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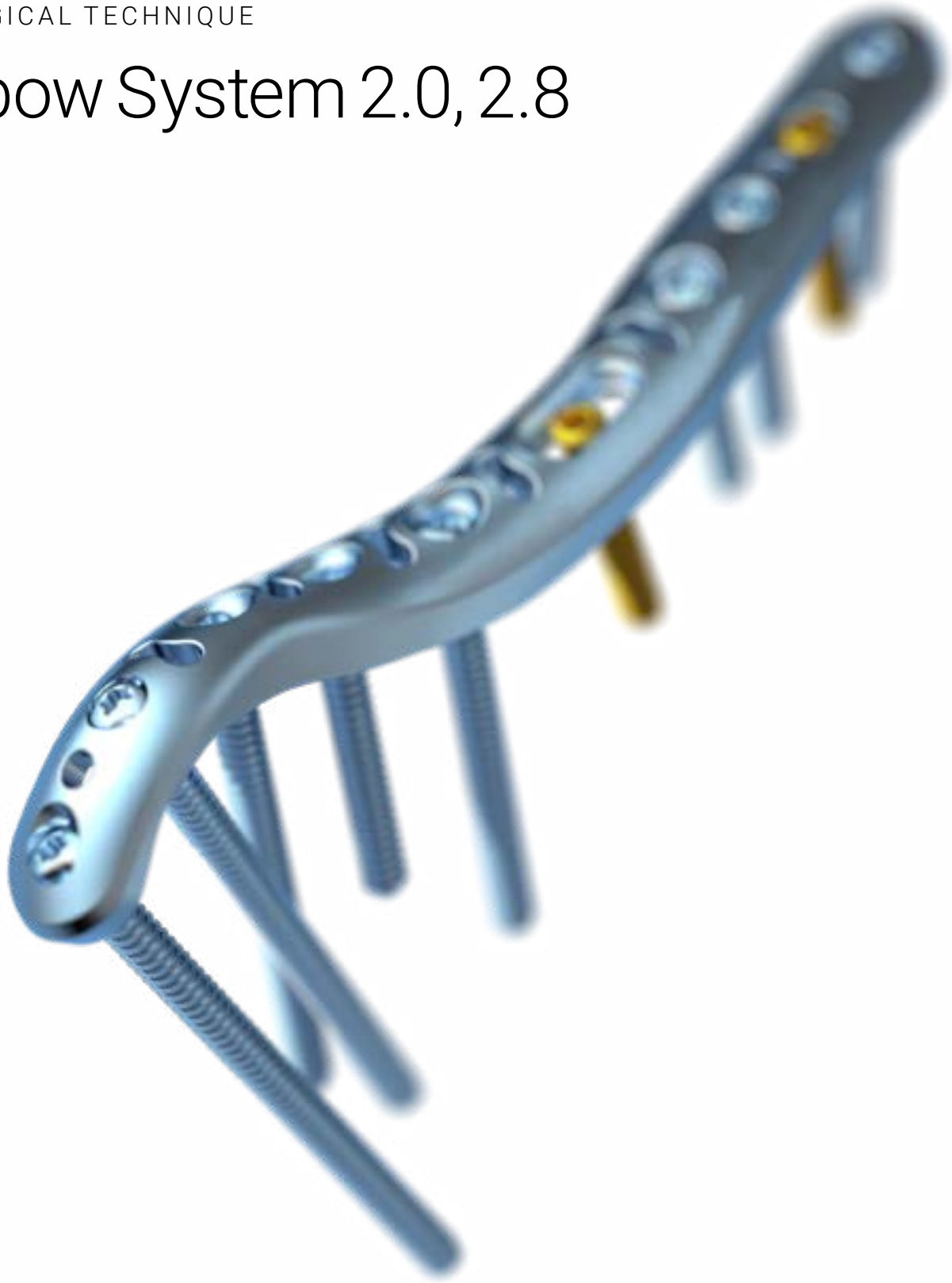
PRECISION IN FIXATION

SURGICAL TECHNIQUE

Elbow System 2.0, 2.8



APTUS Elbow

Contents

For further information regarding the APTUS product line visit www.medartis.com

Introduction

Product Materials

Plates, Screws and Washers
cpTi (ASTM F67), Ti6Al4V (ASTM F136)

K-Wires
Stainless steel (ASTM F138)

Instruments
Stainless steel, aluminum, aluminum alloy, cpTi (ASTM F67), Nitinol, PA, PEEK, POM, PP, PPSU, PTFE, silicone

Containers
Stainless steel, aluminum alloy, PEEK, PP, PPSU, silicone

Indications

APTUS Elbow
Fractures and osteotomies of the bones of the elbow

- Proximal radius plates
  - fractures and osteotomies of the proximal radius
- Distal humerus plates
  - fractures, osteotomies and non-unions of the distal humerus
- Proximal ulna plates
  - fractures and osteotomies of the proximal ulna

Contraindications

- Preexisting or suspected infection at or near the implantation site
- Known allergies and/or hypersensitivity to implant materials
- Inferior or insufficient bone quality to securely anchor the implant
- Patients who are incapacitated and/or uncooperative during the treatment phase
- Growth plates are not to be blocked with plates and screws

Specific Complications

Specific complications that may be associated with the fixation of proximal ulna fractures include:

- early osteoarthritis

Color Coding

System Size	Color Code
2.0	Blue
2.8	Orange

Plates and Screws
Special implant plates and screws have their own color:

Implant plates blue	TriLock plates (locking)
Implant screws gold	Cortical screws (fixation)
Implant screws blue	TriLock screws (locking)

Possible Combination of Plates and Screws

Plates and screws can be combined within one system size:

2.0 TriLock Plates
2.0 Cortical Screws, HexaDrive 6
2.0 TriLock Screws, HexaDrive 6
2.3 Cortical Screws, HexaDrive 6

2.8 TriLock Plates
2.8 Cortical Screws, HexaDrive 7
2.8 TriLock Screws, HexaDrive 7
2.8 Lag Screws, HexaDrive 7

Symbols

HexaDrive

TriLock (locking technology)

System Overview

The plates of the APTUS Elbow System 2.0, 2.8 are available in different designs and various plate lengths. For the complete implant portfolio, please refer to chapter "Appendix".

2.0 Radial Head Plates

A-4656.68
Rim plate

A-4656.69
Buttress plate

2.0 Coronoid Plates

A-4656.80/81
Left and right

2.8 Olecranon Plates

A-4856.01
Tension plate

A-4856.12/15
Straight
double plates

A-4856.10/13 left

A-4856.11/14 right

Curved double plates

2.8 Dorsal Olecranon Plates

A-4856.91–96S
Extended plates

A-4856.81–84
Medium plates

A-4856.61–72S
Standard plates

2.8 Distal Humerus Plates

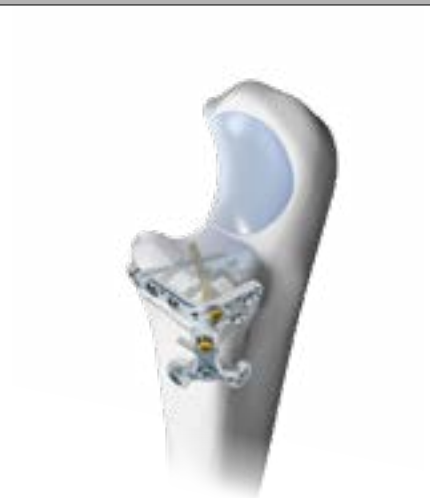
A-4856.29–34
Medial plates
Left and right

A-4856.39–44
Lateral plates
Left and right

A-4856.49–54
Posterolateral plates
Left and right

Treatment Concept

The table below lists typical clinical findings which can be treated with the implants of the APTUS Elbow System 2.0, 2.8.

Radial Head		
		
Fracture type	Complex and/or comminuted fractures of the radial head requiring subchondral support.	Osteotomies and fractures in the neck region of the radial head, particularly impacted fractures requiring buttressing. This plate shape allows a combination with isolated headless compression screws outside the plate for additional subchondral support.
Plate type recommended	2.0 Radial Head Rim Plate A-4656.68	2.0 Radial Head Buttress Plate A-4656.69
Proximal Ulna		
		
Fracture type	Fractures of the coronoid in which internal fixation with a plate is indicated. Buttressing and fixation of the sublime tubercle.	
Plate type recommended	2.0 Coronoid Plates A-4656.80/81	

Proximal Ulna				
				
Fracture type	Fractures and osteotomies of the proximal ulna with interfragmentary support.	Complex distal olecranon fractures without interfragmentary support.	Complex proximal olecranon fractures without interfragmentary support.	Complex olecranon fractures without interfragmentary support. Monteggia fractures, Monteggia-like lesions
Plate type recommended	2.8 Olecranon Tension Plate A-4856.01	2.8 Straight Double Plates A-4856.12/15	2.8 Curved Double Plates A-4856.10/11/13/14	2.8 Dorsal Olecranon Plates A-4856.61–72S, A-4856.81–84, A-4856.91–96S
Distal Humerus				
Examples for plate combinations	180° configuration: Combination of a medial (A-4856.29–34) and a lateral (A-4856.39–44) 2.8 Distal Humerus Plate		90° configuration: Combination of a medial (A-4856.29–34) and a posterolateral (A-4856.49–54) 2.8 Distal Humerus Plate	
				

Per AO/OTA classification, typical clinical findings in the distal humerus can be treated with the APTUS distal humerus plates as suggested in the table below.

AO/OTA Classification	Medial Plate	Lateral Plate	Posterolateral Plate	180° Configuration	90° Configuration
13A2.2					
13A2.3					
13A3.1					
13A3.2					
13B1.1					
13B1.2					
13B1.3					
13B2.1					
13B2.3					
13B3.3					
13C1					
13C2					
13C3					

Primary recommendation

Possible

The above-mentioned information is a recommendation only. The operating surgeon is solely responsible for the choice of the suitable implant for the specific case.

Instrument Application

General Instrument Application

Sizing Templates

Sizing templates facilitate the intraoperative selection of the appropriate implant.
Sizing templates for the 2.8 TriLock olecranon plates are available according to chapter “Appendix”.

The sizing templates feature symbols that indicate the type of the screw hole and its position on the respective implant:

- for a TriLock screw hole (locking) using a TriLock or a cortical screw
- for a TriLock^{PLUS} screw hole (locking/compression) using a TriLock or a cortical screw

Sizing template with TriLock screw hole symbols

The article number of the sizing template (e.g. A-4856.11TP) corresponds to the article number of the sterile implant (e.g. A-4856.11S). The suffix TP stands for template.

A-4856.11TP
Template for A-4856.11S

Use appropriate K-wires to temporarily fix the sizing template to the bone, if necessary.

Notice
Do not implant sizing templates.
Do not bend or cut sizing templates.

Bending

If required, the plates can be bent with the plate bending pliers.

There are various options available for this.

Warning
Wrong bending of the plate may lead to impaired functionality and postoperative construct failure.

A-2040
1.2–2.3 Plate Bending Pliers, with Vario Pin

The plate bending pliers have two different pins to protect the locking holes of flat and curved plates during the bending process.

Plate bending pliers with Vario pin (A-2040):
The curved radial head plates and the coronoid plate can be bent with the plate bending pliers with Vario pin (A-2040).

Plate bending pliers with pins (A-2047):
The flat olecranon plates and the lateral flap of the postero-lateral distal humerus plates can only be bent with the plate bending pliers with pins (A-2047).

A-2047
2.0–2.8 Plate Bending Pliers, with Pins

The plate bending pliers with Vario pin/pins are always used in pairs.

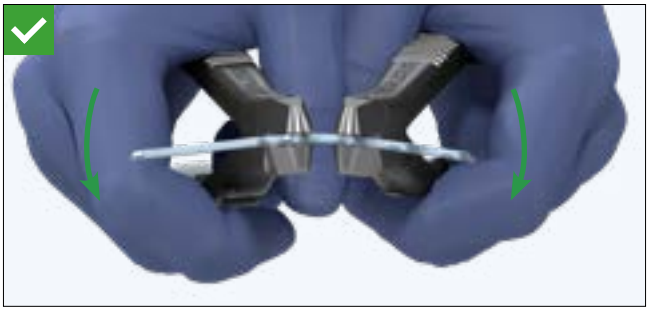
The labeled side of the plate must always face upward («UP») when inserting the plate into the bending pliers.

When bending a flat plate (olecranon plate), the plate bending pliers with pins must be held so that the letters «F – FLAT PLATE THIS SIDE UP» are legible from above. This ensures that the plate holes are not damaged.

Warning
While bending, the plate must always be held at two adjacent holes to prevent contour deformation of the intermediate plate hole.

When bending the flap of the posterolateral plate, the plate bending pliers with pins must be held so that the letters «F – FLAT PLATE THIS SIDE UP» are legible from above. This ensures that the plate holes are not damaged.

Warning
Do not bend the plate by more than 30°. Bending the plate further may deform the plate holes and may cause the plate to break postoperatively.



Warning
Repeatedly bending the plate in opposite directions may cause the plate to break postoperatively. Always use the provided plate bending pliers or plate bending irons to avoid damaging the plate holes. Damaged plate holes prevent correct and secure seating of the screw in the plate and increase the risk of system failure.

