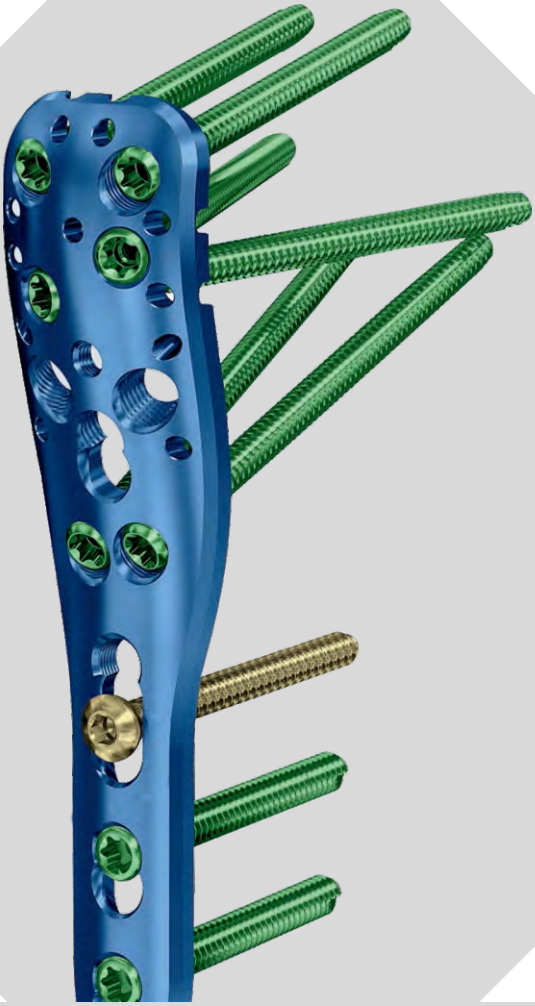


Surgical Technique

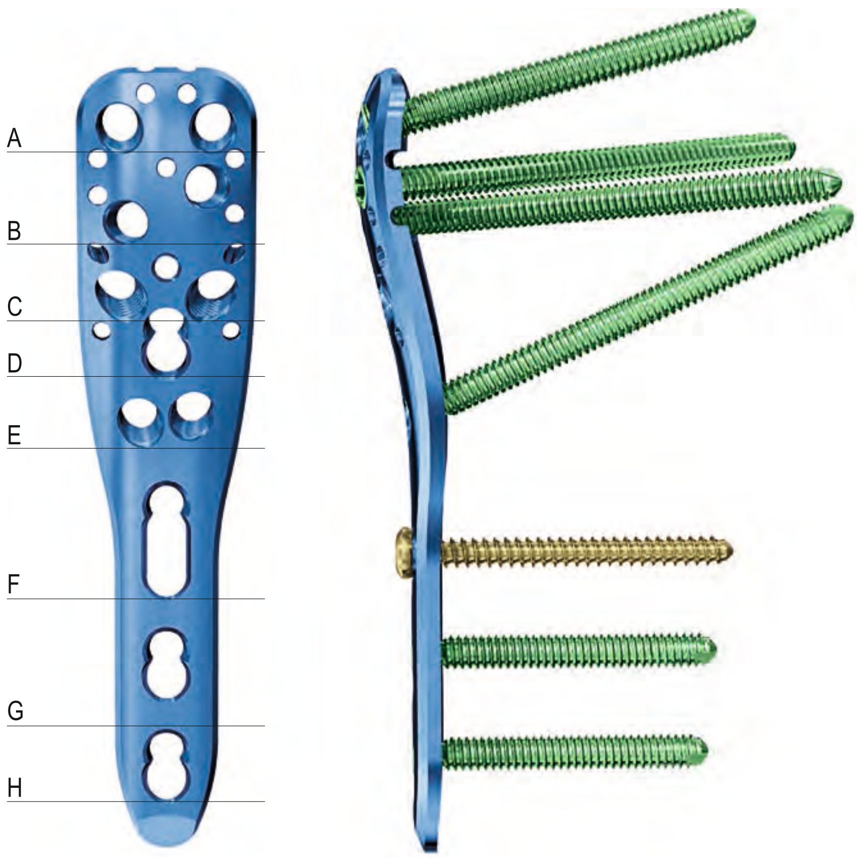
***3.5mm Wise-Lock** PHEELOS-Proximal Humerus plate*

