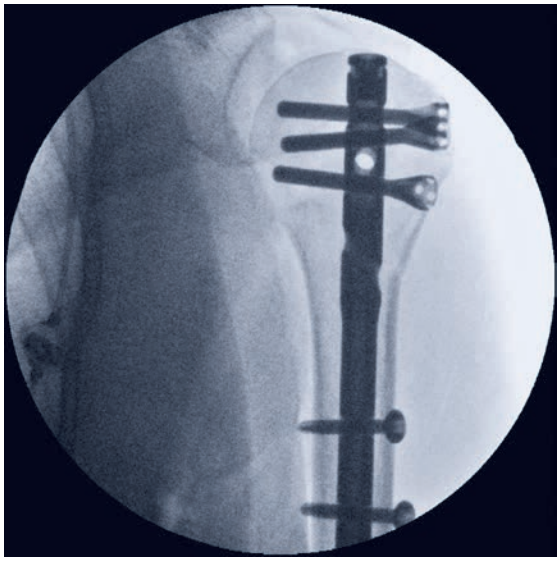
Clinical Cases

Case 1: 2-part surgical neck fracture

78-year-old woman. Simple fall.
Treatment with:
- MultiLoc Proximal Humeral Nail (short) ∅ 8.0 mm
- 3 MultiLoc screws
- Distal locking

Preoperative, anteroposterior view

Preoperative, scapular Y-view



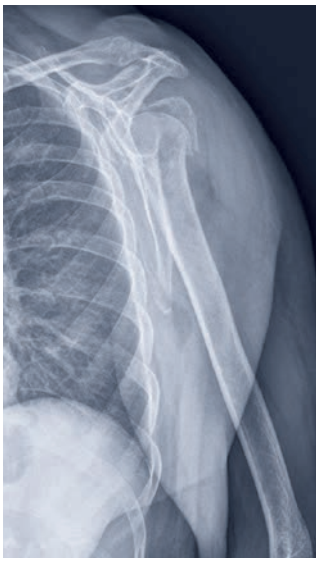
Postoperative, anteroposterior view

Postoperative lateral view

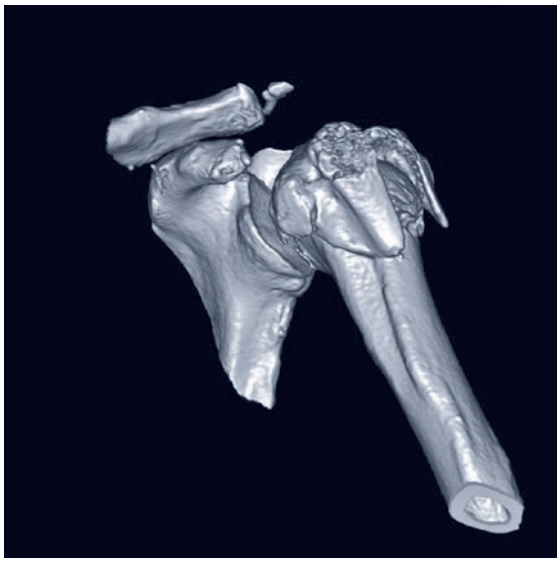
Case 2: Osteoporotic 4-part fracture

80-year-old woman. Simple fall.
Treatment with:
- MultiLoc Proximal Humeral Nail (short) ∅ 8.0 mm
- 3 MultiLoc screws
- 1 3.5 mm locking screw (screw-in-screw)
- Suture fixation of minor tuberosity fragment
- Distal locking

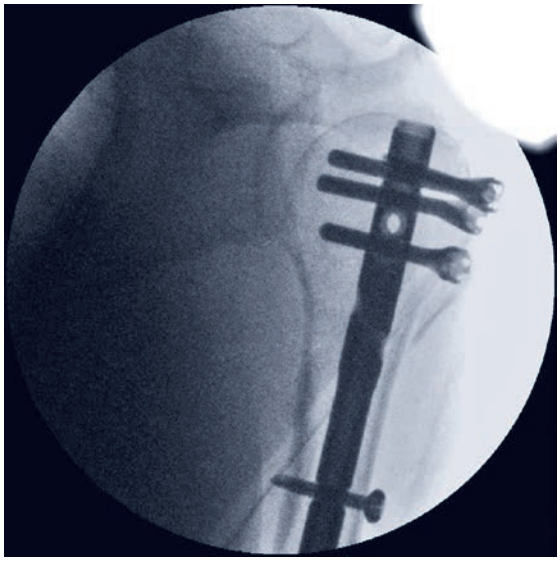
Preoperative, anteroposterior view



Preoperative, scapular Y-view



Preoperative, 3-D CT reconstruction



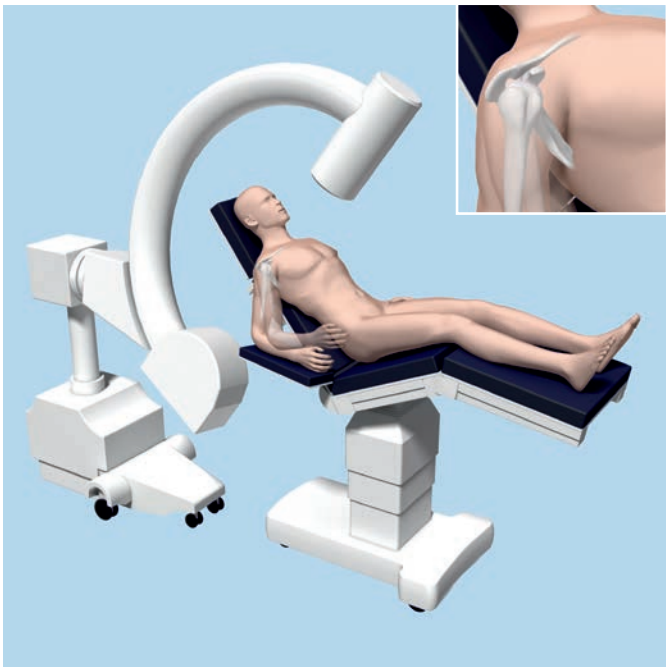
Postoperative, lateral view

Patient Positioning and Approach

1. Position patient

Position the patient in a beach chair position on a radiolucent table. Support the shoulder with pads and place the fractured arm on an adjustable side table or arm rest. Make sure that the arm can be sufficiently reclined to expose the humeral head anterior to the acromion.

- Place the image intensifier so that the entire humerus can be visualized in two planes, e.g. at the head of the patient or contralateral to the injured arm.

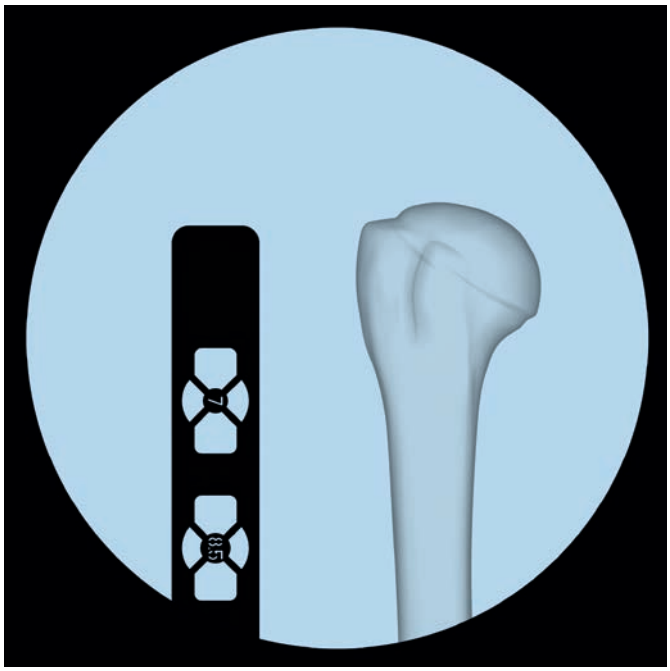


Alternatively, the patient can be placed in a modified supine position (30 to 40 degrees tilted towards contra-
- lateral) on a completely radiolucent table. Place the image intensifier so that the entire humerus can be visualized in two planes. Place the image intensifier opposite the surgeon, perpendicular to the longitudinal axis of the humeral shaft in the anteroposterior view.

- Obtain a scapular «Y» lateral view by bringing the image intensifier through a 90° arc and projecting the beam directly at the glenoid.

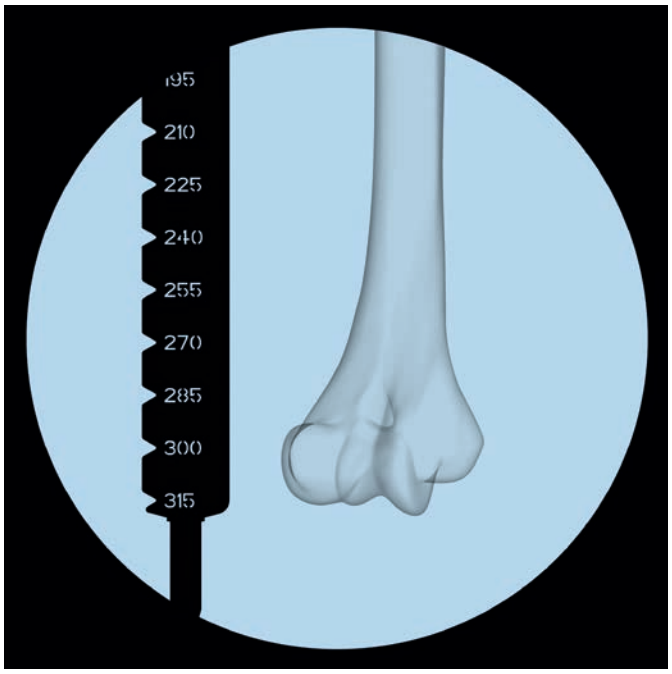
2. Determine nail length for MultiLoc Humeral Nail (long)

Instrument	
03.019.001	Radiographic Ruler for MultiLoc Humeral Nailing System



Position the image intensifier for an anteroposterior view of the proximal humerus. When measuring the fractured humerus, apply gentle traction to restore length.

With long clamp, hold the radiographic ruler along the humerus with the top at the desired entry point. Mark the skin at the top of the ruler.



Move the image intensifier to the distal humerus. Take an anteroposterior image of the distal humerus. Verify fracture reduction.

Orient the top of the ruler to the skin mark. Read the nail length directly from the ruler image, selecting the measurement that is at least 25 mm proximal to the cranial boundary of the olecranon fossa.

Notes:

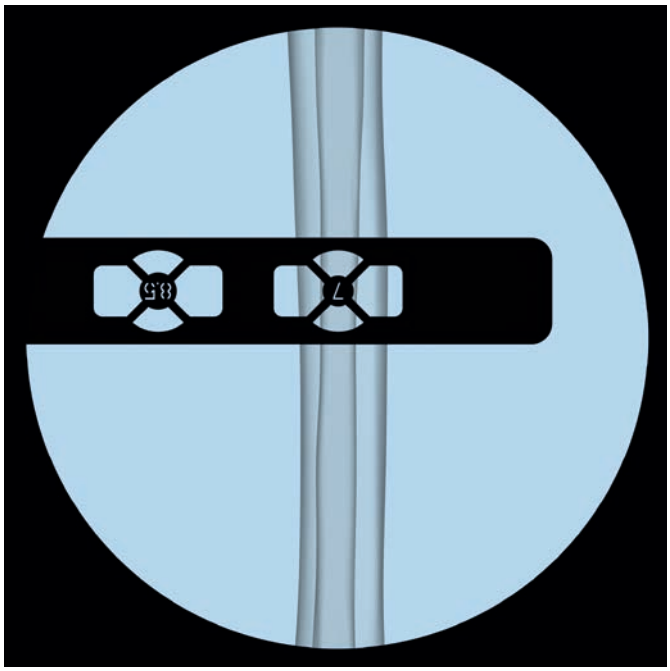
- **The length can be determined correctly on the fractured arm only after the fracture has been correctly reduced.**
- **Potential compression must be taken into account when determining the nail length and a shorter nail may be chosen. The locking screw in the compression slot can move by up to 8 mm distally.**

A technique to determine the nail length intraoperatively is described on 2. Determine the Nail length.