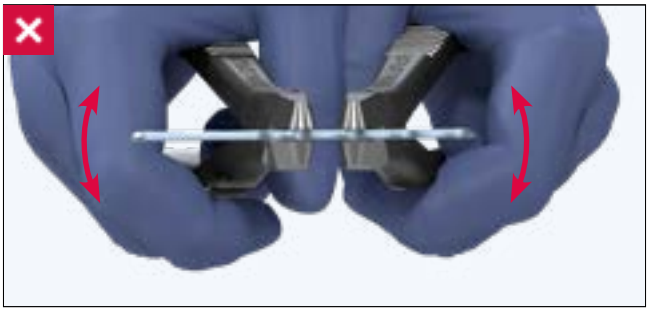
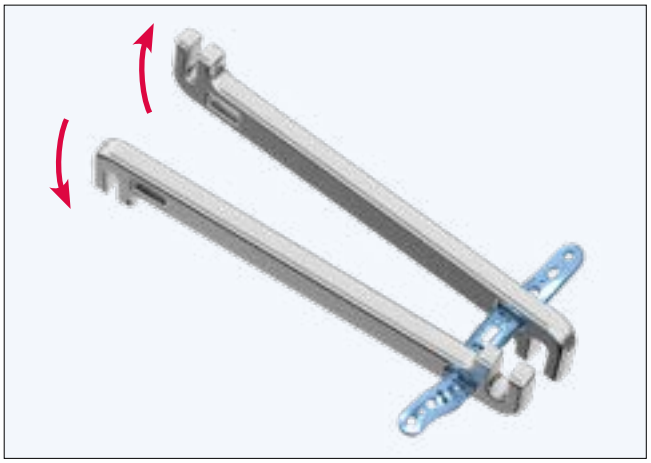


Plate Bending Irons Elbow (A-2090, A-2093)

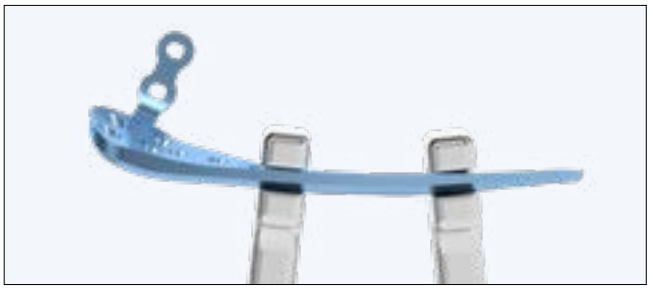
With the help of the plate bending irons (A-2090), the distal humerus plates can be twisted or bent out of the plate plane.

A-2090
Plate Bending Iron Distal Humerus

The medial and lateral distal humerus plates are to be bent in the open slits «med» and «lat», respectively, out of the plate plane and to be twisted in the closed slits «med» and «lat», respectively.

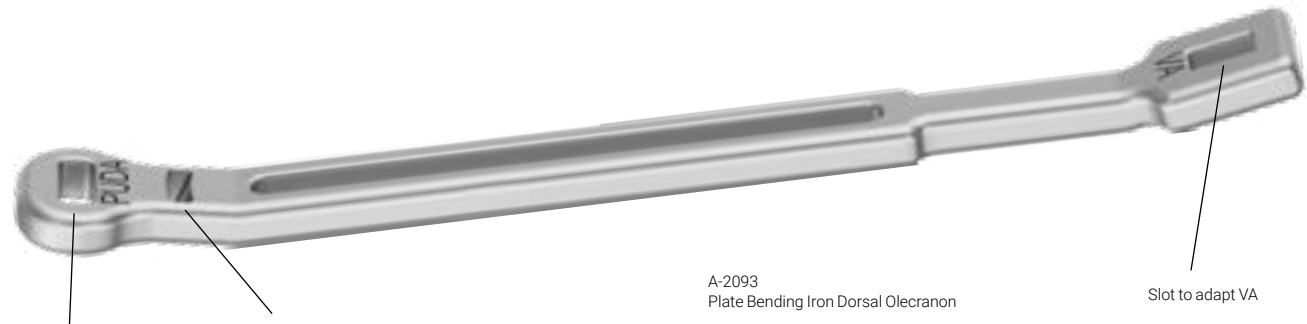


The posterolateral distal humerus plates are both to be bent and twisted in the open slit «post-lat».



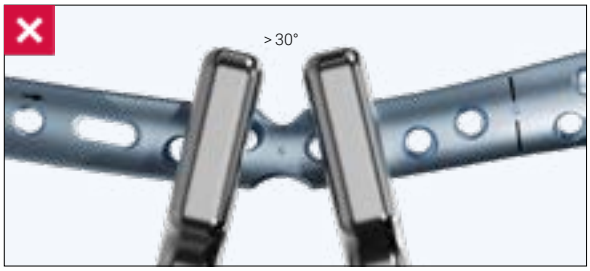
The bending irons for the dorsal olecranon plates (A-2093) are designed to adapt the varus angle (VA) and the proximal ulna dorsal angulation (PUDA) in the respective bending zones of the plates.

The proximal end of the extended dorsal olecranon plates (A-4856.91–96S) can also be bent with a dedicated slot in the bending iron.



Warning
While bending, the plate must always be held at two adjacent holes to prevent contour deformation of the intermediate plate hole.

Warning
Do not bend the plate by more than 30°. Bending the plate further may deform the plate holes and may cause the plate to break postoperatively.



Warning
Repeatedly bending the plate in opposite directions may cause the plate to break postoperatively. Always use the provided plate bending pliers or plate bending irons to avoid damaging the plate holes. Damaged plate holes prevent correct and secure seating of the screw in the plate and increase the risk of system failure.

Drilling

Color-coded twist drills are available for every APTUS system size. All twist drills are color-coded with a ring system.

System size	Color Code
2.0	Blue
2.8	Orange

A-3434

A-3832

A-3837

Core hole drills = one colored ring

There are two different types of twist drills for every system size: the core hole drills are characterized by one colored ring, the gliding hole drills (for lag screw technique) are characterized by two colored rings.

A-3431

A-3834

Gliding hole drills = two colored rings

Warning

The twist drill must always be guided by the corresponding drill guide (A-2620 or A-2820 or A-2026) or the self-holding drill sleeve (A-2826). This prevents damage to the screw hole and protects the surrounding tissue from direct contact with the twist drill. The drill guide also serves to limit the pivoting angle.

A-2620
2.0/2.3 Drill Guide

A-2820
2.8 Drill Guide

A-2026
2.5/2.8 Drill Guide, TriLock^{PLUS}

A-2826
2.8 Drill Sleeve, Self-Holding

The end with one colored bar of the double-ended drill guide (A-2620 or A-2820) can be used for all screw holes and for the insertion of independent screws (e.g. fragment fixation with screws alone).

The end marked with the two circles of the drill guide for TriLock^{PLUS} (A-2026) can be used for all screw holes. The other end marked with the arrow is used for the TriLock^{PLUS} holes only.

A-2026
2.5/2.8 Drill Guide, TriLock^{PLUS}

The self-holding drill sleeve (A-2826) can be locked with a clockwise turn in the TriLock holes of the plate (no more than ± 15°). It thus performs all the functions of a drill guide without the need to be held.

A-2826
2.5/2.8 Self-Holding Drill Sleeve

Warning
For TriLock plates ensure that the screw holes are predrilled with a pivoting angle of no more than ± 15°. For this purpose, the drill guides feature a limit stop of ± 15°. A predrilled pivoting angle of >15° no longer allows the TriLock screws to correctly lock in the plate.

Assigning the Screw Length

The depth gauges (A-2032 for 2.0 screws and A-2836 for 2.8 screws) are used to assign the ideal screw length for use in monocortical or bicortical screw fixation of TriLock screws and cortical screws.

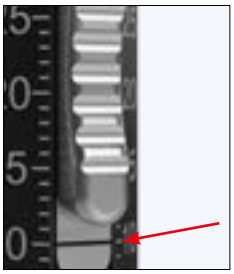
A-2032
2.0/2.3 Depth Gauge

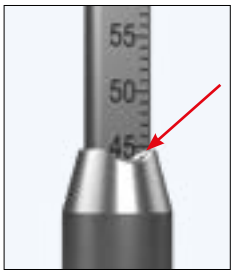
A-2836
2.8 Depth Gauge

Retract the slider of the depth gauge.
The caliper of the depth gauge has a hooked tip that is either inserted to the bottom of the hole or is used to catch the far cortex of the bone. When using the depth gauge, the caliper stays static, only the slider is adjusted.

To assign the screw length, place the distal end of the slider onto the implant plate or directly onto the bone (e.g. for fracture fixation with lag screws).

The ideal screw length for the assigned drill hole can be read on the scale of the depth gauge.





Thread Preparation with the Tap

Caution
All APTUS screws are self-tapping. In the case of very hard bone, especially in the shaft region of the distal humerus, it may be necessary to use the 2.8 tap (A-3839) to reduce the insertion torque of the 2.8 screws and to prevent fragment dislocation.

An unusually high resistance during the drilling of the core hole and/or an unusually high insertion torque of the screw can be a sign of a particularly hard bone requiring prior tapping.

After drilling a core hole with a 2.8 core hole drill (A-3832 or A-3837, one orange ring), create a thread for the screw using the 2.8 tap (A-3839) together with the handle (A-2070, A-2073, A-2078 or A-2079).

Assign the screw length and insert the screw with the corresponding screwdriver (screwdriver blade A-2013 with handle A-2070, A-2073, A-2078 or A-2079).

A-3839
2.8 Tap

A-2070
Handle with Quick Connector, AO

A-2073
Handle with Quick Connector, AO

A-2078
Handle with Quick Connector, AO

A-2079
Ratcheting Handle with Quick Connector, AO

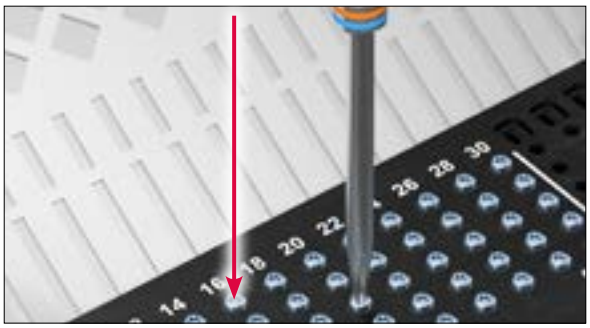
Screw Pick-Up

The screwdriver (A-2610) and the screwdriver blade (A-2013) feature the HexaDrive self-holding system.

A-2610
2.0/2.3 Screwdriver, HD6, Self-Holding

A-2013
2.5/2.8 Screwdriver Blade, HD7, AO

To remove the screws from the implant container, insert the appropriately color-coded screwdriver perpendicularly into the screw head of the desired screw and pick up the screw with axial pressure.



Notice
The screw will not hold without axial pressure.

Caution
Vertically extract the screw from the compartment. Picking up the screw repeatedly may lead to permanent deformation of the self-retaining area of the HexaDrive inside the screw head. Therefore, the screw may no longer be able to be picked up correctly. In this case, a new screw has to be used.

Notice
Check the screw length and diameter on the scale of the measuring module. The screw length is determined at the end of the screw head.

Ratcheting Handle

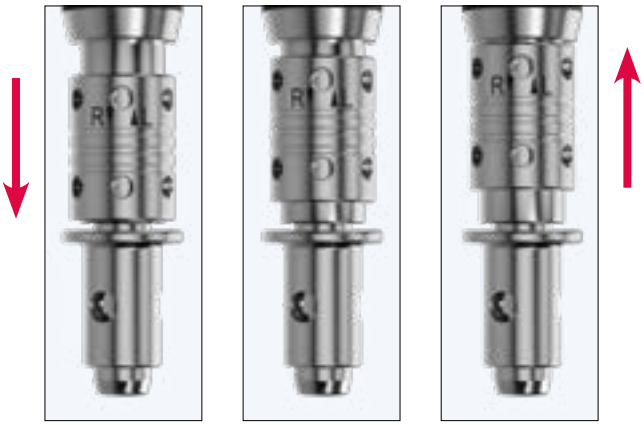
The screwdriver handle (A-2079) has a ratcheting function. The ratcheting mechanism can be adjusted by moving the sliding sleeve to the position A, B or C.