PHEELOS AND LONG PHEELOS

PHEELOS PROXIMAL HUMERAL INTERNAL LOCKING SYSTEM

PHEELOS
- 9 proximal screw holes in section A–E for Wise-Lock locking screws 3.5 mm enable an angular stable construct to enhance the grip in osteoporotic bone and multi-fragment fractures
- Carefully apply for osteoporotic bone
- Optimal screw placement
- 10 proximal holes for suturing to help maintain fracture reduction

PHEELOS Long
- Shaft reinforced to 3.7 mm
- Distal Wise-Lock long holes for maximum adaptability
- Plate length up to 290 mm



INDICATIONS

PHEELOS indications

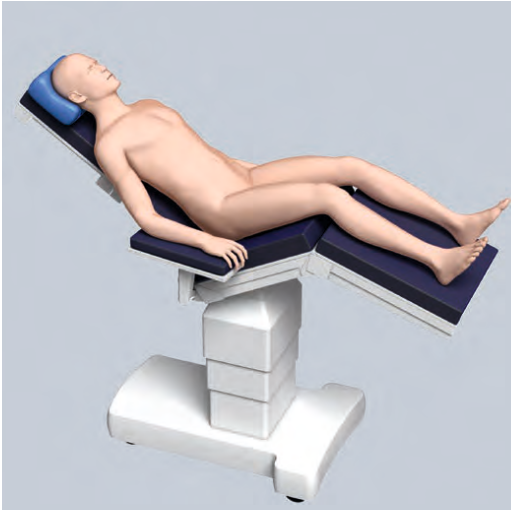
- Dislocated two-, three-, and four-fragment fractures of the proximal humerus, including fractures involving osteopenic bone
- Pseudarthroses in the proximal humerus
- Osteotomies in the proximal humerus

PHEELOS long indications

- As for PHEELOS, but for fractures extending to the shaft or without medial support

PATIENT POSITIONING AND APPROACH

Note: **For information on fixation principles using conventional and locked plating techniques, please refer to the Wise-Lock Locking Compression Plate Surgical Technique (DSEM/TRM/0115/0278).**



Position the patient

Place the patient in the beach chair position or supine position on a radiolucent table.

Ensure the fluoroscope is positioned in a way that allows visualization of the proximal humerus in two axes (AP and lateral/axial).

Prepare the patient's arm so that it can be mobilized intraoperatively.

Approach

A deltopectoral or transdeltoid approach is recommended.

If the transdeltoid approach is performed, the use of the Wise-Lock Percutaneous Aiming System 3.5 for PHEELOS is recommended.

Warnings:
- **Do not injure the axillary nerve. The axillary nerve can be palpated at the lower margin of the incision.**
- **To avoid damaging the axillary nerve, do not split the deltoid more than 4 cm distal to its origin.**

IMPLANTATION

Reduce fracture and fix temporarily

Proper reduction of the fracture is crucial for good bone healing and function. In some cases closed reduction before prepping the patient is beneficial.

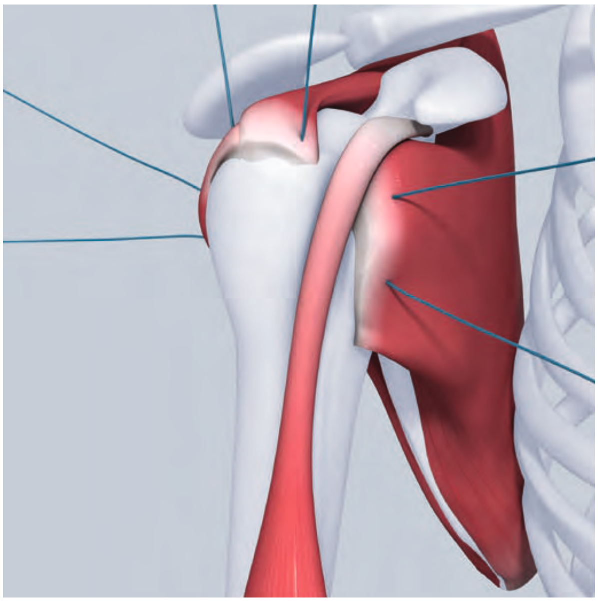
Reduce the head fragments and check the reduction under image intensifier control.