3. Determine nail diameter for MultiLoc Humeral Nail (long)

Position the image intensifier and hold the radiographic ruler over the humerus with the diameter gauge centered over the narrowest part of the medullary canal (isthmus) that will contain the nail. Read the diameter measurement on the circular indicator that fills the canal.

Note: The ruler is not at the same level as the humerus, which will affect the accuracy of the measurement.

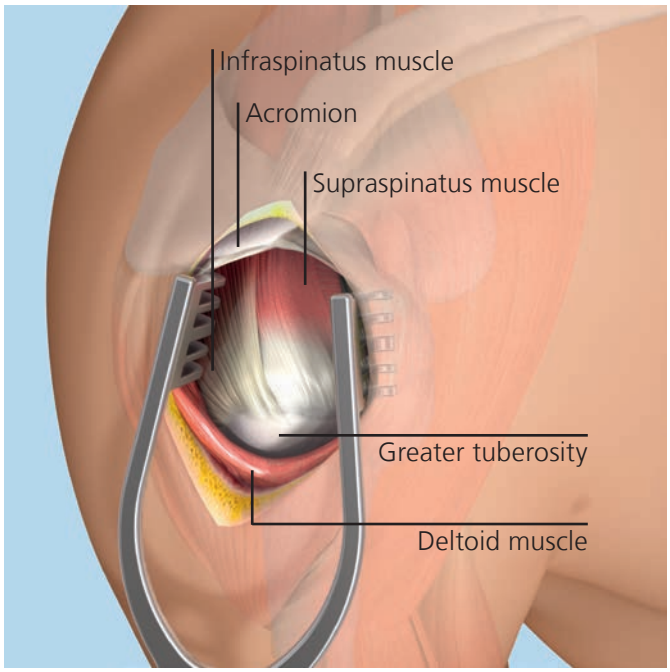


4. Approach

Perform an anterolateral approach. Begin the incision at the anterolateral tip of the acromion and carry it distally over the deltoid muscle. Split the deltoid muscle at the tendinous intersection between its anterior and middle third along the fibers and retract it.

In complex fractures, a better view may be achieved by partially detaching the deltoid muscle subperiostally from the anterior border of the acromion.

Precaution: Do not extend the approach too far distally to prevent iatrogenic injury of the axillary nerve. The nerve may be identified by gentle palpation or careful dissection. A stay suture may be placed to prevent further extension of the incision.



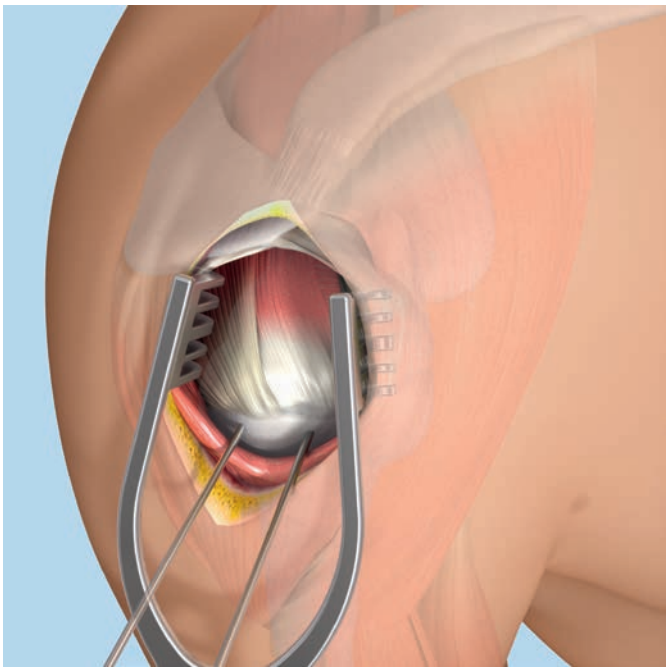
5. Reduce fracture

Instrument	
292.160	Kirschner Wire ∅ 1.6 mm with trocar tip, length 150 mm, Stainless Steel

Reduce the fracture via indirect reduction maneuvers, traction sutures, an elevator, or via Schanz screws or Kirschner wires used as joysticks.

If necessary, use Kirschner wires to hold the fragments temporarily in place during implant insertion. Ensure that the Kirschner wires do not hinder nail insertion.

- Check the reduction under image intensification.

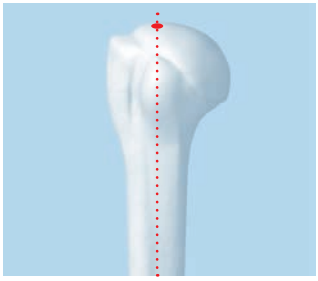


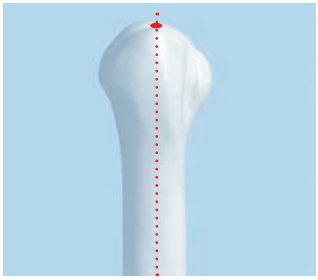
Entry Point

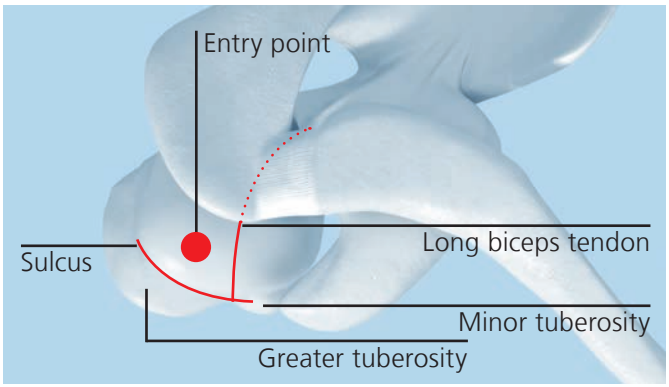
1. Determine entry point

The ideal entry point is situated at the apex of the humeral head, in line with the medullary canal in both anteroposterior and lateral views. This point is located posterolateral to the biceps tendon and medial to the sulcus between the greater tuberosity and the humeral head.

Note: **If the acromion inhibits access to the ideal entry point, slightly extend or recline the shoulder to move the apex of the humeral head in front of the acromion.**







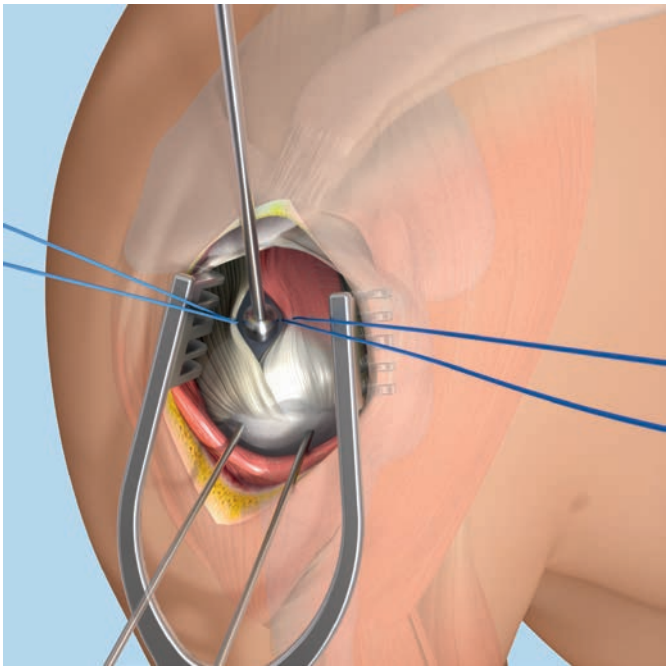
2. Insert guide rod (for use with hollow drill bit)

Instruments	
03.019.026	Guide Rod ∅ 2.5 mm for Hollow Drill with Stop, with trocar tip, length 230 mm, Stainless Steel
393.105	Universal Chuck, small, with T-Handle

Partially insert the guide rod at the appropriate insertion point, using the small universal chuck.

Check the position of the guide rod in both, anteroposterior and lateral views.

Make a longitudinal incision of 1 to 2 cm through the supraspinatus tendon along its fibers at the position of the guide rod. Use holding sutures and retractors to obtain access to the operative field.



Advance the guide rod until its stop reaches the bone surface.

Remove the small universal chuck.

Continue with "Open Medullary Canal", Step 1, Option A.

Precaution: **Do not damage the hypovascular zone of the rotator cuff near its insertion on the humerus.**

Alternative technique: Insert Kirschner wire (for use with cannulated awl)

Instrument	
292.260	Kirschner Wire ∅ 2.5 mm with trocar tip, length 280 mm, Stainless Steel

If the cannulated awl is preferred for opening the medullary canal, insert a 2.5 mm Kirschner wire instead of the guide rod.

Continue with "Open Medullary Canal", Step 1, Option B.

Opening of the Humerus
Open Medullary Canal

1. Open medullary canal
Option A: with hollow drill bit

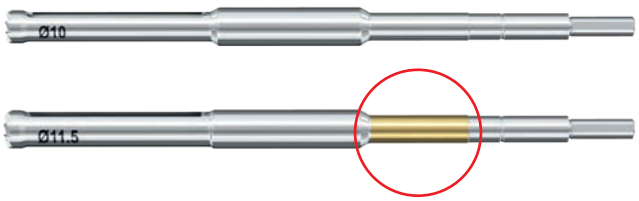
Instruments	
03.019.003	Hollow Drill Bit ∅ 10.0 mm for MultiLoc Humeral Nailing System
or	
03.019.004	Hollow Drill Bit ∅ 11.5 mm for MultiLoc Proximal Humeral Nail ∅ 9.5 mm
03.019.027	Protection Sleeve, for Nos. 03.019.003 and 03.019.004

Pass the hollow drill bit through the protection sleeve and over the guide rod to the bone. Drill to the depth of the medullary canal.

Remove the hollow drill bit, the protection sleeve, and the guide rod.

Notes:

- **Use the ∅ 11.5 mm hollow drill bit marked with a gold band for the MultiLoc Proximal Humeral Nail (short) ∅ 9.5 mm. For all other nails, use the ∅ 10.0 mm hollow drill bit.**



Nail	Nail ∅ (mm)	Hollow drill bit (mm)
MultiLoc Proximal Humeral Nail (short)	8.0	10.0
MultiLoc Proximal Humeral Nail (short)	9.5	11.5 (gold)
MultiLoc Humeral Nail (long)	7.0	10.0
MultiLoc Humeral Nail (long)	8.5	10.0

Option B: with cannulated awl

Instrument	
03.010.039	Awl, cannulated

Pass the cannulated awl over the Kirschner wire to the bone. Use a twisting motion to advance the awl to the depth of the medullary canal.

Remove the awl and the Kirschner wire.

Precaution: **When using the cannulated awl, take care not to displace the fracture, especially in complex fracture cases.**

Reduce Fracture and Ream MultiLoc Humeral Nail (long)

1. Reduce fracture

Instruments	
03.019.011	Reduction Instrument for MultiLoc Humeral Nailing System, length 330 mm
351.709S	SynReam Reaming Rod ∅ 2.5 mm, length 650 mm, sterile

Insert the reduction instrument into the medullary canal. Introduce the reaming rod into the reduction instrument. Turn the reduction instrument to facilitate the insertion of the reaming rod across the fracture site.

After reduction, push the reaming rod down the medullary canal. Remove the reduction instrument leaving the reaming rod in place.

Notes:

- **The two arrows on the handle of the reduction instrument indicate the position of the distal opening.**
- **Be careful not to remove the reaming rod when pulling on the reduction instrument.**
- **As each manipulation in the fat-filled medullary canal causes intramedullary pressure increase, reduction with the reduction instrument also increases the pressure. Manipulations should therefore be minimized. As an alternative, reduction can also be carried out using the reaming rod only.**

2. Determine nail length

Instruments	
03.019.001	Radiographic Ruler for MultiLoc Humeral Nailing System
351.719	Elongation Tube for Reaming Rods, for Depth Gauge for Medullary Nails, for Nos. 351.717 and 03.019.001

Assemble the radiographic ruler with the elongation tube. Place the assembly over the reaming rod and ensure that the tip of the assembly is located at the desired position of the proximal nail end.

Determine the length of the nail and choose the implant accordingly.