A-2079
Ratcheting Handle with Quick Connector, AO

Position A
Clockwise rotation, insert the screw

Position B
Neutral position, ratcheting mechanism is blocked

Position C
Counterclockwise rotation, explant or loosen the screw



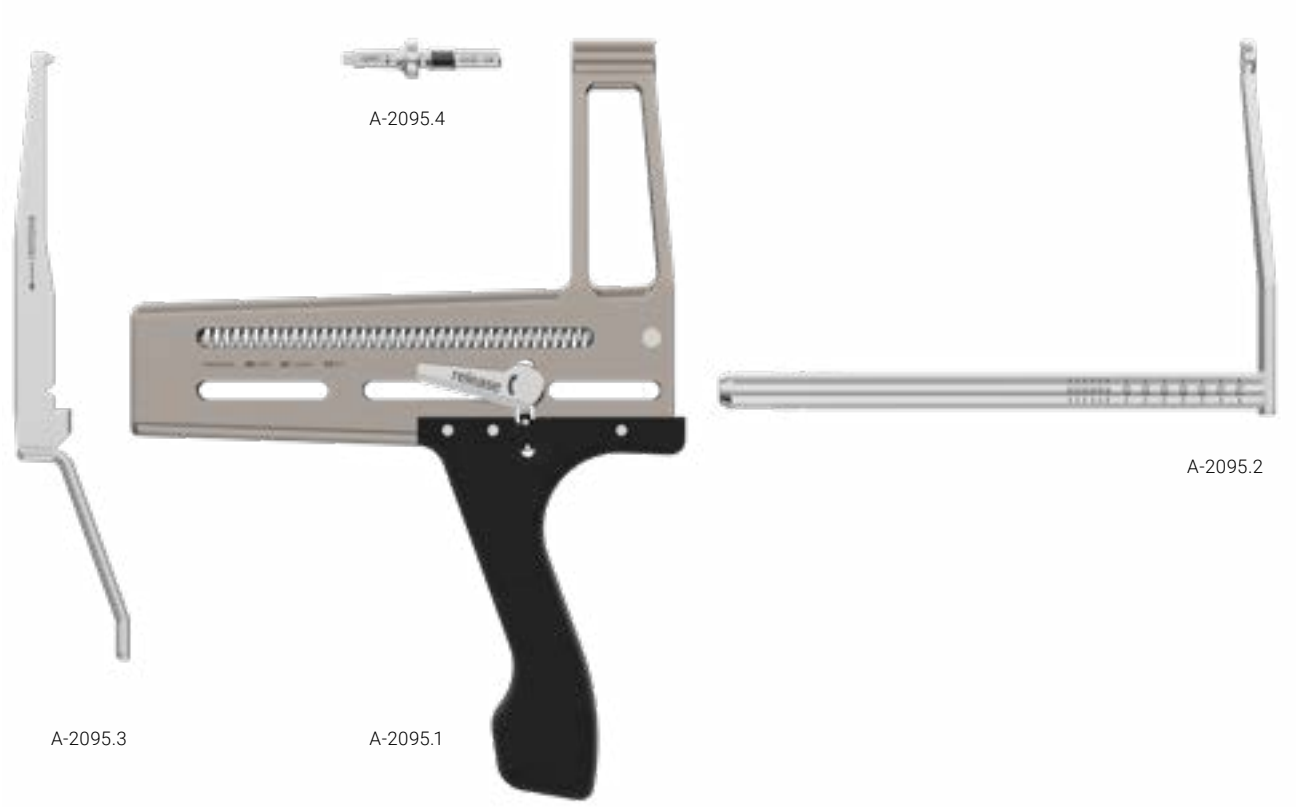
Position A | Position B | Position C

Specific Instrument Application

Aiming Device for Distal Humerus Plates

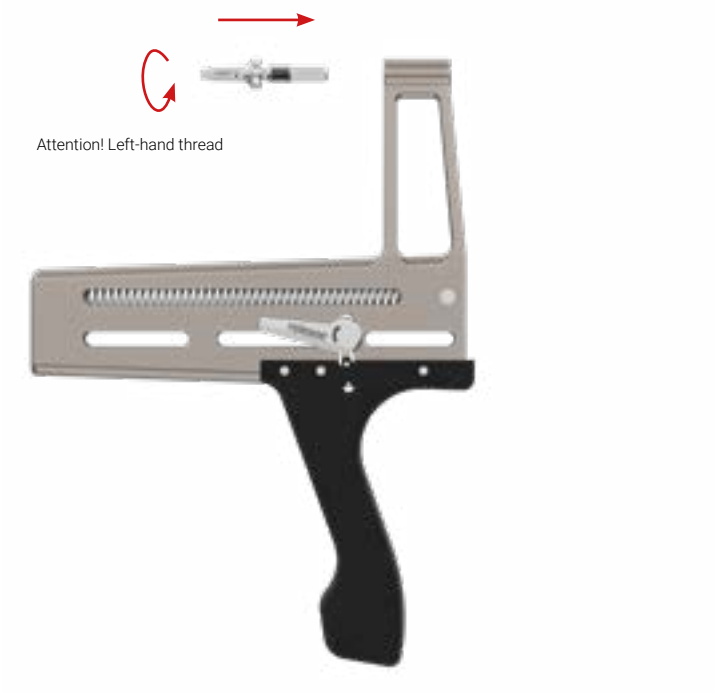
The aiming device facilitates the placement of long bicondylar screws in particular. With the device, the exit point of the twist drill can be determined before drilling.
It is used with the long twist drill (A-3837) which is stopped by the device when reaching the targeted exit point.

Assembly of the aiming device
The aiming device consists of the components A-2095.1–4 which are stored individually in the container module.

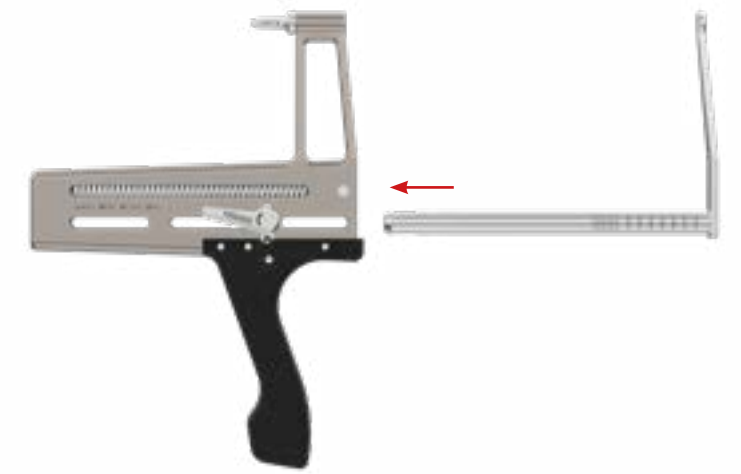


Article numbers of the components:
A-2095.1 Frame with handle
A-2095.2 Axle with drill stop
A-2095.3 Trigger with target tip
A-2095.4 Drill guide 2.8

Step 1
Insert the drill guide 2.8 (A-2095.4) into the frame with handle (A-2095.1).



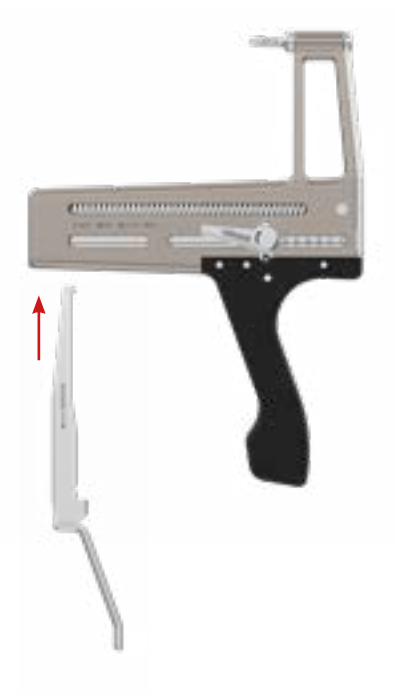
Step 2
Slightly lift the handle “Release” to insert the axle with drill stop (A-2095.2).



Step 3
Insert the trigger with target tip (A-2095.3).

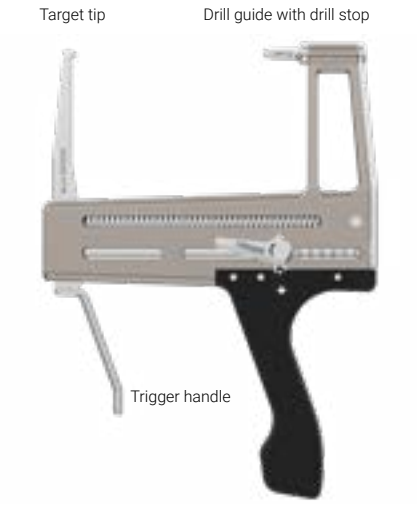
The axle with drill stop must be completely inserted until it sits flush. A slight click should be heard at the end of the insertion of the trigger with target tip.

Also refer to “Assembly/Disassembly Instructions” at ifu.medartis.com.



Drilling through the aiming device

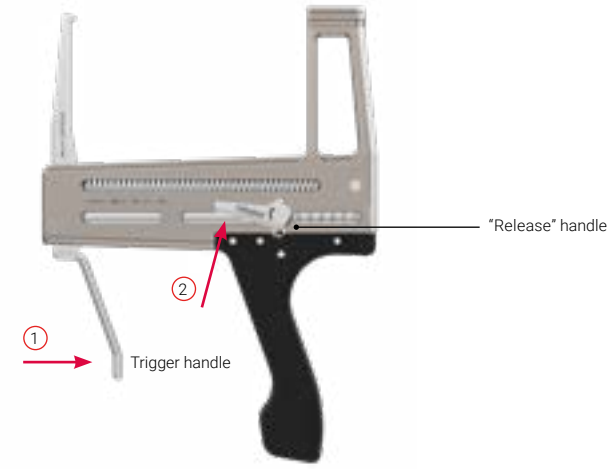
Position the target tip of the aiming device at the place where the screw should exit. Now position the drill guide of the aiming device onto the screw hole in which the screw should be inserted by pulling the trigger handle. This reduces the distance between the target tip and the drill guide until both are in contact with the bone or the plate.



The device also exerts a slight compression on the fracture.

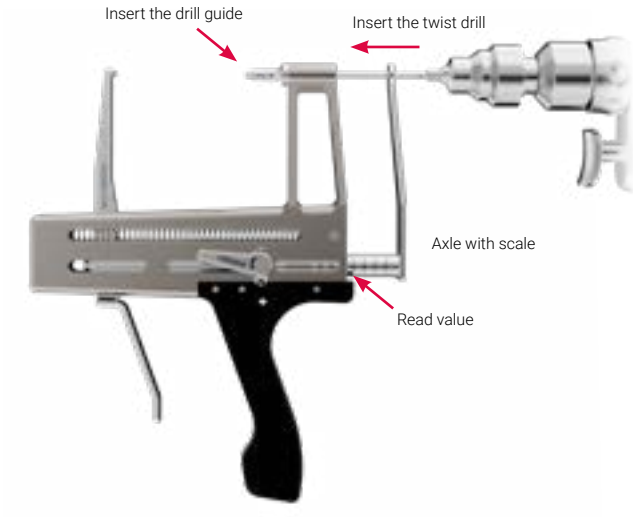
By pulling the trigger handle, the distance between the target tip and the drill guide is reduced.

By lifting the “Release” handle the distance is increased.



Insert the twist drill (A-3837) into the drill guide of the aiming device and drill the hole. The drill bit stops automatically just before it reaches the target tip.

When the device is in position on the bone and the plate, the screw length can be read on the scale on the axle.



Surgical Techniques

General Surgical Techniques

Lag Screw Techniques

Two lag screw techniques can be used, depending on the implant.

Warning
Incorrect application of the lag screw technique may result in postoperative loss of reduction.

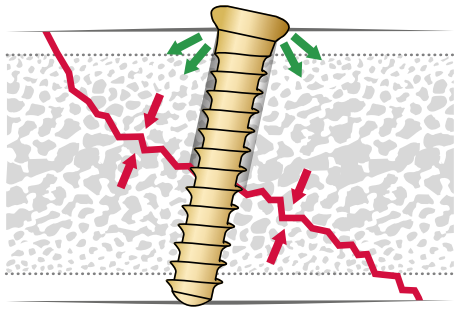
Lag Screw Technique Using Cortical Screws

1. Drilling the gliding hole
Drill the gliding hole using the twist drill marked with two rings (A-3431 Ø 2.1 mm or A-3834 Ø 2.9 mm) in combination with the end of the drill guide (A-2620 or A-2820) labeled with "LAG". Drill perpendicular to the fracture line.

Do not drill further than the fracture line.

2. Drilling the core hole
Insert the other end of the drill guide into the drilled gliding hole and use the twist drill for core holes with one ring (A- 3434 Ø 1.6 mm, A-3832 Ø 2.35 mm, A-3837 Ø 2.35 mm) to drill the core hole.

3. Compressing the fracture
Compress the fracture with the corresponding cortical screw.



4. Optional steps before compression
If required, use the countersink (A-3835) to create a recess in the bone for the screw head.

Caution
Use the handle (A-2070, A-2073, A-2078 or A-2079) instead of a power tool to reduce the risk of countersinking too far through the near cortex.

Lag Screw Technique Using Lag Screws

For lag screws (A-5830.xx, ∅ 2.8 mm) without thread in the shaft/neck, it is sufficient to drill a core hole using the drill guide and the core hole drill and to insert the screw.

A-5830.xx/1
2.8 Lag Screw, HexaDrive 7

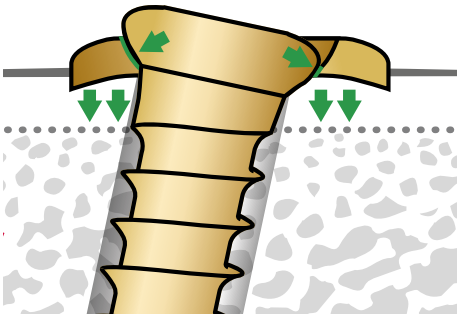
1. Drilling the core hole
Drill the core hole using the twist drill for core holes with one ring (A- 3434 ∅ 1.6 mm, A-3832 ∅ 2.35 mm, A-3837 ∅ 2.35 mm) in combination with the end of the drill guide (A-2820 or A-2026) or the self-holding drill sleeve (A-2826) marked with one colored bar. Drill perpendicular to the fracture line.

2. Compressing the fracture
Compress the fracture with the corresponding lag screw.

3. Optional steps before compression
If required, use the countersink (A-3835) to create a recess in the bone for the screw head.

Caution
Use the handle (A-2070, A-2073, A-2078 or A-2079) instead of a power tool to reduce the risk of countersinking too far through the near cortex.

Warning
If the cortical bone is soft, a washer (A-4700.70/1 concave or A-4750.70/1 biconcave) can be used for 2.8 cortical or lag screws in order to distribute the lag forces over a larger surface of the bone around the screw hole.



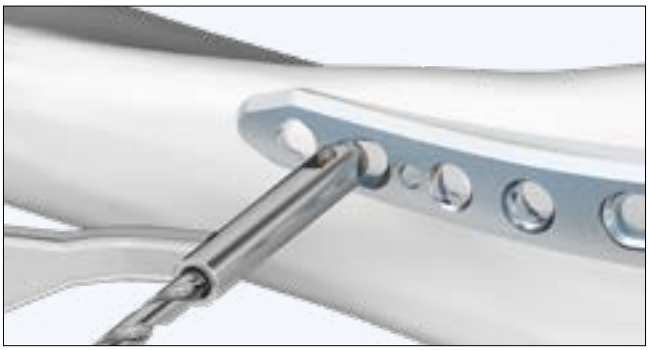
Use of the Compression Hole

In every distal humerus plate (A-4856.29–54), the second most proximal screw hole can be used as a compression hole. It can be used if compression is to be exerted on the fracture and allows for a maximum of 1.4 mm compression. If compression is not required, the screw hole can be used as a regular screw hole with a cortical screw (A-5800–xx).

