

Gratitude to AO international and  
Danish AO faculty for pictures and  
cases.

# Distal humerus

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Fix-replace-concervative?  
Tips and tricks

# Disclosure: No potential conflicts of interest

Faculty: Frank Damborg.

Consultant. Kolding hospital. Denmark.

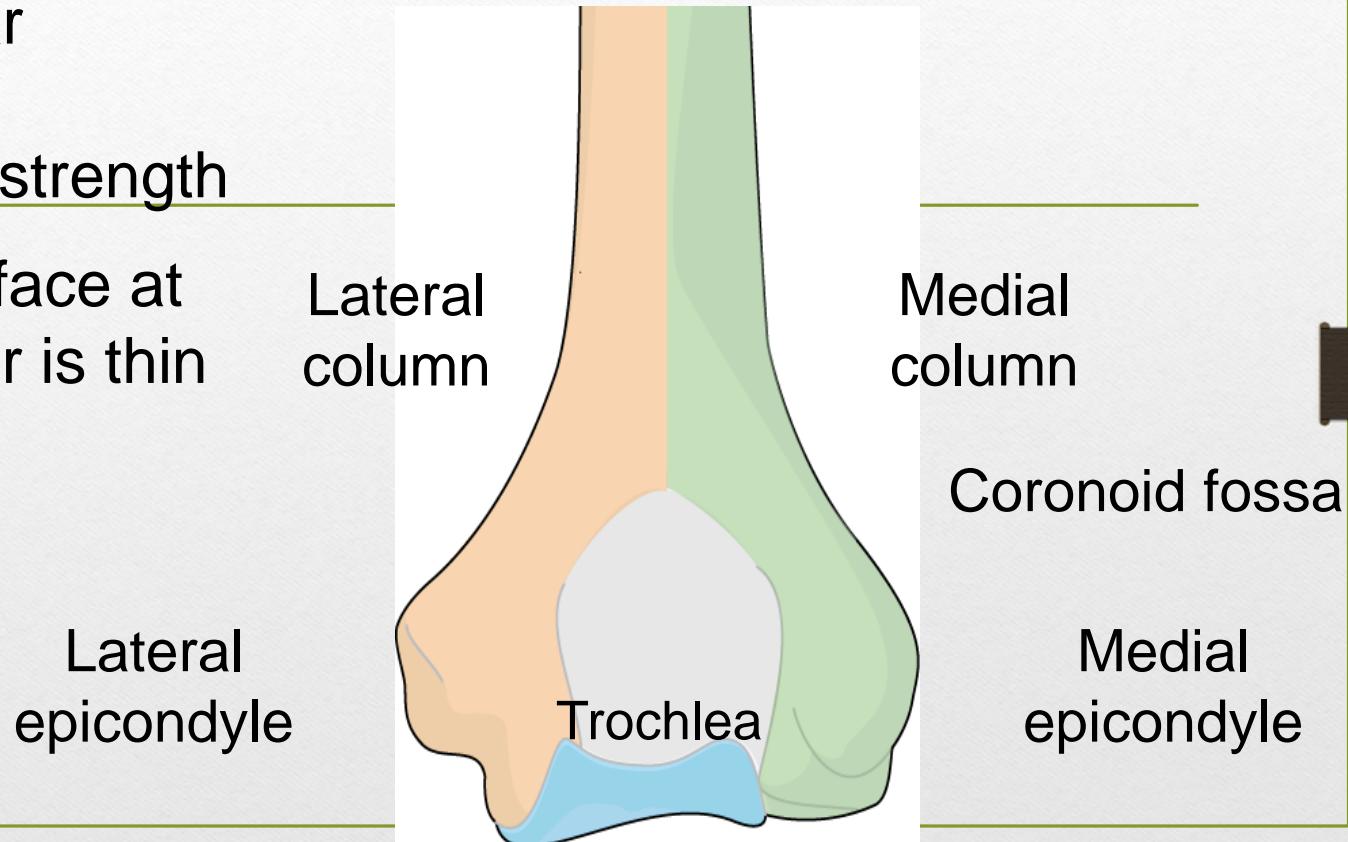
I have no financial relationships with commercial entities that produce health-care related products.

# Learning objectives

- Knowledge of the anatomy of the distal humerus
- Proper preoperative planning
- Adequate exposure for articular reduction
- Knowledge of reduction and fixation methods
- (Treatment principles as for all intraarticular injuries)

# Anatomy—anterior

- Triangular structure provides strength
- Bony surface at the center is thin = tie-rod

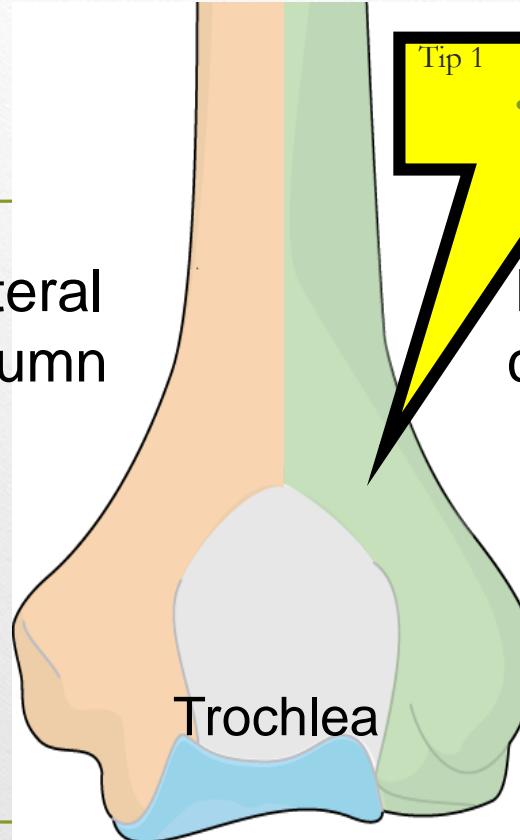


# Anatomy—anterior

- Triangular structure provides strength
- Bony surface at the center is thin = tie-rod

Lateral epicondyle

Lateral column



Tip 1

- Know anatomy

Medial column

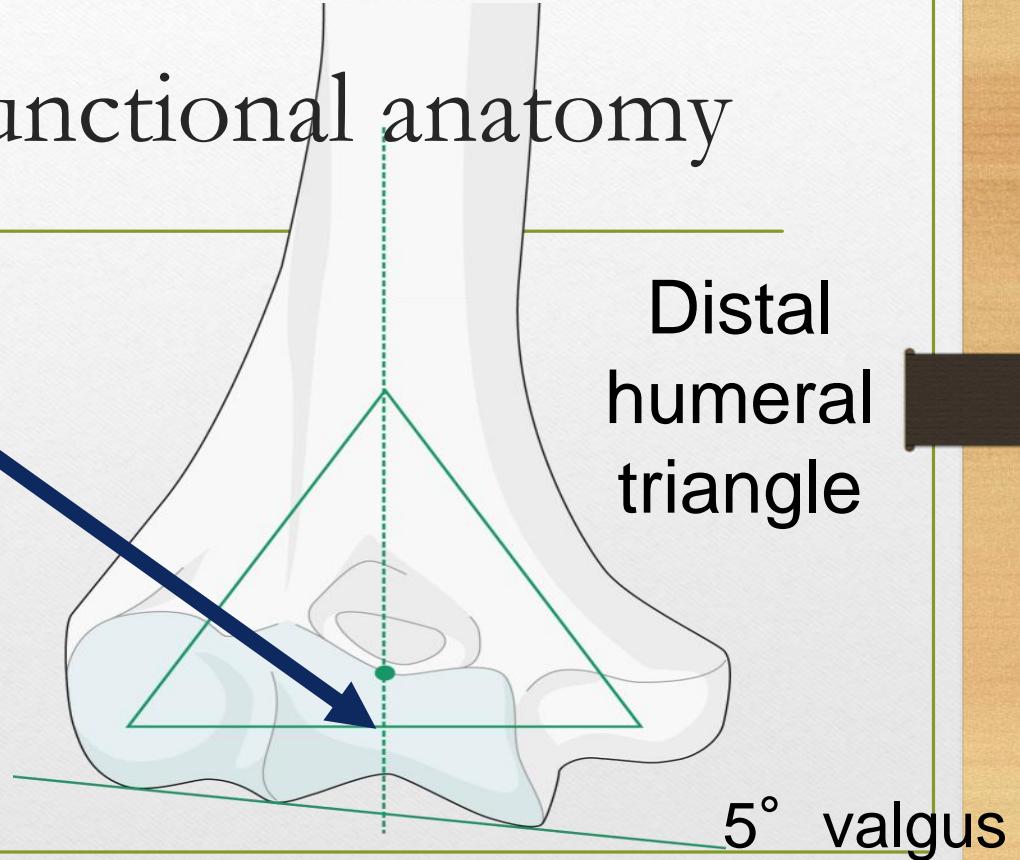
Coronoid fossa

Medial epicondyle

# Anatomy—functional anatomy

Trochlea is center point

Hinged joint with single  
axis of rotation  
(trochlear axis)