Note: **The locking screws are not suitable for reduction since they cannot exert compression. The head fragments must be reduced before insertion of locking screws.**

Kirschner wires can be used for reduction as joysticks in the fragments as well as for temporary fixation. Ensure that Kirschner wires do not interfere with correct plate placement.

Suturing

Provisionally reduce the tubercles using sutures through the insertions of the musculi subscapularis, infra- and supra-spinatus. The sutures will help to maintain the stability of the reconstruction when fixing them to the plate later.



Attach aiming device to plate

Insert the stabilization pin of the aiming device in the specially provided hole on the PHEELOS plate. Use the screwdriver to tighten the securing screw of the aiming device.

Precaution: **Intraoperative bending of the proximal portion of the plate is not recommended for maintaining proper alignment between the aiming device and the plate.**

Position plate

Position the plate 2–4 mm posterior to the bicipital groove and 5–7 mm distal to the top of the greater tubercule. Align the plate properly to the humeral shaft.

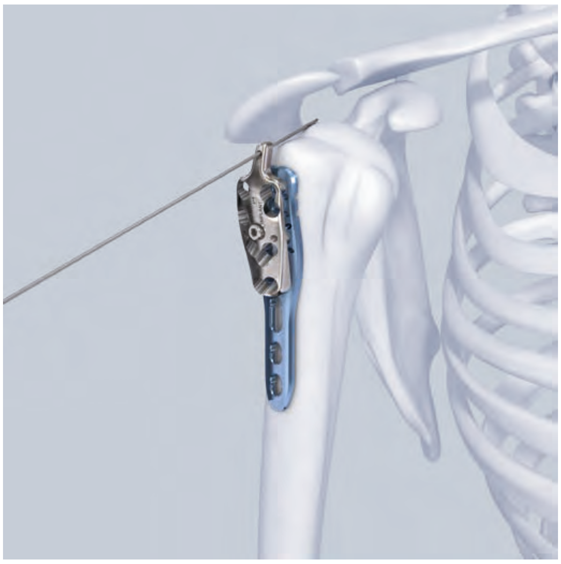
Precaution: **Placing the plate too high increases the risk of subacromial impingement. Placing the plate too low can prevent the optimal distribution of screws in the humeral head.**

Warnings:

- **Do not injure the axillary nerve. The axillary nerve can be palpated at the lower margin of the incision.**
- **To avoid damaging the axillary nerve, do not split the deltoid more than 4 cm distal to its origin.**

Alternative techniques

Option A: Determine the position of the plate using the PHEELOS aiming device with nose. Insert a Kirschner wire into the proximal guide hole below the rotator cuff so that the Kirschner wire aims at the proximal joint sur face.



Option B: Insert two positioning Kirschner wires 2–4 mm lateral to the bicipital groove and 5–7 mm below the tip of the greater tubercule. Position the plate between the Kirschner wires.

Fix plate temporarily

Fix the plate temporarily with a cortex screw in the elongated combi-hole in the plate shaft.

Use the 2.5 mm drill bit with the 3.5 universal drill guide to drill the bone through both cortices.