Warning
Regardless of the use of the compression function of the hole, only cortical screws may be used in a compression hole.

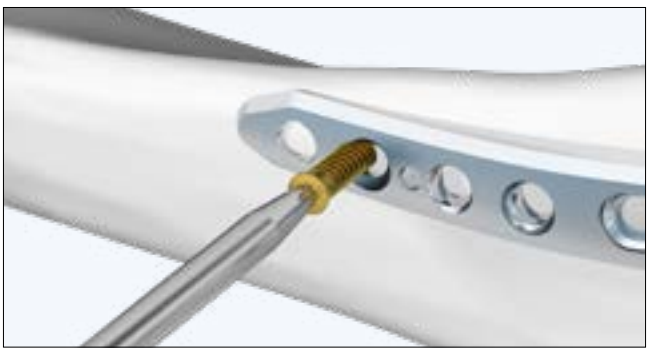
Before using the compression hole, make sure that the fragments distal to the fracture line are securely fixed to the plate.

Drill a core hole using the drill guide (A-2820 or A-2076) in the proximal part of the eccentric compression hole. Drill, assign the screw length and insert a cortical screw (A5800.xx) without tightening it.

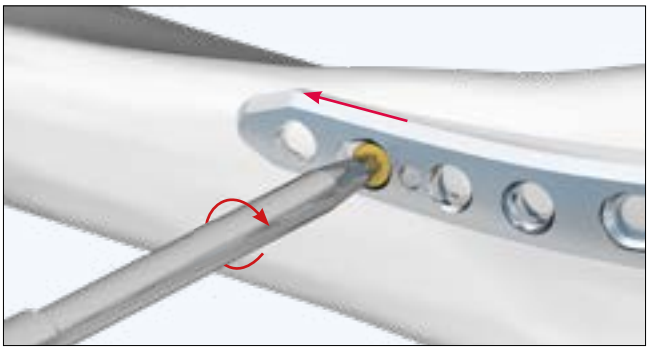


Warning
Correct compression is only achieved if the drill guide is inserted in a 90° angle into the plate.

Untighten the screw in the oblong hole and remove all temporary (olive) K-wires and screws proximal to the fracture line. Tighten the screw in the compression hole.



During the tightening of the screw in the compression hole, the screw head glides from the proximal part into the distal part of the eccentric hole, which moves the plate in proximal direction and exerts compression on the fracture.



TriLock^{PLUS}

TriLock^{PLUS} holes are available on APTUS 2.8 dorsal olecranon plates (except A-4856.61–62, A-4856.91–92).

TriLock^{PLUS} allows for 1 mm compression and angular stable locking in one step.

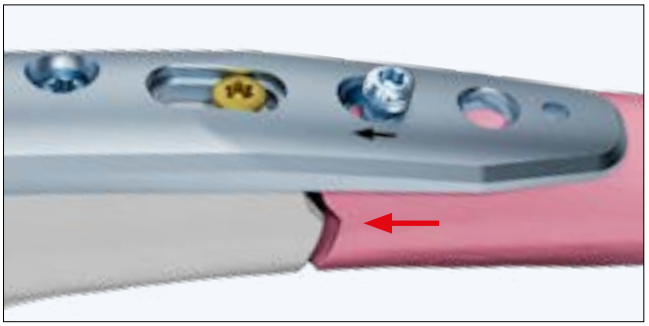
For this technique, a TriLock screw, the 2.5/2.8 drill guide TriLock^{PLUS} (A-2026) and a plate with a TriLock^{PLUS} hole are required. The TriLock^{PLUS} holes and the drill guide are both marked with an arrow indicating the direction of the compression. Before using a TriLock^{PLUS} hole, ensure that there is no fixation on the TriLock^{PLUS} side. Then fix the plate with at least one TriLock screw on the opposite side of the fracture or osteotomy line.

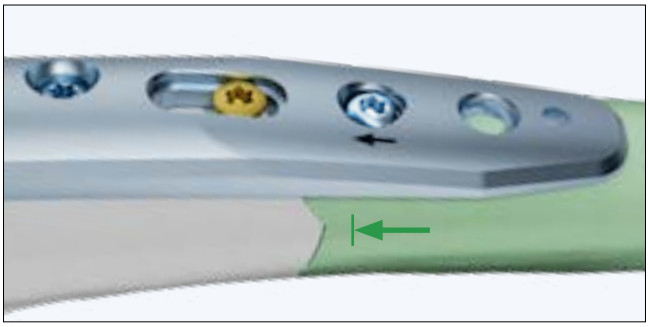
1. Positioning the drill guide in the plate
Following the direction of the compression, insert the 2.5/2.8 drill guide TriLock^{PLUS} perpendicular to the plate. The arrow on both the drill guide and the plate indicates the direction of the compression.

Warning
Correct compression is only achieved if the drill guide is inserted in a 90° angle into the plate.

2. Drilling through the drill guide TriLock^{PLUS}
Use the twist drill for core holes with one orange ring (A-3832) to completely drill through the bone (bicortically).

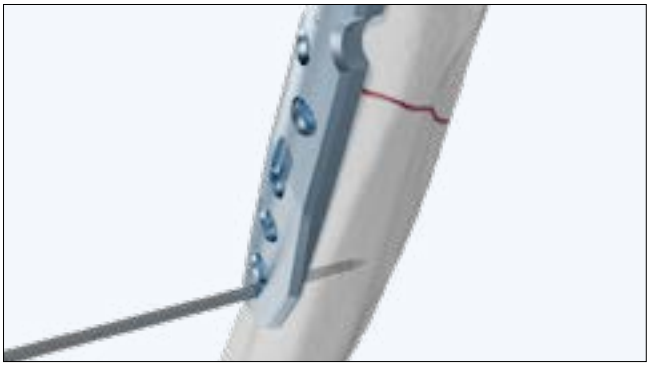
3. Inserting the screw and locking in final position
Insert a TriLock screw into the predrilled hole. Axial compression starts as soon as the screw head touches the plate. The final position is reached when the screw is locked into the TriLock^{PLUS} hole.





TriLock^{PLUS} holes can also be used as conventional TriLock holes allowing for multidirectional (±15°) and angular stable locking with TriLock screws or for the insertion of cortical screws. For conventional drilling, use the respective end of the drill guide (A-2820, see also chapter “Drilling”).

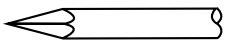
Temporary Plate Fixation



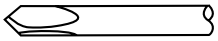
Temporary fixation using K-wires

After reducing the fracture, temporary fixation of the plates can be performed using K-wires. The K-wires can be inserted through the K-wire holes in the plate to either reduce fracture fragments against the plate or temporarily fix the plate to the bone.

The K-wires are available with lancet or trocar tip.

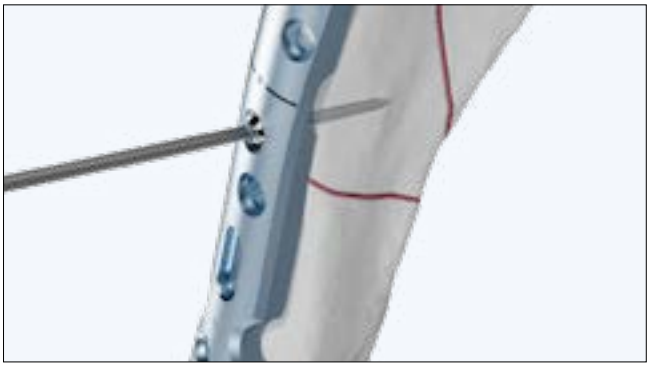


K-wire with trocar tip



K-wire with lancet tip

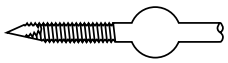
Plate Type	K-Wire ∅	K-Wire
2.0 Coronoid Plate 2.0 Radial Head Plates	1.2 mm	A-5040.21 trocar A-5042.21 lancet
2.8 Olecranon Plates	1.6 mm	A-5040.41 trocar A-5042.41 lancet
2.8 Distal Humerus Plates	1.8 mm	A-5040.51 trocar A-5042.51 lancet



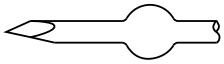
Temporary fixation using olive K-wires

The olive K-wires can be inserted through the screw holes or through the K-wire holes in the plate.
Insert the olive K-wire into the hole and slow down the insertion once the olive comes in contact with the plate.

The K-wires with olive are available in a threaded and a non-threaded option.



Olive K-wire with threaded tip



Olive K-wire with non-threaded tip

Plate Type	K-Wire ∅	K-Wire
2.0 Coronoid Plate 2.0 Radial Head Plates	1.2 mm	A-5045.21/1* Olive 10 mm, with thread A-5046.21/1* Olive 10 mm, no thread
2.8 Olecranon Plates 2.8 Distal Humerus Plates	1.6 mm	A-5045.41/1* Olive 10 mm, with thread A-5046.41/1* Olive 10 mm, no thread

* Not available in all countries

Caution

When using threaded olive K-wires, overinsertion can lead to stripping of the bone threads and loosening of the temporary fixation.

Specific Surgical Techniques

2.0 Radial Head Plates

A-4656.68 and A-4656.69

A-4656.68
Radial Head Rim plate

A-4656.69
Radial Head Buttress Plate

1. Positioning the plate

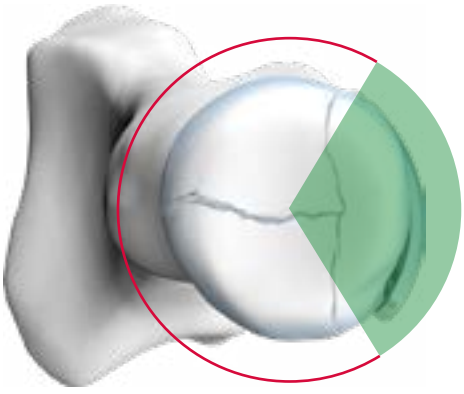
After reducing the fracture, select the appropriate radial head plate (A-4656.68 or A-4656.69) according to the fracture pattern.

If required, bend the plate with the plate bending pliers (A-2040) to achieve an adequate fit to the individual shape of the bone.

Caution

The plates should be placed in the so-called safe zone whenever the fracture pattern allows it.

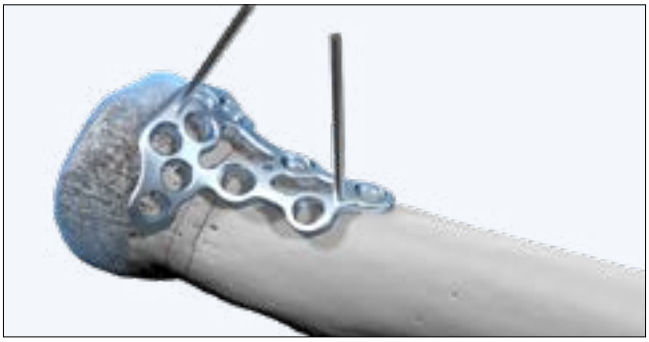
The safe zone is the part of the radial head that does not come into contact with the incisura radialis of the proximal ulna during forearm rotation. It measures about 110° of the radial head and has thinner, yellowish cartilage.
With the forearm in the neutral position, the center of the safe zone is located 10° anteriorly to the lateral side of the radial head. *



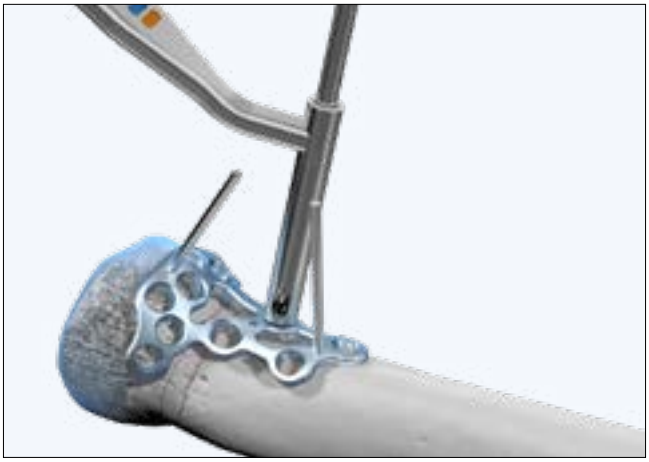
Safe Zone
View on the articulation of the radial head from proximal.
Right radius in neutral position.

* K. J. Burkhart, K. Wegmann, J. Dargel, C. Ries, L. P. Mueller, «Treatment of radial head and neck fractures: in favor of anatomical reconstruction», 2012, Eur J Trauma Emerg Surg, 38:593–603

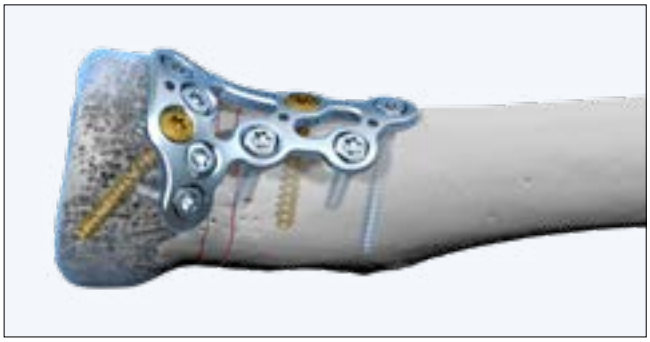
For temporary plate fixation, 1.2 mm K-wires (A-5040.21 or A-5042.21) or olive K-wires (A-5045.21/1 or A-5046.21/1) may be used.



2. Fixing the plate
Start the fixation with a cortical screw (A-5400.xx) in the shaft region. Drill, assign the screw length and insert the screw.
This screw allows to pull the plate against the bone in order to establish a close contact.



