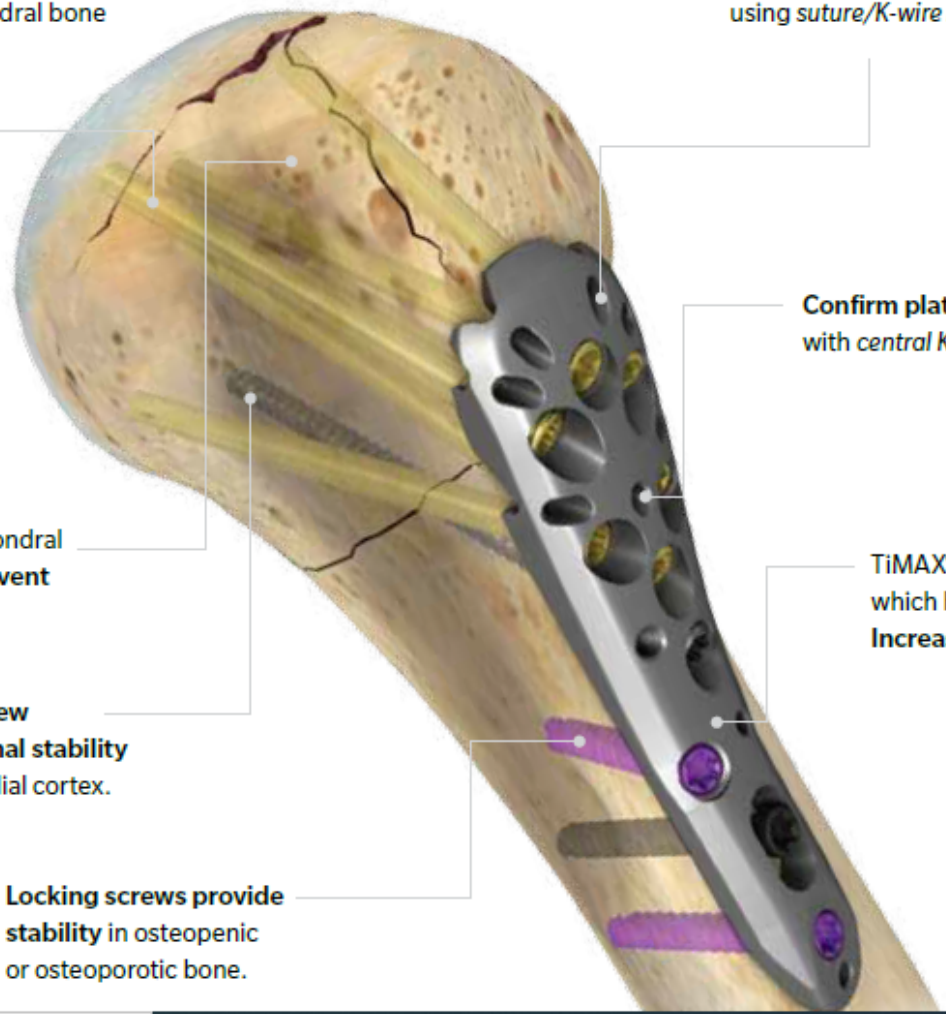
PHILOS

Approach & Techniques

Design

Designed to help minimize the risk of articular surface penetration by using *Smooth Blunt Locking Pegs* to engage subchondral bone

Temporary stabilization of the fracture and suture capture of the tuberosities using *suture/K-wire holes*



Confirm plate positioning with *central K-wire hole targeting*

The spatial subchondral support helps **prevent varus collapse.**

TiMAX® surface treatment, which has been shown to have **Increased Fatigue Strength***

Medial calcar screw provides additional stability in the inferior medial cortex.

Locking screws provide stability in osteopenic or osteoporotic bone.

Designed to reduce the need to release the deltoid by using *pre-contoured anterior curvature* to navigate the deltopectoral interval (7,11,14-hole plates)

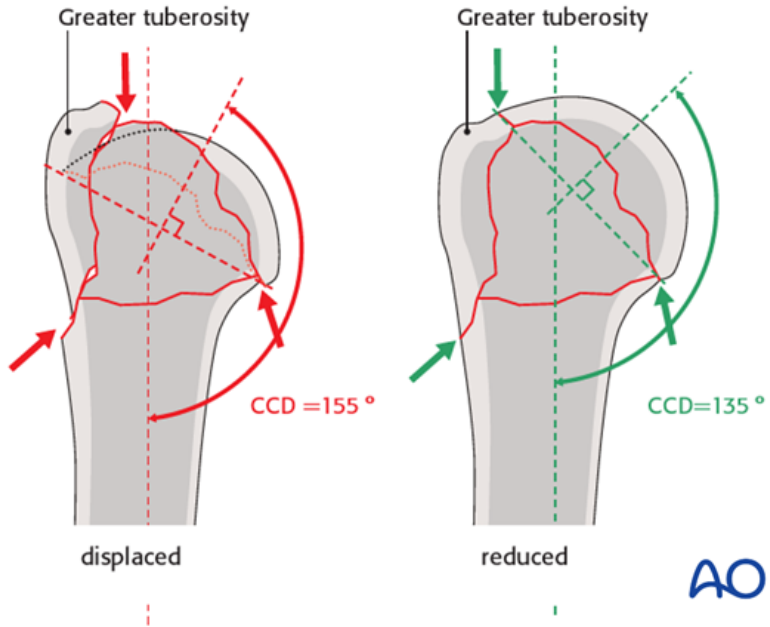
Customized contouring utilizing *in-situ multi-planar bending* of the shaft (11 and 14-hole plates)

Preoperative planning

1.Assess CCD angle over normal side

2. Assess number of fractured pieces (Head , neck greater & lesser tuberosity involvement)

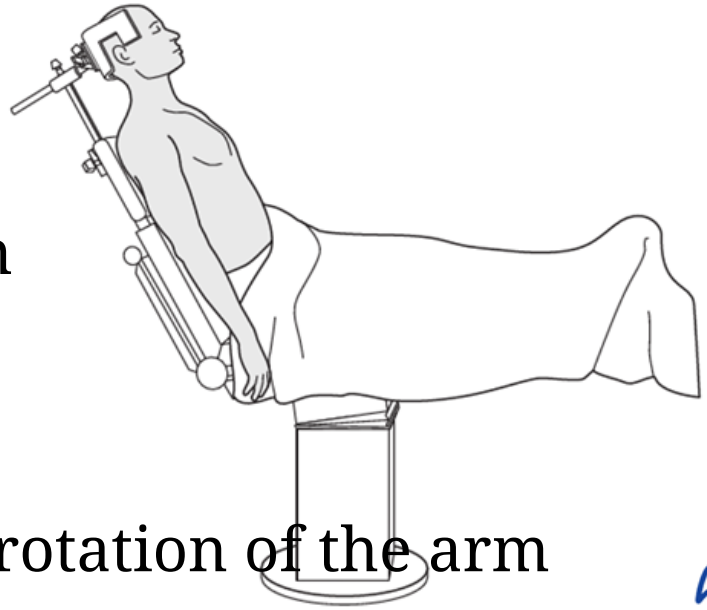
3. Assess degree and type of impaction .



Positioning

1. **Beach chair** (semi-reclined supine) position :

Position the patient with the upper body raised at an **angle of 60°**



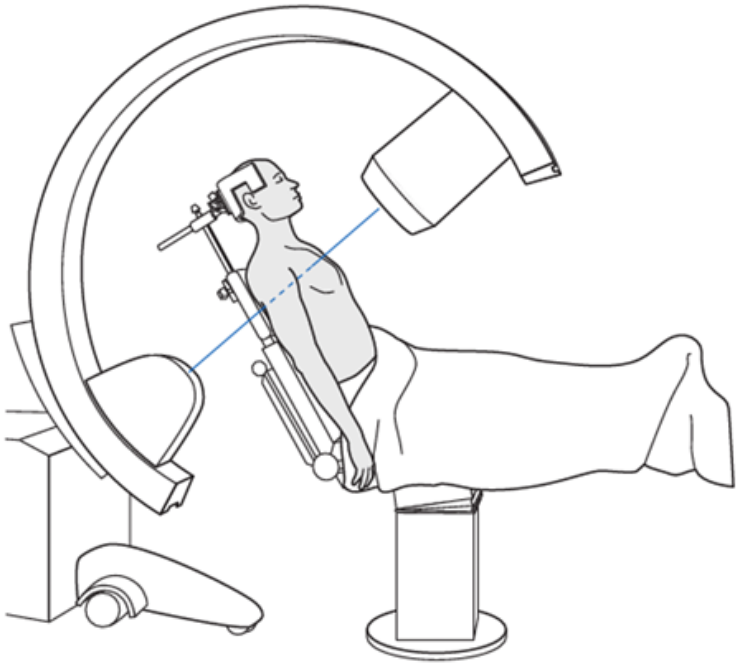
Advantage:

- Possible wide range of motion of the arm
- easier conversion to arthroplasty

Disadvantage:

- Difficult to get a true axial view without rotation of the arm

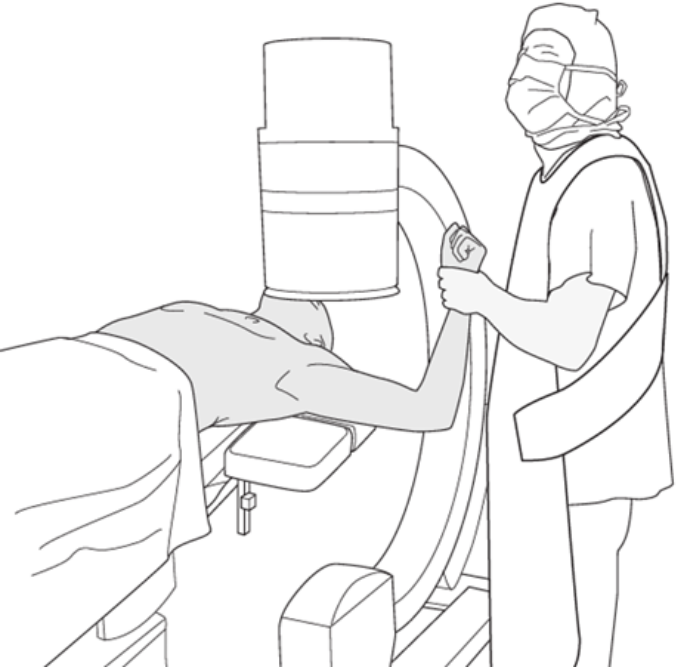
- ***Image intensification***
- Apply C arm **parallel to the longitudinal axis of the patient**, coming from a cranial direction.
- The central ray is aimed at the shoulder.
- Two orthogonal radiographic views are obtained by tilting the C-arm medially or laterally.
- The beam is directed **from anterolateral to posteromedial** (30-45°) or from anteromedial to posterolateral (30-45°).