Notes:

- **The nail tip should be positioned at least 25 mm away from the cranial boundary of the olecranon fossa.**
- **Potential compression must be taken into account when determining the nail length and a shorter nail may be chosen. The locking screw in the compression slot can move by up to 8 mm distally.**
- **Use the radiographic ruler only with the 650 mm reaming rod.**

3. Reaming guidelines (optional)

Use a reaming system intended for humeral reaming procedures. Using image intensification, ensure that fracture reduction has been maintained.

Ream to a diameter at least 1.0 mm greater than the nail diameter in accordance with the surgeon's preference. Ream in 0.5 mm increments and advance the reamer with steady, moderate pressure.

Precaution: **Do not force the reamer. Frequently retract the reamer partially to clear debris from the medullary canal.**

Remove the reaming assembly, leaving the reaming rod in place. All MultiLoc Humeral Nails (long) can be inserted over the reaming rod.

Note: **Flush the surgical site after reaming to remove remaining debris and minimize the risk of heterotopic ossification.**

Precaution: **Reaming should be avoided in case of comminution in the area where the radial nerve contacts the bone in the radial sulcus.**

1. Assemble insertion instruments

Instruments	
03.019.006	Insertion Handle for MultiLoc Humeral Nailing System
03.019.007	Connecting Screw, cannulated, for MultiLoc Humeral Nailing System
321.160	Combination Wrench ∅ 11.0 mm

Orient the insertion handle laterally and match the geometry of the insertion handle to the nail. Pass the connecting screw through the insertion handle and into the nail. Secure the assembly with the combination wrench.

Precaution: **The anatomic design of the MultiLoc Proximal Humeral Nail (short) and the MultiLoc Humeral Nail (long) requires right and left versions. Nails are labeled "RIGHT" or "LEFT". Using the incorrect version leads to instrumented drilling into the nail which may lead to subsequent premature implant failure.**

2. Insert nail

Insert the nail over the reaming rod (if used) and advance it into the medullary canal using twisting motions. Orient the insertion handle laterally.

Monitor the nail passage across the fracture and control it in two planes to prevent misalignment. Proceed carefully to avoid injuring the radial nerve, particularly in fractures of the mid to distal third of the diaphysis.

In case of a metaphyseal fracture, advance the nail to the fracture site, reduce the fracture and continue into the diaphysis.

If radial nerve paresis is present preoperatively, the nerve must be explored through a short anterolateral incision at the transition of the mid to distal third of the diaphysis.

Check the nail position in anteroposterior and lateral views.

If the reaming rod is used, remove it before locking.

Precautions:

- **The proximal end of the nail must be inserted below the humeral head surface to avoid impingement. The nail length can be extended with an end cap.**
- **Do not hammer, as this may increase the risk of iatrogenic fractures.**

Notes:

- **If nail insertion is difficult, choose a smaller diameter nail or ream the intramedullary canal to a larger diameter.**
- **Pressure against the elbow when advancing the nail prevents distraction and potential healing problems.**

1. Assemble lateral aiming arm

Instruments	
03.019.008	Aiming Arm, lateral, for MultiLoc Proximal Humeral Nail
or	
03.019.012	Aiming Arm, lateral, for MultiLoc Humeral Nail

Choose the appropriate aiming arm.

Insert the connecting screw into the aiming arm, ensuring that the aiming arm is oriented correctly. Attach the aiming arm to the insertion handle and tighten the connecting screw.

Notes:
- **Ensure that the aiming arm shows "RIGHT" if used for the right humerus and "LEFT" if used for the left humerus.**
- **For MultiLoc Proximal Humeral Nail (short) use 03.019.008 marked "MULTILOC PHN". For MultiLoc Humeral Nail (long) use 03.019.012 marked "MULTILOC HN".**

Optional technique: Assemble anterior aiming arm for anterior screw placement (level C) or height determination of ascending screw (level E)

Instrument	
03.019.009	Aiming Arm, anterior, for MultiLoc Proximal Humeral Nail

If the anterior screw (minor tuberosity) or the ascending screw will be used, connect the anterior aiming arm to the insertion handle and tighten the connecting screw.

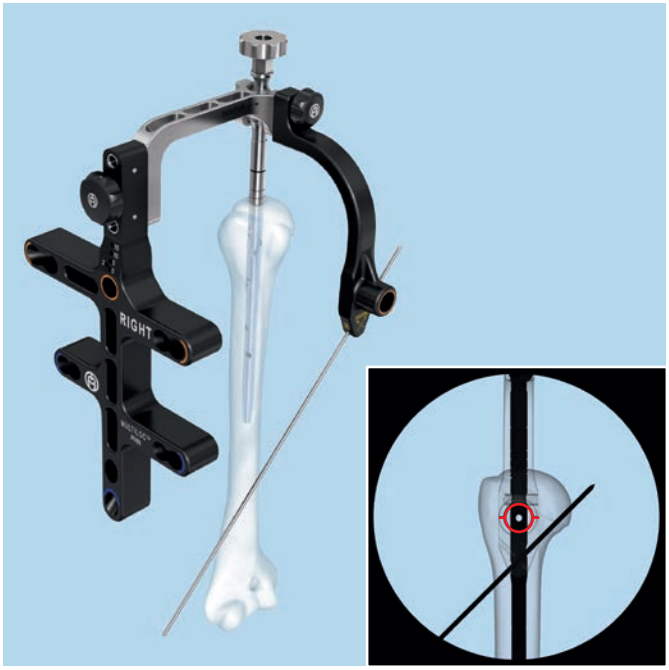
2. Position nail – Adjust insertion depth

Instrument	
292.260	Kirschner Wire ∅ 2.5 mm with trocar tip, length 280 mm, Stainless Steel

The proximal nail end should be at least 2 to 3 mm below the cartilage to reduce the risk of impingement while enhancing stability. This determines the insertion depth of the implant.

- Check the proximal nail position clinically and under image intensification in a pure anteroposterior view.

Note: **To better identify the proximal nail end, place a 2.5 mm Kirschner wire through the hole in the aiming arm marked "0".**



Optional technique: Ascending screw (level E)

If the ascending screw is used, place a 2.5 mm Kirschner wire through the hole in the anterior aiming arm marked "ASCEND". Adjust the position of the image intensifier or the patient's arm so that the circle of the anterior aiming arm aligns with the screw hole for the anterior screw in the nail. The Kirschner wire will indicate the position of the ascending screw.

Correct the insertion depth of the nail to have the ascending screw within the calcar region.

Precaution: **The proximal nail end should be at least 2 to 3 mm below the cartilage to reduce the risk of impingement while enhancing stability. Checkthe proximal nail position clinically and under image intensification.**

3. Position nail – Adjust rotation

Instruments	
03.019.013	Protection Sleeve 13.0/10.0, length 150 mm
03.019.014	Drill Sleeve 10.0/3.8, for No. 03.019.013
03.019.015	Trocar ∅ 3.8 mm, for No. 03.019.014
292.260	Kirschner Wire ∅ 2.5 mm with trocar tip, length 280 mm, Stainless Steel

Insert a trocar combination (protection sleeve, drill sleeve and trocar) through the most proximal hole of the lateral aiming arm (level A).

Insert a second trocar combination through the anterior hole of the lateral aiming arm (level D).

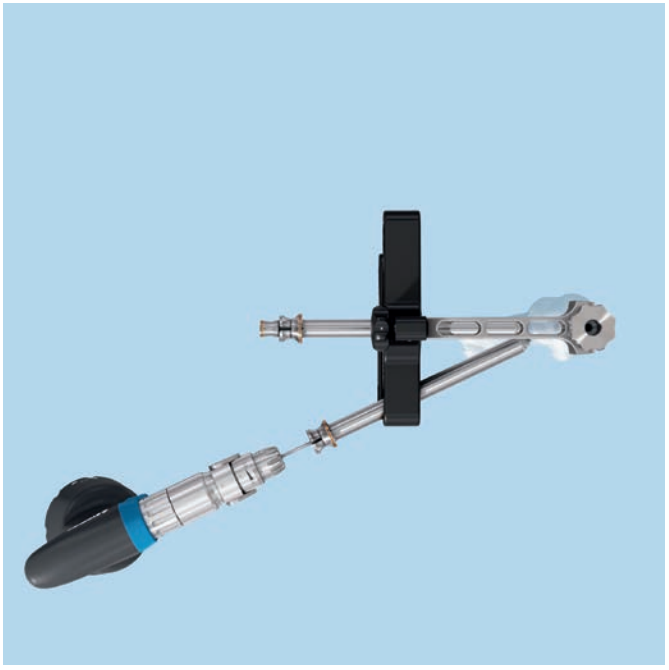
The screw on level D should be placed as anteriorly as possible without injuring the long biceps tendon. This determines the rotation of the implant.

The holes for the MultiLoc screws are marked with an orange circle.

For temporary fixation, remove one of the trocars and insert a 2.5 mm Kirschner wire.

Precaution: **Do not place any screw in the bicipital groove.**

Push the trocar down to the bone. Remove the trocar.



Optional technique: Anterior screw (level C)

If the anterior screw (minor tuberosity) is used, make a small incision with blunt dissection of the soft tissues. Then insert the second trocar combination through the anterior aiming arm.

Precaution: **Ensure that the tip of the trocar touches the tip of the minor tuberosity. This helps to prevent irritation of the long biceps tendon or the ascending branch of the anterior circumflex artery through the anterior screw (minor tuberosity). Slightly rotate the nail if needed.**

Note: **Ensure that the minor tuberosity is large enough to accommodate a MultiLoc screw. If not, consider other means of fixation, such as smaller independent screws or osteosuturing.**

Proximal Locking
MultiLoc Screws

Note: **If applying compression is desired, refer to Compression Locking (optional) MultiLoc Humeral Nail (long).**

1. Drill and determine screw length

Instrument	
03.019.016	Drill Bit ∅ 3.8 mm, calibrated, length 270 mm, 3-flute, for Quick Coupling, for No. 03.019.014

Insert the calibrated drill bit and drill carefully until the level of the subchondral bone is reached. Confirm drill bit position with the image intensifier.

Read the required length of the screw directly off the calibrated drill bit at the back of the drill sleeve. Press the drill sleeve firmly to the cortex to ensure accurate measurement.

Remove the drill bit and the drill sleeve.

Precautions:
- **Before inserting the MultiLoc screw at level D, identify and protect the axillary nerve and its branches.**
- **Do not penetrate the articular surface.**

Alternative technique: Measure using length probe

Instrument	
03.019.029	Length Probe for MultiLoc Humeral Nailing System

Alternatively, the length probe can be used for screw length determination.

Assemble the length probe with its outer sleeve.

Insert the length probe through the protection sleeve and advance it until resistance of the subchondral space is felt. Monitor under image intensification. Press the outer part of the length probe firmly to the cortex to ensure accurate measurement. Read the screw length directly from the length probe at the back of the outer sleeve.

Note: **The orange marking on the length probe will align with the outer opening of the protection sleeve.**

2. Option: Overdrill in hard bone

Instrument	
03.019.018	Countersink for MultiLoc Screws ∅ 4.5 mm, with Stop, for Quick Coupling

In hard bone, overdrill the lateral cortex with the countersink to countersink the MultiLoc screw.

Precaution: **The conical drill bit should not be used in poor bone quality as it may increase the risk of iatrogenic fractures.**

3. Insert MultiLoc screw

Instrument	
03.019.025	Screwdriver for MultiLoc Screws ∅ 4.5 mm, with selfholding Mechanism, length 330 mm

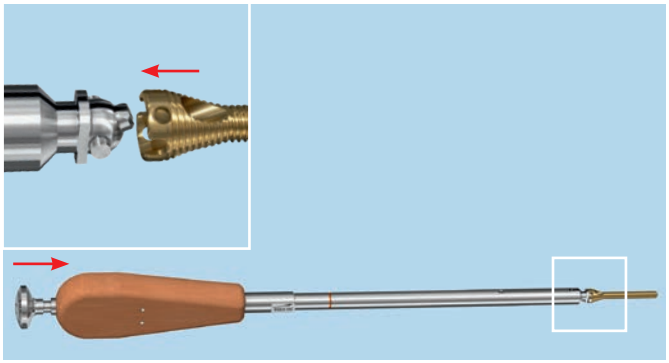
Assemble the screwdriver with its inner part.