Repeat the steps above to fill the remaining screw holes with TriLock screws (A-5450.xx) or with cortical screws (A-5400.xx) wherever the fracture pattern requires it. Remove all (olive) K-wires.



Place at least three screws in the shaft and the proximal portion of the plate in order to achieve sufficient stability. A distribution of the screws into the head utilizing both proximal screw rows increases the stability of the fixation.

Angular stable screws generally provide a higher stability of the construct, especially in the case of a comminuted fracture or poor bone quality.

The multidirectionality of the locking (±15°) and non-locking screws allows to individually address each fragment and avoid screw collisions.

Warning
Check the subchondral position of the screws clinically and radiographically, especially when using the radial head rim plate (A-4656.68).

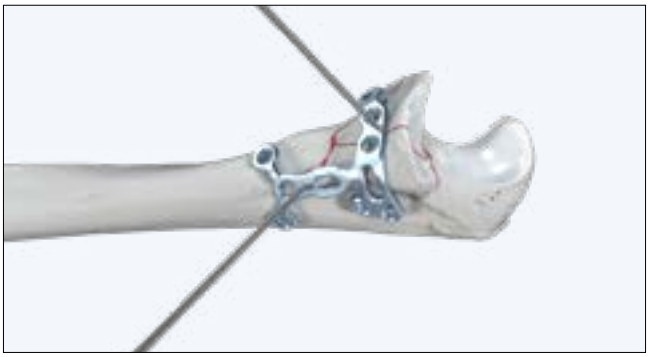
2.0 Coronoid Plates

A-4656.80 and A-4656.81

1. Positioning the plate

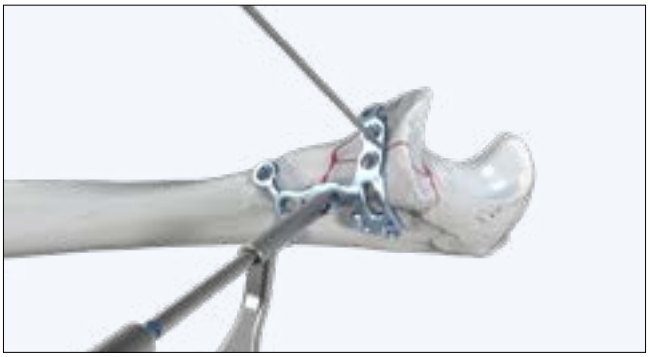
If required, bend the plate with the plate bending pliers (A-2040) to achieve an adequate fit to the individual shape of the bone.

For temporary plate fixation, 1.2 mm K-wires (A-5040.21 or A-5042.21) or olive K-wires (A-5045.21/1 or A-5046.21/1) may be used. Position the coronoid plate as proximal as possible. This allows for a subchondral fixation of the articular fragment by inserting screws in the proximal screw row.

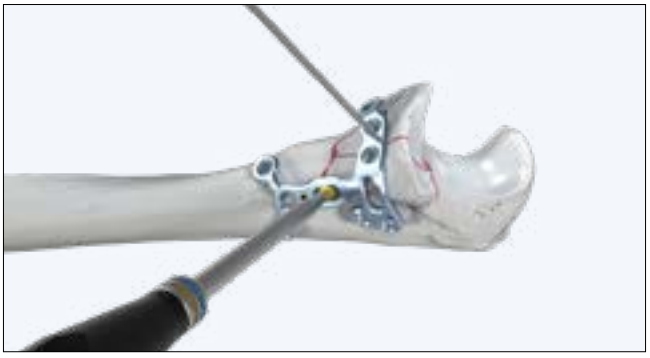


2. Fixing the plate

Start the fixation with a cortical screw (A-5400.xx) in the center of the distal oblong hole. Drill, assign the screw length and insert the screw.



Do not completely tighten the screw. It is thus possible to slightly adjust the plate position for further distal or proximal final plate positioning. Remove all (olive) K-wires in the fragment to be adjusted in case the plate position needs to be changed.



Correspondingly, fill the remaining screw holes with TriLock screws (A-5450.xx) or cortical screws (A-5400.xx) depending on the fracture pattern. Remove all (olive) K-wires.

Warning
Use intraoperative X-ray control to verify the subchondral position of the screws.

Recommendation
Depending on an anteromedial or medial Hotchkiss approach, either the anterior or the medial plate hole in the distal region can be used.

Recommendation
If insertion of a screw is not possible and the fracture allows for it, the proximal anterior arm can be used to buttress the fragment.

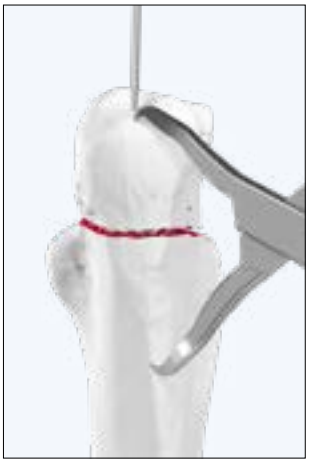
2.8 Olecranon Tension Plate

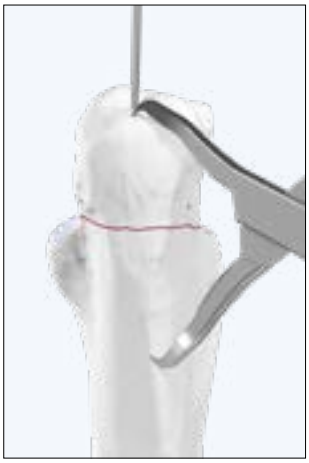
A-4856.01

1. Temporary fracture fixation

After reducing the fracture, a K-wire (for example 1.6 mm, A-5040.41 or A-5042.41) is used for temporary fixation. The K-wire is positioned in the middle of the olecranon tip and aimed to the anterior cortex of the ulna. After insertion of the K-wire use reduction forceps to exert compression on the fracture and to make sure that the fracture is completely reduced.

If necessary, drill a small hole in the distal cortex to securely anchor the distal tip of the reduction forceps away from the anticipated plate position.





2. Precontouring the plate

Contour the plate by hand so that the two proximal holes fit around the tip of the olecranon. The distal holes come to lie on both sides laterally to the dorsal rim of the proximal ulna.

Warning

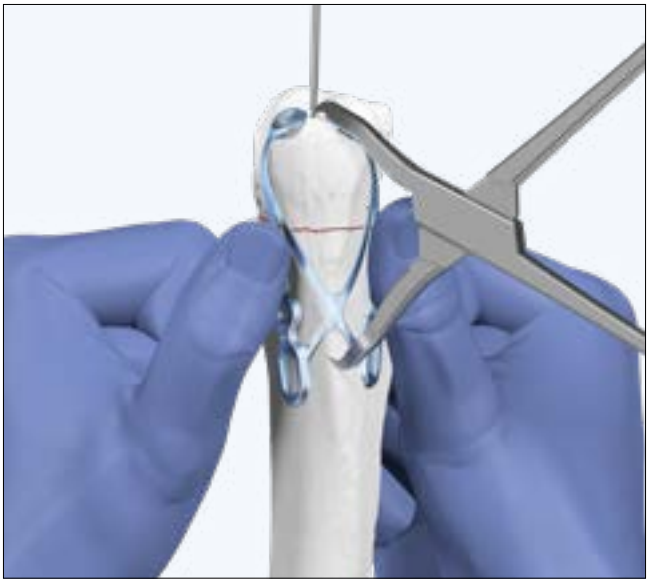
Repeatedly bending the plate in opposite directions may cause the plate to break.

3. Positioning the plate

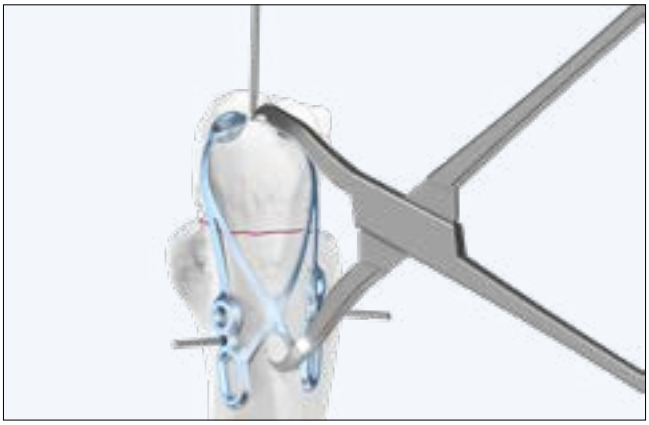
Make two small incisions into the triceps tendon on the olecranon and place the two proximal screw holes in direct contact with the bone of the proximal fragment. These incisions should be parallel to the muscle fibers.

Caution

Make sure that the plate lies tightly and symmetrically on the dorsal rim of the proximal ulna.



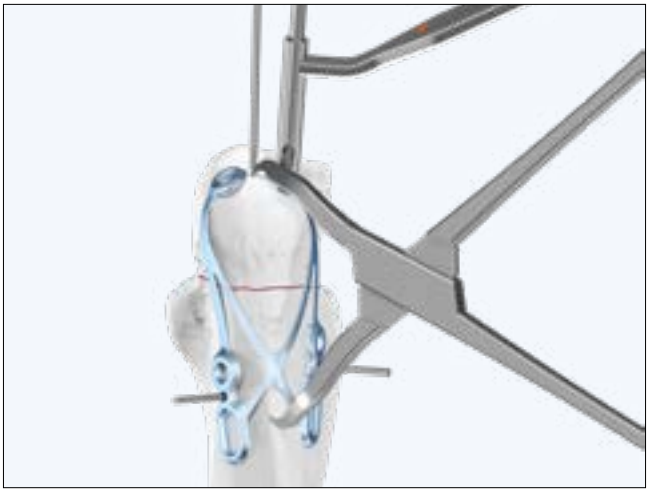
Temporarily fix the plate with two 1.6 mm K-wires (A-5040.41 or A-5042.41) or olive K-wires (A-5045.41/1 or A-5046.41/1) through the K-wire holes. This ensures that the plate remains centered on the dorsal edge of the ulna while inserting the long lag screws in the next steps.



4. Placing fracture-crossing screws
Two parallel, bicortical screws crossing the fracture are inserted in the proximal plate holes. The direction of these screws should be subchondral to the trochlear notch of the ulna, similar to the direction of the k-wires in classical tension band wiring.

Drill bicortically, assign the screw length and insert a lag screw (A-5830.xx) into the first proximal screw hole without fully tightening it.

Repeat the procedure with the second proximal screw hole.



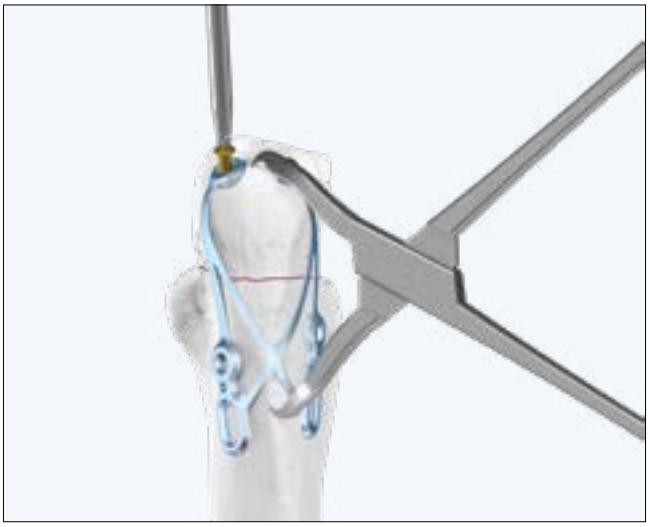
Warning
Use intraoperative X-ray control to verify the subchondral position of the screws.

Remove the two 1.6 mm (olive) K-wires.

5. Closing the fracture gap
Remove the central reduction K-wire.

Close the fracture gap by carefully tightening the two fracture-crossing lag screws and exert a slight compression on the fracture to complete the reduction.

Remove the reduction forceps.



Caution
Only when the plate lies flat on the bone, the function of the tension relief is secured.

6. Inserting the distal screws
Drill a core hole through the center of one of the oblong holes, assign the screw length and insert a cortical screw (A-5800.xx). Do not tighten the screw yet.

Caution
Make sure that the plate lies completely flat on the bone. If necessary, push the plate down with a finger to ensure an optimal fit.

To put the plate under tension, hook the pointed reduction forceps (A-7003) in the distal part of the oblong hole and engage the forceps crosswise on the other side of the dorsal rim of the ulna. Tighten the reduction forceps until the longitudinal plate bar lies flat on the ulna.

Tighten the screw.

Drill another core hole through the neighboring plate hole, assign the screw length and insert a TriLock screw (A-5850.xx) or a cortical screw (A-5800.xx).

Angular stable screws generally provide a higher stability of the construct.

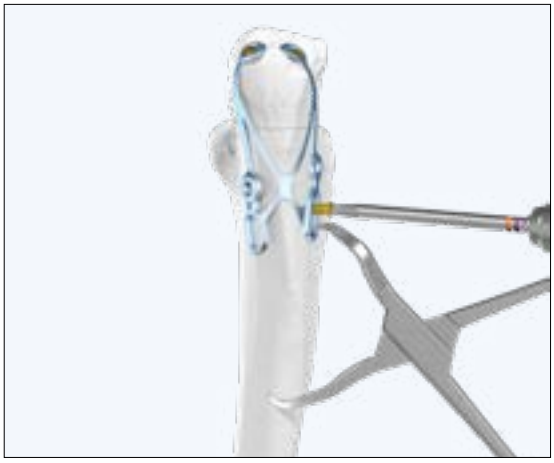
Warning
When drilling the core hole from the medial side towards lateral, make sure the proximal radioulnar joint is not perforated. This can be checked clinically and radiographically.