Distal  
humeral  
triangle

5° valgus

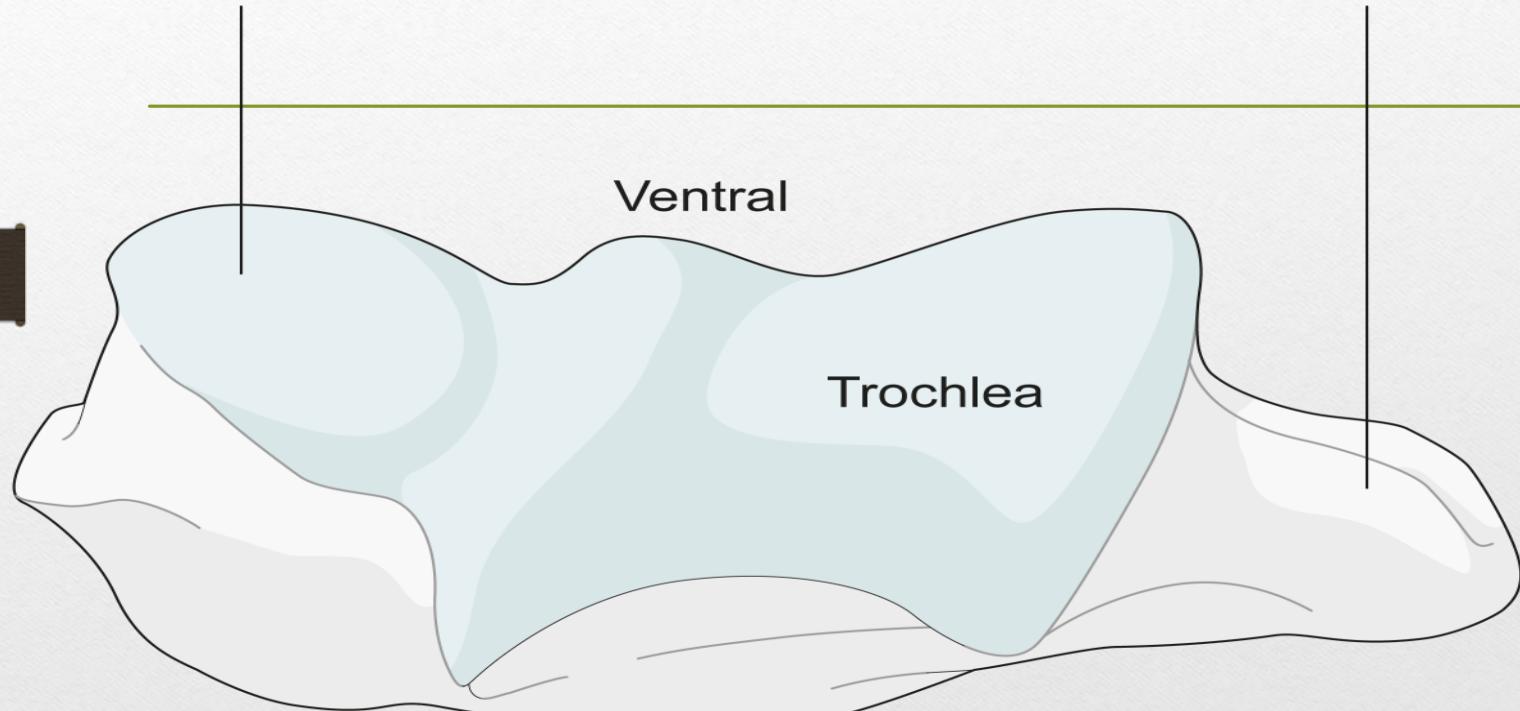
# Anatomy

Capitulum

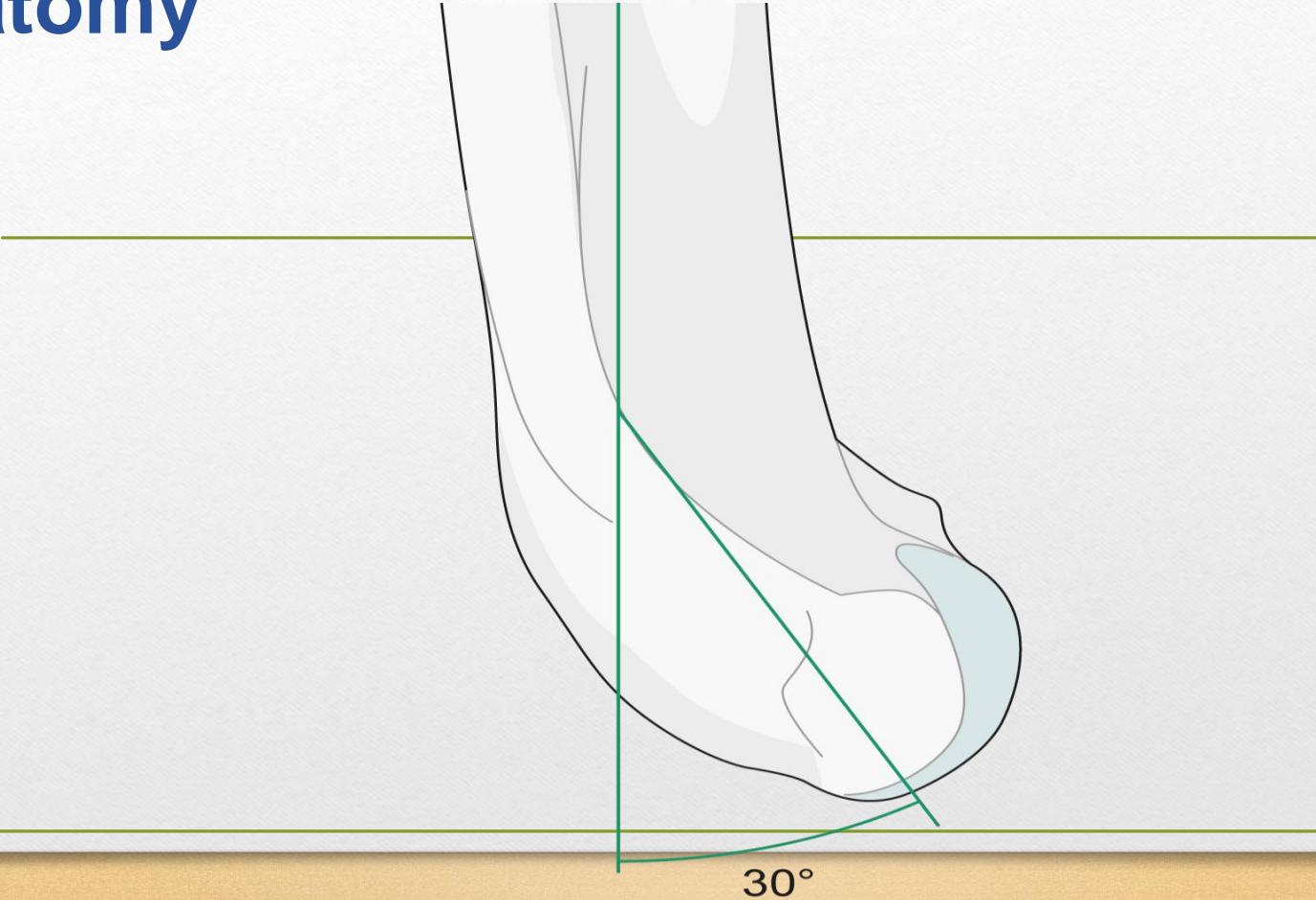
Medial epicondyle

Ventral

Trochlea



# Anatomy



# Evaluation

- Physical examination
- Soft-tissue envelope
- Vascular status
- Radial and ulnar pulses
- Neurological status:
  - Radial nerves
  - Ulnar nerve
  - Median nerves (rarely injured)



# Evaluation

- Physical examination
  - Soft-tissue envelope
  - Vascular status
  - Radial and ulnar pulses
- Neurological status:
    - Radial nerves
    - Ulnar nerve
    - Median nerves (rarely injured)

Tip 2

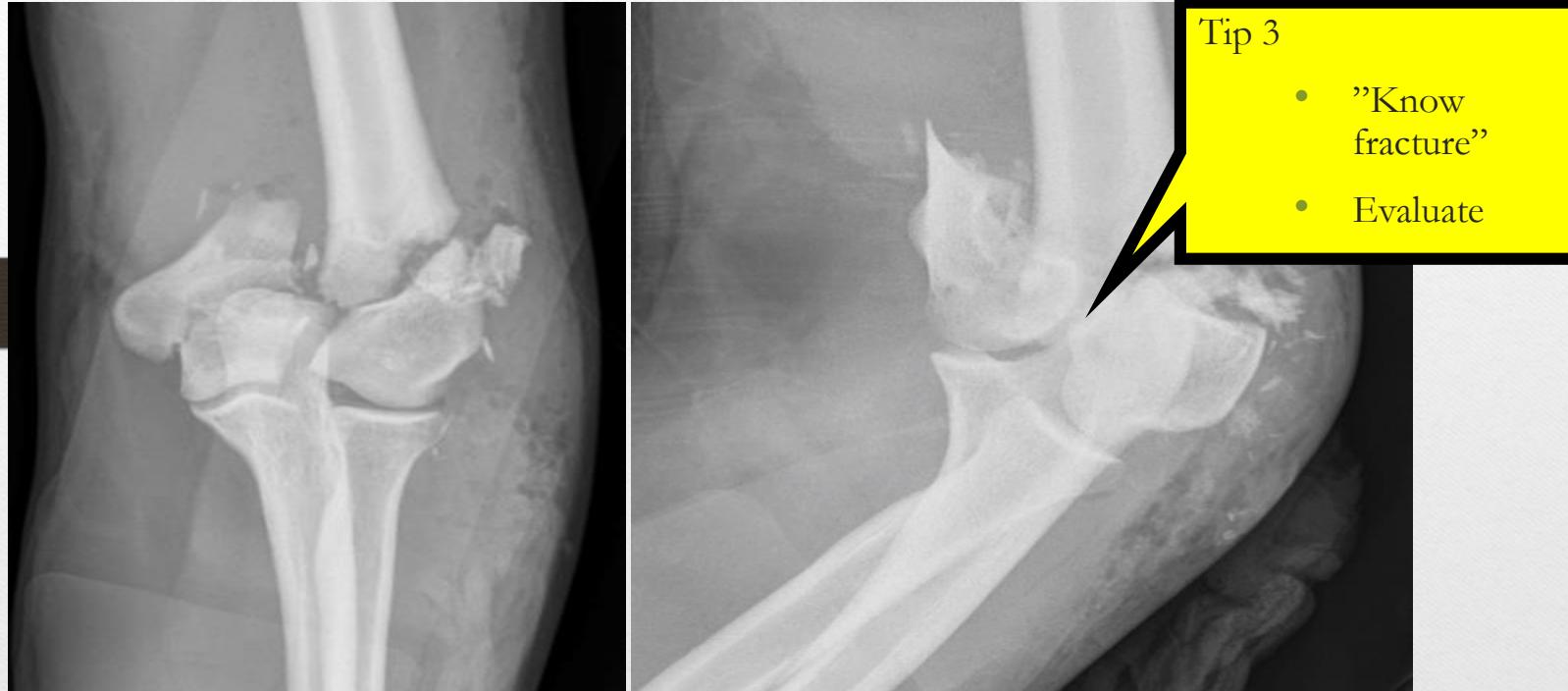
- Know soft tissue



# X-ray evaluation—AP and lateral



# X-ray evaluation—AP and lateral



# Radiological evaluation

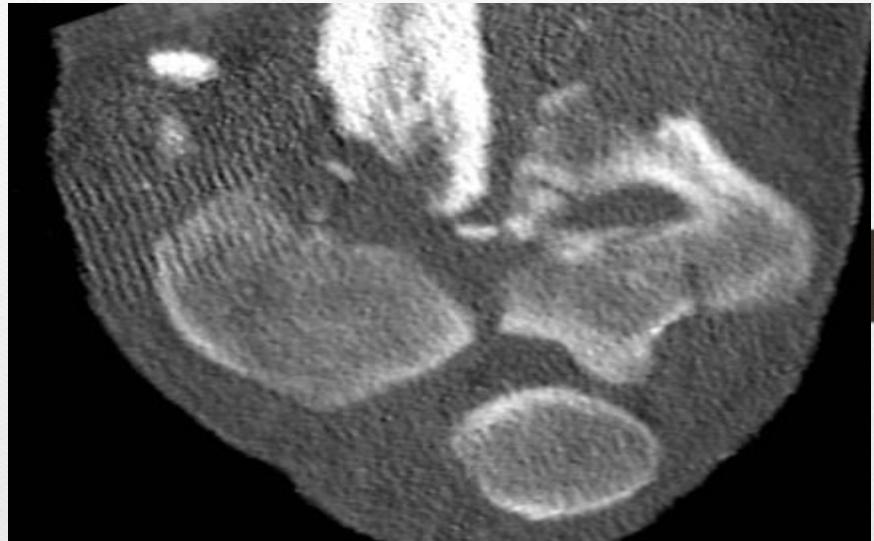
- Anteroposterior
- Lateral
- Traction view
- CT scan



# Value of CT scans?

CT scans are helpful in case of:

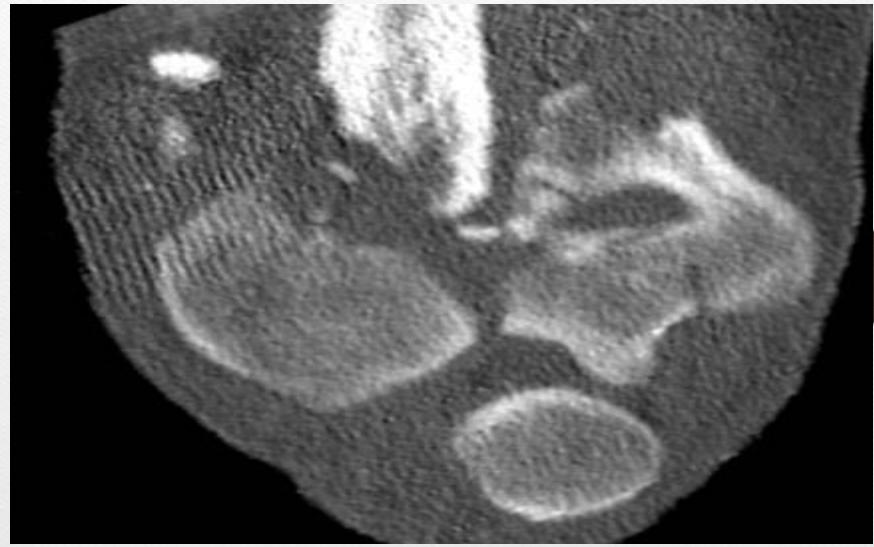
- Intraarticular fractures
  - Severe osteoporosis
  - Preexisting deformities
  - Comminution
- 
- Analyse your CT scans while planning



# Value of CT scans?

CT scans are helpful in case of:

- Intraarticular fractures
  - Severe osteoporosis
  - Preexisting deformities
  - Comminution
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- Analyse your CT scans while planning



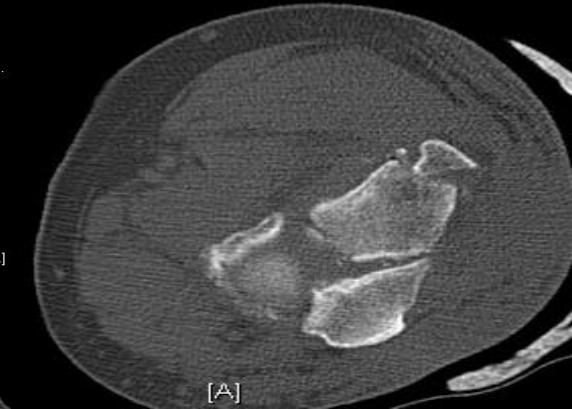
Tip 4

- Plan every step
- Plan A
- Plan B

Se:5  
Im:38



Se:5  
Im:48



C30  
VV1400

Se:450  
Im:3D1UXCF25  
Set: 4  
Volume Rendering No cut

DFOV 16.2 cm  
B20s

A  
[AFR]  
R

[FPL]  
IPL

P  
[PBL]  
L

No VOI  
kv 120  
mA Mod.  
1.0s  
0.8mm / 0.7sp  
Tilt: 0.0  
01:08:44 PM  
W = 753 L = 212

450/101

[FAR]

C128  
W256

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Se: 4  
Volume Rendering No cut

DFOV 16.2 cm  
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Volume Rendering No cut

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SOP  
[HAR]

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SOP  
[HAR]

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SOP  
[PAR]

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450/41

SAP  
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C128  
W256

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Im:31 UXCF25  
Set: 4  
Volume Rendering No cut