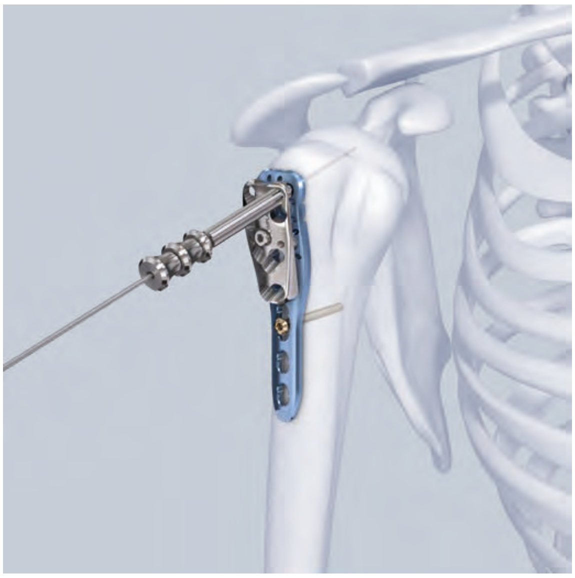
Determine the required length of the cortex screw using the depth gauge.

Insert the appropriate 3.5 mm cortex screw using the screwdriver.

Option: Temporary fixation with Kirschner wires

If required, use Kirschner wires through the triple sleeve system for temporary fixation of the humeral head.

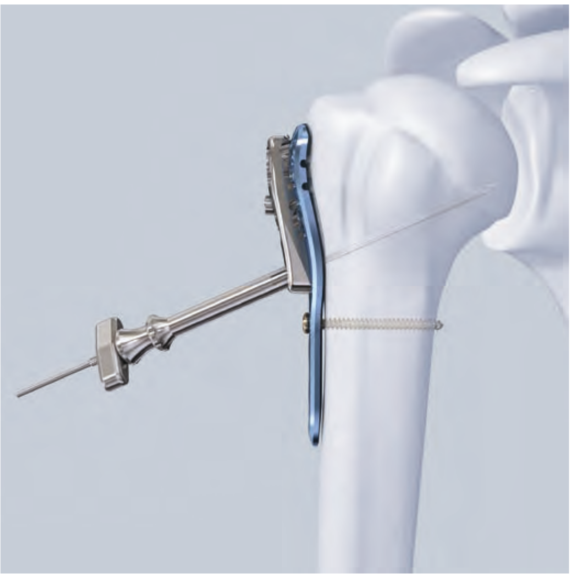
Warning: **Do not penetrate the joint surface with the Kirschner wires.**



Option: Temporarily reduce with pull reduction device

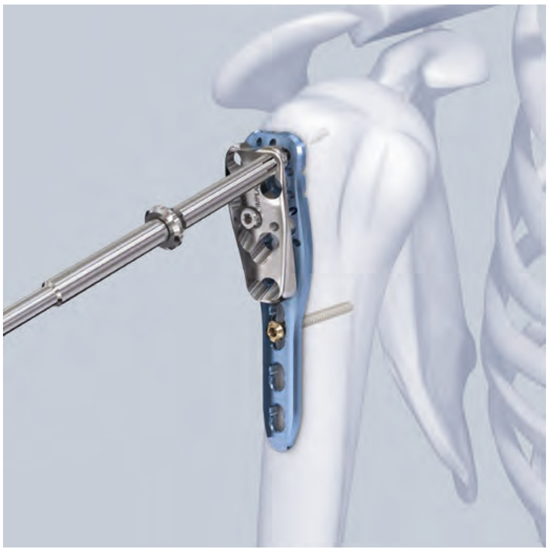
In good bone stock, the pull reduction device can optionally be used for temporary reduction. Using a power tool, insert the pull reduction device through the drill sleeve to the desired depth. Slide the wing nut over the wire and tighten. In this way, bone fragments are pulled towards the plate.

Warning: **Do not penetrate the joint surface with the pull reduction device.**



Drill the lateral cortex and determine proximal screw length

5a Technique for osteoporotic bone:
The following technique describes screw depth measuring optimized for osteoporotic bone. In good bone stock, change to options A or B for drilling the screw hole and depth measuring.



Insert the outer sleeve in the desired hole of the aiming device. Drill the lateral cortex using the drill bit with stop through the outer sleeve.

Warning: **In porotic bone, only drill the lateral cortex.**

Alternative instrument

Use the drill sleeve with thread independently from the aiming device.