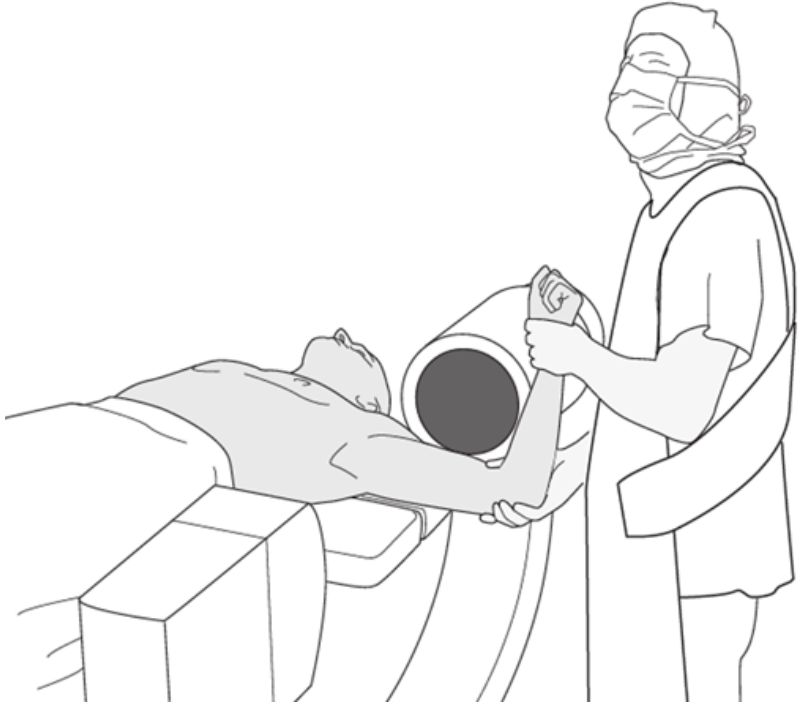


2. Supine position

- *Advantage:*
- true axial view without movement of the fractured arm is possible (crucial in unstable fracture situations)

- *Disadvantage:*
- some limitation in motion during intraoperative manipulation

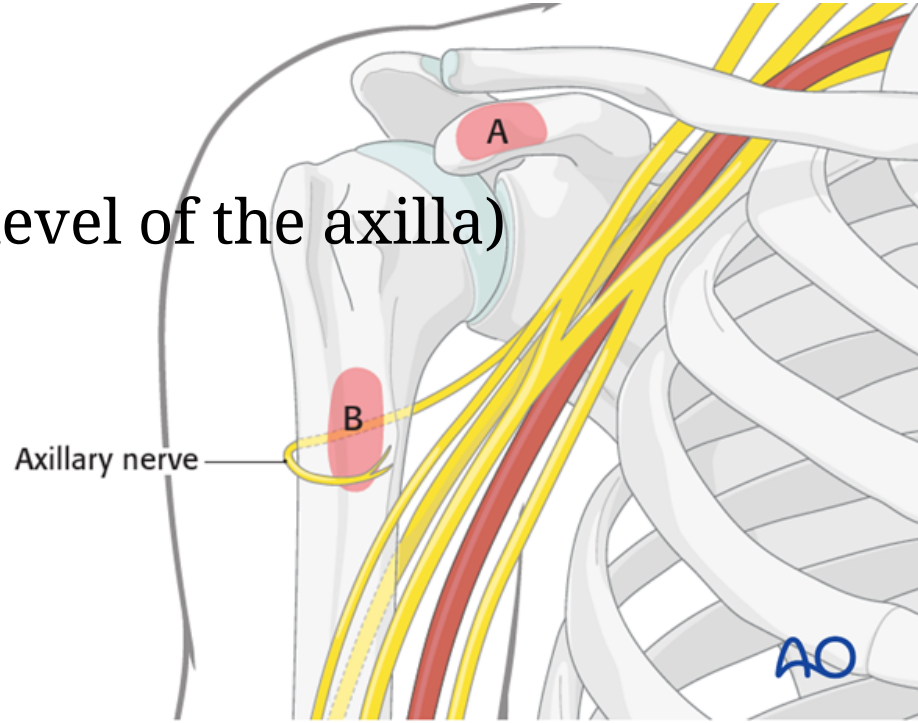




Approach : Deltopectoral approach

- landmarks

A) Coracoid process
B) Proximal humeral shaft (on the level of the axilla)

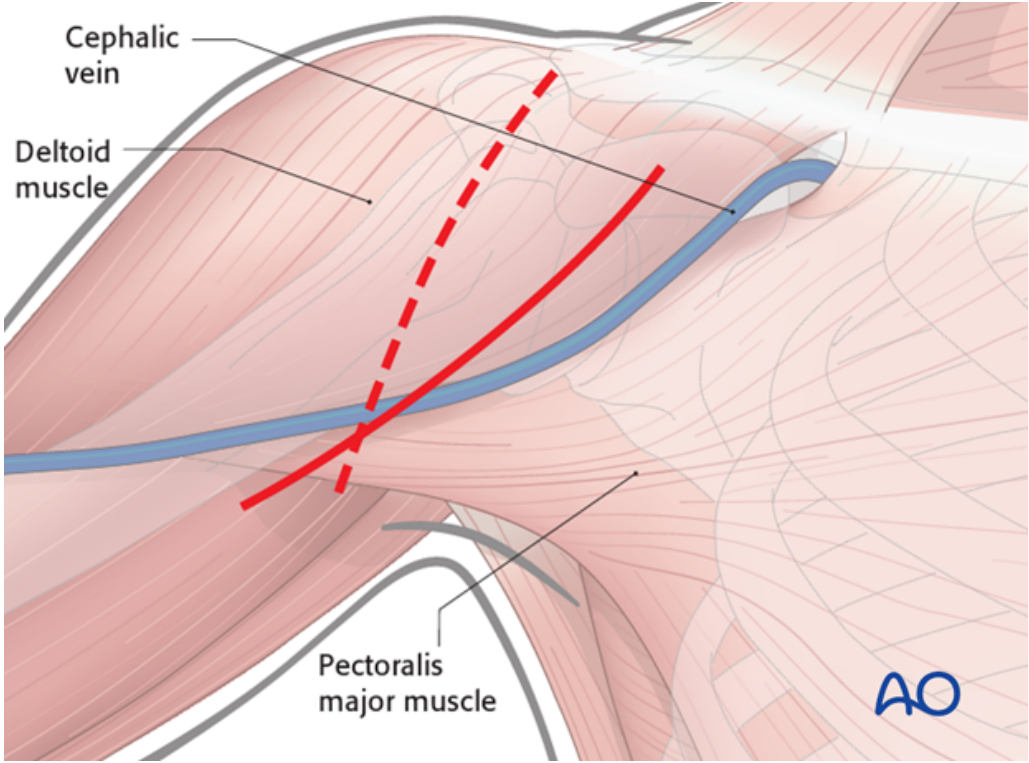


- Skin incision

- 12-14 cm long skin incision between the coracoid process and the proximal humeral shaft.

- The shape of the skin incision can be straight or curved depending on surgeon's preference.

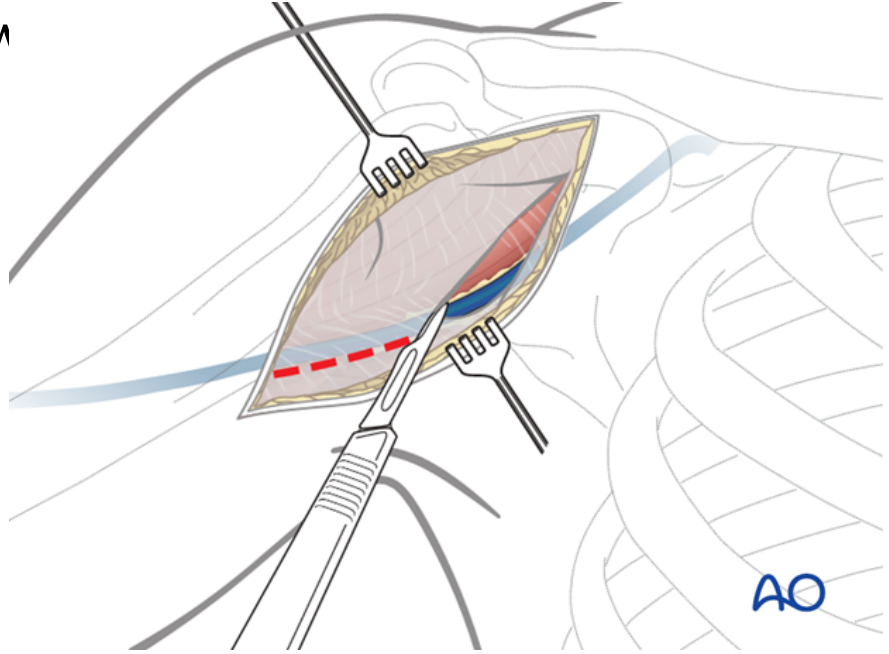
- For an arthroplasty, a **vertical** incision may be preferred (**dashed** line).