DFOV 16.2 cm  
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C128  
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Im:21 UXCF25  
Se: 4  
Volume Rendering No cut

DFOV 16.2 cm  
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No VDI  
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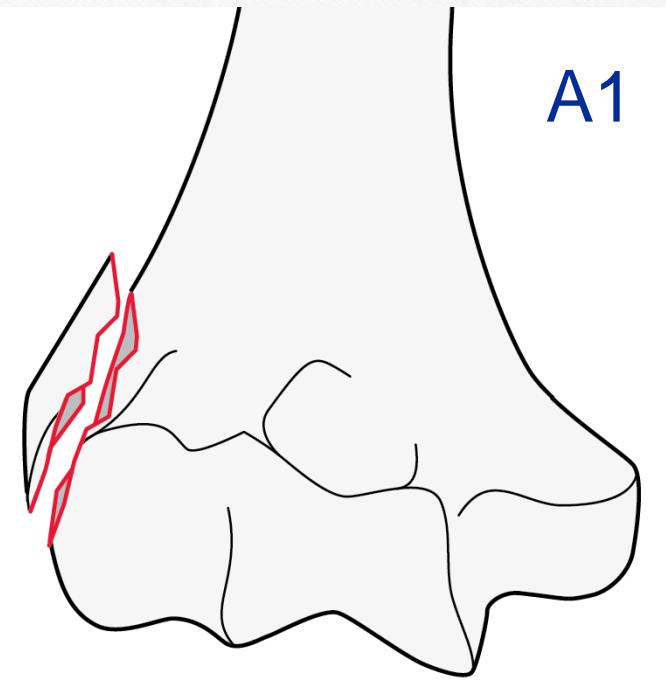
C128  
W256

# AO/OTA Fracture and Dislocation Classification—type A

Humerus, distal segment (13)

Type A—extraarticular:

- A1—avulsion fracture
- A2—simple fracture
- A3—multifragmentary fracture

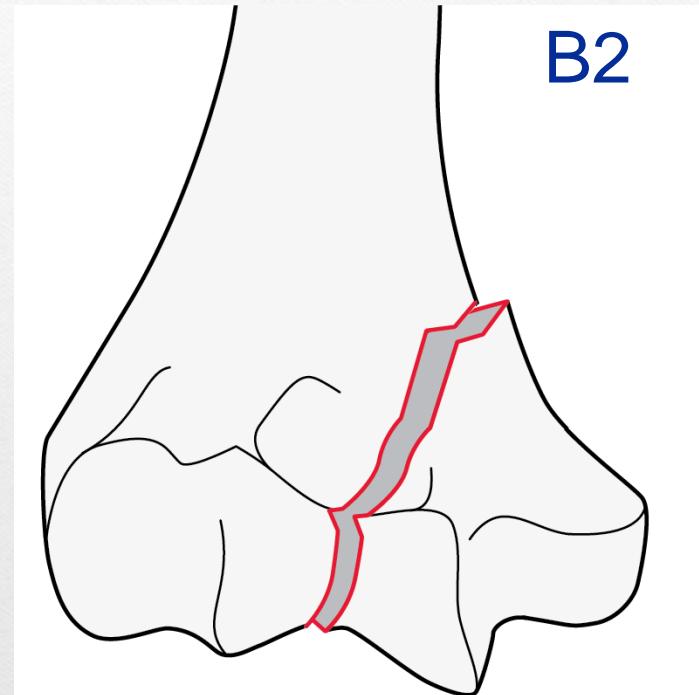


# AO/OTA Fracture and Dislocation Classification—type B

Humerus, distal segment (13)

Type B—partial articular:

- B1—lateral condyle fracture
- B2—medial condyle fracture
- B3—frontal plane fracture,  
trochlea/capitulum

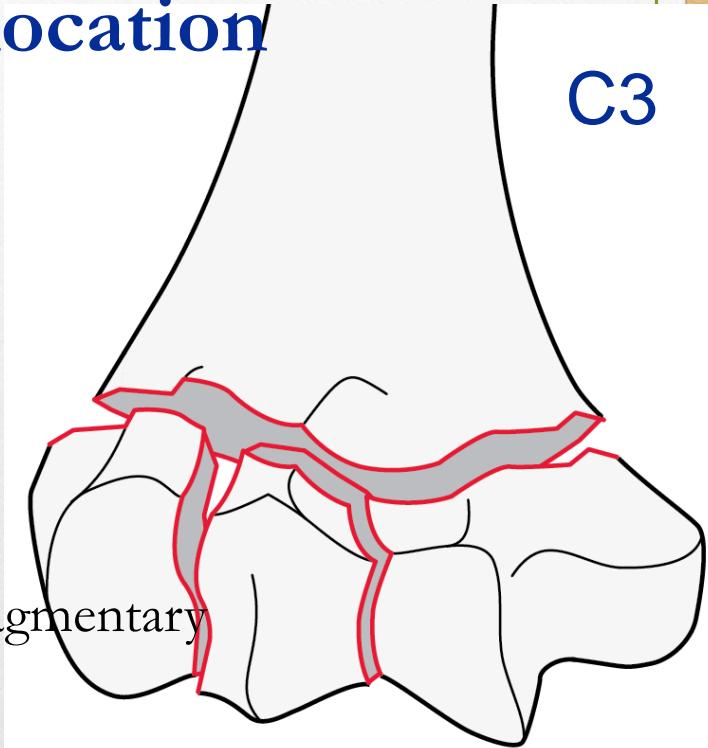


# AO/OTA Fracture and Dislocation Classification—type C

Humerus, distal segment (13)

Type C—complete articular:

- C1—articular simple; metaphyseal simple
- C2—articular simple; metaphyseal multifragmentary
- C3—articular multifragmentary



# Treatment principles

What do we want:

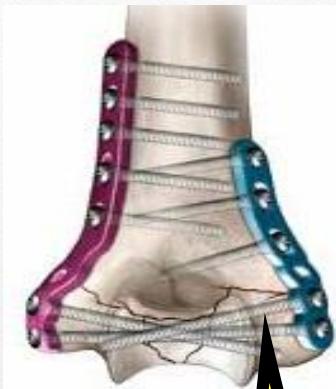
- Anatomical reduction of the articular surfaces
- Stable internal fixation of the articular surface
- Restoration of articular axial alignment
- Stable fixation of the articular segment to the metaphysis and diaphysis
- Early range of motion (ROM) of the elbow



# Treatment principles

What do we want:

- Anatomical reduction of the articular surfaces
- Stable internal fixation of the articular surface
- Restoration of articular axial alignment
- Stable fixation of the articular segment to the metaphysis diaphysis
- Early range of motion (ROM) of the elbow



Tip 5

- Know your implants

# Other treatment options

- Total elbow arthroplasty:
  - Comminuted intraarticular fracture in the elderly
  - Promotes immediate ROM
  - Usually limited by poor remaining bone stock
- “Bag of bones” technique = Non-operative treatment
- Cast or brace:
  - Indicated for completely non-displaced, stable fractures

# Other treatment options

- Total elbow arthroplasty:
    - Comminuted intraarticular fractures in the elderly
    - Promotes immediate ROM
    - Usually limited by poor remaining bone stock
  - “Bag of bones” technique = nonoperative treatment
  - Cast or brace:
    - Indicated for completely nondisplaced, stable fractures
- Tip 6
- Know your alternatives

# Decision making > plating

## Questions to ask:

- One or two column fracture ?
- Intraarticular surface disturbed?
- Reduction and fixation possible?
- Severity of soft-tissue damage?

# Decision making > plating

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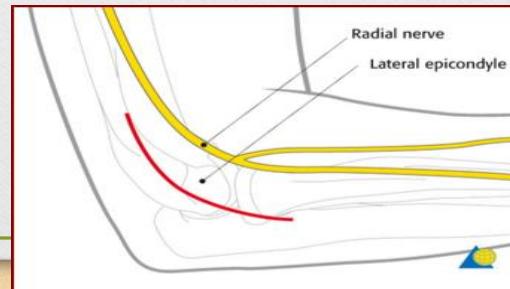
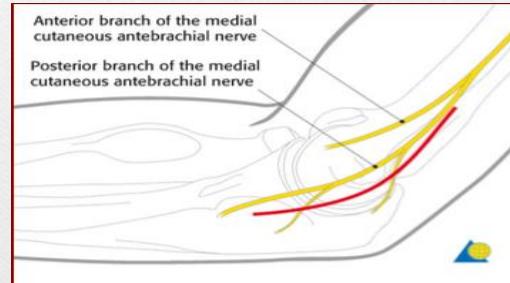
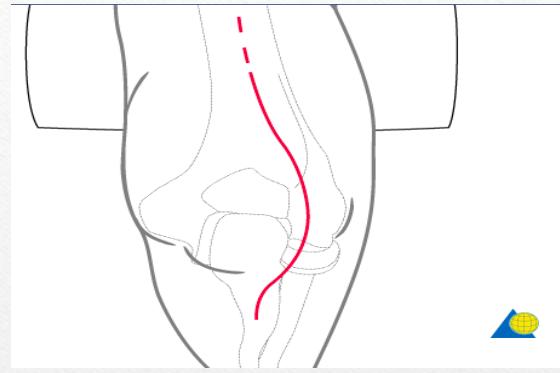
Questions to ask:

- Approach ?
- Olecranon osteotomy or triceps split?
- Minor approach?

# Approach

## Distal humerus

- Posterior
- Lateral
  - Isolated lateral column
- Medial
  - Isolated medial column



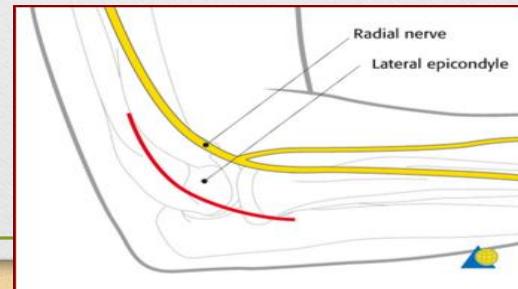
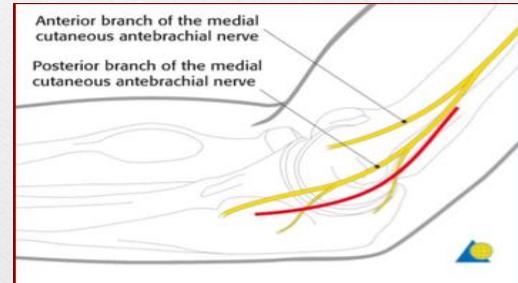
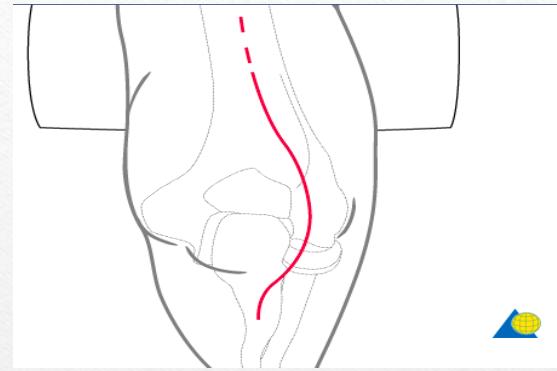
# Approach

## Distal humerus

- **Posterior**
- **Lateral**
  - Isolated lateral column
- **Medial**
  - Isolated medial column