Warnings:
- **Do not drill through the joint surface.**
- **Do not insert overly long screws in order to prevent primary or secondary screw penetration.**

Use the length probe through the outer sleeve and push it carefully into the humeral head. Stop pushing when increased bone density is felt. Read off the required screw length from the length probe.

Warning: **Do not push the length probe through the joint surface.**

Note: **The tip of the length probe should be located approximately 5–8 mm below the joint surface for locking screws.**

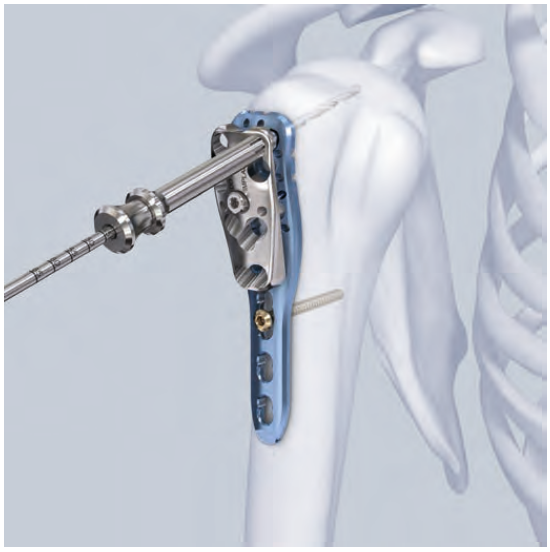
Alternative techniques for good bone stock

If the bone stock is good, choose one of the following options:

Option A: Use a 2.8 mm drill bit through the drill sleeve and drill 5–8 mm below the joint surface. Read the required screw length from the drill bit.

Note: **The drill bit tip should come as close as possi ble to the subchondral bone, approximately 5–8mm from the joint surface. Since it may not always be possible to feel the resistance from the subchondral bone, and the drill bit represents the final position of the locking screw, the use of image intensification is recommended.**

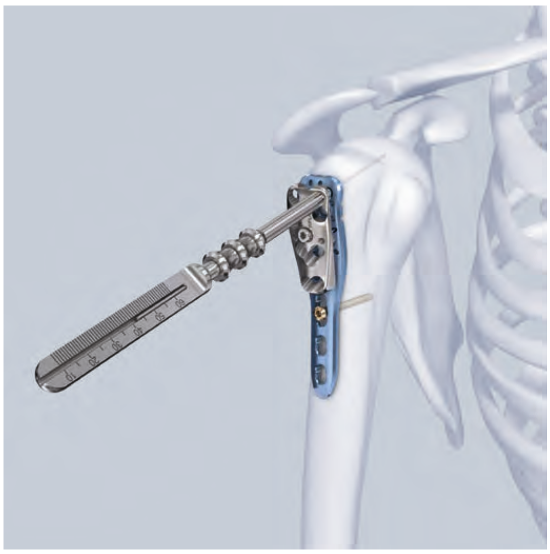
Warning: **Do not push the drill bit through the joint surface.**



Option B: Check the subsequent position of the screws using Kirschner wires. Attach the triple sleeve system, consisting of a outer sleeve, a drill sleeve, and a centering sleeve for the Kirschner wire onto the aiming device and insert a Kirschner wire 1.6 mm, 150 mm long.

Check the position of the Kirschner wire. The tip of the Kirschner wire should be located in the subchondral bone (5–8 mm below the joint surface).

Slide the PHEELOS direct measuring device for Kirschner wire 1.6 mm over the Kirschner wire and determine the length of the required screw.



Insert proximal screws

Remove drill sleeve and insert the screw with the appro - priate screwdriver shaft (hexagonal or Stardrive recess) and 1.5 Nm torque limiting attachment through the outer sleeve. The sleeve ensures that the locking screw is correctly locked in the plate. The angular stability is reduced if a locking screw is inserted obliquely.

Insert the screw manually or with power until a click is heard. If using power, reduce speed when tightening the head of the locking screw into the plate.

Repeat the above steps for all required proximal screw holes.