- Exposure & Disection of the **superficial fascia(Deltopectoral fascia)**

- Expose the **deltopectoral groove** w

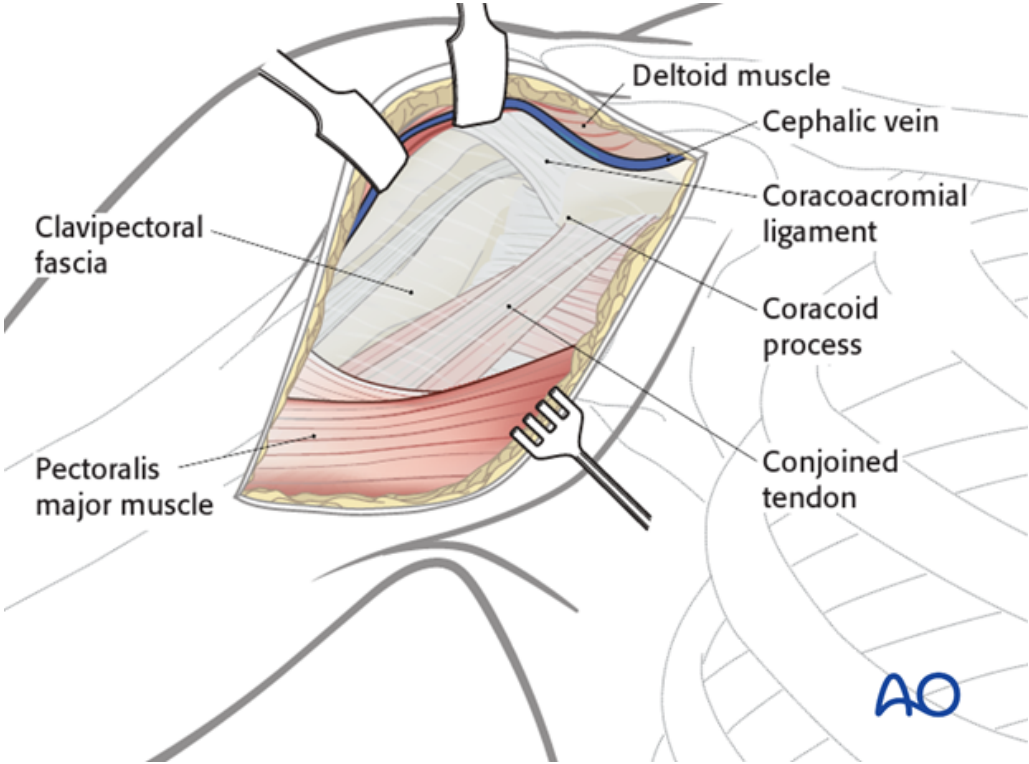
How to identify ?
By identifiying :
1- The course of the muscle fibers
2- The **cephalic vein** itself
3- Fat tissue surrounding the vein



- Expose the **clavipectoral fascia**

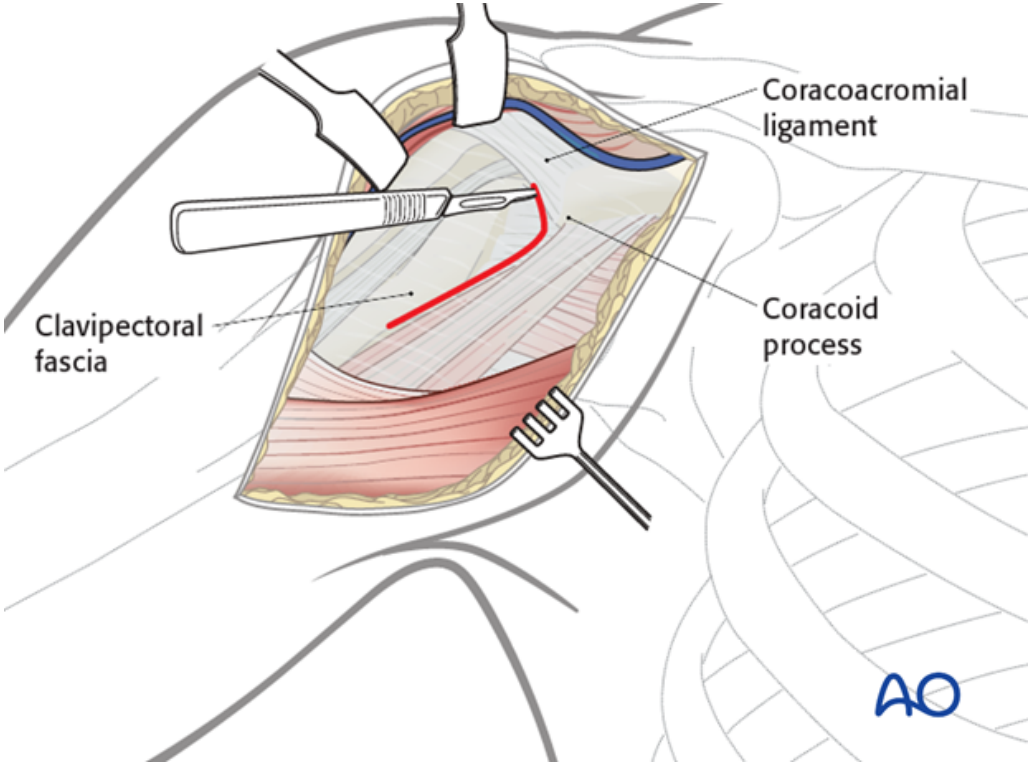
- Retract the cephalic vein laterally or medially (If retracted laterally, the anatomical drainage of blood from the deltoid muscle is respected)

- Bluntly dissect between and under the deltoid and pectoralis muscles down to



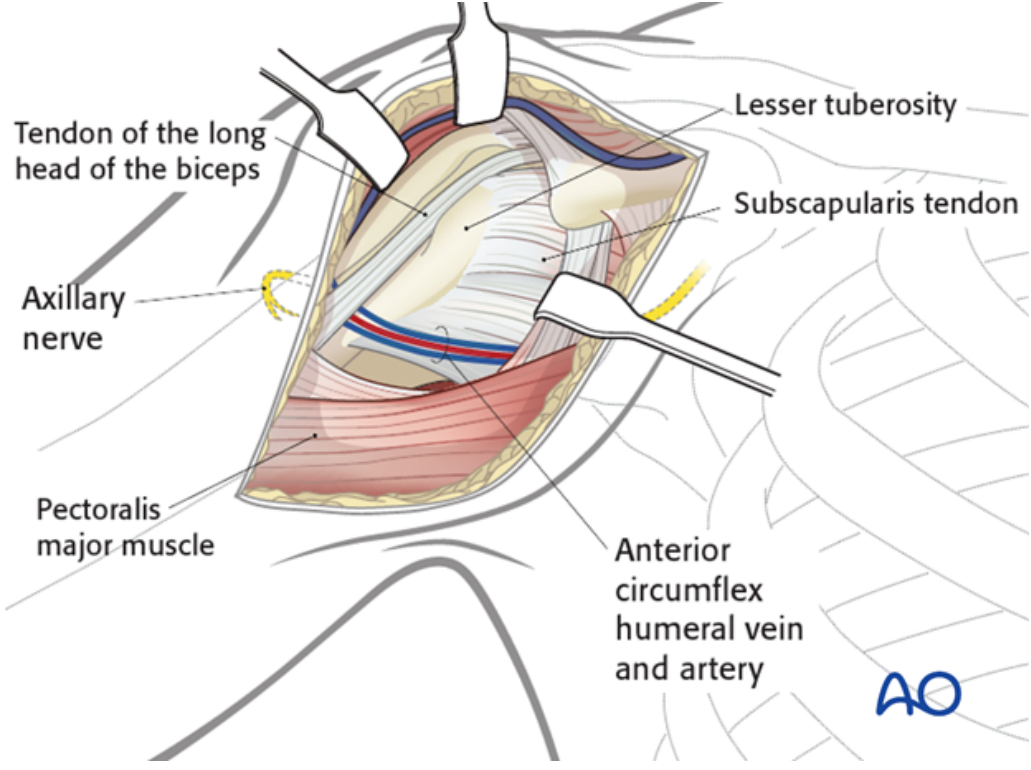
Incise the clavipectoral fascia

- Identify the coracoid process and the conjoined tendon.
- Incise the clavipectoral fascia **lateral to the conjoined tendon** and inferior the coracoacromial ligament.



- Expose proximal humerus & confirm landmarks

- Retract the deltoid laterally and the conjoined tendon medially
- Expose the proximal humerus and confirm the anatomical landmarks (Subscap tendon, LT,GT, bicipital groove with the **biceps tendon**).
- Distally, expose the pectoralis major.