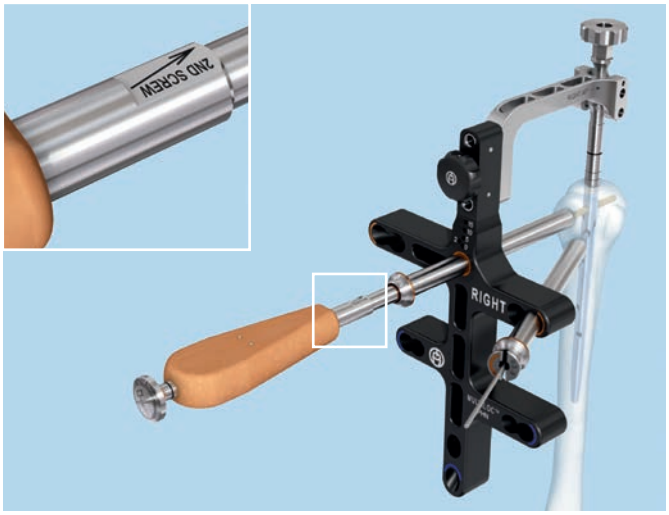
Pull back the knob of the screwdriver and attach the appropriate MultiLoc screw. Push the knob forward to lock the screw into place. Insert the screw through the protection sleeve until it is countersunk.

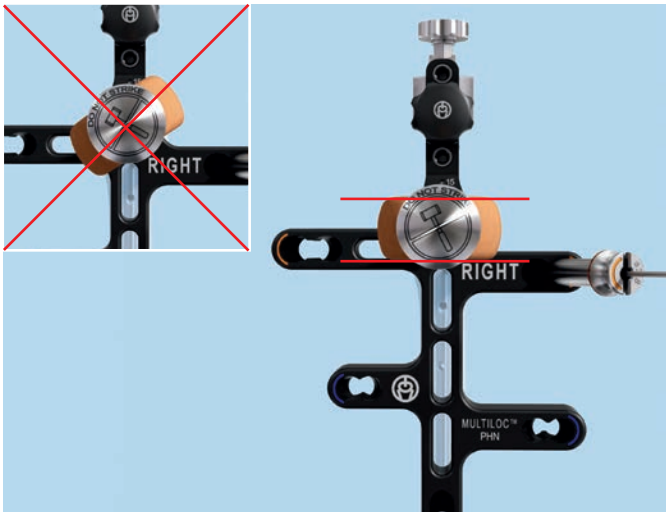
Ensure that the final position of the screwdriver handle is perpendicular to the nail with the arrow pointing posteriorly. Verify the position of the screw under image intensification.

Pull back the knob to release the screwdriver.

Note: **Properly countersink the most proximal screws. Do not overinsert the screw to allow suture fixation (see "2. Insert end cap"). Use the orange marking on the shaft of the screwdriver as an indicator of screw insertion depth.**







4. Option: Attach centering sleeve for 3.5 mm locking screw (screw-in-screw)

Instruments	
03.019.019	Centering Sleeve 9.8/5.8 for Locking Screws ∅ 3.5 mm, with Coupling, for MultiLoc Screws ∅ 4.5 mm
03.019.020	Screwdriver Stardrive, SD25, with Coupling, for No. 03.019.019, length 330 mm

If a 3.5 mm locking screw (screw-in-screw) is used in combination with a MultiLoc screw, assemble a centering sleeve to the SD25 Stardrive screwdriver. Insert the assembly into the protection sleeve. Turn the screwdriver slightly, until the centering sleeve aligns with the screw recess. Push the screwdriver to lock the centering sleeve into the MultiLoc screw.

Remove the screwdriver and protection sleeve.

Notes:

- **Do not insert a 3.5 mm locking screw through the anterior screw (level C).**
- **The centering sleeve may also be inserted manually, see "1. Position centering sleeve".**

5. Insert remaining MultiLoc screws

For the remaining screws, repeat Steps 1 through 4.

Carefully inspect the final position of all MultiLoc screws under image intensification in different planes and ensure that they do not penetrate the articular surface.

Remove the anterior aiming arm, if used.

Notes:

- **MultiLoc Proximal Humeral Nail (short): The three lateral screws (greater tuberosity, levels A, B and D) must be used in any fracture situation as they ensure the basic stability of the construct.**
- **MultiLoc Humeral Nail (long): For fractures of the proximal humerus with diaphyseal extension and combined fractures of the proximal humerus and the humeral diaphysis, the three lateral screws (greater tuberosity, levels A, B and D) must be used to ensure the basic stability of the construct.**
  For fractures of the humeral diaphysis, two of the three lateral screws (greater tuberosity, levels A, B or D) may be sufficient, depending on the nature of the fracture.

3.5 mm Locking Screws (Screw-in-screw)

1. Position centering sleeve

Instruments	
03.019.019	Centering Sleeve 9.8/5.8 for Locking Screws ∅ 3.5 mm, with Coupling, for MultiLoc Screws ∅ 4.5 mm
03.019.021	Drill Sleeve 5.8/2.8, for No. 03.019.019

Remove the lateral aiming arm.

If not done so previously, attach a centering sleeve to the MultiLoc screw. (1)

Gently tilt the centering sleeve anteriorly and lock the drill sleeve in the centering sleeve by clicking it into place. (2)

Ensure the two handles of the drill sleeve are exactly perpendicular to the nail. Rotate the assembly, if necessary.

2. Drill and determine screw length

Instrument	
310.284	LCP Drill Bit ∅ 2.8 mm with Stop, length 165 mm, 2-flute, for Quick Coupling

Insert the drill bit and drill carefully until the level of the subchondral bone is reached. Confirm drill bit position under image intensification.

Read the required screw length directly off the calibrated drill bit, at the back of the drill sleeve.

Remove the drill bit and drill sleeve.

Do not penetrate the articular surface.

Notes:

- **The drill bit can only be inserted if the drill sleeve is properly locked in the centering sleeve.**
- **Do not change the position of the centering sleeve.**
- **Do not squeeze the two handles of the drill sleeve during insertion of the drill bit.**

Alternative technique: Measure using length probe

Instrument	
03.019.029	Length Probe for MultiLoc Humeral Nailing System

Alternatively, the length probe can be used for screw length determination.

Assemble the length probe with its outer sleeve.

Insert the length probe through the drill sleeve and advance it until resistance of the subchondral space is felt. Monitor under image intensification. Read the screw length on the fenestrated scale of the length probe.

Remove the drill sleeve.

Note: **Do not change the position of the centering sleeve.**

3. Insert 3.5 mm locking screw

Instruments	
511.773	Torque Limiter, 1.5 Nm, for AO/ASIF Quick Coupling
03.019.005	Handle with Quick Coupling, length 150 mm
314.116	Screwdriver Shaft Stardrive 3.5, SD15, self-holding, for AO/ASIF Quick Coupling
or	
314.030	Screwdriver Shaft, hexagonal, small, ∅ 2.5 mm

Assemble the torque limiter, handle and screwdriver shaft.

Pick up the appropriate length 3.5 mm locking screw and insert it through the centering sleeve. Tighten the screw until a click is heard.

Remove the centering sleeve.

Notes:
- **Always use a torque limiter when inserting the 3.5 mm locking screws.**
- **The centering sleeve can only be removed when the 3.5 mm locking screw is fully seated.**

4. Insert remaining 3.5 mm locking screws and assemble lateral aiming arm

Instrument	
03.019.008	Aiming Arm, lateral, for MultiLoc Proximal Humeral Nail

To insert the remaining 3.5 mm locking screws, repeat Steps 1 through 3.

Carefully inspect the final position of all 3.5 mm locking screws under image intensification in different planes and ensure that they do not penetrate the articular surface.

If the MultiLoc Proximal Humeral Nail (short) is used, reassemble the lateral aiming arm to the insertion handle and tighten the connecting screw.

Note: **Ensure that the aiming arm shows "RIGHT" when used for the right humerus and "LEFT" when used for the left humerus.**

Ascending Screw

1. Insert trocar combination

Instruments	
03.010.063	Protection Sleeve 12.0/8.0, length 188 mm
03.010.064	Drill Sleeve 8.0/3.2, for No. 03.010.063
03.010.069	Trocar ∅ 3.2 mm, for No. 03.010.064

Insert the trocar combination (protection sleeve, drill sleeve and trocar) through the ascending screw hole in the aiming arm. Make a skin incision and dissect carefully to the bone to avoid injury to the surrounding neurovascular structures and soft tissue.

Advance the trocar assembly and push the trocar down to the bone. Remove the trocar.

Precaution: **Before insertion of the ascending screw, identify and protect the axillary nerve. Only incise the skin and then perform blunt dissection, to avoid injuring the axillary nerve and its branches.**

Notes:

- **The ascending screw should not be used if the humerus is too small to place the screw within the humeral head.**
- **The hole in the aiming arm for ascending screw is marked with a blue circle.**

2. Drill and determine screw length

Instrument	
03.010.060	Drill Bit ∅ 3.2 mm, calibrated, length 340 mm, 3-flute, for Quick Coupling, for No. 03.010.064

Insert the calibrated drill bit and drill carefully until the level of the subchondral bone is reached. Confirm drill bit position under image intensification.

Read the required length of the screw directly off the calibrated drill bit at the back of the drill sleeve. Press the drill sleeve firmly to the cortex to ensure accurate measurement.

Remove the drill bit and the drill sleeve.

Do not penetrate the articular surface.

Alternative technique: Measure using depth gauge

Instrument	
03.019.017	Depth Gauge for MultiLoc Humeral Nailing System

The depth gauge can be used for screw length determination.

Assemble the depth gauge with its outer sleeve.

Insert the depth gauge through the protection sleeve and advance it until resistance of the subchondral space is felt. Monitor under image intensification. Press the outer part of the depth gauge firmly to the cortex to ensure accurate measurement. Read the screw length directly off the depth gauge.

Note: **The blue mark on the depth gauge will align with the outer opening of the protection sleeve.**

3. Insert 4.0 mm locking screw

Instrument	
03.019.020	Screwdriver Stardrive, SD25, with Coupling, for No. 03.019.019, length 330 mm

Insert the appropriate length 4.0 mm locking screw through the protection sleeve using the SD25 Stardrive screwdriver.

Targeted Distal Locking
MultiLoc Proximal Humeral Nail (short)

1. Insert trocar combination

Instruments	
03.010.063	Protection Sleeve 12.0/8.0, length 188 mm
03.010.064	Drill Sleeve 8.0/3.2, for No. 03.010.063
03.010.069	Trocar ∅ 3.2 mm, for No. 03.010.064

Insert the trocar combination (protection sleeve, drill sleeve and trocar) through one of the distal holes in the aiming arm. Make a skin incision and dissect carefully to the bone to avoid injury to the surrounding neurovascular structures and soft tissue.

Advance the trocar assembly and push the trocar down to the bone. Remove the trocar.

Note: **The holes in the aiming arm for distal locking screws are marked with a blue circle.**

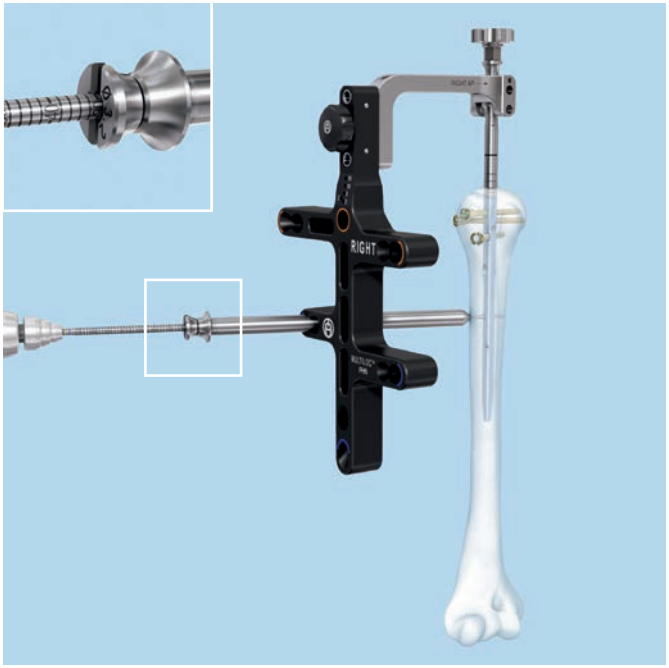
2. Drill and determine screw length

Instrument	
03.010.060	Drill Bit ∅ 3.2 mm, calibrated, length 340 mm, 3-flute, for Quick Coupling, for No. 03.010.064

Insert the calibrated drill bit and drill carefully until the tip of the drill bit just breaks through the medial cortex.
Confirm drill bit position under image intensification.