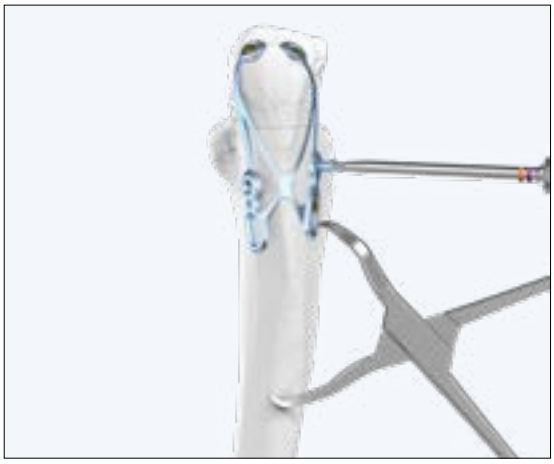
Remove the pointed reduction forceps.

Repeat these steps on the other side of the plate to complete plate fixation.

Warning
The multidirectionality of the locking (±15°) and non-locking screws allows to avoid screw collisions.

The small incisions in the triceps can be closed over the proximal screw holes.





2.8 Olecranon Double Plates

A-4856.10–A-4856.15

1. Selecting the plate

After reducing the fracture, select the appropriate pair of olecranon double plates (A-4856.10–15). If necessary, bend the plates with the bending pliers (A-2047) in order to achieve an adequate fit to the individual shape of the bone.

Warning

The olecranon double plates must be used as a pair. Using only one plate will not provide sufficient stability.

The curved olecranon double plates (A-4856.10/13 and A-4856.11/14) are intended for proximal fractures that require fixation with at least two screws in the tip of the olecranon.

The straight olecranon double plates (A-4856.12/15) are intended for more distal fractures that do not require fracture fixation around the tip of the olecranon.

A-4856.12/15
Straight plates

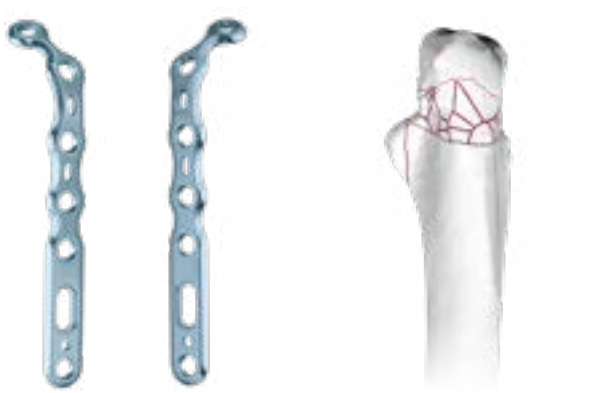
A-4856.10/13
Curved plates
Right

A-4856.11/14
Curved plates
Left

2. Positioning the plate
If the curved double plates are used, two different plate placements are possible:

In most cases, the plates are placed with the proximal plate holes pointing away from each other. With this orientation, the plates fit most anatomies and only a small incision in the triceps tendon in the direction of its fibers is required.

Alternatively, the plates can be positioned with the proximal plate holes pointing towards each other. This enables the placement of long, fracture-crossing screws.

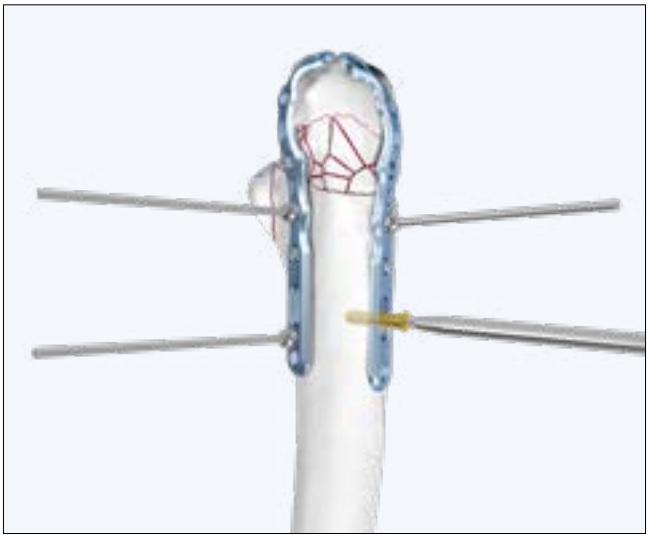


Caution
The plate orientation with the proximal holes pointing towards each other might not be possible with a narrow olecranon as the plates could touch or overlap. This placement requires a larger cut into the triceps tendon across its fibers.

Warning
A dissection of the insertions of the M. anconeus and the M. flexor carpi ulnaris may be required to place the plates on the sides of the dorsal rim of the ulna. The soft tissue flaps can be used to cover the implants after fixation of the plates.

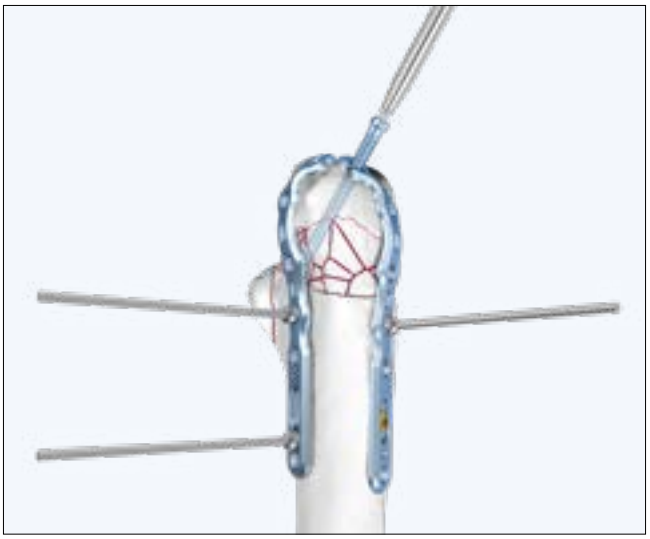
For temporary plate fixation, 1.6 mm K-wires (A-5040.41 or A-5042.41) or olive K-wires (A-5045.41/1 or A-5046.41/1) may be used.

3. Fixing the plate
Start the fixation of the first plate with a cortical screw (A-5800.xx) in the distal section of the oblong hole. Drill, assign the screw length and insert the screw.



Caution
In the case of very hard bone use the tap (A-3839) to reduce the insertion torque of the screw and to prevent fragment dislocation.

If long fracture-crossing screws are to be placed (proximal plate holes pointing towards each other) continue with a cortical screw or a TriLock screw (A-5850.xx) in the most proximal hole.



In case of a stable fracture with interfragmentary support, a fracture-crossing cortical screw (A-5800.xx) allows to pull the plate to the bone. A lag screw (A-5830.xx) additionally allows to compress the fracture. When using a cortical or a lag screw, slightly loosen the screw in the oblong hole, remove any possible (olive) K-wires, tighten the proximal screw and then retighten the screw in the oblong hole.
In case of a comminuted unstable fracture, a TriLock screw should be used, as applying compression on the fracture could narrow the joint.

Warning
Use intraoperative X-ray control to verify the subchondral position of the proximal screws.

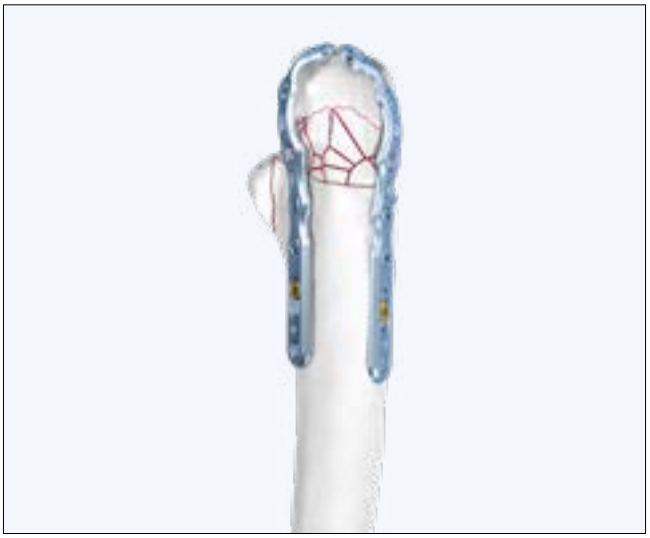
Repeat the steps above for the second plate.

Remove the (olive) K-wires.

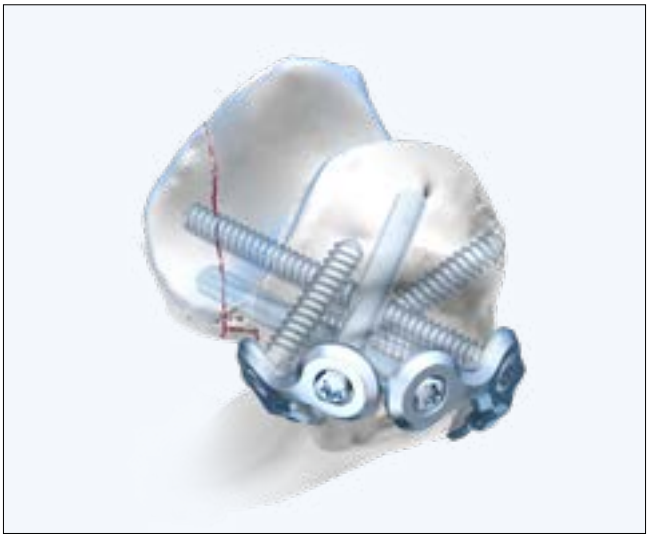
Fill the remaining screw holes with TriLock screws (A-5850.xx) or cortical screws (A-5800.xx) wherever indicated by the fracture pattern.

For each plate, set at least two TriLock screws distally and proximally to the fracture to ensure sufficient stability.

Warning
The multidirectionality of the locking (±15°) and non-locking screws allows to individually address each fragment and avoid screw collisions.



A fracture of the coronoid process that does not require fixation with a separate plate can be addressed with screws aiming towards the fragment.



Close the incisions of the muscle insertions over the plates and cover the implants as much as possible.

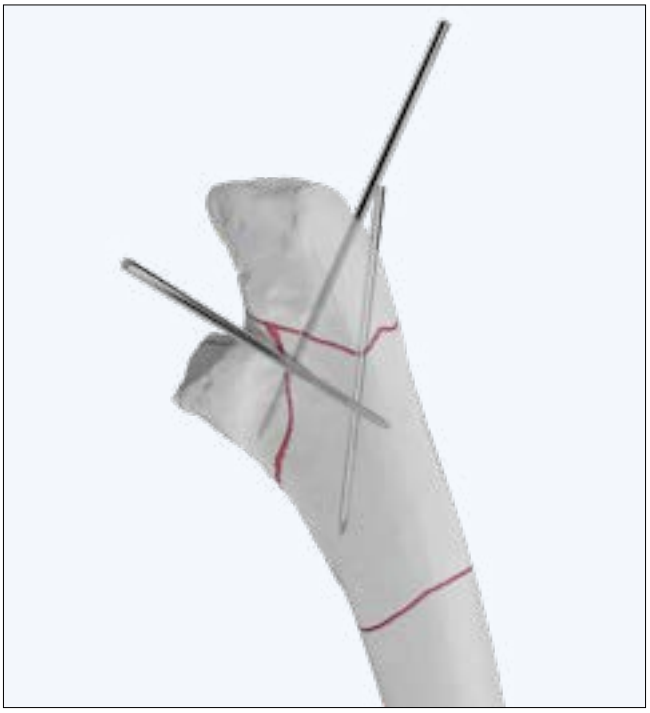
2.8 Dorsal Olecranon Plates

Standard Plate
A-4856.61–70
A-4856.71S–72S (sterile only)

Medium Plate
A-4856.81–84

Extended Plate
A-4856.91–94
A-4856.95S–96S (sterile only)

1. Temporary fixation of the fracture
Reduce the fracture to restore the anatomy of the proximal ulna. Ensure that the articular surface and the main fragments of the proximal ulna are aligned. Use K-wires (for example 1.6 mm, A-5040.41) for temporary fixation.



2. Selecting the plate

Select one of the plate types in the appropriate plate length. Ideally, the plate offers three screw holes both distal and proximal to the fracture.

Standard Plate A-4856.61–70 A-4856.71S–72S	Allows for one fracture-crossing sagittal screw. Designed to be positioned without affecting the triceps tendon insertion. Plates ranging from 3 shaft-holes to 17 shaft-holes (longest plate sterile only).	
Medium Plate A-4856.81–84	Allows for up to two fracture-crossing sagittal screws. Designed to be positioned on top of the triceps tendon. Plate available with 5 holes and 11 shaft-holes.	
Extended Plate A-4856.91–94 A-4856.95S–96S	Designed for additional fixation of the proximal olecranon. The plate allows for a maximum of three sagittal screws in the proximal area. Designed to be positioned under the triceps, placement requires splitting of the triceps tendon. Plate available with 3, 8 and 13 shaft-holes (longest plate sterile only).	

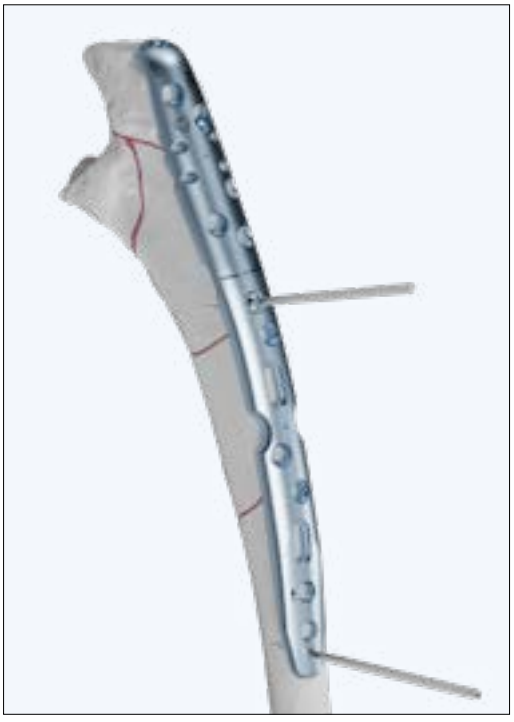
Caution

Fit the plate to the bone proximally. If necessary, bend the plate with the bending irons (A-2093) to achieve an adequate fit of the distal end of the plate to the individual form of the bone, taking into consideration the individual's proximal ulna dorsal angulation (PUDA).
If bending of the proximal end of the extended plate is necessary, adjust the PUDA angle first, before bending the proximal end of the plate.