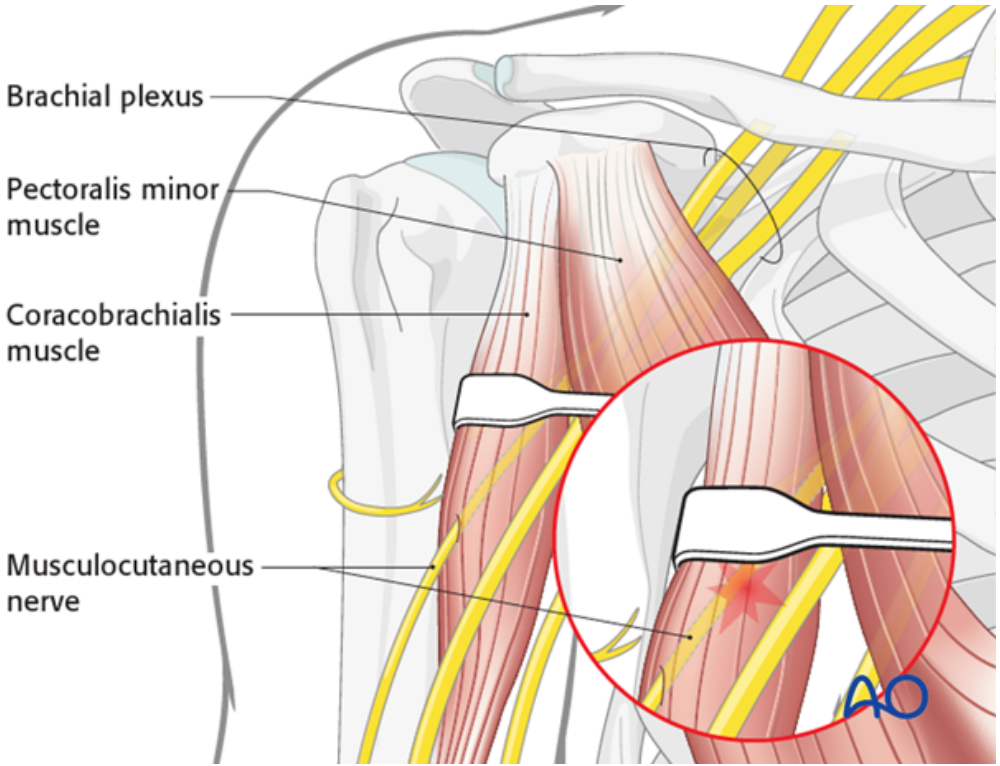


- The **biceps tendon** is **kept intact** throughout the procedure for rotational alignment and **plate positioning** and then may be released/tenodesed after implant fixation.

- Plate position in relation to biceps tendon : Immediately **lateral(Posterior)** to bicipital groove (Biceps tendon)

- *The musculocutaneous nerve enters the coracobrachialis muscle about 2.5 cm distal to the tip of the coracoid.*

- *Retractors placed under the conjoined tendon can cause neurapraxia; therefore, vigorous retraction must be avoided.*



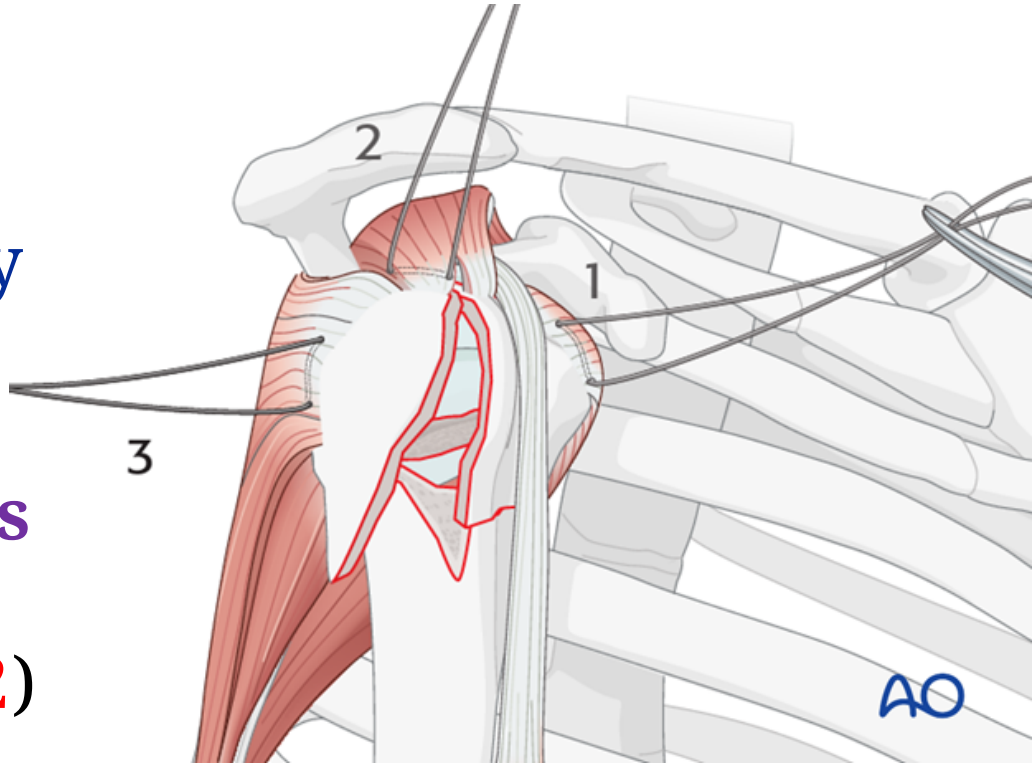
- Intraarticular exposure

- There are several ways to expose the intraarticular aspect of the glenohumeral joint:

1. Incision of the **rotator interval**
2. Opening **through the fracture** (dislocation of the lesser tuberosity fragment)
3. Tenotomy of the **subscapularis** tendon

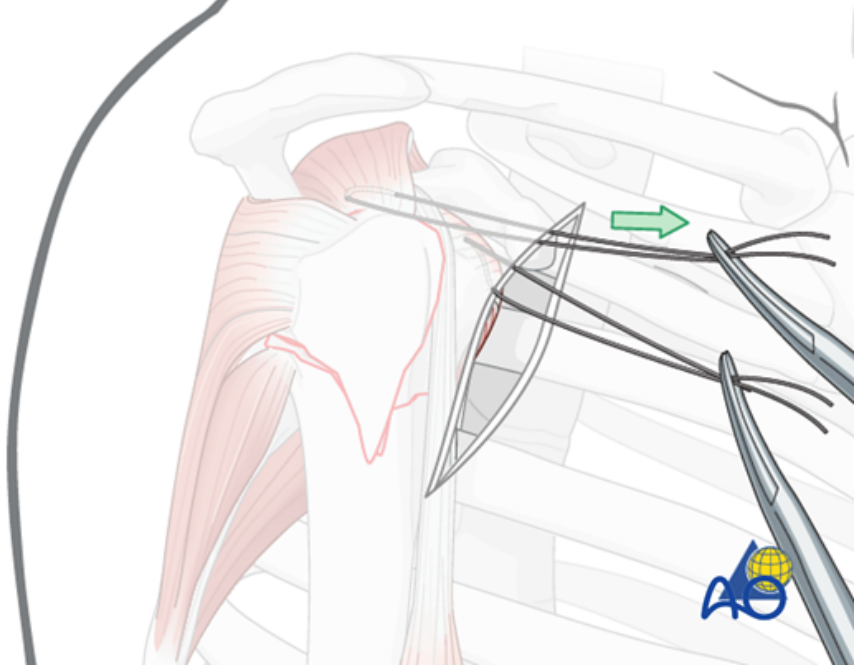
Technique

1. Reduction and preliminary fixation

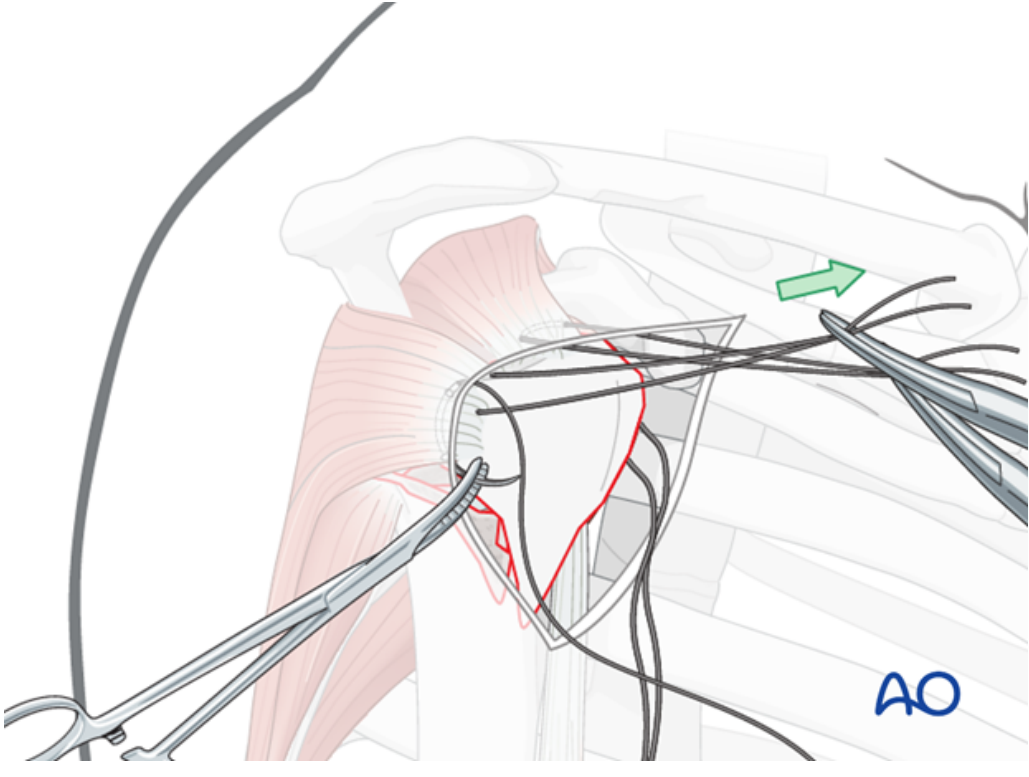


1- **Place rotator cuff sutures** beginning with (1) subscapularis tendon then (2) supraspinatus tendon and finally into (3) infraspinatus tendon insertion.