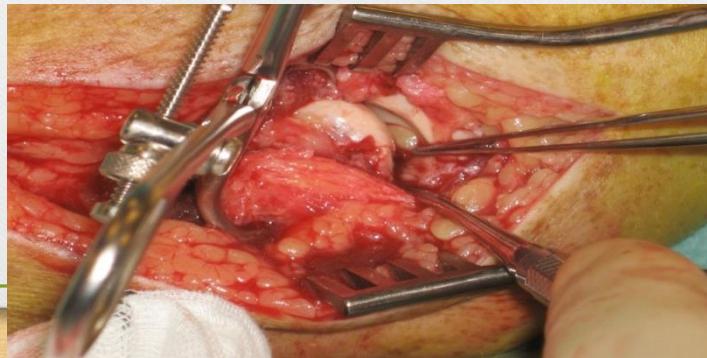
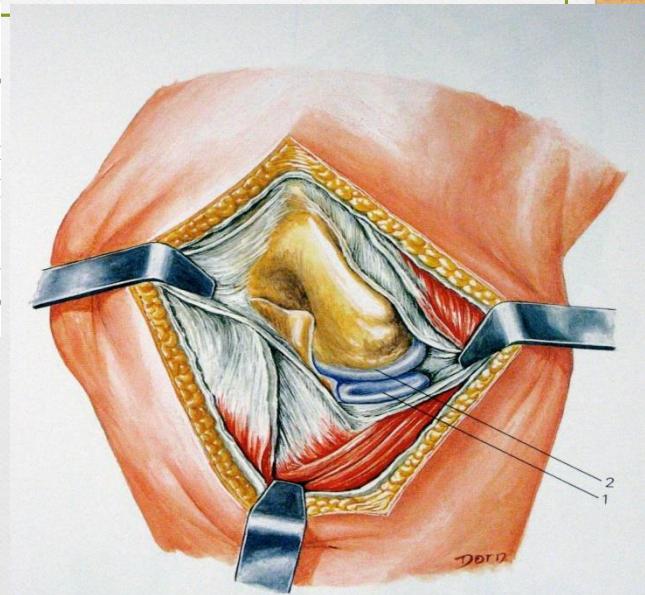
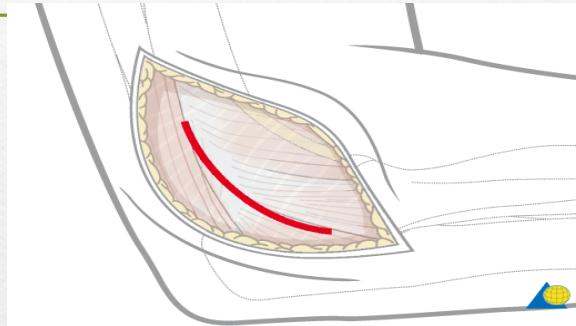
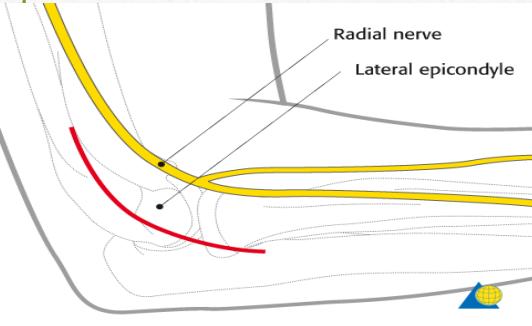
Tip 7