Warning: **Do not insert overly long screws in order to prevent primary or secondary screw penetration.**

Precaution: **The plate should be secured with at least 4 proximal screws of 3.5 mm. In poor bone stock, multiple fixation points using all screws is recommended.**

Insert shaft screws

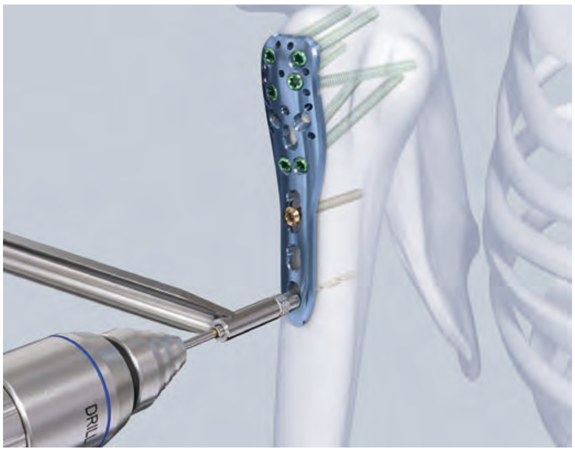
After inserting the proximal screws, determine where locking or cortex screws will be used in the shaft.

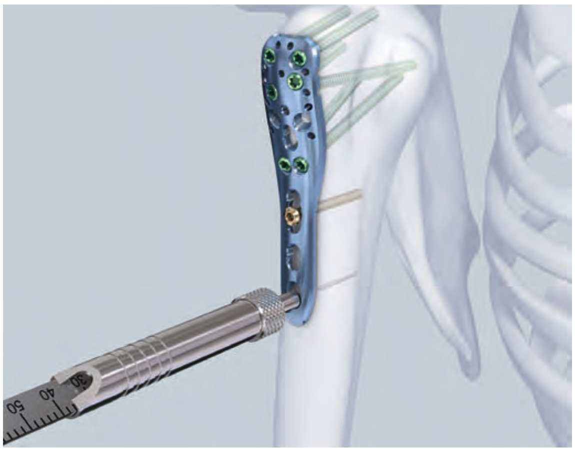
Note: **If a combination of cortex and locking screws is used, cortex screws must be inserted first to pull the plate to the bone.**

Fixation with 3.5 mm cortex screws

Use the 2.5 mm drill bit with the 3.5 universal drill guide to drill the bone through both cortices.

To set screws in a neutral position, press the drill guide down in the non-threaded hole. To obtain compression, place the drill guide at the end of the non-threaded hole away from the fracture, avoiding downward pressure on the spring-loaded tip.

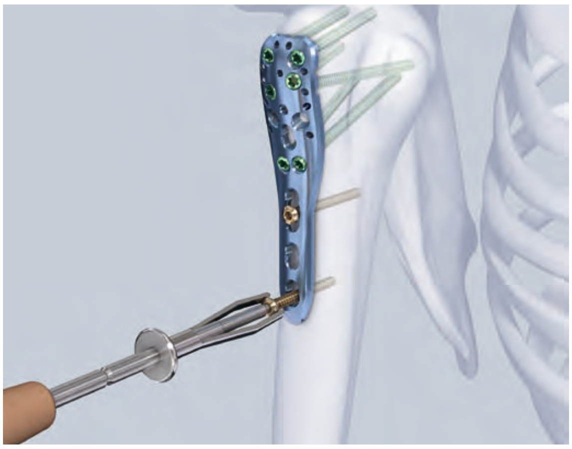




Determine the required length of the cortex screw using the depth gauge.

Insert the appropriate 3.5 mm cortex screw using the hexagonal or the Stardrive T15 screwdriver and PHEELOS Long.

Plate holes in the plate shaft (distal to section E) are Wise-Lock combi-holes (see page 2). An Wise-Lock combi-hole can be fixed with a cortex screw to generate interfragmentary compression. In this case, the screws are inserted according to the technique for fixing LC-DCP standard plates, but using the universal drill guide instead of the LC-DCP drill sleeve.