- **Anterior traction** on the **supraspinatus** tendon helps **expose** the **greater tuberosity** and **infraspinatus** tendon.



- Insert a preliminary traction suture into the visible part of the posterior rotator cuff and pull it anteriorly. This will expose the proper location for a suture in the **infraspinatus** tendon insertion.
- Then the initial traction suture is removed.

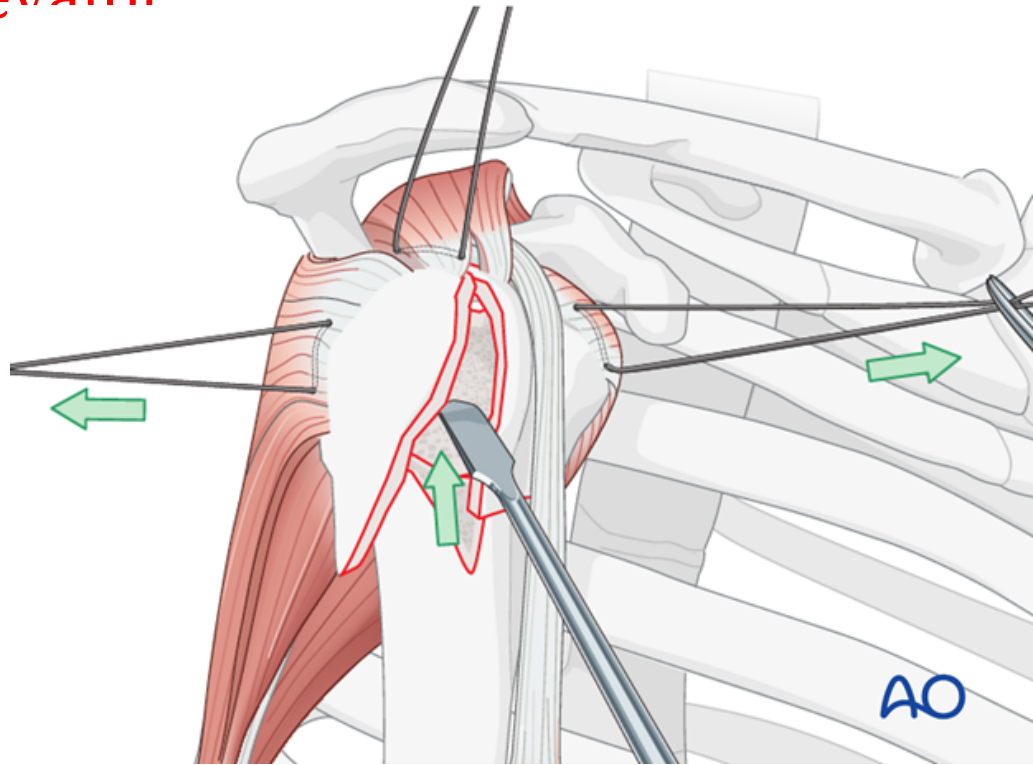


2- Reduce the humeral head

- Various techniques can be used to lift the humeral head & correcting the **valgus** impaction :

A) Digital pressure
B) Use of a blunt periosteal elevator
C) Leverage technique
D) Combination of direct manipulation and leverage.
E) Disimpaction of jammed fragments

- A) Digital pressure
  B) Use of a blunt periosteal elevator



- C) Leverage. A varus force can be applied to the humeral shaft. This can be achieved by using a fulcrum (eg, the surgeons fist, as shown, or a roll of towels) in the axilla.
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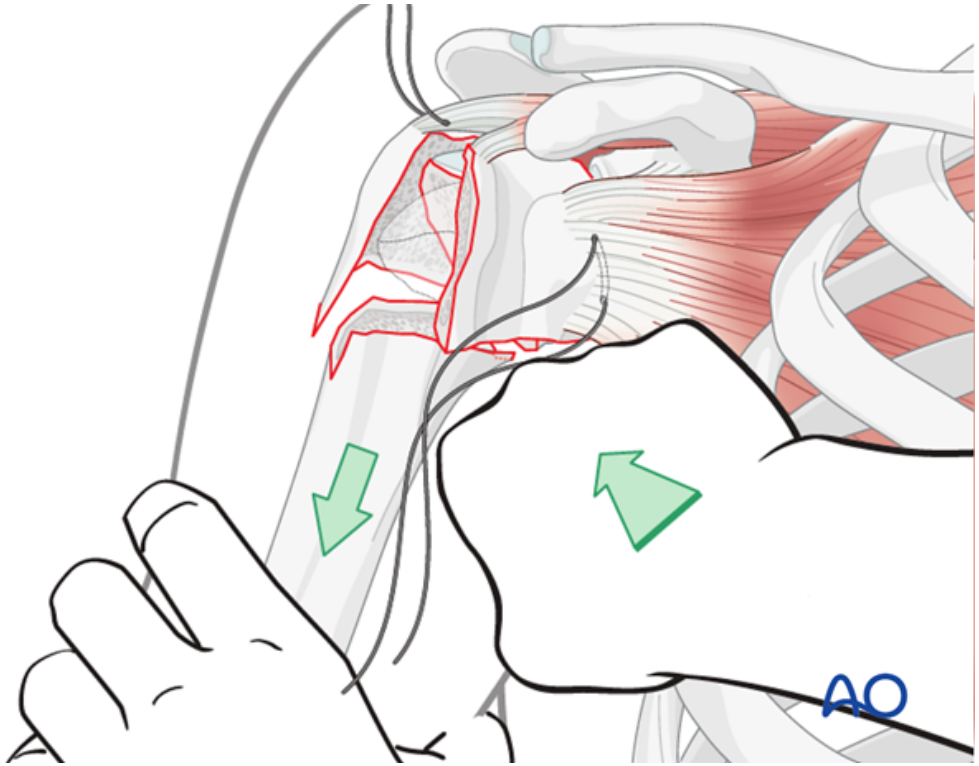
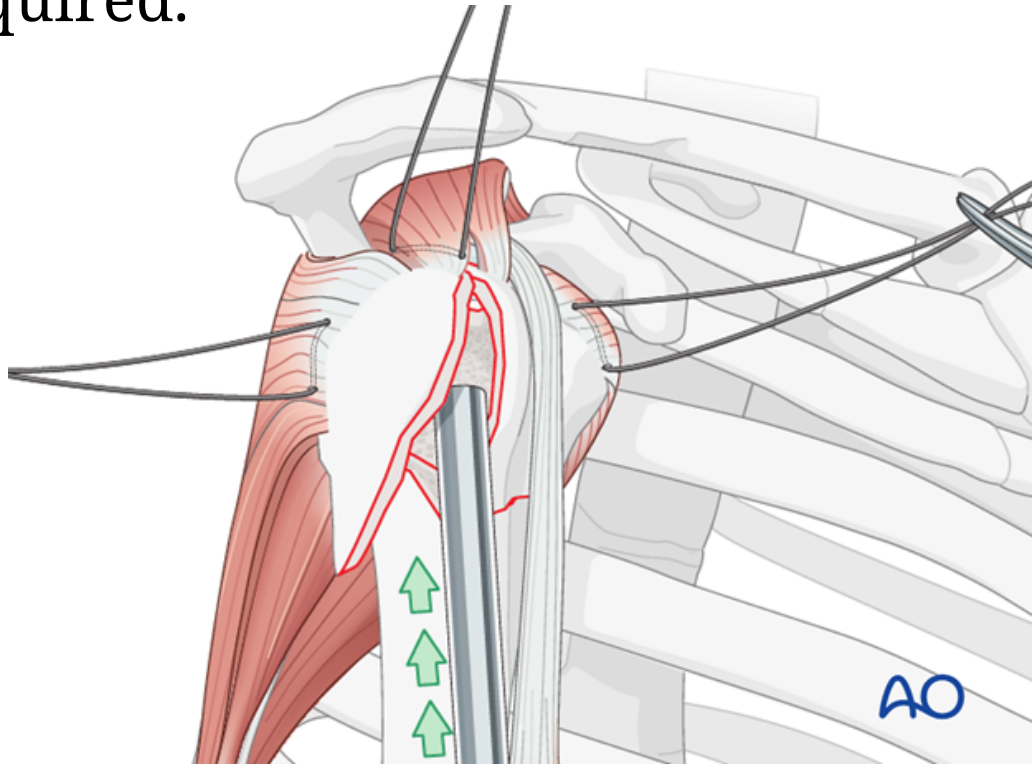
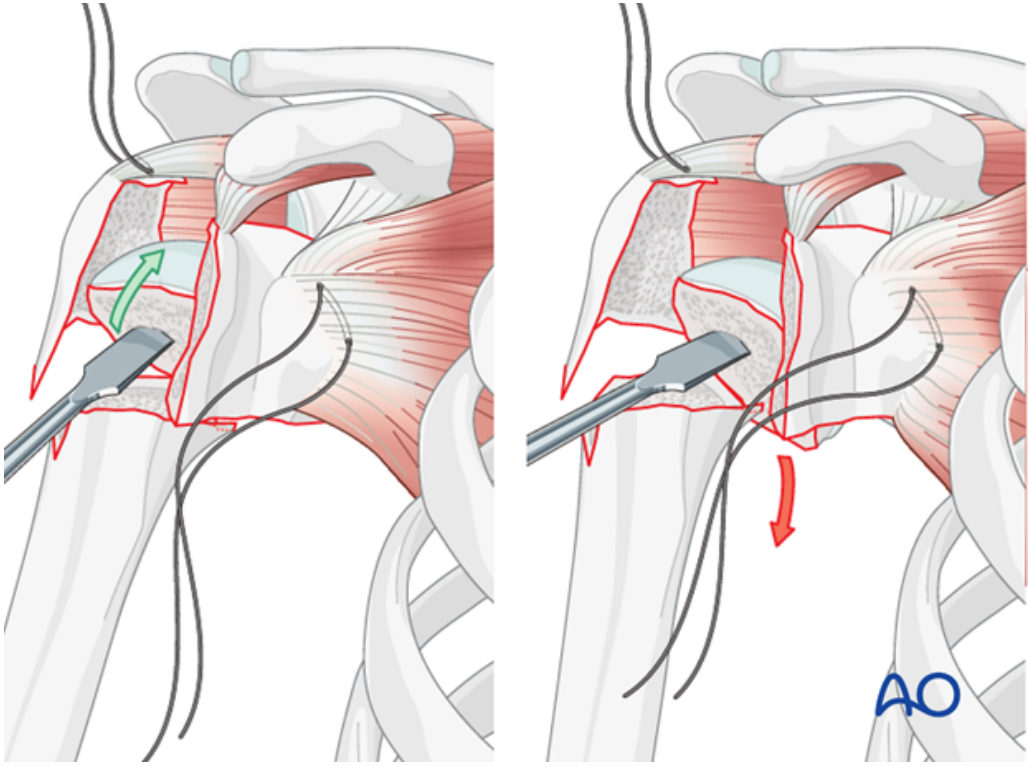