- Know your approaches



# Approach

- Lateral - Between anconeus and brachioradialis

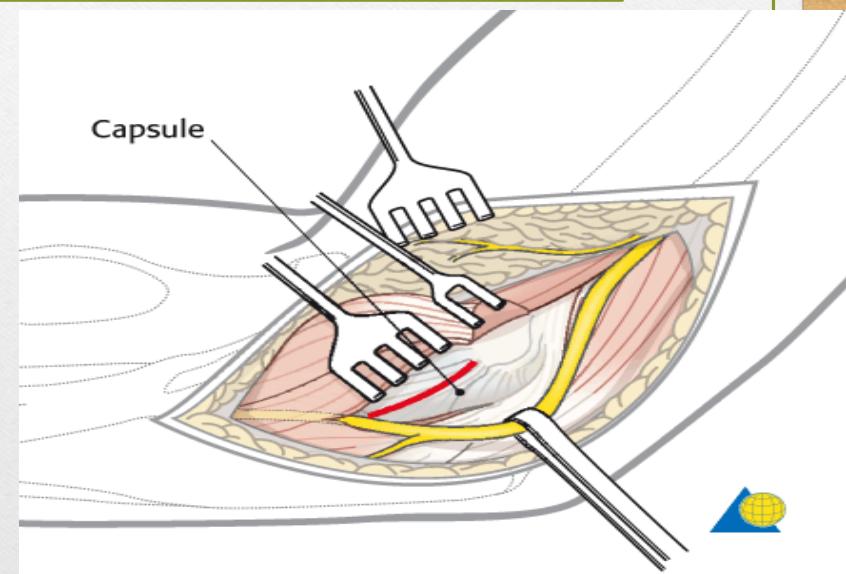


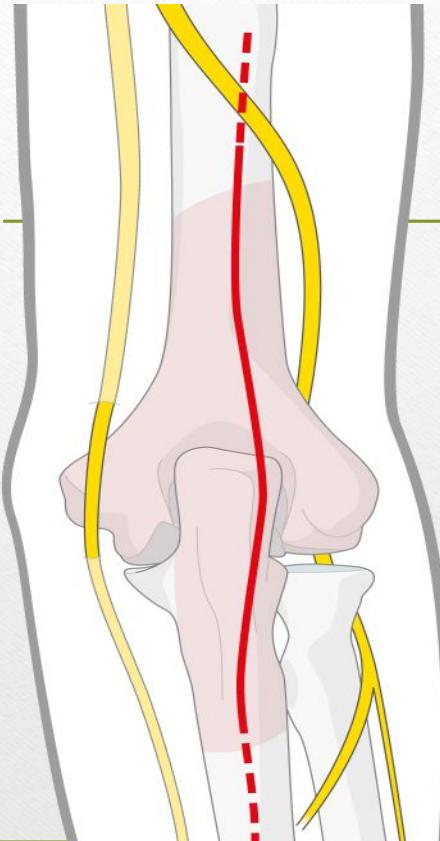
# Approach

- Medial – NB: n. ulnaris

Anterior branch of the medial cutaneous antebrachial nerve

Posterior branch of the medial cutaneous antebrachial nerve



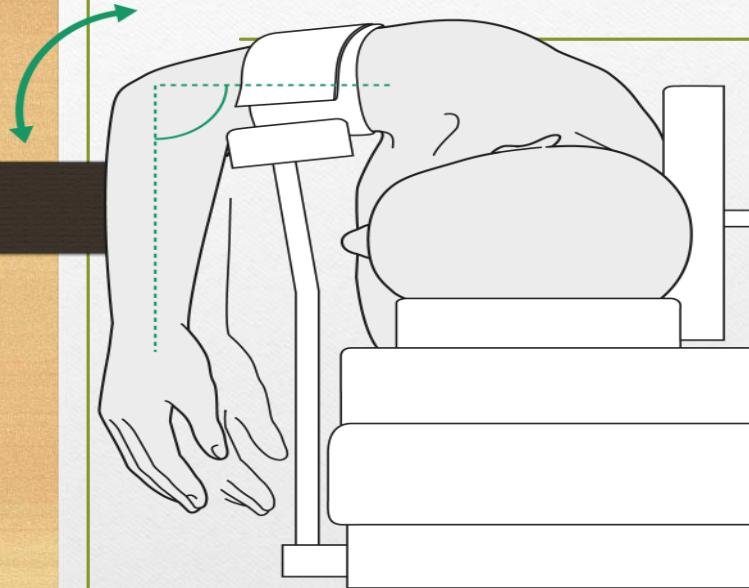


Approach posterior

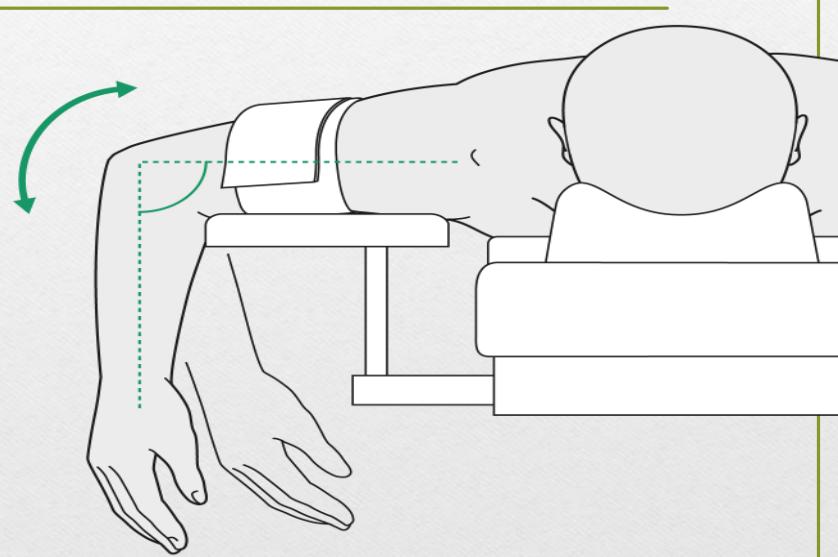


# Positioning of the patient

Lateral

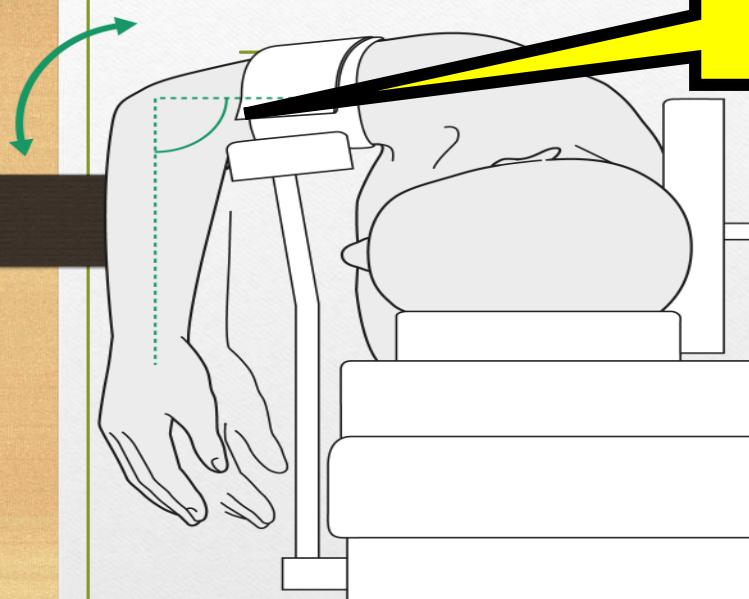


Prone



# Positioning of the patient

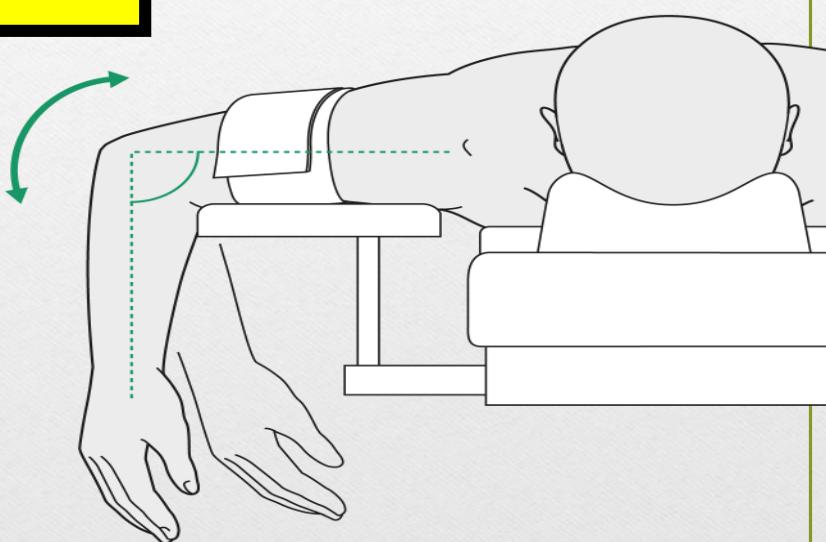
Lateral



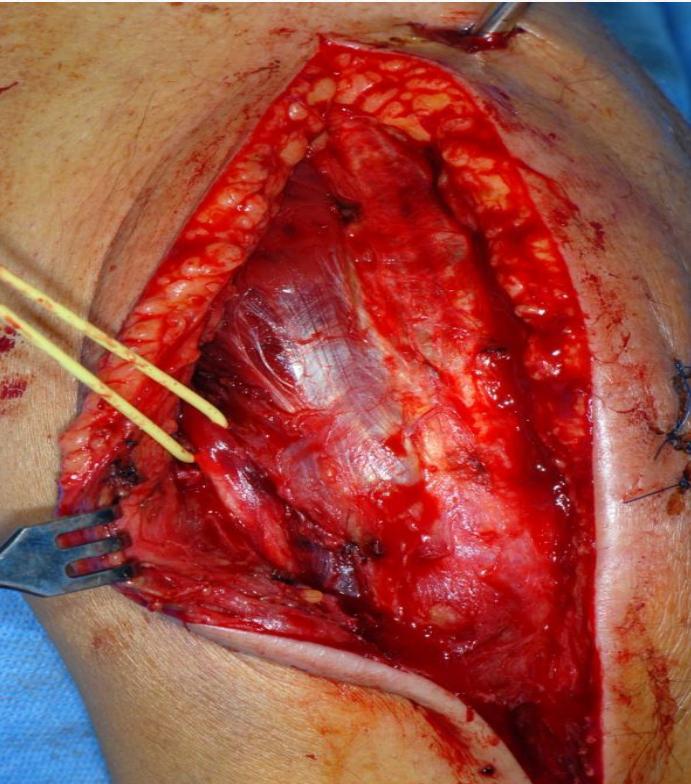
Tip 8

- Know "your" position
- Help yourself

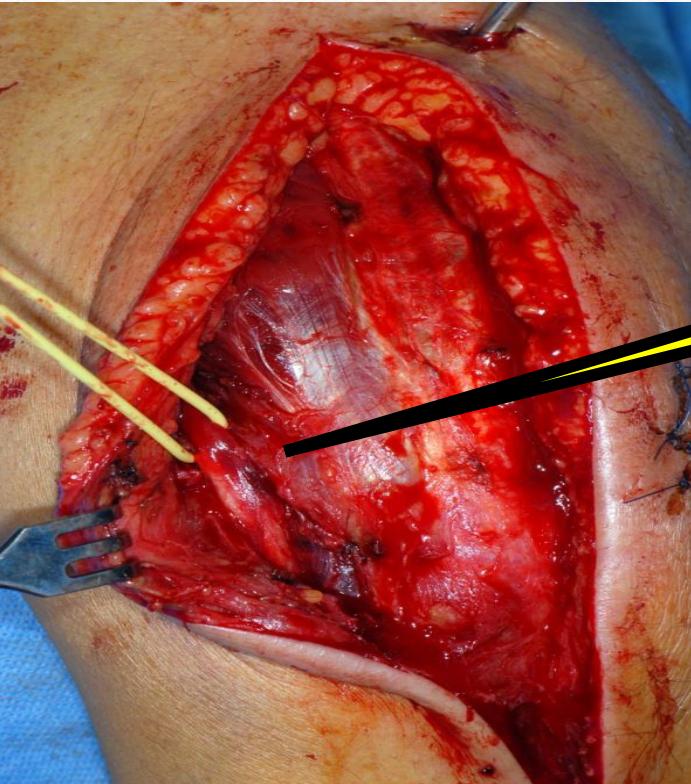
Prone



# Identification of the ulnar nerve



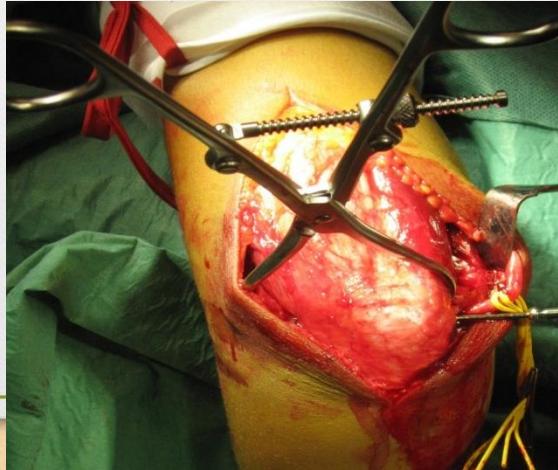
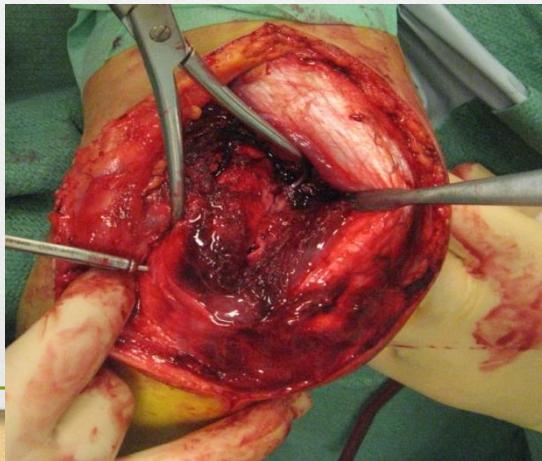
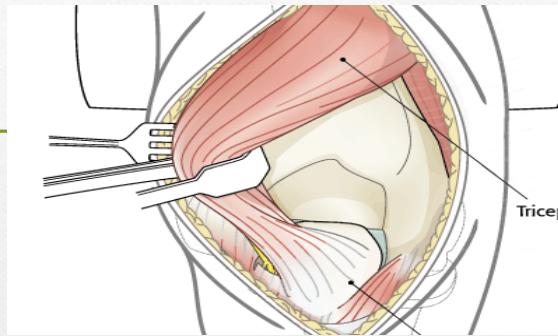
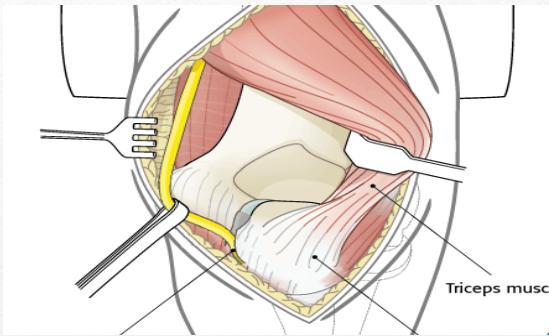
# Identification of the ulnar nerve



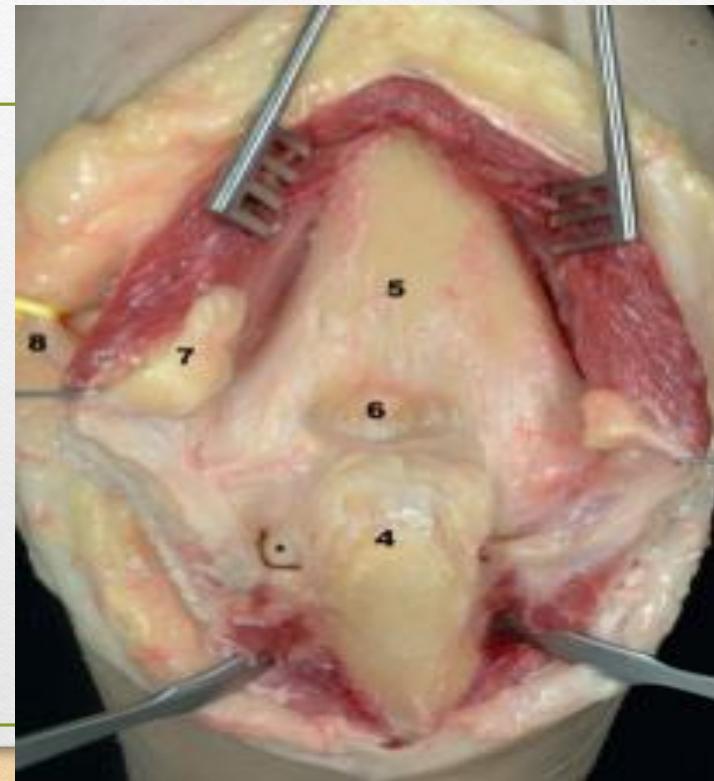
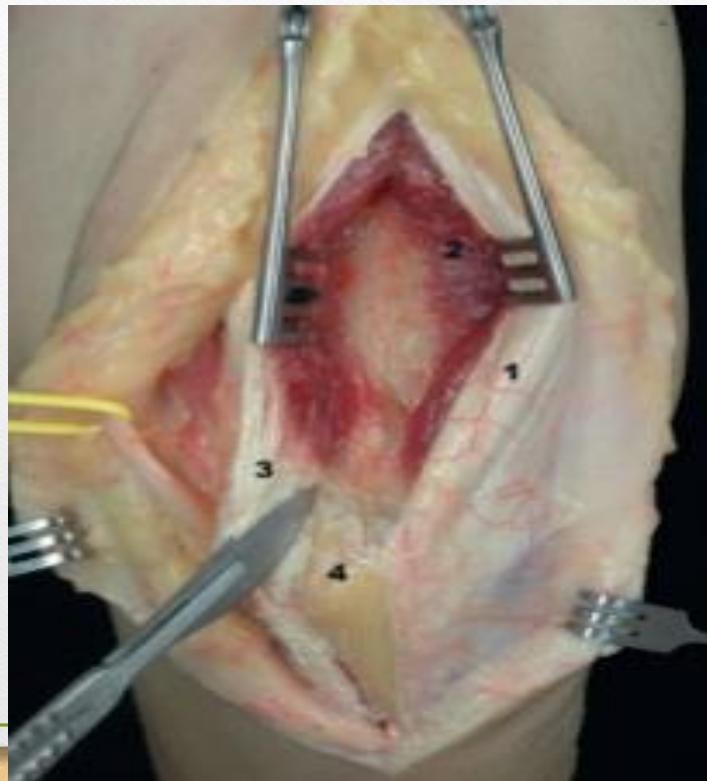
Tip 9

- Always!!

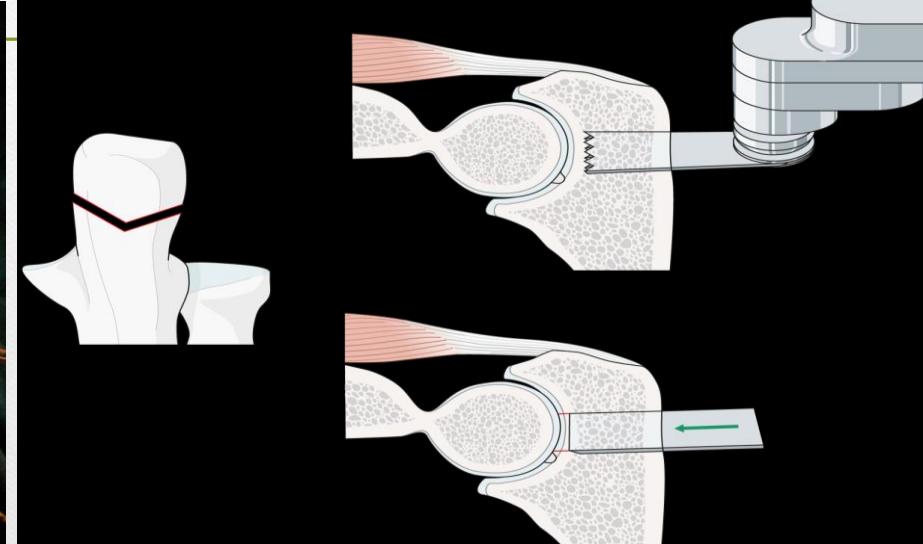
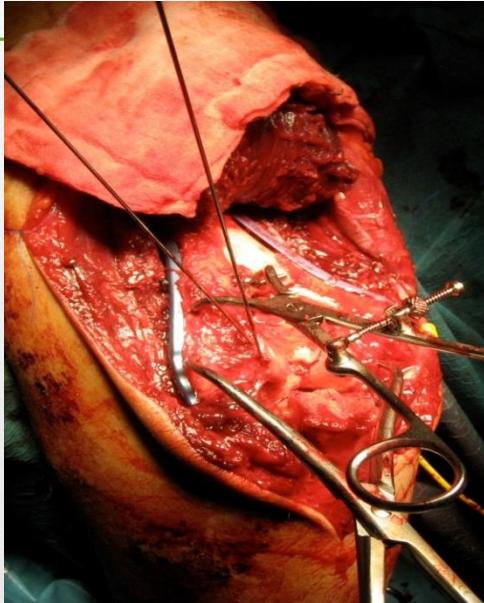
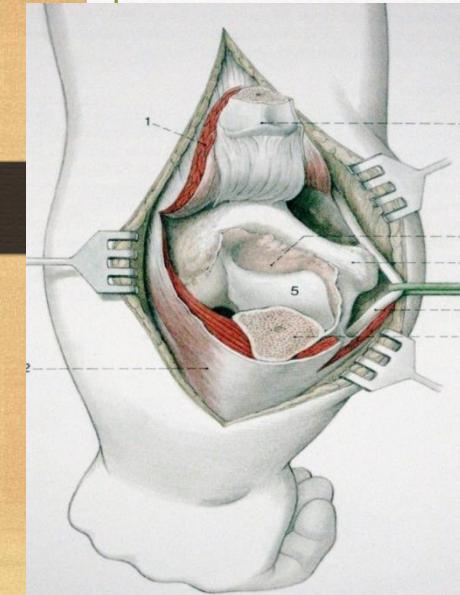
- Posterior - medial/lateral triceps



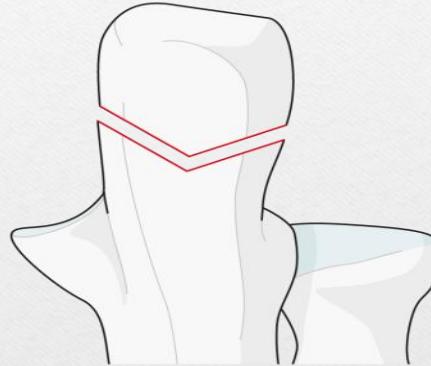
- Posteriore – tricepssplit



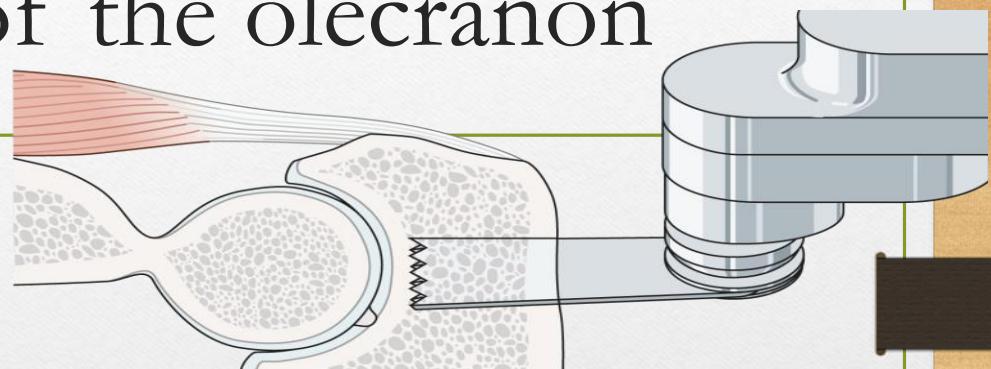
- Posteriore – olecranonosteotomi (Chewron)