Read the required length of the screw directly off the calibrated drill bit at the back of the drill sleeve. Press the drill sleeve firmly to the cortex to ensure accurate measurement.

Remove the drill bit and the drill sleeve.



Alternative technique: Measure using depth gauge

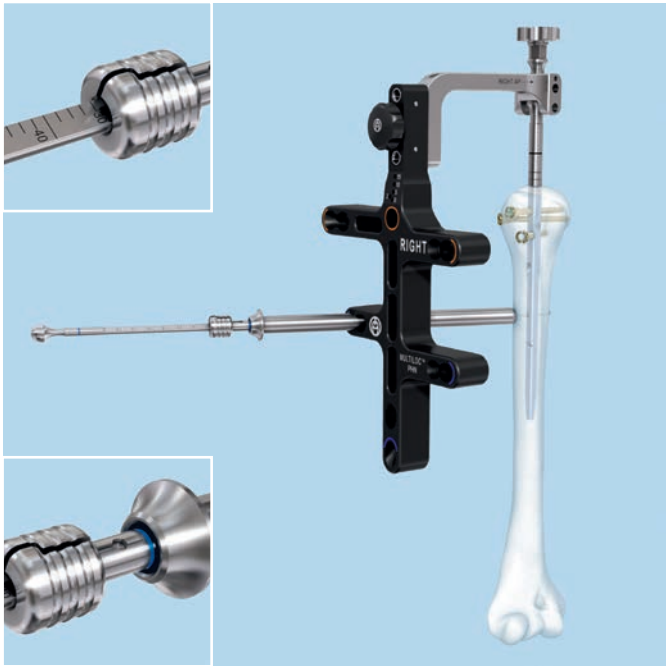
Instrument	
03.019.017	Depth Gauge for MultiLoc Humeral Nailing System

The depth gauge can be used for screw length determination.

Assemble the depth gauge with its outer sleeve.

Insert the depth gauge through the protection sleeve. Press the outer part of the depth gauge firmly to the cortex to ensure accurate measurement. Read the screw length directly off the depth gauge.

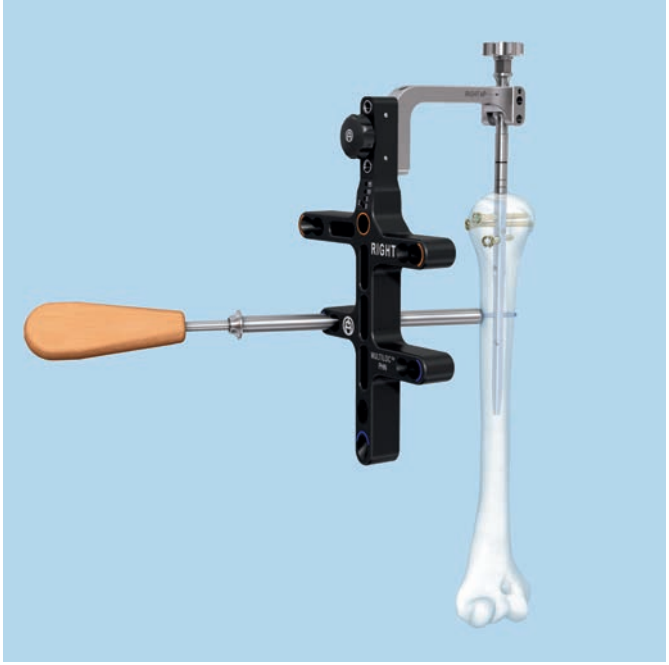
Note: **The blue mark on the depth gauge will align with the outer opening of the protection sleeve.**



3. Insert 4.0 mm locking screw

Instrument	
03.019.020	Screwdriver Stardrive, SD25, with Coupling, for No. 03.019.019, length 330 mm

Insert the appropriate length 4.0 mm locking screw through the protection sleeve using the SD25 Stardrive screwdriver.



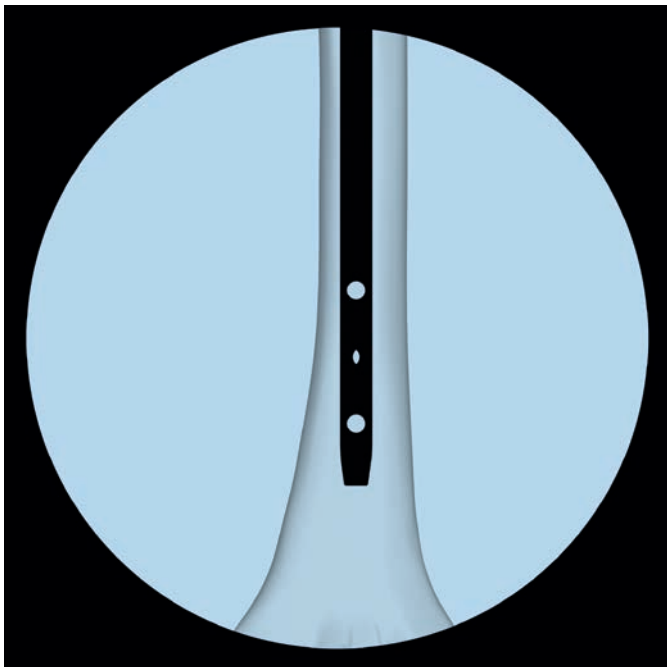
4. Insert second 4.0 mm locking screw

To insert the second distal 4.0 mm locking screw, repeat Steps 1 through 3.

Remove the lateral aiming arm.

Freehand Distal Locking
MultiLoc Humeral Nail (long)

Distal locking with the radiolucent drive is described below.



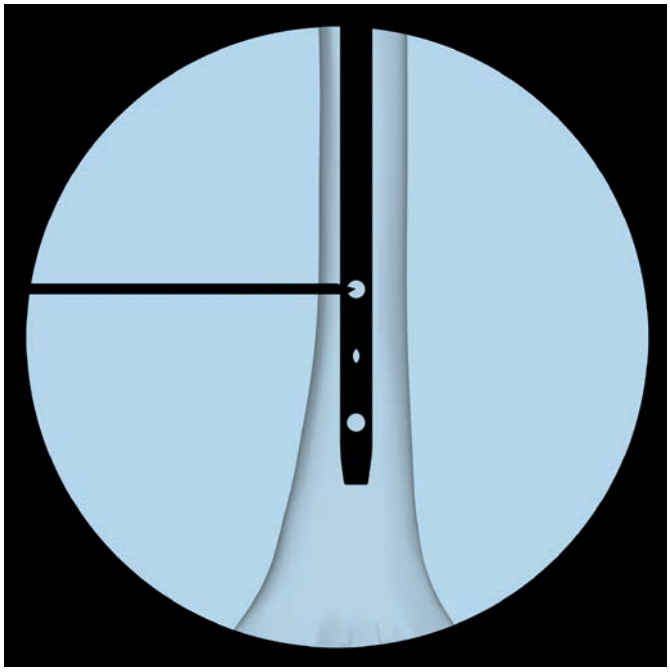
1. Adjust image

- Confirm fracture reduction with anteroposterior and lateral images.
- Align the image intensifier with the hole in the nail until a perfect circle is visible in the center of the screen.

Precaution: **To visualize the round holes, always move the image intensifier without moving the arm since this can cause severe malrotation.**

Note: **It is recommended that the most proximal distal hole is locked first.**

2. Perform incision

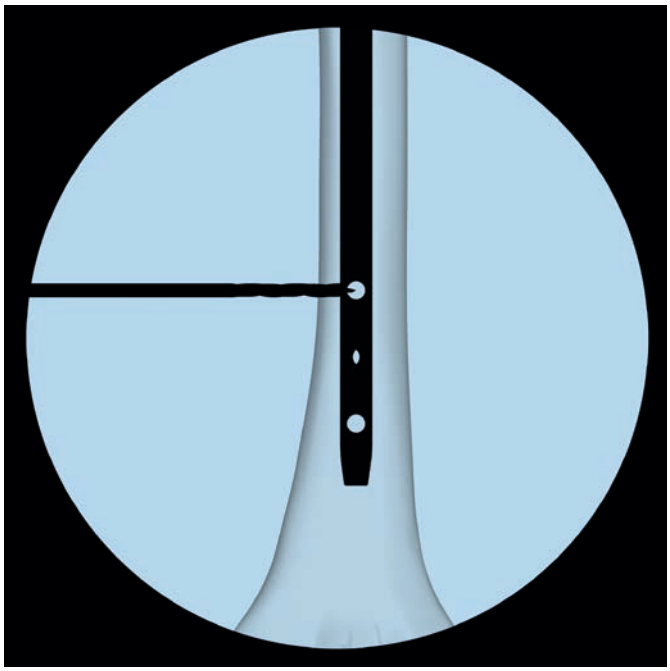


Identify the center of the hole with a Kirschner wire to mark the incision point and make a skin incision. Dissect the soft tissues to create a clear view of the bone. Use spreaders or retractors to avoid injury to neurovascular structures.

Only incise the skin and then perform blunt dissection down to the bone to avoid injuring the median or radial nerve or the brachial artery.

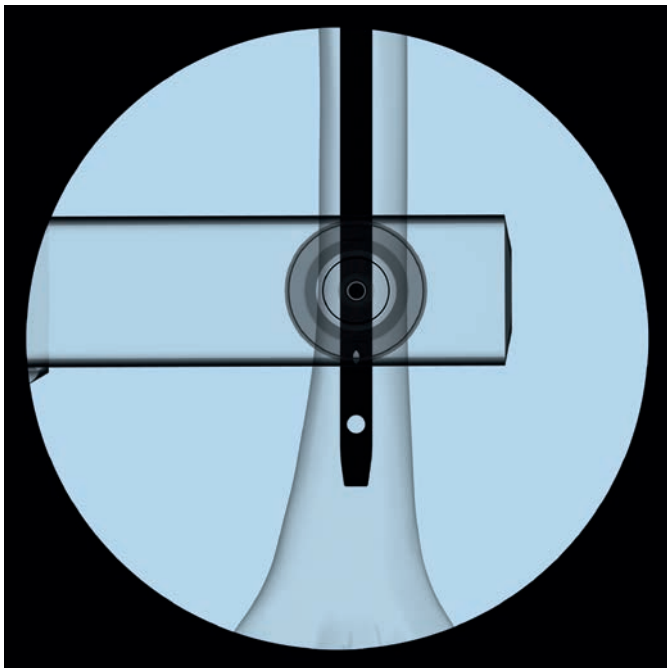
3. Drill

Instruments	
03.010.100	Drill Bit ∅ 3.2 mm, calibrated, length 145 mm, 3-flute, with Coupling for RDL
or	
03.010.103	Drill Bit ∅ 3.2 mm, calibrated, length 145 mm, 3-flute, for Quick Coupling



- Under image intensification, insert the tip of the drill bit through the incision and onto the bone. Keep the drill bit oblique to the x-ray beam until the tip is centered in the locking hole.

Note: **Be sure to use a sharp drill bit to prevent slippage and ensure accuracy.**



- Tilt the drill until the drill bit is in line with the beam and centered in the outer ring. The drill bit will nearly fill the locking hole image. Hold the drill firmly in this position
- and drill through both cortices. Monitor drill bit insertion with the image intensifier, as the position of the drill bit tip directly represents the screw position in the bone.