- E) If the fragments are jammed together, disimpaction with a bone punch may be required.



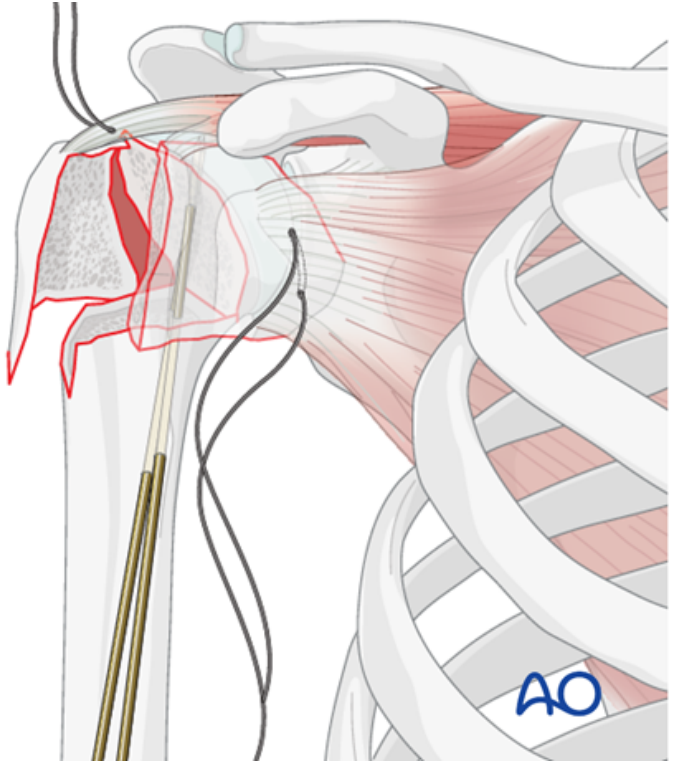
- *In displaced fractures, the medial hinge (periosteum) is often disrupted. If so, the **humeral head** is unstable and might **displace medially** upon reduction.*



3- Fix the humeral head temporarily

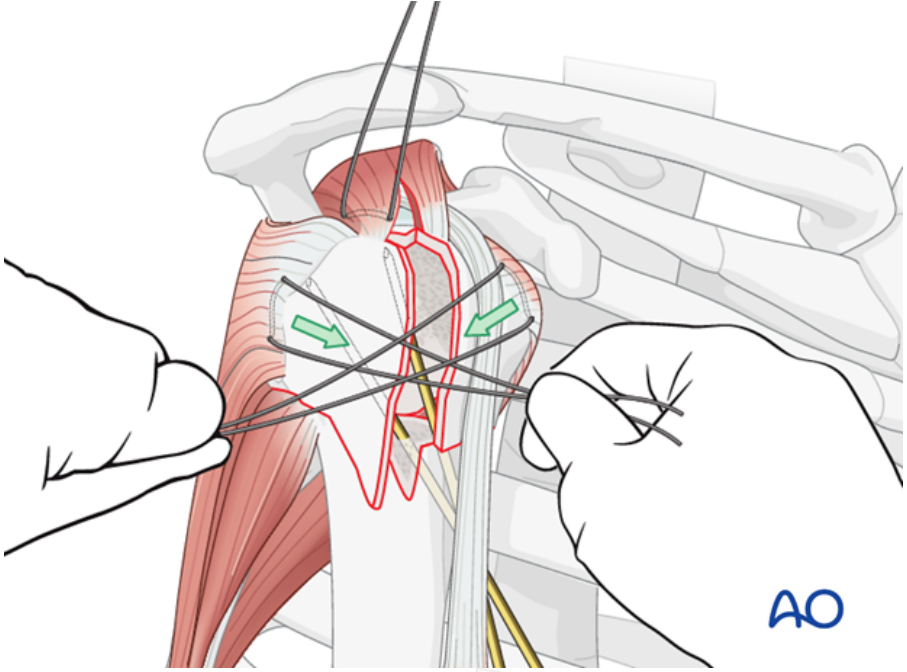
- Using 2 or 3 K-wires from distal to proximal

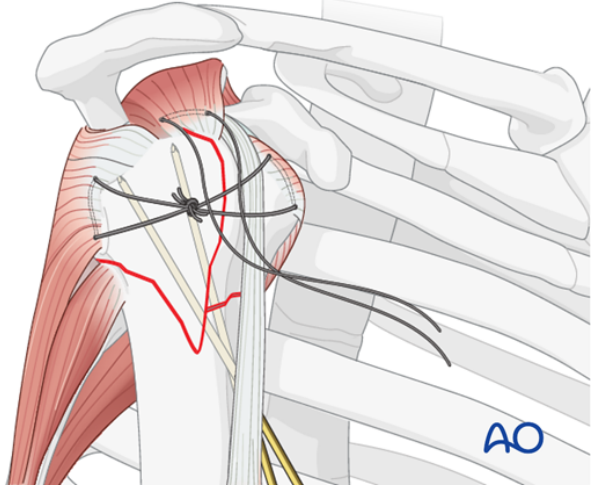
- Make sure that they are anterior enough to avoid interfering with the **plate** application.



4- Reduce the tuberosities

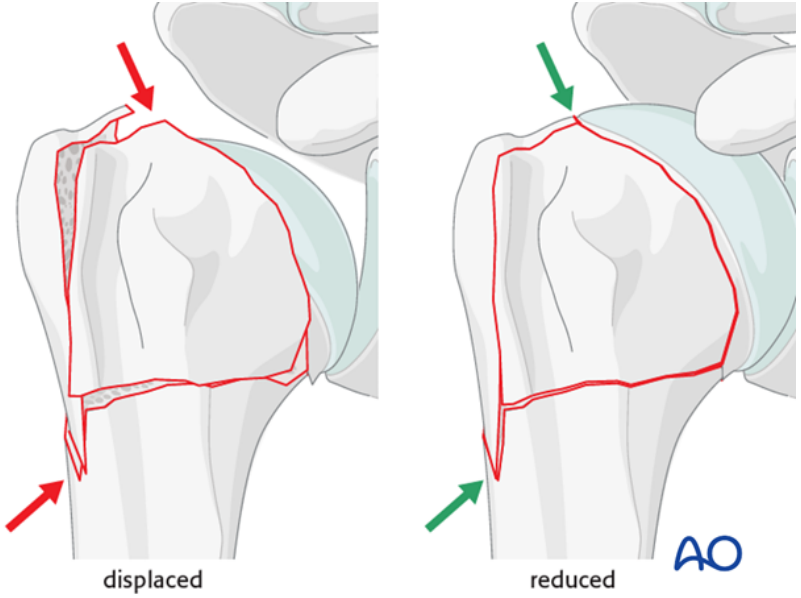
- After humeral head is properly reduce, the tuberosities can now easily be positioned underneath the humeral head.
- Pull the sutures between the subscapularis and the infraspinatus tendons horizontally and tie them together.





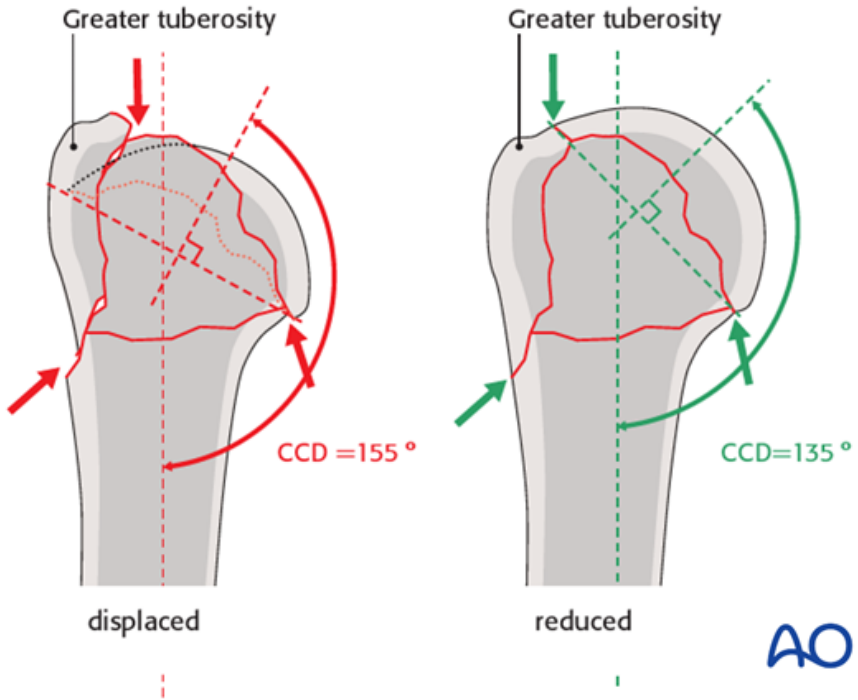
5- Confirm reduction

- After preliminary fixation check the reduction visually and by image intensification.