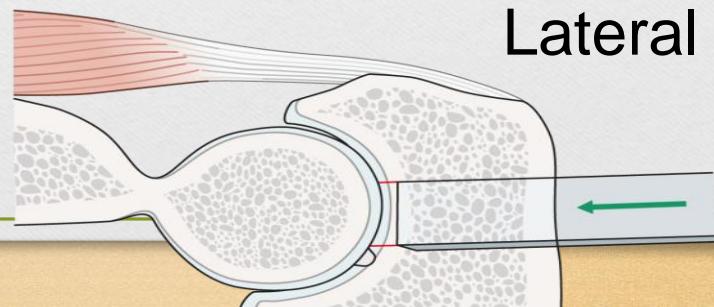
# Osteotomy of the olecranon



AP view



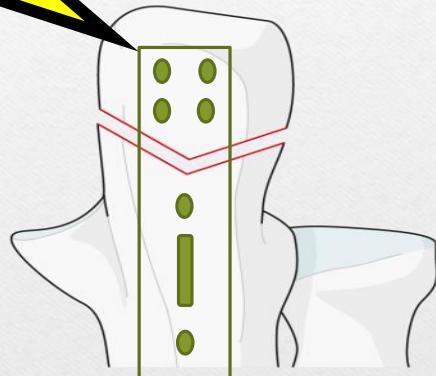
Lateral view



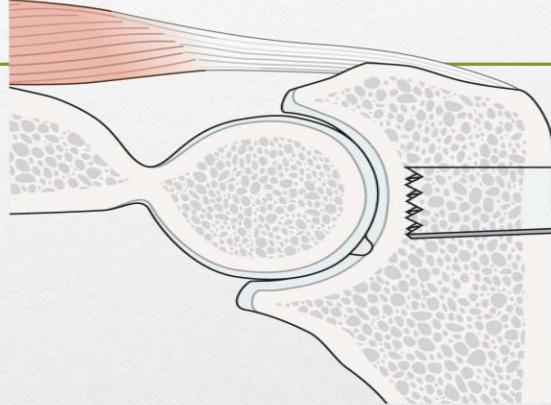
# Osteotomy of the olecranon

Tip 10

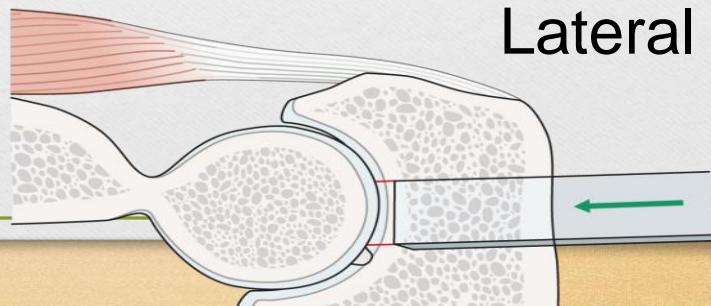
- Place plate before doing chevron!



AP view



Lateral view



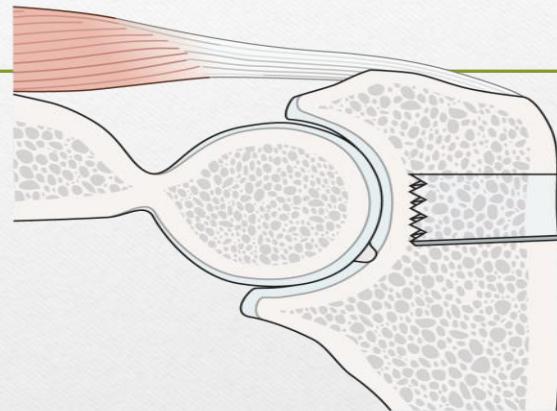
# Osteotomy of the olecranon

Tip 11

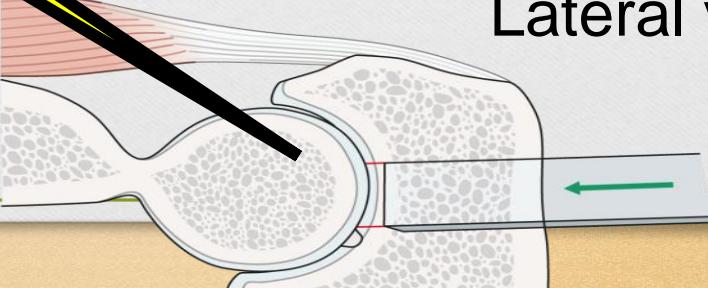
- OBS



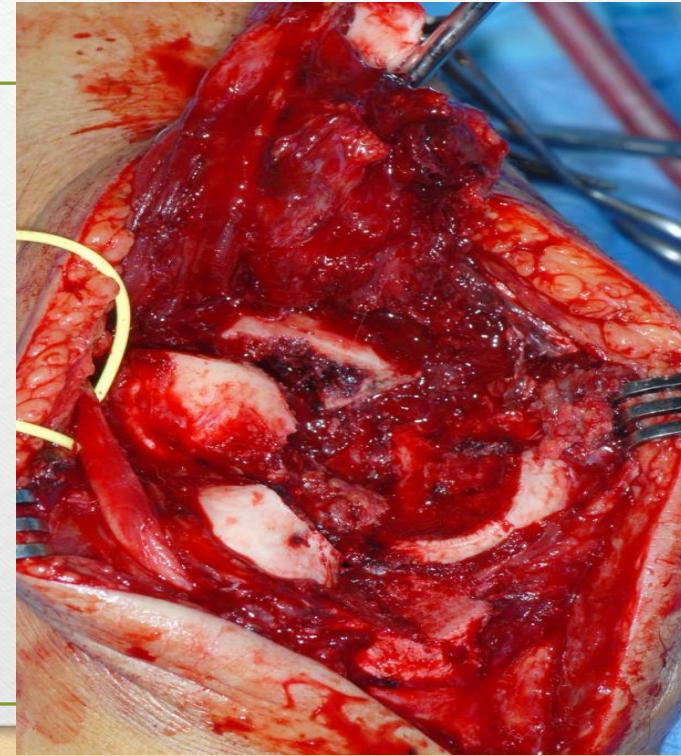
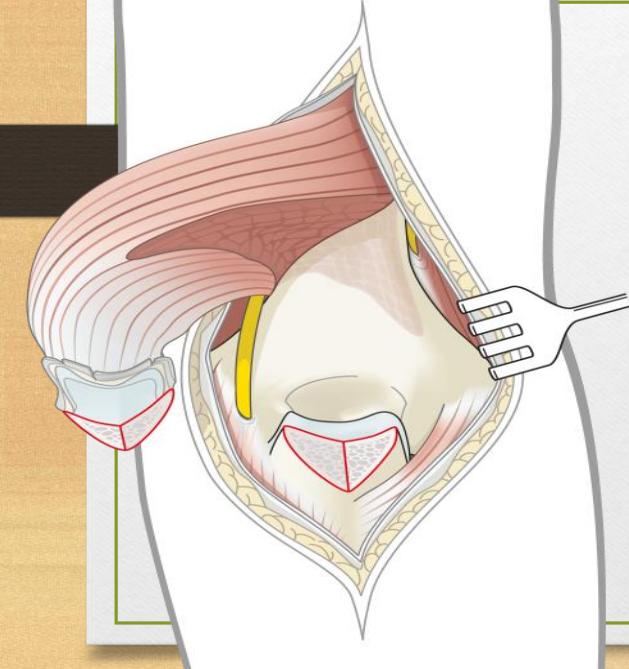
AP view