3. Positioning the plate

Position the plate onto the bone and respect the triceps tendon insertion as much as possible. Depending on the plate type selected, make a longitudinal incision into the triceps tendon to ensure close bone contact of the plate. For temporary plate fixation, 1.6 mm K-wires (A-5040.41 or A-5042.41) or olive K-wires (A-5045.41/1 or A-5046.41/1) may be used.

If required, the plate can be fixed to the bone by inserting a cortical screw (A-5800.xx) into an oblong hole. Drill, assign the screw length and insert the screw.



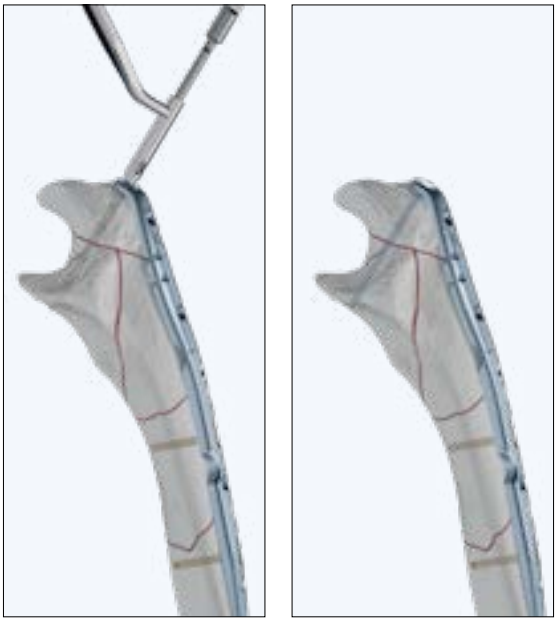
After positioning the plate, use X-ray control to verify the alignment with the bone. Make any adjustments before inserting additional screws.

If the plate position needs to be adjusted: remove any (olive) K-wires, slightly loosen the cortical screw in the oblong hole, readjust the position of the plate and retighten the cortical screw.

Caution
In case of very hard bone use the tap (A-3839) to reduce the insertion torque of the screw and to prevent fragment dislocation.

4. Fixing the plate
Start the fixation in the proximal or the distal segment according to the fracture type. Carefully plan your screw trajectories and the sequence of screw insertion to leave enough space for sagittal screws, screws aiming into the coronoid (see “Coronoid Cluster Screws”) and screws aiming into the olecranon tip retrogradely.

Fracture-crossing sagittal screw(s)
Choose a proximal plate hole that allows for the placement of a fracture-crossing screw. The standard plates allow for insertion of one transversal screw, while the medium and extended plates allow for insertion of up to two fracture-crossing screws. Drill, assign the screw length and insert a cortical screw (A-5800.xx) or a TriLock screw (A-5850.xx). The screw trajectory should pass underneath the ulnohumeral joint surface and exit in the anterior area adjacent to the coronoid.



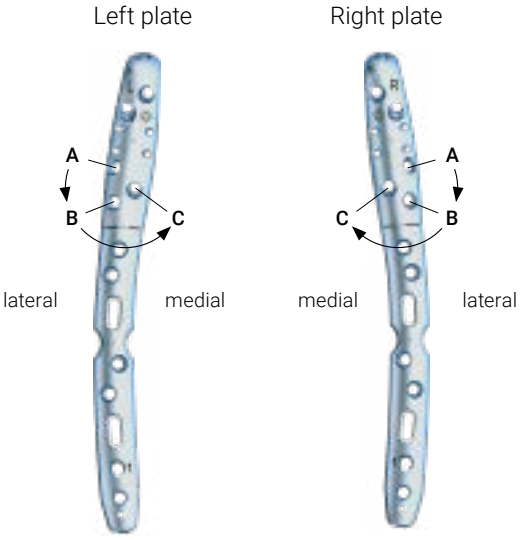
Cortical screws permit to pull a fragment to the plate. If a cortical screw is used to achieve appropriate plate and bone contact, it should be inserted before any locking screw is inserted into that fragment. Angular stable screws generally provide a higher stability of the construct, especially in case of a comminuted fracture or poor bone quality.

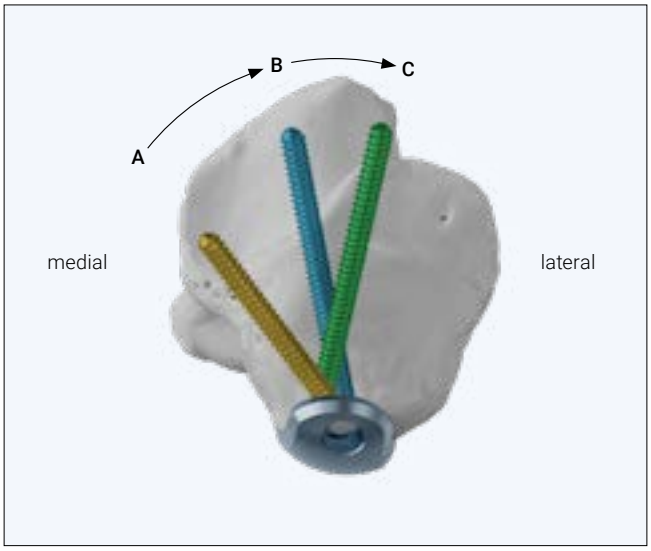
Warning
Use intraoperative X-ray control to verify the subchondral position of the screw.

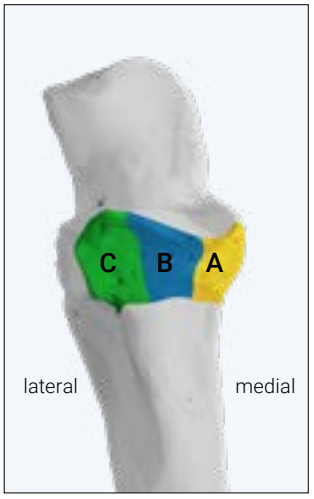
Coronoid Cluster Screws
All plate types offer multiple fixation options to achieve stable fixation of the coronoid. The screw holes of the coronoid cluster are preangled to enable specific screw trajectories.

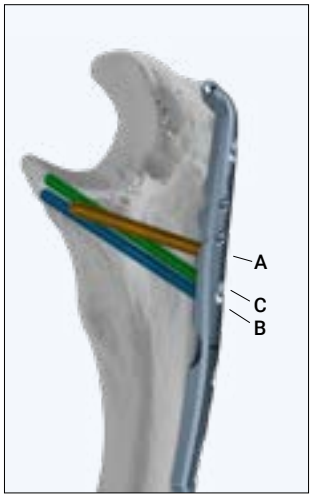
Warning
Make use of the multidirectionality of the TriLock screws (± 15°) to reach the designated areas and to avoid screw collisions.

Screw A
Crosses from the lateral plate rim to the medial side of the coronoid (sublime tubercle)
Screw B
Courses from the lateral plate rim to the center of the coronoid
Screw C
Courses from the medial plate rim to the lateral side of the coronoid









Warning
Use intraoperative X-ray control to verify the position of the screws. A medial oblique and a lateral oblique image should be performed to ensure that no screw penetrates the sigmoid and lesser sigmoid notch and that screw A is correctly positioned in the sublime tubercle.

Retrograde Screws
Use the two options for retrograde screws aiming at the olecranon tip for additional tip fixation if required.

Warning
Use intraoperative X-ray control to verify the subchondral position of the screw.

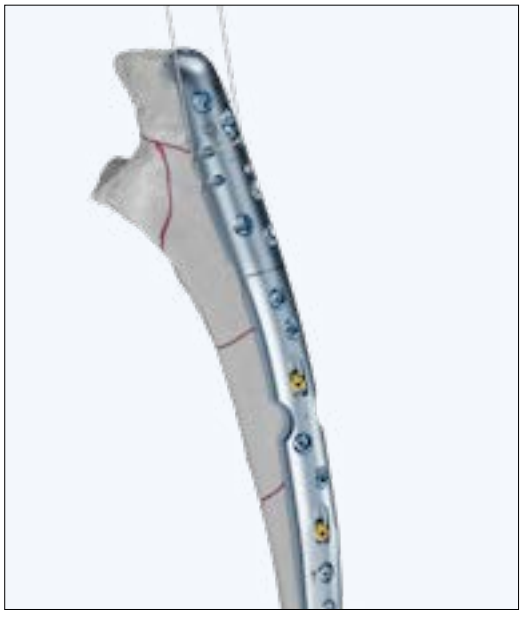
5. Filling the remaining screw holes
Fill the remaining screw holes with TriLock screws or cortical screws wherever indicated by the fracture pattern.
TriLock^{PLUS} holes can be used to apply compression to fractures in the shaft.

Warning
If a TriLock^{PLUS} hole is used to compress the fracture, the TriLock^{PLUS} hole should be used before placing any other TriLock screws on the same side of the fracture (see chapter "TriLock^{PLUS}").

Warning
The multidirectionality of the locking (±15°) and non-locking screws allows to individually address each fragment and to avoid screw collisions.

Remove any previously placed (olive) K-wires.

6. Optional: Triceps off-loading suture
Apply a triceps off-loading suture if needed. This may help counteract the pulling forces of the triceps on fragments, especially in multifragmentary unstable fractures or in cases of bad bone quality, for example in osteoporotic bone.



2.8 Distal Humerus Plates

A-4856.29–54

1. Selecting the plate

After reducing the fracture, select the appropriate distal humerus plate or plate configuration (A-4856.29–54).

The plates can be used individually or as a pair in the case of complex fractures. The plate types available allow to choose between a 90° (perpendicular) or a 180° (parallel) configuration.

The 180° configuration may be preferred for very distal fractures requiring stabilization with transcondylar screws. The plates act as a template for the anatomic reduction of the fracture in the epicondylar area.

The 90° configuration may be advantageous in cases involving capitellar fractures, such as anterior shear fractures.

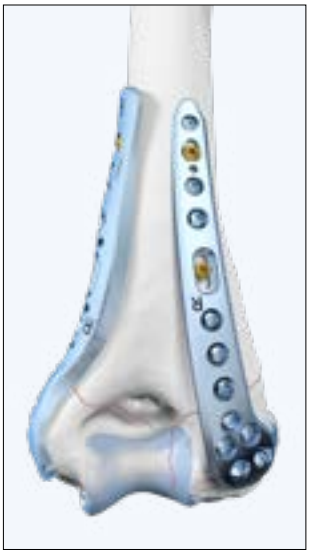
If necessary, bend the plates with the bending irons (A-2090) in order to achieve an adequate fit to the individual shape of the bone.
The flap on the posterolateral plates (A-4856.49–54) can be contoured with the plate bending pliers (A-2047). The flap can be removed fully (both screw holes) or partially (one screw hole) with suitable cutting pliers if not needed.

A-4856.29–34
Medial plates
Left and right

A-4856.39–44
Lateral plates
Left and right

A-4856.49–54
Posterolateral plates
Left and right

180° configuration:
Combination of a medial (A-4856.29–34) and a lateral (A-4856.39–44) 2.8 distal humerus plate



90° configuration:
Combination of a medial (A-4856.29–34) and a posterolateral (A-4856.49–54) 2.8 distal humerus plate

2. Positioning the plate
The medial plates (A-4856.29–34) are positioned on the medial ridge of the distal humerus.

The lateral plates (A-4856.39–44) are designed to fit the rim of the lateral epicondyle distally and twist to a posterior position on the shaft proximally.

The posterolateral plates (A-4856.49–54) are positioned far distally on the posterior side of the lateral column of the distal humerus. In addition, the two most distal screw holes are preangled distally to help reach very distal fragments of the capitellum.

Position of the medial plates (A-4856.29–34)

Position of the lateral plates (A-4856.39–44)

Position of the posterolateral plates (A-4856.49–54) showing the preangulation of the two most distal screw holes

2. Fixing the plate

Prior to placement of the plate, lag screw fixation across the major fracture fragments may be performed (see chapter “Lag Screw Techniques”).

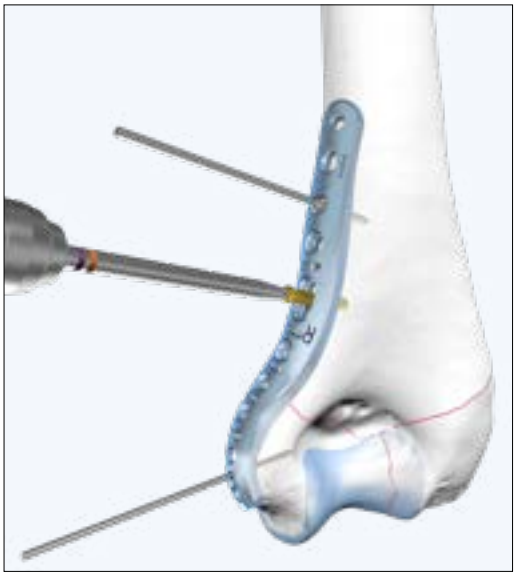
For temporary plate fixation, 1.8 mm K-wires (A-5040.51 or A-5042.51) or 1.6 mm olive K-wires (A-5045.41/1, A-5046.41/1) may be used.