- On Xray :

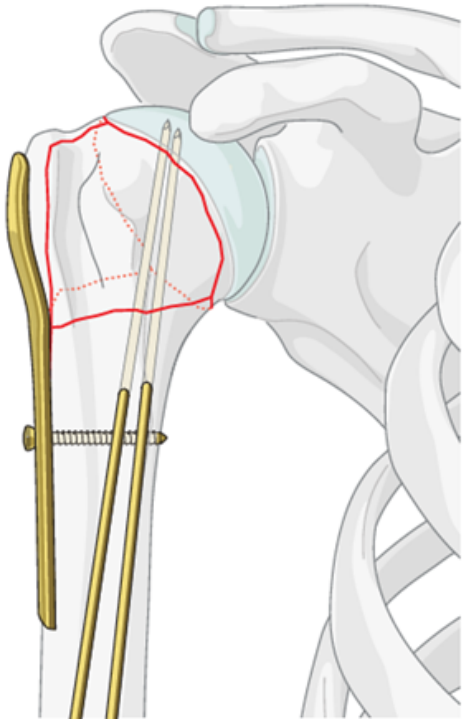
- Superolaterally, the humeral head and the GT should be flush without a step-off or gap.
- Make sure that the GT is not above the humeral head.
- Confirm the inclination of the humeral head by checking CCD should be approximately 135°.
- Valgus displacement of the humeral head must be corrected so there is enough room laterally for the tuberosities to be reduced.

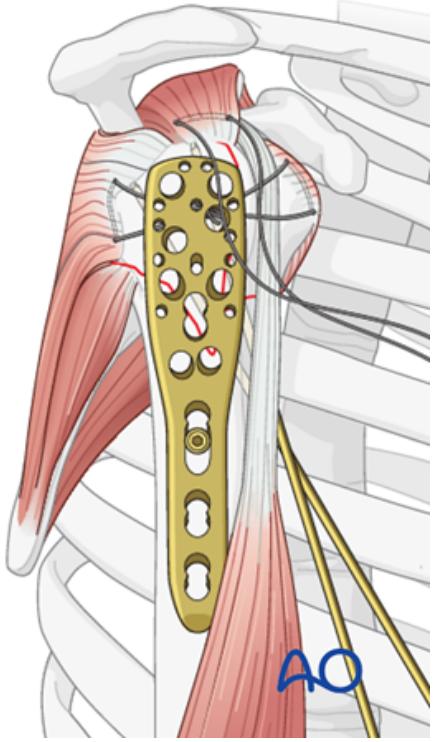


2. Plate fixation

1- Attach plate to humeral shaft

using a bicortical small fragment 3.5 mm screw inserted through the **elongated (oblong) hole**.

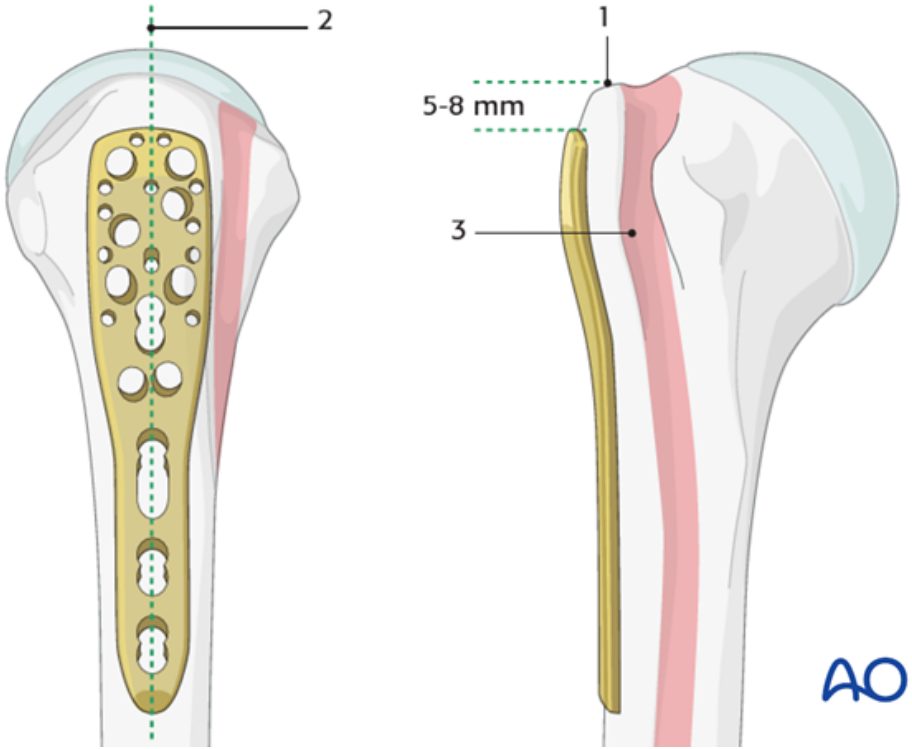




- *fine tuning of plate position*
  If the first screw is inserted only loosely in the center of the elongated hole, fine-tuning of the plate position is still possible. With the plate in proper position, tighten this screw securely.

- ***Correct plate position***
  The correct plate position is:

1. about **5-8 mm distal** to the top of the greater tuberosity
2. aligned properly along the axis of the humeral shaft
3. slightly **posterior** to the bicipital groove (2-4 mm)
   (*bicipital tendon and the ascending branch of the anterior humeral circumflex artery*)

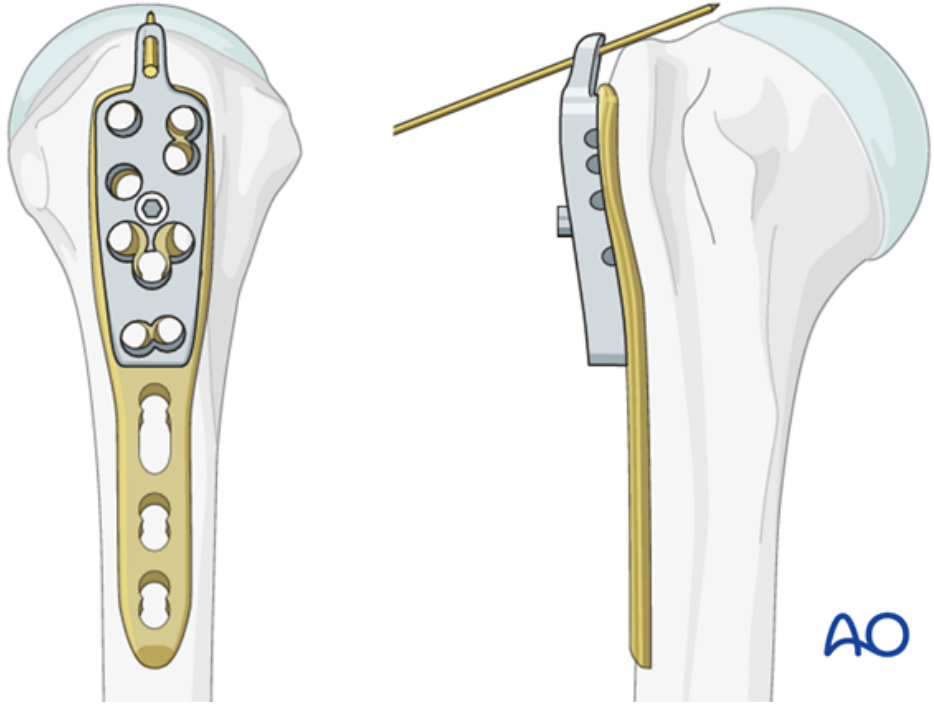


- *Confirmation of correct plate position*

  - by palpation of its relationship to the bony structures

- confirmed by image intensification.