Note: **For greater drill bit control, discontinue power after perforating the near cortex. Manually guide the drill bit through the nail before resuming power to drill the far cortex.**

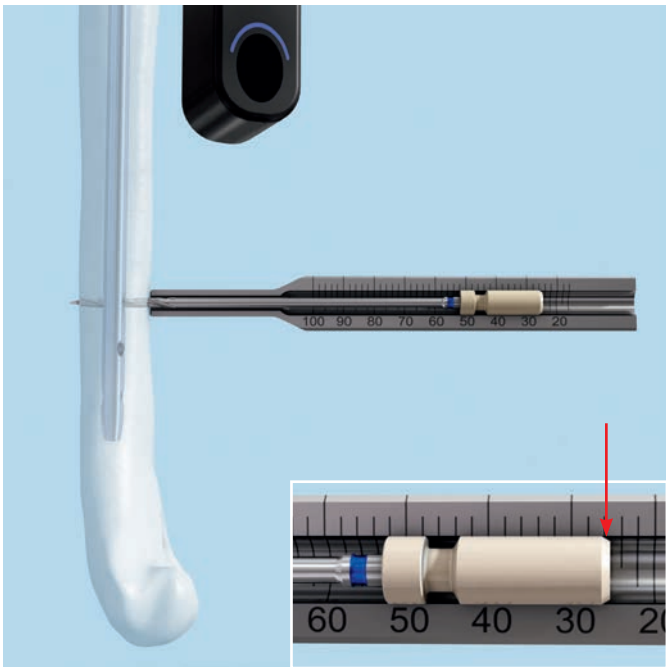
4. Determine screw length

Instrument	
03.010.429	Direct Measuring Device for Drill Bits, length 145 mm

Leaving the drill bit in place, detach the drill. Place the direct measuring device against the drill bit, with the tip of the direct measuring device against the bone. Read the graduation against the end of the drill bit to determine the screw length.

Remove the drill bit.

Note: **To avoid measurement errors, it is important that the tip of the direct measuring device is pressed against the bone.**



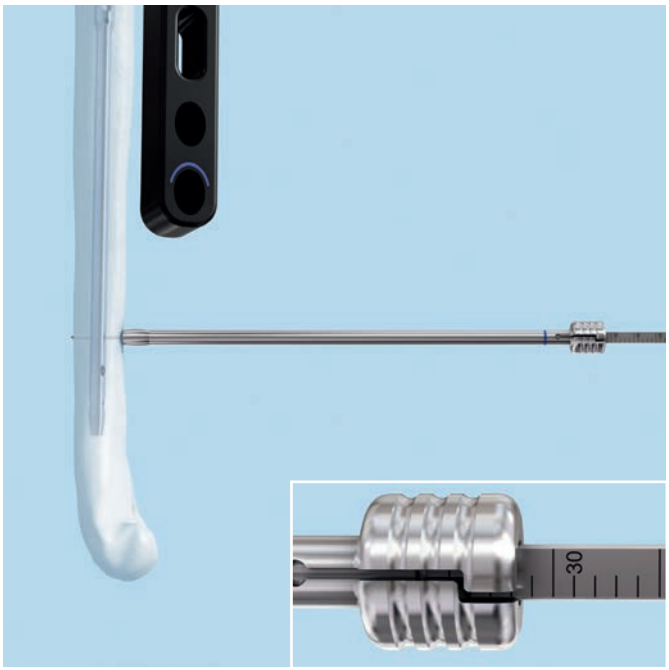
Alternative technique: Measure using depth gauge

Instrument	
03.019.017	Depth Gauge for MultiLoc Humeral Nailing System

The depth gauge can be used for screw length determination.

Assemble the depth gauge with its outer sleeve.

Insert the depth gauge and grasp the far cortex of the bone with the hook. Press the outer part of the depth gauge firmly to the cortex to ensure accurate measurement. Read the screw length directly off the depth gauge.



5. Insert 4.0 mm locking screw

Instrument	
03.019.020	Screwdriver Stardrive, SD25, with Coupling, for No. 03.019.019, length 330 mm

Insert the appropriate length 4.0 mm locking screw using the SD25 Stardrive screwdriver.

6. Insert remaining 4.0 mm locking screws

To insert the remaining 4.0 mm locking screws, repeat Steps 1 through 5.

Compression Locking (optional) MultiLoc Humeral Nail (long)

Compression locking of the MultiLoc Humeral Nail (long) can help close a transverse or short oblique fracture gap that is up to 8 mm wide.

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

Precaution: **When radial nerve impingement is suspected or possible, the nerve should be explored and isolated prior to nailing or using the compression function.**

Note: **Distal locking must be performed prior to applying compression. For further details, please refer to "Freehand Distal Locking MultiLoc Humeral Nail (long)".**

1. Lock nail distally

Overinsert the nail by at least the anticipated amount of interfragmentary travel. The maximum amount of travel produced by the compression device is 8 mm.

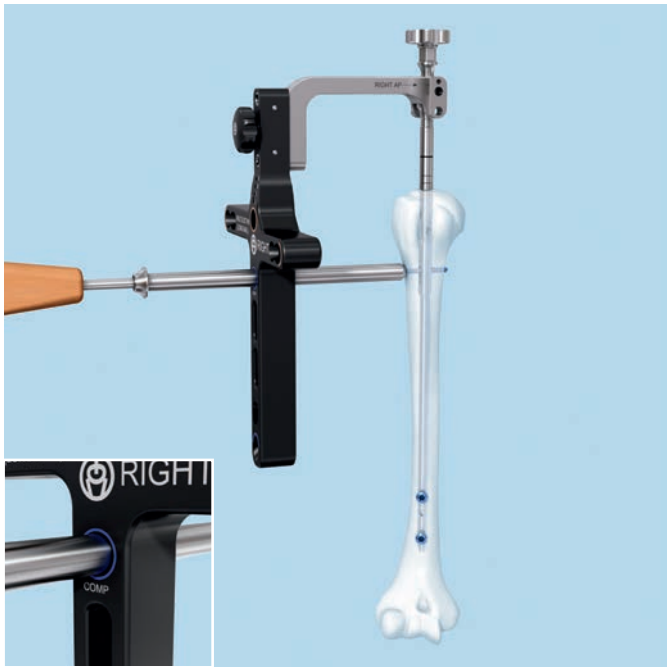
Lock the nail in the distal fragment as described in "Freehand Distal Locking MultiLoc Humeral Nail (long)".

2. Apply compression

Insert a 4.0 mm locking screw through the hole in the aiming arm marked "COMP", which targets the superior end of the nail slot, using standard insertion technique. See "Targeted Distal Locking MultiLoc Proximal Humeral Nail (short)".

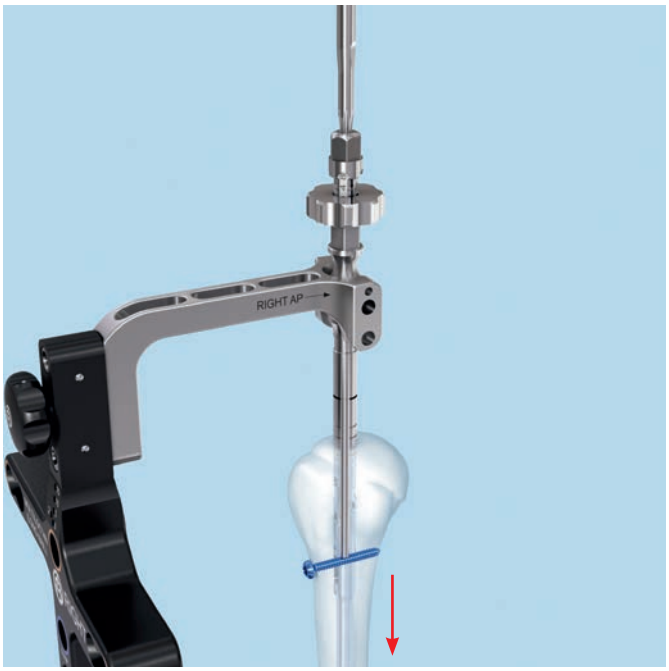
Precautions:

- **Ensure that the nail is not left proud after compression because this may cause impingement.**
- **Before insertion of the 4.0 mm locking screw, identify and protect the axillary nerve. Only incise the skin and then perform blunt dissection, to avoid injuring the axillary nerve and its branches.**



Instruments

03.019.038	Compression Screw for MultiLoc Humeral Nail
03.019.020	Screwdriver Stardrive, SD25, with Coupling, for No. 03.019.019, length 330 mm
or	
321.160	Combination Wrench ∅ 11.0 mm



Insert the compression screw into the connecting screw. Advance the compression screw with the SD25 Stardrive screwdriver or the combination wrench. The tip of the compression screw will contact the 4.0 mm locking screw, pulling the nail up and moving the interlocked far fragment toward the near fragment to compress the fracture.

- Continue to advance the compression screw, monitoring interfragmentary travel under image intensification, until the desired amount of compression is achieved.

- Check the compression under image intensification since the base of the nail can move proximally and cause impingement.

Remove the compression screw.

Ensure that the nail is firmly attached to the insertion handle. Re-secure the assembly with the combination wrench if necessary.

Monitor both the fracture site and the 4.0 mm locking screw during the procedure. If the fragments do not compress and/or the 4.0 mm locking screw migrates or deforms excessively, discontinue the compression locking procedure.

Note: Each revolution of the compression screw corresponds to an axial movement of 1 mm.

3. Lock nail proximally

Insert the proximal locking screws as described in "Proximal Locking".

End Cap Insertion

1. Determine end cap length

Instruments	
03.019.023	End Cap Ruler for MultiLoc Humeral Nailing System
321.160	Combination Wrench ∅ 11.0 mm

Slide the end cap ruler over the proximal groove of the insertion handle. Push the ruler down to the bone and read the end cap length directly off the ruler.

Remove the end cap ruler, the connecting screw and the insertion handle. If removal of the connecting screw is difficult, use the combination wrench.

Note: **The proximal nail end and end cap should be 2 to 3 mm below the cartilage.**

Alternative technique: Measure using aiming arm and Kirschner wire

Instruments	
03.019.008	Aiming Arm, lateral, for MultiLoc Proximal Humeral Nail
or	
03.019.012	Aiming Arm, lateral, for MultiLoc Humeral Nail
292.260	Kirschner Wire ∅ 2.5 mm with trocar tip, length 280 mm, Stainless Steel

Connect the lateral aiming arm to the insertion handle and tighten the connecting screw. Insert a 2.5 mm Kirschner wire through the corresponding end cap hole in the proximal portion of the aiming arm. Estimate the extension length using a pure anteroposterior image of the proximal nail end.

Remove the Kirschner wire and the lateral aiming arm.

Notes:

- **The grooves on the insertion handle help to identify the insertion depth under image intensification.**
- **The proximal nail end and end cap should be 2 to 3 mm below the cartilage.**

2. Insert end cap

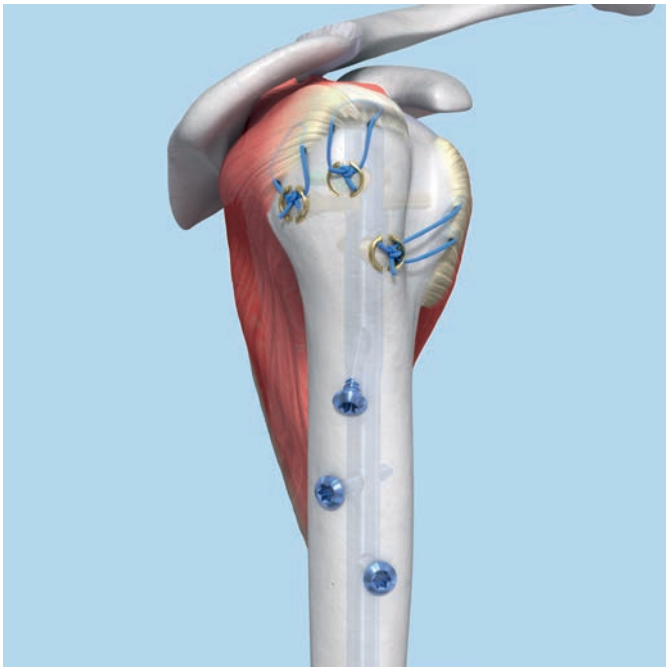
Instrument	
03.019.020	Screwdriver Stardrive, SD25, with Coupling, for No. 03.019.019, length 330 mm

Use the SD25 Stardrive screwdriver to tighten the end cap securely.

Notes:
- **The end cap must be inserted securely below the humeral head surface to avoid impingement. If in doubt, choose a shorter end cap.**
- **To reduce the chance of cross-threading, turn the end cap counterclockwise until the thread of the end cap aligns with the nail.**

3. Insert sutures (optional)

Place one or more heavy, nonabsorbable sutures in the region of the tendinous insertion of the supraspinatus, infraspinatus, and subscapularis muscle. Attach the sutures to the MultiLoc screws using the suture holes provided.



Implant Removal (optional)

1. Remove end cap

Instruments	
03.019.020	Screwdriver Stardrive, SD25, with Coupling, for No. 03.019.019, length 330 mm
03.019.024	Extraction Screw for MultiLoc Humeral Nailing System

Carefully dissect the soft tissues and visualize all locking implants.