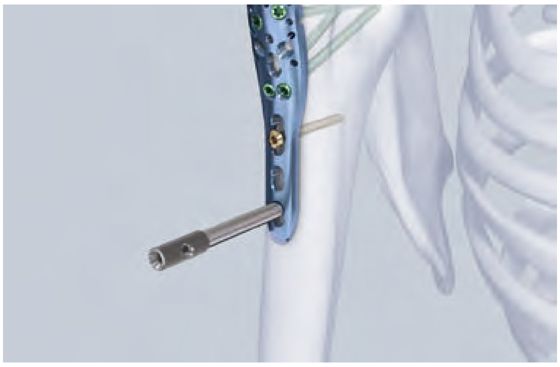


Fixation with 3.5 mm locking screws

Insert the Wise-Lock Drill Sleeve 3.5 into the locking hole until fully seated. Drill through both cortices with the 2.8 mm drill bit and use the scale on the Drill Bit (Fig. 1) to read-off the screw length.

Alternative technique: Remove the drill sleeve. Use the depth gauge to determine the screw length.

Insert the locking screw with the appropriate screwdriver shaft (hexagonal or Stardrive recess) mounted on the 1.5 Nm torque limiter. Insert the screw manually or with the use of a power tool until a click is heard. If a power tool is used, reduce the speed when tightening the head of the locking screw into the plate.



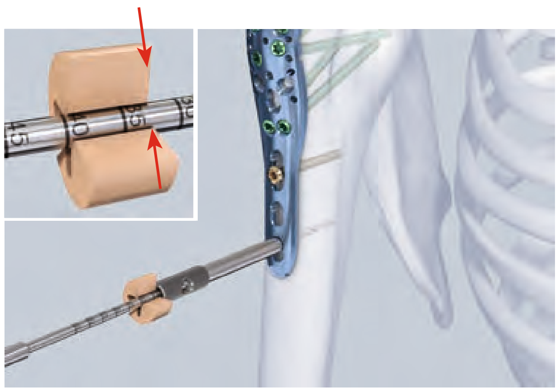
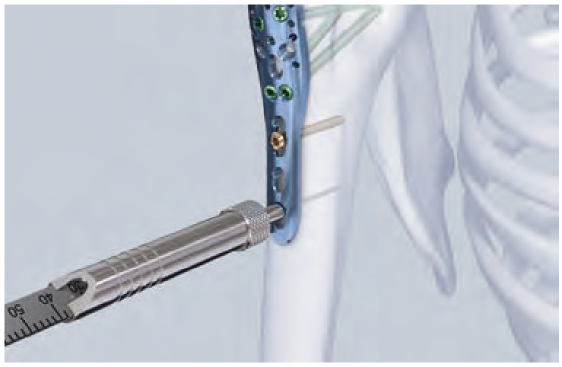
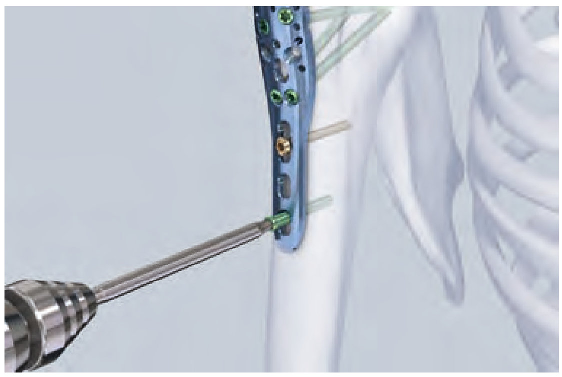
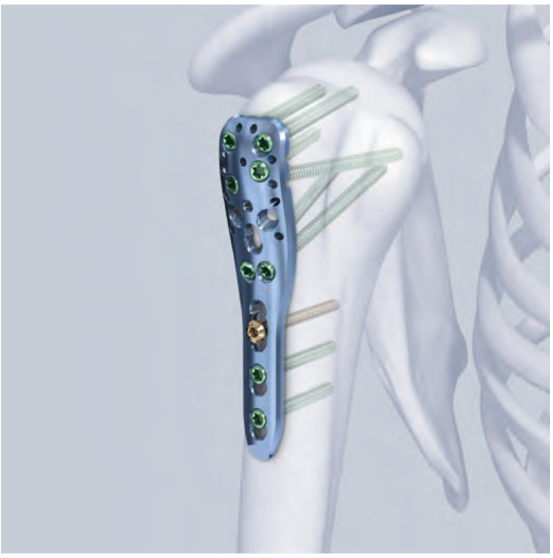


Fig. 1





Repeat the above steps for all required shaft holes.