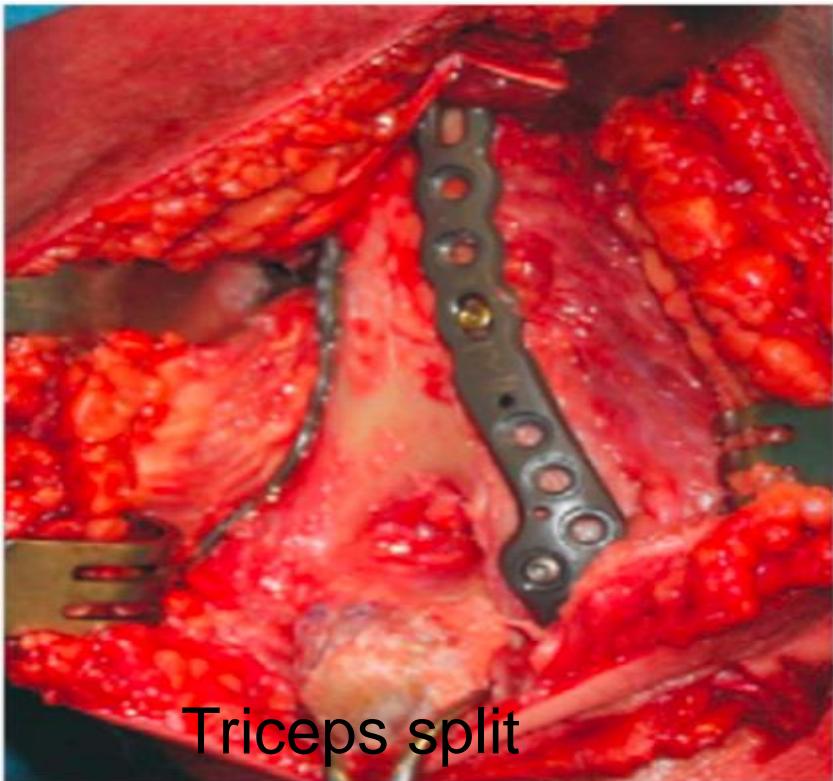
Lateral view



# Intraoperative view

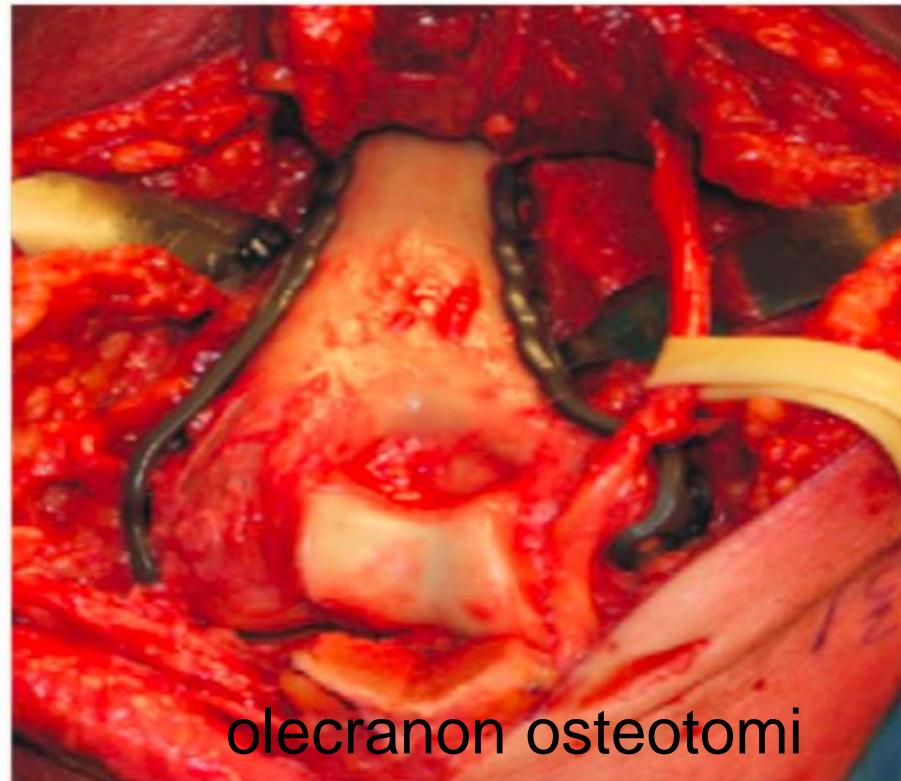


## **Distal humerus fraktur**



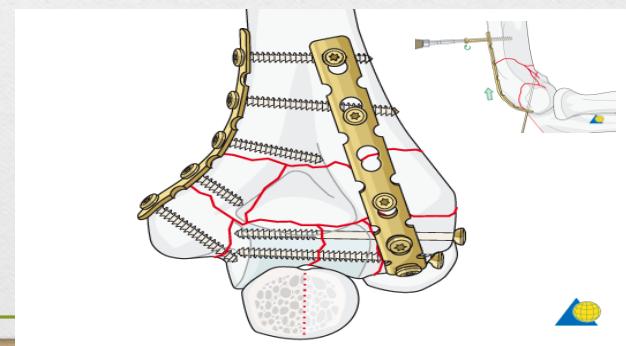
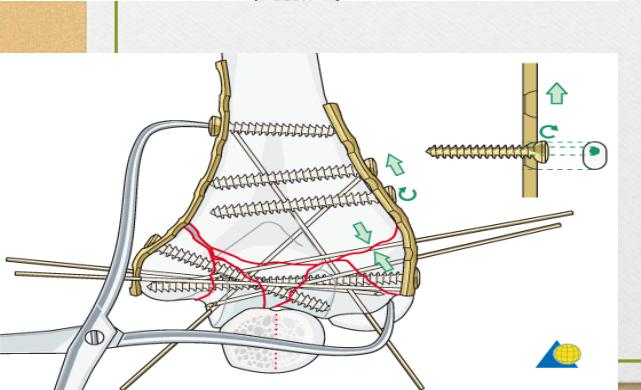
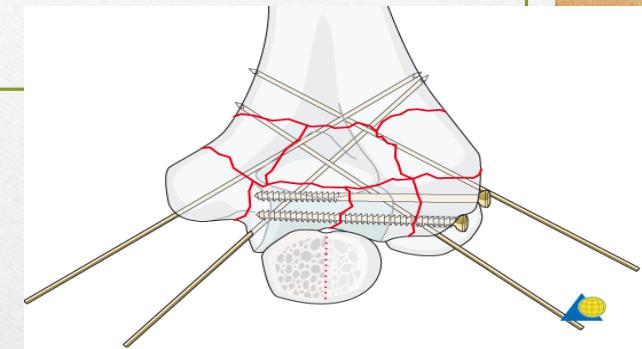
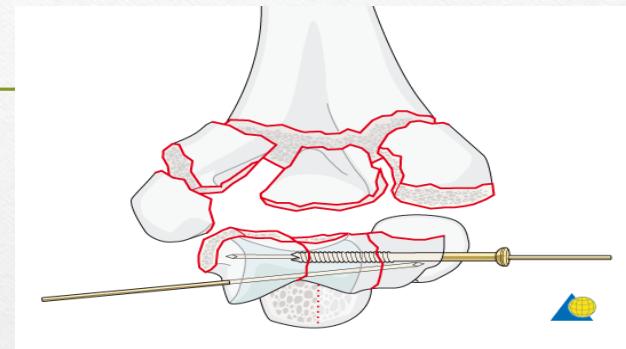
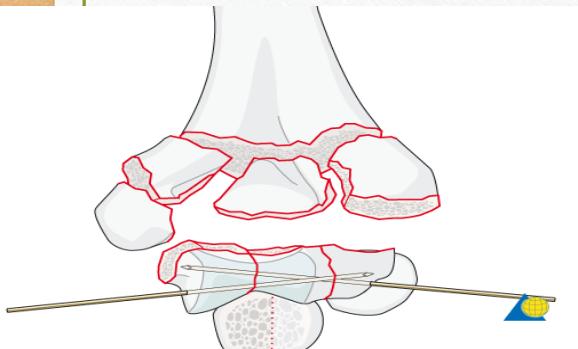
Triceps split

vs.



olecranon osteotomi

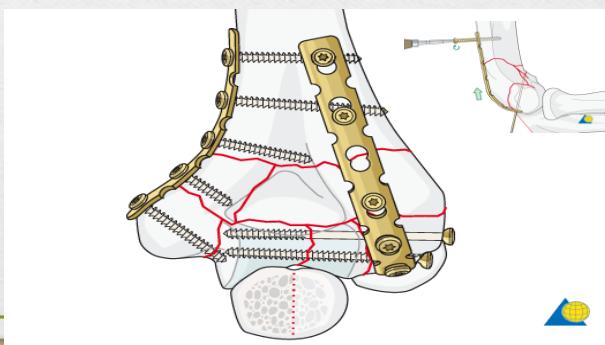
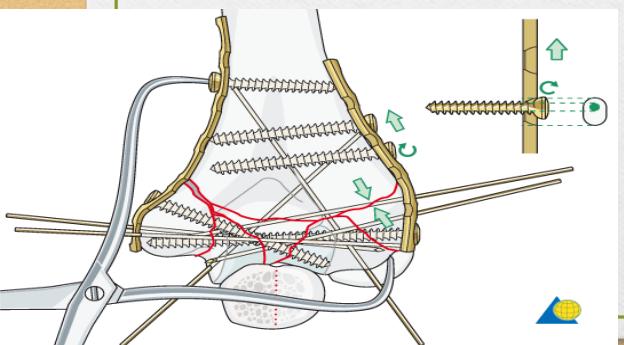
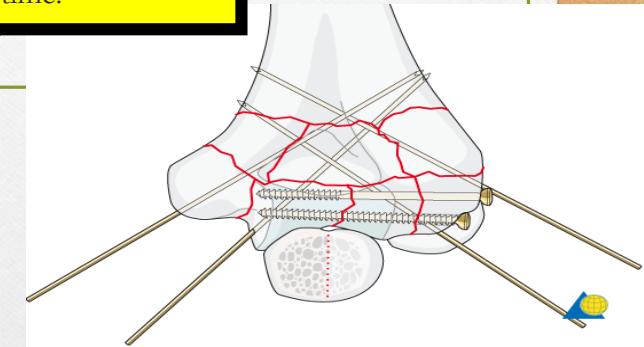
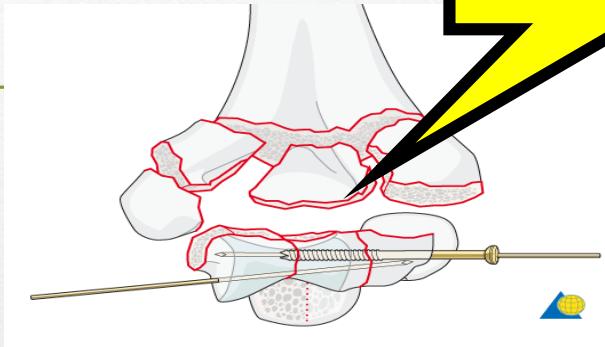
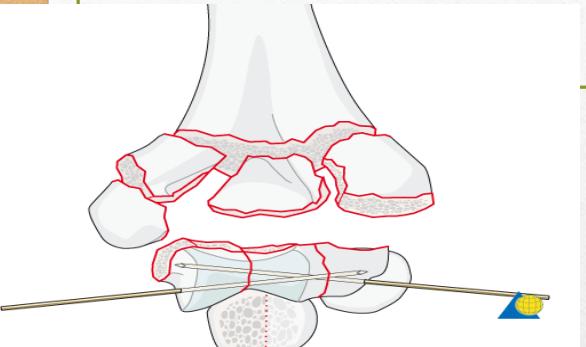
# Reposition and fixation



# Reposition and fixation

Tip 12

- Stick to plan
- One thing at a time!



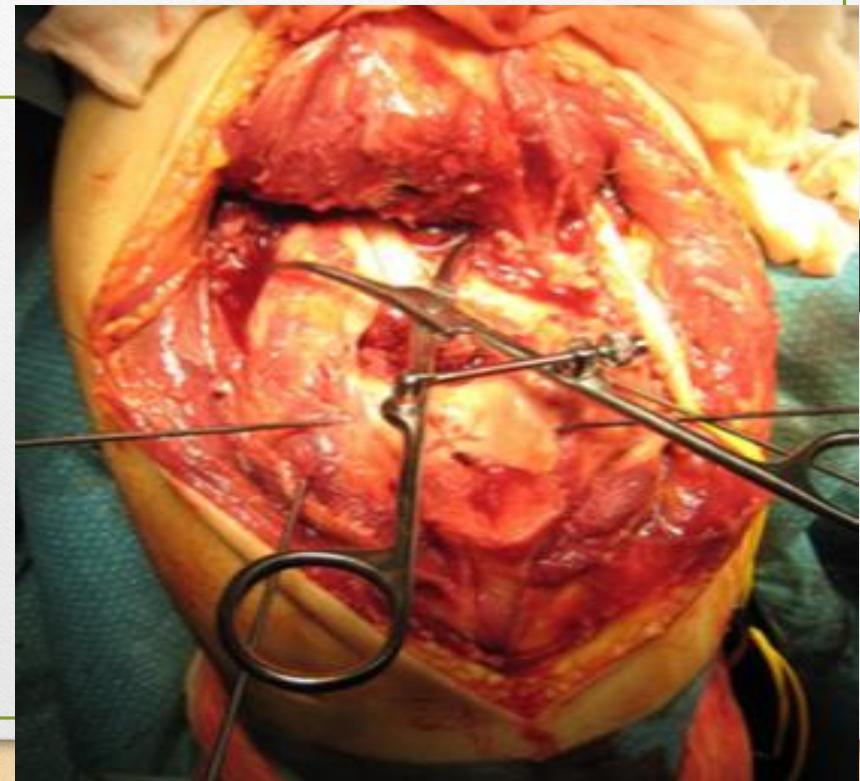
Case – 33 y male  
Distal humerus fracture



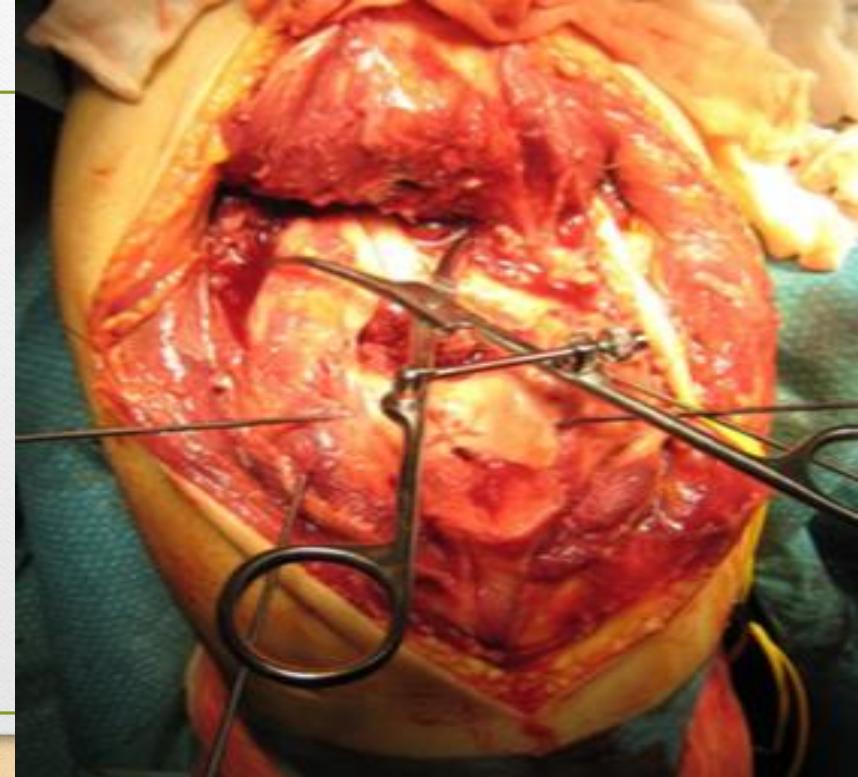
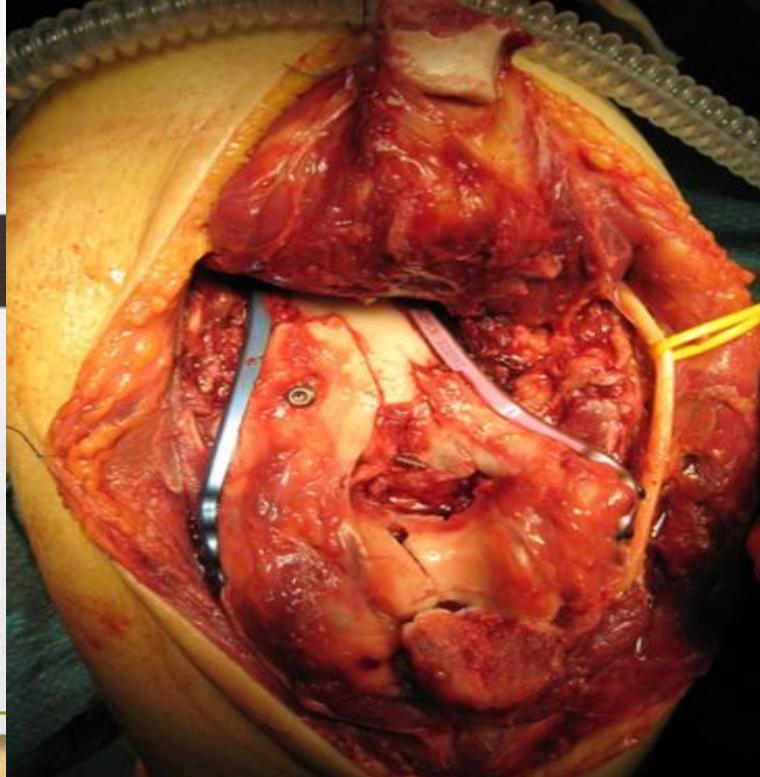
Case – 33 y male  
Distal humerus fracture