Remove the end cap with the SD25 Stardrive screwdriver.

Thread the extraction screw into the nail.

Note: **Always mount the extraction screw prior to removal of the screws.**

2. Remove 3.5 mm locking screws (screw-in-screw)

Instruments	
314.116	Screwdriver Shaft Stardrive 3.5, SD15, self-holding, for AO/ASIF Quick Coupling
or	
314.030	Screwdriver Shaft, hexagonal, small, ∅ 2.5 mm
03.019.005	Handle with Quick Coupling, length 150 mm

Assemble the screwdriver shaft and handle and remove all 3.5 mm locking screws.

3. Remove MultiLoc screws

Instruments	
03.019.010	Extraction Shaft for MultiLoc Screws ∅ 4.5 mm, for AO/ASIF Quick Coupling
03.019.005	Handle with Quick Coupling, length 150 mm

Assemble the extraction shaft and handle and remove all MultiLoc screws.

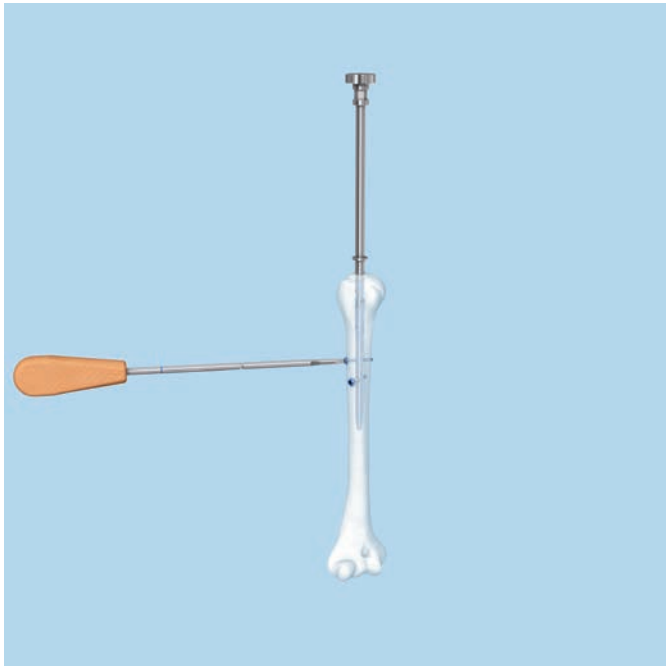
Note: **If 3.5 mm locking screws were used, remove them first.**

4. Remove 4.0 mm locking screws

Instrument	
03.019.020	Screwdriver Stardrive, SD25, with Coupling, for No. 03.019.019, length 330 mm

Remove all 4.0 mm locking screws with the SD25 Stardrive screwdriver.

Note: **Ensure the extraction screw is connected to the nail before removing the last locking screw.**



5. Difficult extraction of screws

If the extraction of screws turns out to be difficult, follow the procedures described in the chapter "Removal of jammed screws" in the Screw Extraction Set Handling Technique.

In case of a 3.5 mm locking screw that cannot be extracted with a conical extraction screw, use the carbide drill bit ∅ 4.0 mm (309.004S) with the technique described below.

Instruments	
309.004S	Carbide Drill Bit ∅ 4.0 mm for Instrument Steel and Titanium, sterile
03.607.040	Drill Sleeve 4.0, clip-on, for No. 03.607.110
03.607.110	Drill Suction Device

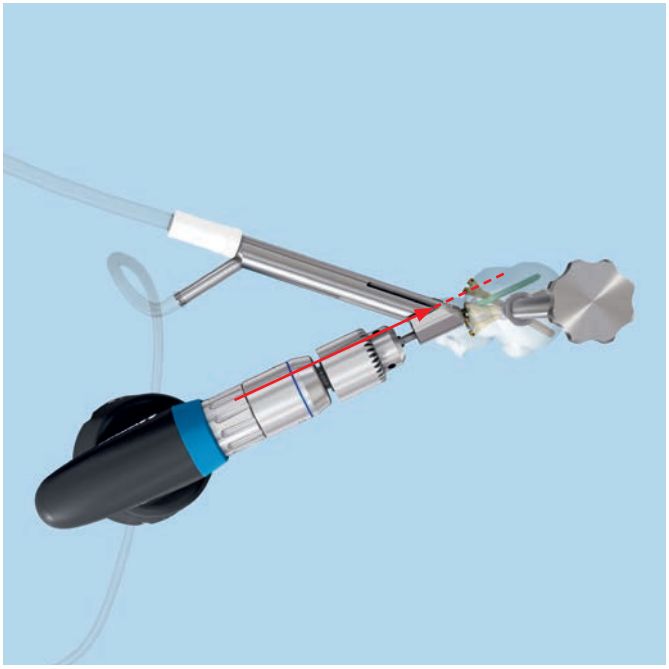
Attach the drill bit to the universal chuck of the power tool and tighten.

Attach the drill sleeve to the drill suction device. Connect the drill suction device to the irrigation system and the vacuum pump. Switch on the rinsing equipment and the vacuum pump.

Position the drill suction device on the relevant screw. Insert the drill bit into the drill sleeve, start up the drill and then start the drilling process.

Carefully drill co-axially to the axis of the 3.5 mm locking screw until the screw head is completely removed.

Precaution: **Be careful to maintain the drilling direction co-axially to the 3.5 mm locking screw. Avoid drilling into the direction of the MultiLoc screw.**



Notes:

- **The carbide drill bit is hard and brittle. Start drilling with the drill bit already revolving and maintain the chosen drill axis throughout the entire drilling process.**
- **While drilling, cool with the irrigation system operating. Do not interrupt the water supply. Ensure that the supply and waste hose is not bent.**
- **Remove generated drill chips with the suction device. No drill bit material should be left in the body.**
- **The carbide drill bit may not be reprocessed or resterilized. It is single use only.**

Remove the MultiLoc screw with the technique described in Step 3.

Extract the shaft of the 3.5 mm locking screw with the technique for removal of broken screws described in the Screw Extraction Set Handling Technique.

Optional instruments

309.006S	Carbide Drill Bit Ø 6.0 mm for Instrument Steel and Titanium, sterile
03.607.060	Drill Sleeve 6.0, clip-on, for No. 03.607.110

In the rare case of impossible screw extraction with the carbide drill bit ∅ 4.0 mm, use the carbide drill bit ∅ 6.0 mm (309.006S) and carefully drill out the screw head of the 3.5 mm locking screw using the technique described above.

Precaution: **Drill carefully and ensure not to damage the MultiLoc screw.**

6. Remove nail

Instrument	
03.019.028	Combined Hammer 360 g

Before nail extraction, ensure all locking screws are removed.

Remove the nail. If resistance is encountered, use gentle hammer blows to extract the nail.

Implants

Nails

Design:
Straight, cannulated, right and left

Material:
Titanium-6% aluminium-7% niobium alloy (TAN)

Diameters:
MultiLoc Proximal Humeral Nail (short)
- 8 mm (proximal diameter 9.5 mm)
- 9.5 mm (proximal diameter 11.0 mm)

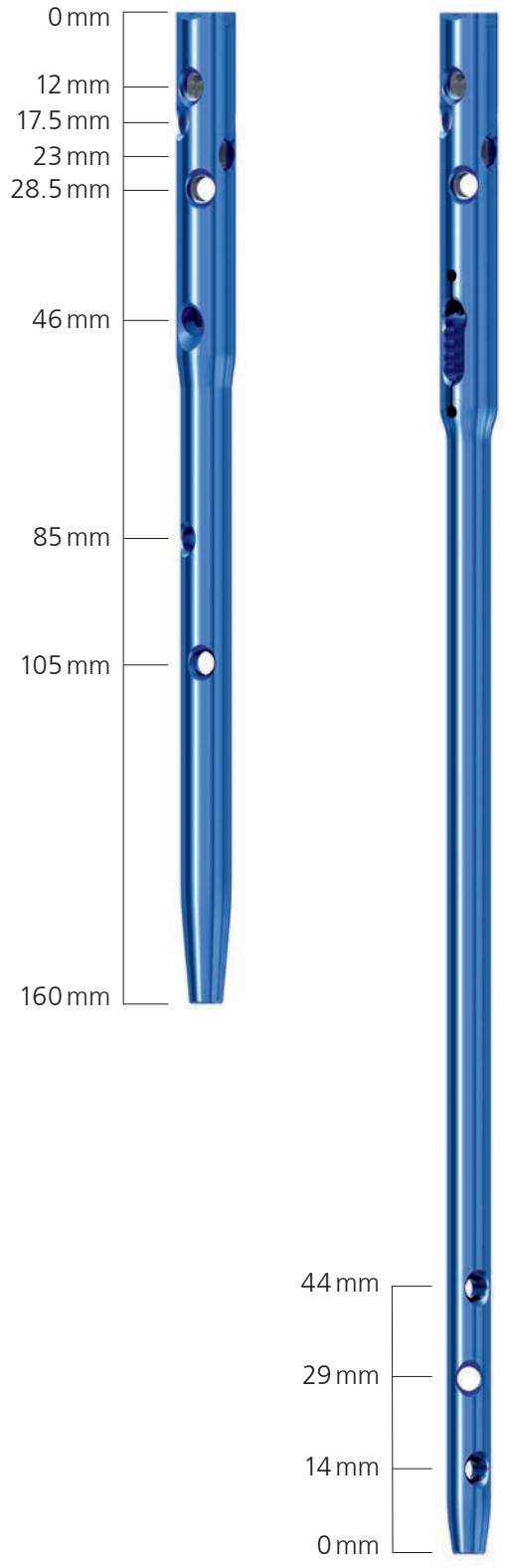
MultiLoc Humeral Nail (long)
- 7 mm (proximal diameter 9.5 mm)
- 8.5 mm (proximal diameter 9.5 mm)

Color:
Blue

MultiLoc Proximal Humeral Nail (short), sterile				
Length (mm)	∅ 8.0 mm right	∅ 8.0 mm left	∅ 9.5 mm right	∅ 9.5 mm left
160	04.016.034S	04.016.035S	04.016.038S	04.016.039S

MultiLoc Humeral Nail (long), sterile				
Length (mm)	∅ 7.0 mm right	∅ 7.0 mm left	∅ 8.5 mm right	∅ 8.5 mm left
180	04.016.180S	04.017.180S	04.018.180S	04.019.180S
195	04.016.195S	04.017.195S	04.018.195S	04.019.195S
210	04.016.210S	04.017.210S	04.018.210S	04.019.210S
225	04.016.225S	04.017.225S	04.018.225S	04.019.225S
240	04.016.240S	04.017.240S	04.018.240S	04.019.240S
255	04.016.255S	04.017.255S	04.018.255S	04.019.255S
270	04.016.270S	04.017.270S	04.018.270S	04.019.270S
285	04.016.285S	04.017.285S	04.018.285S	04.019.285S
300	04.016.300S	04.017.300S	04.018.300S	04.019.300S
315	04.016.315S	04.017.315S	04.018.315S	04.019.315S

Locking hole locations



MultiLoc screws ∅ 4.5 mm*

Material:
- Titanium-6% aluminium-7% niobium alloy (TAN)

Drill:
- ∅ 3.8 mm

Color:
- Gold

Dimensions:
- 20 mm to 60 mm lengths in 2 mm increments
- Outer diameter 4.5 mm
- Core diameter 3.9 mm
- MultiLoc recess
- Fully threaded
- Blunt screw tip
- Self-cutting, countersinkable screw head with suture holes

Article no.	Length (mm)
04.019.020	20
04.019.022	22
04.019.024	24
04.019.026	26
04.019.028	28
04.019.030	30
04.019.032	32
04.019.034	34
04.019.036	36
04.019.038	38
04.019.040	40

Article no.	Length (mm)
04.019.042	42
04.019.044	44
04.019.046	46
04.019.048	48
04.019.050	50
04.019.052	52
04.019.054	54
04.019.056	56
04.019.058	58
04.019.060	60

* Implants are available nonsterile or sterile packed. Add suffix "S" to article number to order sterile product.