- To confirm a correct axial plate position insert a K-wire through the proximal hole of the insertion guide. The K-wire should rest on the **top** of the **humeral head**



1- K-wire Targeting ***Central K-wire Hole***

- It allows for **symmetrical** peg or screw distribution in all four quadrants of the humeral head.
- Drill K-wire through the **central K-wire** hole on the proximal portion of the plate (Figure 11)
- confirm the K-wire is **centrally** located in both **AP & Lat**

2- *Alternate Targeting through* ***Medial Calcar Screw Hole***

- preferred if there is comminution in the medial calcar that necessitates peg or screw support.
- Insert the K-wire Adapter into the F.A. S.T. Guide of the medial calcar screw position (Figure 13)
- confirm that the K-wire is **2-4 mm proximal** to the **medial wall of the calcar** (Figure 14)

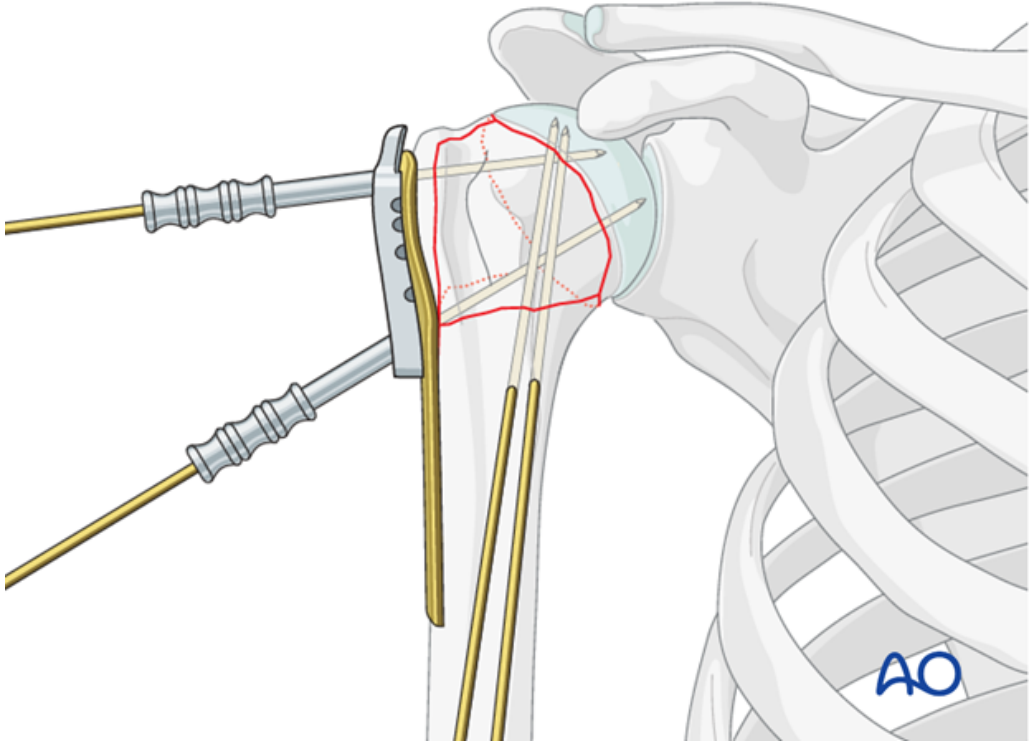
Figure 11

Figure 12

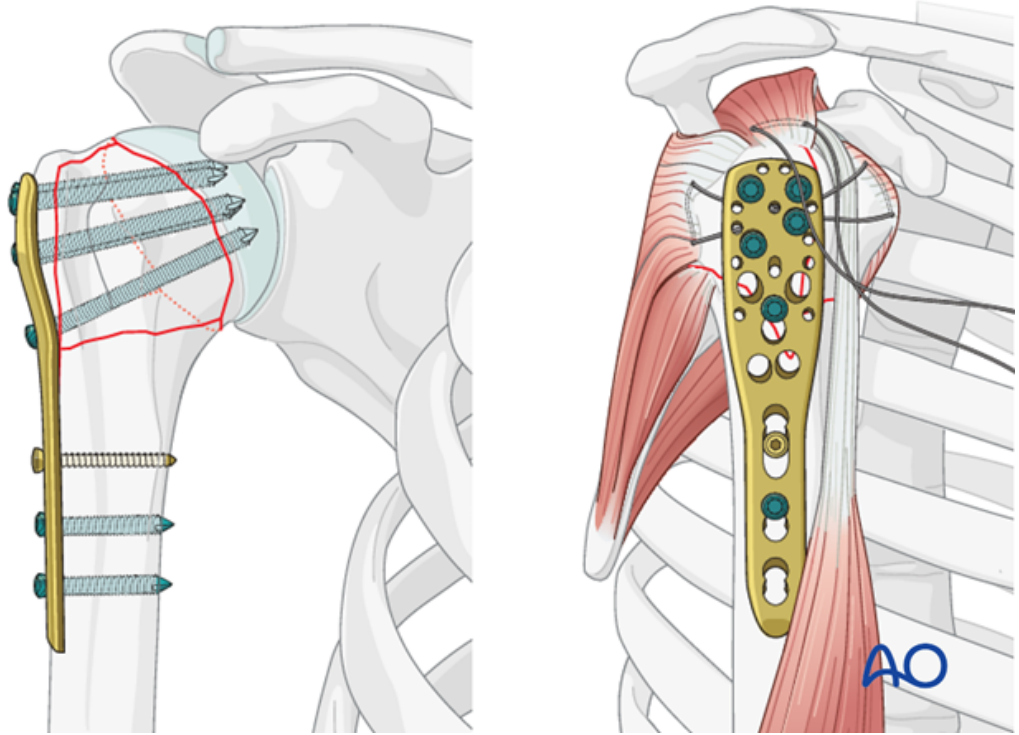
Figure 13

Figure 14

2- Insert K-wires through appropriate guiding sleeves.

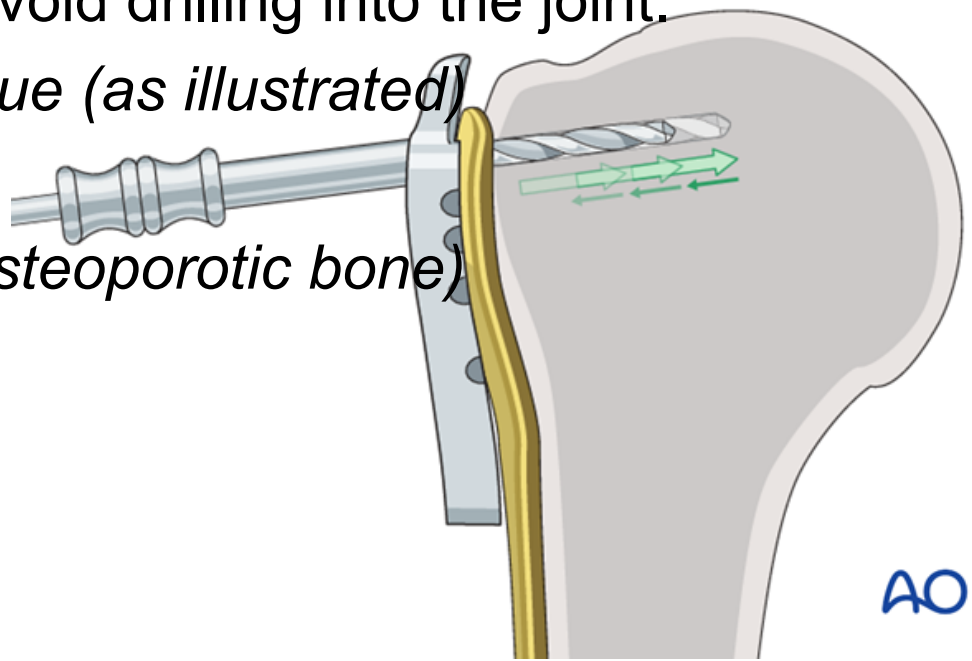


3- Fix plate to the humeral head (5 screws) & insert additional screws into the humeral shaft (more 2 screws)



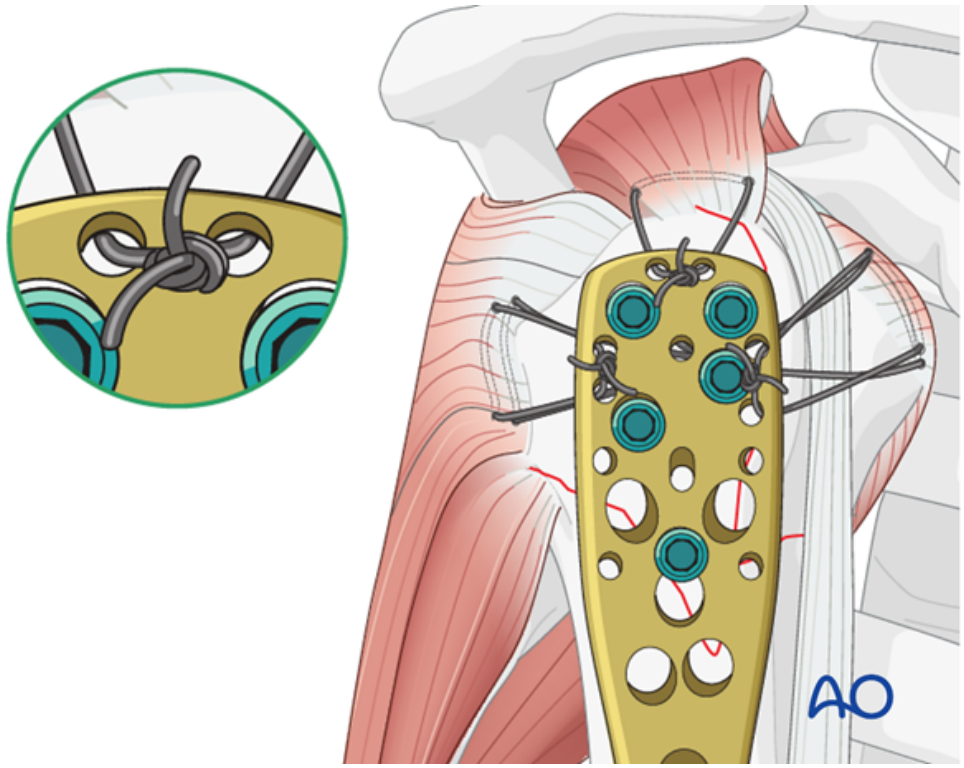
- ***Avoiding intraarticular screw placement***
  Two drilling techniques help to avoid drilling into the joint.

1. *"**Woodpecker**"-drilling technique (as illustrated)*
2. *Drilling **near cortex only** (in osteoporotic bone)*



4- Supplementary rotator cuff tendon sutures

- Secure the tendons of the rotator cuff with additional tension band sutures through the small holes in the plate



Thank you