Start the fixation of the first plate with a cortical screw (A-5800.xx) in the oblong hole. Drill, assign the screw length and insert the screw.

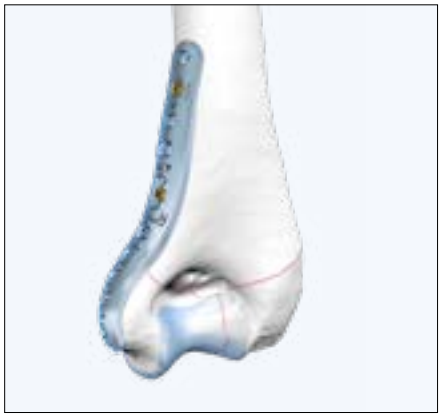
Caution

In the case of very hard bone use the tap (A-3839) to reduce the insertion torque of the screw and to prevent fragment dislocation.

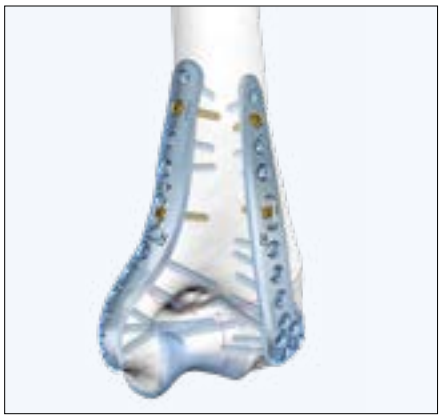
If the plate position needs adjustment: remove all (olive) K-wires in the fragment to be adjusted, slightly loosen the cortical screw in the oblong hole, readjust the position of the plate and retighten the cortical screw.



Fill the remaining screw holes with TriLock screws (A-5850.xx) or cortical screws (A-5800.xx) wherever indicated by the fracture pattern and remove all (olive) K-wires.



If a second plate is used, the steps for fixation are identical to the ones of the first plate. After initial fixation of the plates with a cortical screw in the oblong hole, the sequence of the insertion of the rest of the screws can be varied between the plates according to the fracture pattern.



Warning
The plates are reduced in thickness towards their proximal end to reduce peak stresses in the humeral shaft. The stresses can be further reduced by making sure that the most proximal screws are positioned at different heights.

The second most proximal screw hole of every plate can be used as a compression hole if needed (see chapter “Use of the Compression Hole”).

Cortical screws permit to pull a fragment to the plate. If a cortical screw is used to achieve appropriate plate and bone contact, it should be inserted before any locking screw is inserted into that fragment. Angular stable screws generally provide a higher stability of the construct, especially in case of a comminuted fracture or poor bone quality.

Warning
The multidirectionality of the locking (±15°) and non-locking screws allows to individually address each fragment and avoid screw collisions.

In the case of articular fractures, it is generally advantageous to direct long subchondral screws from one epicondyle to the other. Use the aiming device to facilitate the placement of these long screws (see chapter “Aiming Device for Distal Humerus Plates”).

Warning
Use intraoperative X-ray control to verify the subchondral position of the screws.

Explantation

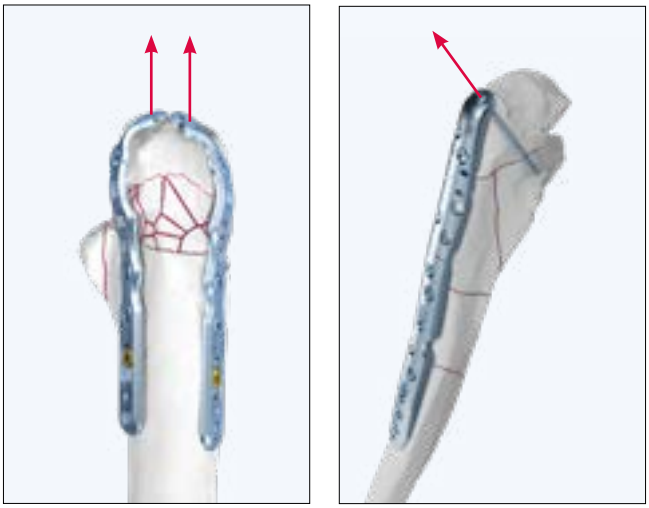
Explantation of Elbow Plates

1. Removing the screws
Unlock all screws and remove them.

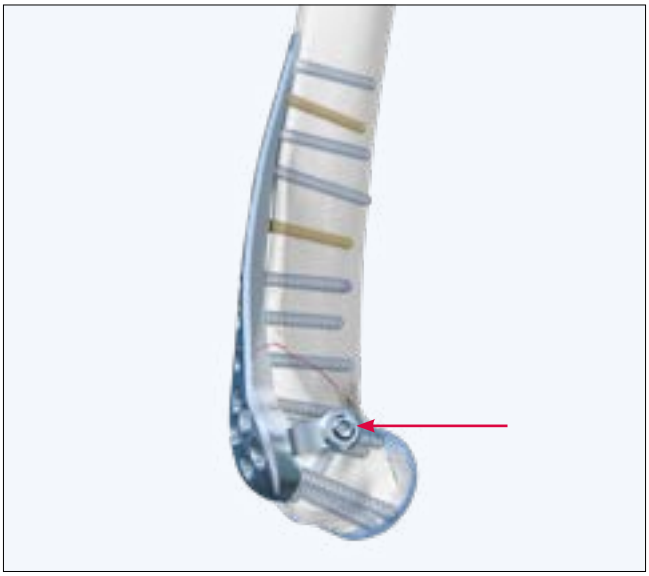
Generally, the order in which the screws are removed is not relevant. However, in case screws have been damaged upon implantation, the recommended sequence for the plate types below may help reduce the risk of screw breakage during explantation.

Olecranon:
For the explantation of curved double plates (A-4856.10/11/13/14) and the tension plate (A-4856.01), any possible long fracture-crossing screws should be explanted last.

For the explantation of dorsal olecranon plates (A-4856.61–96S), any possible long transversal screw should be explanted last.



Distal Humerus (A-4856.29–54):
If the sequence of the original screw implantation is known, it should be reversed for the explantation.
Typically, long epicondylar screws are inserted at an early stage of implantation. Therefore, they should be explanted last and shorter screws should be removed first.
When explanting a posterolateral distal humerus plate (A-4856.49–54) with long transcondylar screws in the flap, remove these screws first.



In case the plate sticks to the bone, use a periosteal elevator to carefully lift and detach it from the bone.

Caution
When removing the screws, ensure that any bone ingrowth in the screw head has been removed, that the screwdriver/screw head connection is aligned in axial direction, and that a sufficient axial force is used between blade and screw.

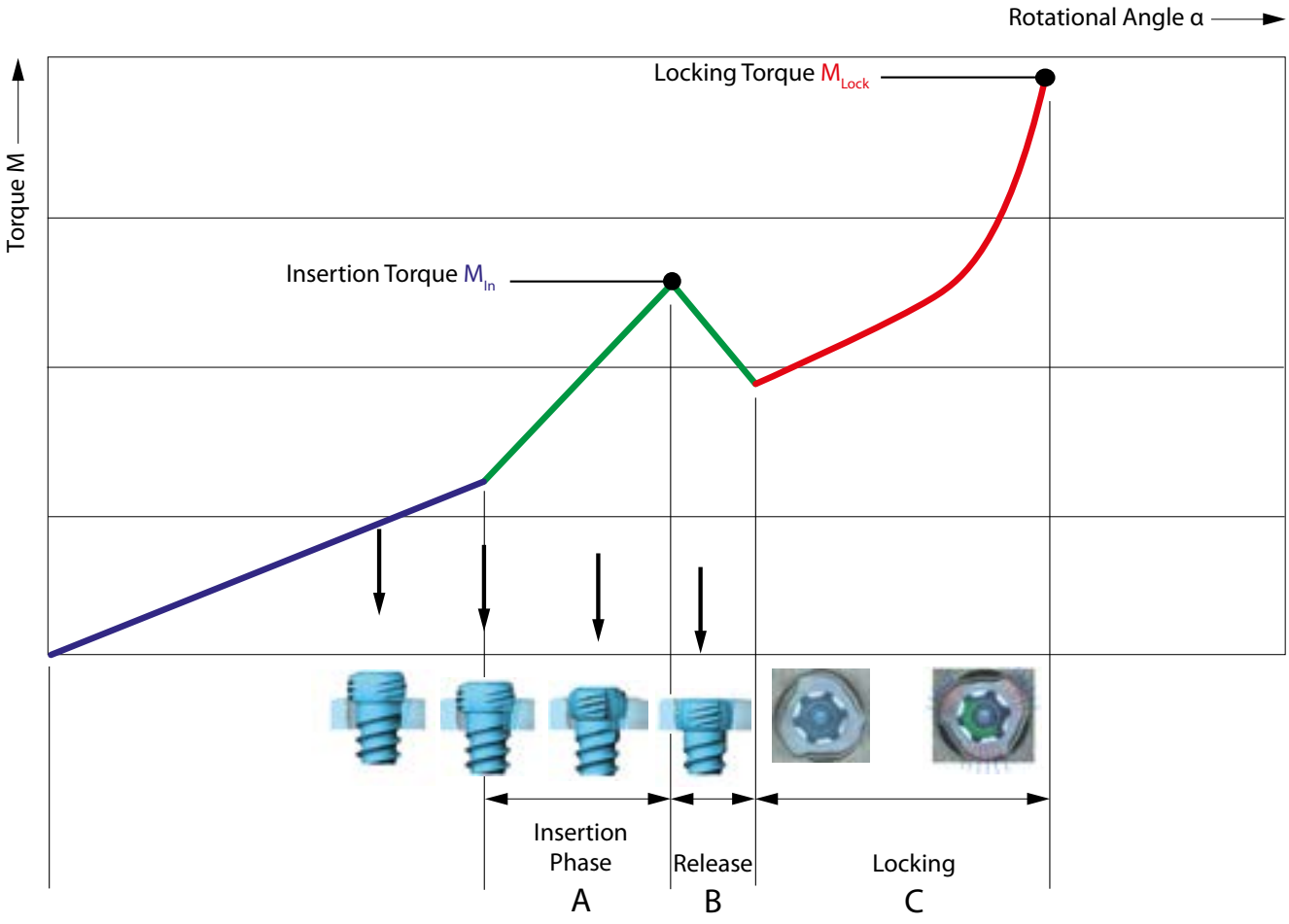
TriLock Locking Technology

Correct Application of the TriLock Locking Technology

The screw is inserted through the plate hole into a predrilled canal in the bone. An increase of the tightening torque will be felt as soon as the screw head gets in contact with the plate surface.

This indicates the start of the "Insertion Phase" as the screw head starts entering the locking zone of the plate (section "A" in the diagram). Afterwards, a drop of the tightening torque occurs (section "B" in the diagram). Finally, the actual locking is initiated (section "C" in the diagram) as a friction connection is established between screw and plate when tightening firmly.

The torque applied during fastening of the screw is decisive for the quality of the locking as described in section "C" of the diagram.



Correct Locking (±15°) of the TriLock Screws in the Plate

The example below representatively depicts the correct locking position of a 2.0 screw in a straight 1.0 mm thick plate. Correct locking occurs only when the screw head is locked flush with the locking contour (fig. 1 and 3).

However, if there is still a noticeable protrusion (fig. 2 and 4), the screw head has not completely reached the locking position. In this case, the screw has to be retightened to obtain full penetration and proper locking. In case of poor bone quality, a slight axial pressure might be necessary to achieve proper locking. Due to the system characteristics, a screw head protrusion of max. 0.2 mm exists when using plates with 1.0 mm thickness or thinner.

After having reached the locking torque (MLock), do not further tighten the screw, otherwise the locking function cannot be guaranteed anymore.

Correct: LOCKED

Figure 1

Incorrect: UNLOCKED

Figure 2

Correct: LOCKED

Figure 3

Incorrect: UNLOCKED

Figure 4

Appendix

Implants, Instruments and Containers

Plates, Templates
A-4656.68
A-4656.68S
A-4656.69
A-4656.69S
A-4656.80
A-4656.80S
A-4656.81
A-4656.81S
A-4856.01
A-4856.01S
A-4856.10
A-4856.10S
A-4856.10TP
A-4856.11
A-4856.11S
A-4856.11TP
A-4856.12
A-4856.12S
A-4856.12TP
A-4856.13
A-4856.13S
A-4856.13TP
A-4856.14
A-4856.14S
A-4856.14TP
A-4856.15
A-4856.15S
A-4856.15TP
A-4856.29
A-4856.29S
A-4856.30
A-4856.30S
A-4856.31
A-4856.31S
A-4856.32
A-4856.32S
A-4856.33
A-4856.33S
A-4856.34
A-4856.34S
A-4856.39
A-4856.39S
A-4856.40
A-4856.40S
A-4856.41
A-4856.41S
A-4856.42
A-4856.42S
A-4856.43
A-4856.43S
A-4856.44
A-4856.44S
A-4856.49
A-4856.49S
A-4856.50
A-4856.50S
A-4856.51
A-4856.51S
A-4856.52
A-4856.52S
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A-4856.53S
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A-4856.54S
A-4856.61
A-4856.61S
A-4856.61TP
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A-4856.62S
A-4856.62TP
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A-4856.63S
A-4856.63TP
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A-4856.64TP
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A-4856.93S
A-4856.93TP
A-4856.94
A-4856.94S
A-4856.94TP
A-4856.95S
A-4856.96S

Screws, Washers
A-4700.70
A-4700.70/1
A-4700.70/1S
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A-5400.05
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A-5400.05/1S
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A-5400.06/1
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A-5400.12/1S
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A-5400.28/1S
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K-Wires
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Twist Drills, Countersink, Tap
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Olive K-Wires
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Instruments
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PRECISION IN FIXATION

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