Locking screws ∅ 3.5 mm, Stardrive*

Material:
Titanium-6% aluminium-7% niobium alloy (TAN)

Drill:
∅ 2.8 mm

Color:
Green

Dimensions:
- 26 mm to 60 mm lengths in 2 mm increments
- Outer diameter 3.5 mm
- Core diameter 2.9 mm
- Stardrive SD15 recess
- Fully threaded
- Self-tapping

Article no.	Length (mm)	Article no.	Length (mm)
412.109	26	412.134	44
412.110	28	412.136	46
412.111	30	412.120	48
412.112	32	412.121	50
412.113	34	412.122	52
412.115	36	04.212.054	54
412.116	38	04.212.056	56
412.117	40	04.212.058	58
412.118	42	412.124	60

* Implants are available nonsterile or sterile packed. Add suffix "S" to article number to order sterile product.

Locking screws ∅ 3.5 mm, hexagonal*

Material:
Titanium-6% aluminium-7% niobium alloy (TAN)

Drill:
∅ 2.8 mm

Color:
Green

Dimensions:
- 26 mm to 60 mm lengths in 2 mm increments
- Outer diameter 3.5 mm
- Core diameter 2.9 mm
- Hexagonal 2.5 mm recess
- Fully threaded
- Self-tapping

Article no.	Length (mm)	Article no.	Length (mm)
413.026	26	413.044	44
413.028	28	413.046	46
413.030	30	413.048	48
413.032	32	413.050	50
413.034	34	413.052	52
413.036	36	413.054	54
413.038	38	413.056	56
413.040	40	413.058	58
413.042	42	413.060	60

* Implants are available nonsterile or sterile packed. Add suffix "S" to article number to order sterile product.

Locking screws ∅ 4.0 mm*

Material:
Titanium-6% aluminium-7% niobium alloy (TAN)

Drill:
∅ 3.2 mm

Color:
Blue

Dimensions:
- 18 mm to 70 mm lengths in 2 mm increments
- Outer diameter 4.0 mm
- Core diameter 3.3 mm
- Stardrive SD25 recess
- Fully threaded
- Self-tapping

Article No.	Length (mm)	Article No.	Length (mm)
04.005.408	18	04.005.436	46
04.005.410	20	04.005.438	48
04.005.412	22	04.005.440	50
04.005.414	24	04.005.442	52
04.005.416	26	04.005.444	54
04.005.418	28	04.005.446	56
04.005.420	30	04.005.448	58
04.005.422	32	04.005.450	60
04.005.424	34	04.005.452	62
04.005.426	36	04.005.454	64
04.005.428	38	04.005.456	66
04.005.430	40	04.005.458	68
04.005.432	42	04.005.460	70
04.005.434	44		

* Implants are available nonsterile or sterile packed. Add suffix "S" to article number to order sterile product.

MultiLoc end caps, sterile

Material:
Titanium-6% aluminium-7% niobium alloy (TAN)

Color:
Gray

0 mm extension:
- Diameter 6.0 mm
- Stardrive SD25 recess

2 mm, 5 mm, 10 mm, or 15 mm extension:
- Extends nail height if nail is overinserted
- Diameter 9.5 mm
- Stardrive SD25 recess

Article no.	Extension (mm)
04.019.000S	0
04.019.002S	2
04.019.005S	5
04.019.010S	10
04.019.015S	15

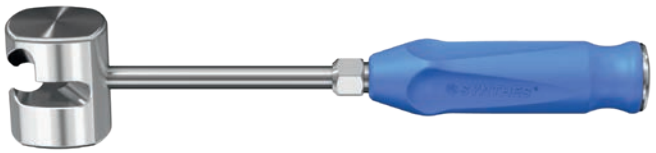
Instruments

03.010.039	Awl, cannulated	
03.010.060	Drill Bit ∅ 3.2 mm, calibrated, length 340 mm, 3-flute, for Quick Coupling, for No. 03.010.064	
03.010.063	Protection Sleeve 12.0/8.0, length 188 mm	
03.010.064	Drill Sleeve 8.0/3.2, for No. 03.010.063	
03.010.069	Trocar ∅ 3.2 mm, for No. 03.010.064	
03.010.103	Drill Bit ∅ 3.2 mm, calibrated, length 145 mm, 3-flute, for Quick Coupling	
03.010.429	Direct Measuring Device for Drill Bits, length 145 mm	
03.019.001	Radiographic Ruler for MultiLoc Humeral Nailing System	

03.019.003	Hollow Drill Bit ∅ 10.0 mm for MultiLoc Humeral Nailing System	
03.019.004	Hollow Drill Bit ∅ 11.5 mm for MultiLoc Proximal Humeral Nail ∅ 9.5 mm	
03.019.005	Handle with Quick Coupling, length 150 mm	
03.019.006	Insertion Handle for MultiLoc Proximal Humeral Nail	
03.019.007	Connecting Screw, cannulated, for MultiLoc Humeral Nailing System	
03.019.008	Aiming Arm, lateral, for MultiLoc Proximal Humeral Nail	
03.019.009	Aiming Arm, anterior, for MultiLoc Proximal Humeral Nail	

03.019.010	Extraction Shaft for MultiLoc Screws ∅ 4.5 mm, for AO/ASIF Quick Coupling	
03.019.011	Reduction Instrument for MultiLoc Humeral Nailing System, length 330 mm	
03.019.012	Aiming Arm, lateral, for MultiLoc Humeral Nail	
03.019.013	Protection Sleeve 13.0/10.0, length 150 mm	
03.019.014	Drill Sleeve 10.0/3.8, for No. 03.019.013	
03.019.015	Trocar ∅ 3.8 mm, for No. 03.019.014	
03.019.016	Drill Bit ∅ 3.8 mm, calibrated, length 270 mm, 3-flute, for Quick Coupling, for No. 03.019.014	
03.019.017	Depth Gauge for MultiLoc Humeral Nailing System	
03.019.018	Countersink for MultiLoc Screws ∅ 4.5 mm, with Stop, for Quick Coupling	
03.019.019	Centering Sleeve 9.8/5.8 for Locking Screws ∅ 3.5 mm, with Coupling, for MultiLoc Screws ∅ 4.5 mm	

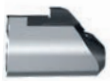
03.019.020	Screwdriver Stardrive, SD25, with Coupling, for No. 03.019.019, length 330 mm	
03.019.021	Drill Sleeve 5.8/2.8, for No. 03.019.019	
03.019.023	End Cap Ruler for MultiLoc Humeral Nailing System	
03.019.024	Extraction Screw for MultiLoc Humeral Nailing System	
03.019.025	Screwdriver for MultiLoc Screws ∅ 4.5 mm, with selfholding Mechanism, length 330 mm	
03.019.026	Guide Rod ∅ 2.5 mm for Hollow Drill with Stop, with trocar tip, length 230 mm, Stainless Steel	
03.019.027	Protection Sleeve, for Nos. 03.019.003 and 03.019.004	

03.019.028	Combined Hammer 360 g	
03.019.029	Length Probe for MultiLoc Humeral Nailing System	
03.019.038	Compression Screw for MultiLoc Humeral Nail	
03.607.040	Drill Sleeve 4.0, clip-on, for No. 03.607.110	
03.607.110	Drill Suction Device	
292.160	Kirschner Wire ∅ 1.6 mm with trocar tip, length 150 mm, Stainless Steel	
292.260	Kirschner Wire ∅ 2.5 mm with trocar tip, length 280 mm, Stainless Steel	
309.004S	Carbide Drill Bit ∅ 4.0 mm for Instrument Steel and Titanium, sterile	
310.284	LCP Drill Bit ∅ 2.8 mm with Stop, length 165 mm, 2-flute, for Quick Coupling	

314.030	Screwdriver Shaft, hexagonal, small, ∅ 2.5 mm	
314.116	Screwdriver Shaft Stardrive 3.5, SD15, self-holding, for AO/ASIF Quick Coupling	
319.970	Screw Forceps, self-holding, length 85 mm	
321.160	Combination Wrench ∅ 11.0 mm	
351.709S	SynReam Reaming Rod ∅ 2.5 mm, length 650 mm, sterile	
351.719	Elongation Tube for Reaming Rods, for Depth Gauge for Medullary Nails, for Nos. 351.717 and 03.019.001	
393.105	Universal Chuck, small, with T-Handle	
511.773	Torque Limiter, 1.5 Nm, for AO/ASIF Quick Coupling	

Optional instruments

03.010.060S	Drill Bit ∅ 3.2 mm, calibrated, length 340 mm, 3-flute, for Quick Coupling, for No. 03.010.064, sterile	
03.010.093	Rod Pusher for Reaming Rod with Hexagonal Screwdriver ∅ 8.0 mm	
03.010.100	Drill Bit ∅ 3.2 mm, calibrated, length 145 mm, 3-flute, with Coupling for RDL	
03.010.100S	Drill Bit ∅ 3.2 mm, calibrated, length 145 mm, 3-flute, with Coupling for RDL, sterile	
03.010.103S	Drill Bit ∅ 3.2 mm, calibrated, length 145 mm, 3-flute, for Quick Coupling, sterile	
03.010.106	Direct Measuring Device for Drill Bits of length 145 mm, for Nos. 03.010.100 to 03.010.105	
03.019.003S	Hollow Drill Bit ∅ 10.0 mm for MultiLoc Humeral Nailing System, sterile	
03.019.004S	Hollow Drill Bit ∅ 11.5 mm for MultiLoc Proximal Humeral Nail ∅ 9.5 mm, sterile	
03.019.016S	Drill Bit ∅ 3.8 mm, calibrated, length 270 mm, 3-flute, for Quick Coupling, for No. 03.019.014, sterile	
03.019.018S	Countersink for MultiLoc Screws ∅ 4.5 mm, with Stop, for Quick Coupling, sterile	

03.019.026S	Guide Rod ∅ 2.5 mm for Hollow Drill with Stop, with trocar tip, length 230 mm, Stainless Steel, sterile	
03.019.030	Connecting Screw for MultiLoc Humeral Nailing System, for No. 03.019.008	
03.019.031	Connecting Screw for MultiLoc Humeral Nailing System, for No. 03.019.009	
03.607.060	Drill Sleeve 6.0, clip-on, for No. 03.607.110	
292.160S	Kirschner Wire ∅ 1.6 mm with trocar tip, length 150 mm, Stainless Steel, sterile	
292.260S	Kirschner Wire ∅ 2.5 mm with trocar tip, length 280 mm, Stainless Steel, sterile	
309.006S	Carbide Drill Bit ∅ 6.0 mm for Instrument Steel and Titanium, sterile	
310.288S	Drill Bit ∅ 2.8 mm, length 165 mm, for AO/ASIF Quick Coupling, sterile	
397.705	Handle for Torque Limiter Nos. 511.770 and 511.771	
511.770	Torque Limiter, 1.5 Nm, for Compact Air Drive and Power Drive	

MRI Information

Torque, Displacement and Image Artifacts according to ASTM F 2213-06, ASTM F 2052-14 and ASTM F 2119-07

Non-clinical testing of worst case scenario in a 3 T MRI system did not reveal any relevant torque or displacement of the construct for an experimentally measured local spatial gradient of the magnetic field of 3.69 T/m. The largest image artifact extended approximately 169 mm from the construct when scanned using the Gradient Echo (GE). Testing was conducted on a 3 T MRI system.

Radio-Frequency-(RF-)induced heating according to ASTM F 2182-11a

Non-clinical electromagnetic and thermal testing of worst case scenario lead to peak temperature rise of 9.5 °C with an average temperature rise of 6.6 °C (1.5 T) and a peak temperature rise of 5.9 °C (3 T) under MRI Conditions using RF Coils (whole body averaged specific absorption rate [SAR] of 2 W/kg for 6 minutes [1.5 T] and for 15 minutes [3 T]).

Precautions: The above mentioned test relies on non-clinical testing. The actual temperature rise in the patient will depend on a variety of factors beyond the SAR and time of RF application. Thus, it is recommended to pay particular attention to the following points:

- **It is recommended to thoroughly monitor patients undergoing MR scanning for perceived temperature and/or pain sensations.**
- **Patients with impaired thermoregulation or temperature sensation should be excluded from MR scanning procedures.**
- **Generally, it is recommended to use a MR system with low field strength in the presence of conductive implants. The employed specific absorption rate (SAR) should be reduced as far as possible.**
- **Using the ventilation system may further contribute to reduce temperature increase in the body.**

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