Attach sutures

Remove the aiming device from the plate.

Knot the sutures through the designated holes in the plate if this has not already been done. This construct functions as a tension band and transmits the forces of the rotator cuff over the plate and into the shaft, while preventing fragment displacement during the early rehabilitation period.

Check position of screw tips

Check the screw lengths under image intensfier control in the full range of gleno-humeral-motion and ensure that they do not penetrate the articular surface.

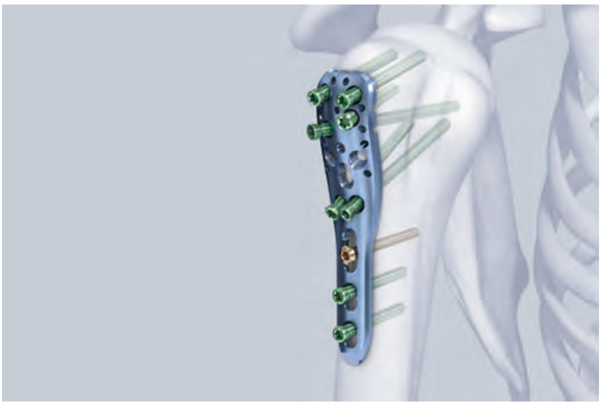
Precaution: **It is important to check the screw lengths in all planes as their angulation and direction may be difficult to visualize.**

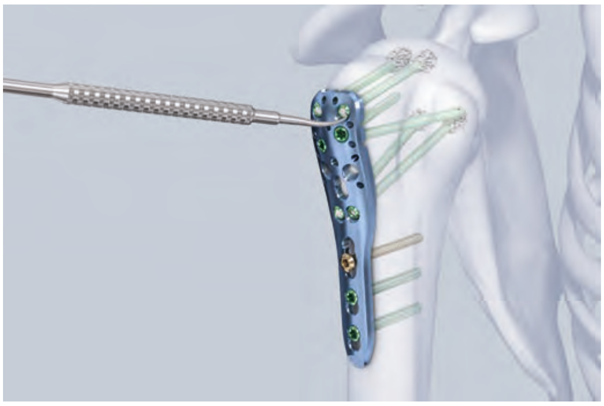
Check the stability of the suture fixation. The sutures must not rupture during motion.

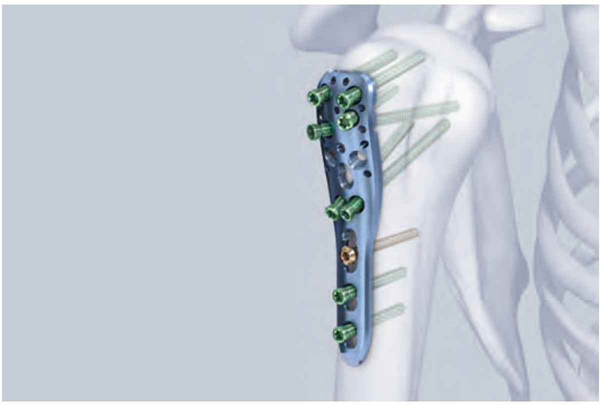
IMPLANT REMOVAL

Instruments

Unlock all screws from the plate, then remove the screws completely from the bone. This prevents simulta - neous rotation of the plate when unlocking the last lock - screw. If a screw cannot be removed with the screw - driver (e.g. if the hexagonal or Stardrive recess of the locking screw is damaged or if the screw is stuck in the plate), use the T-Handle with Quick Coupling (311.440) to insert the Extraction Screw (309.520 or 309.521) into the screw head, and unscrew the screw in a counter-clock direction.







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