Case – 33 y male  
Distal humerus fracture



Case – 33 y male  
Distal humerus fracture







# Complications

Fx. Malunion

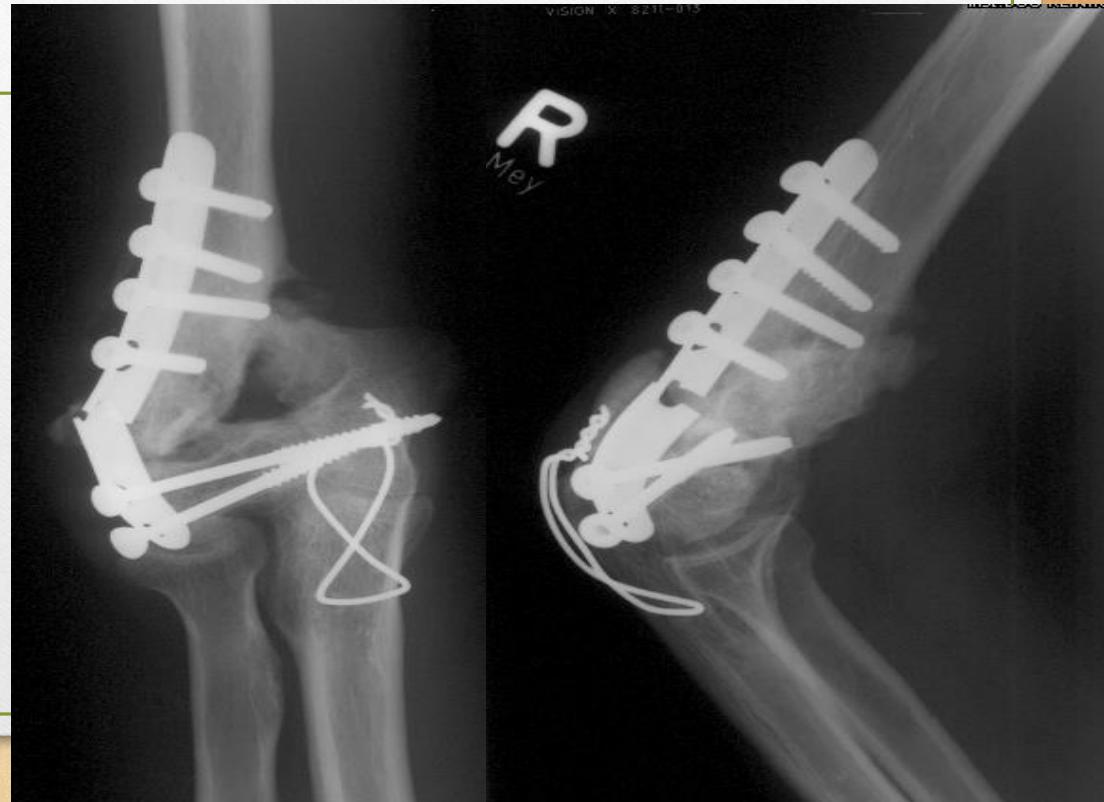


# Complications

Fx. Secondary

Dislocation

- + iatrogenic fx
- + Incomplete rep.
- + infection..
- ++++



# Take-home messages

## Essentials:

- Knowledge of the anatomy of the distal humerus
- Proper preoperative planning
- Adequate exposure for articular reduction
- Knowledge of reduction and fixation methods
- Treatment principles as for all intraarticular injuries

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**Thank you**

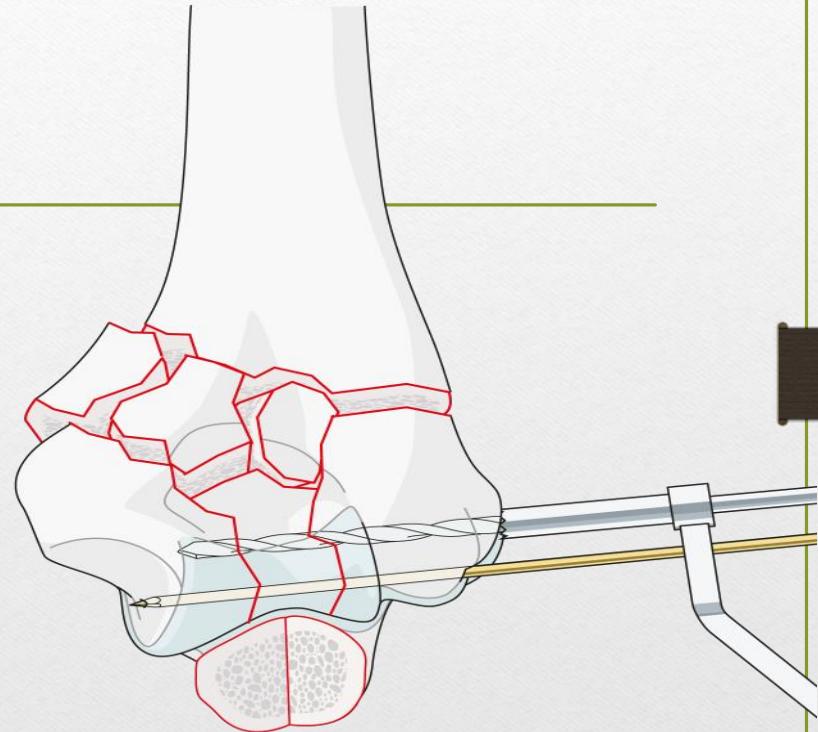
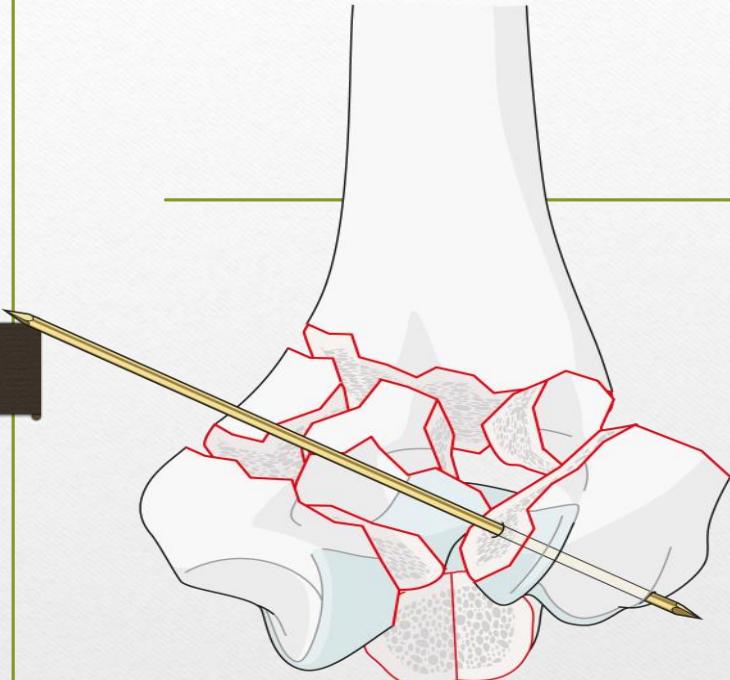
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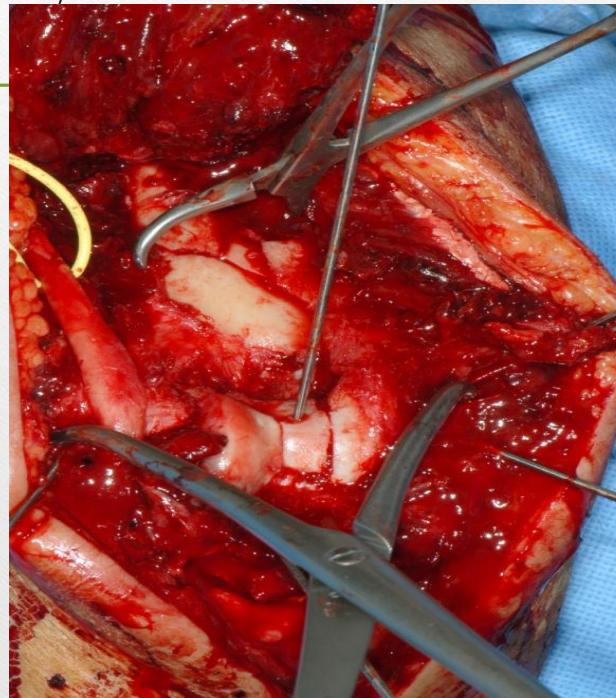
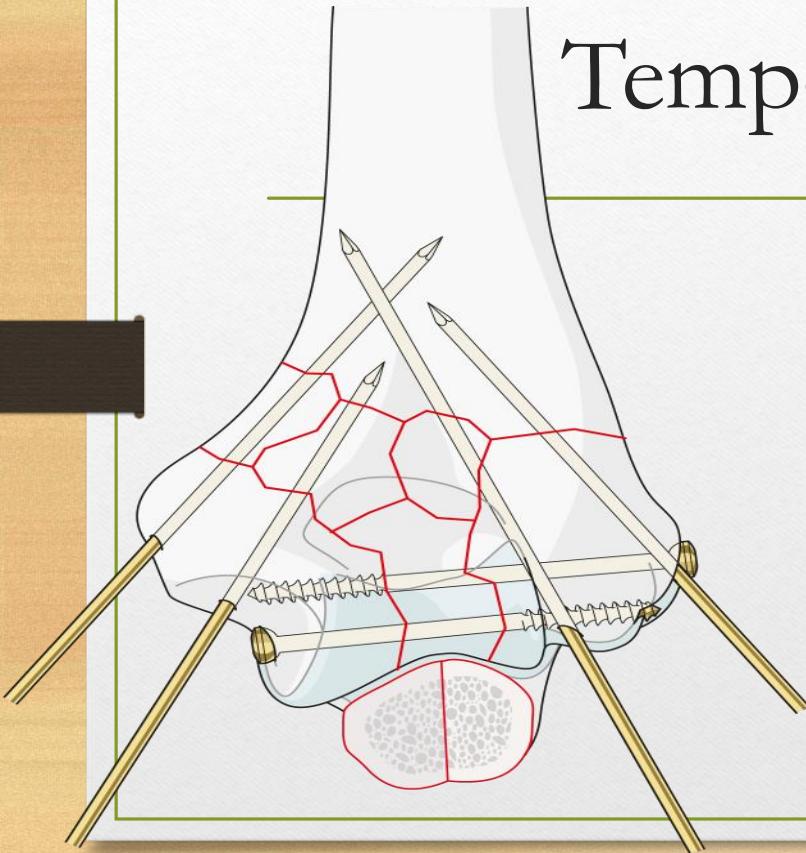
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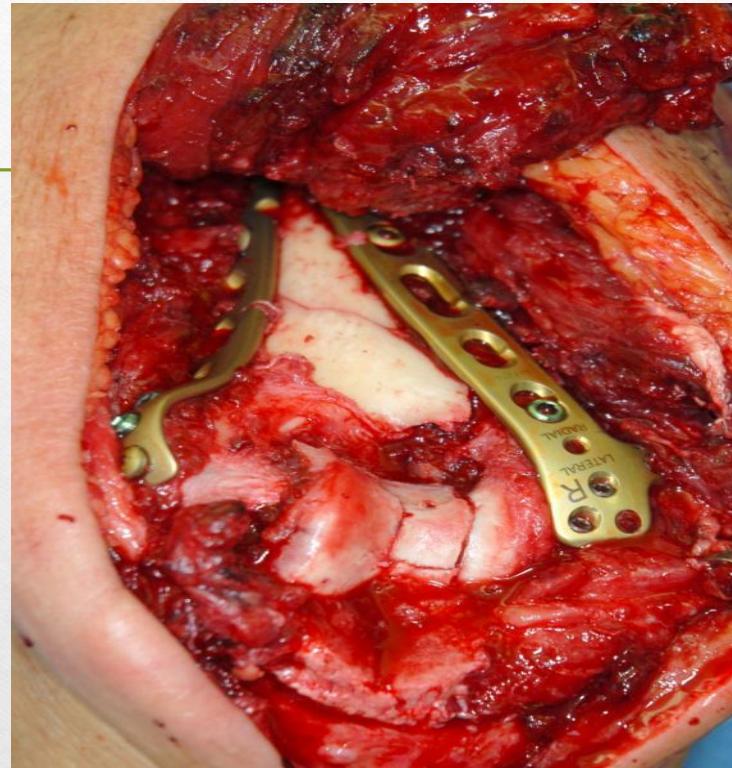
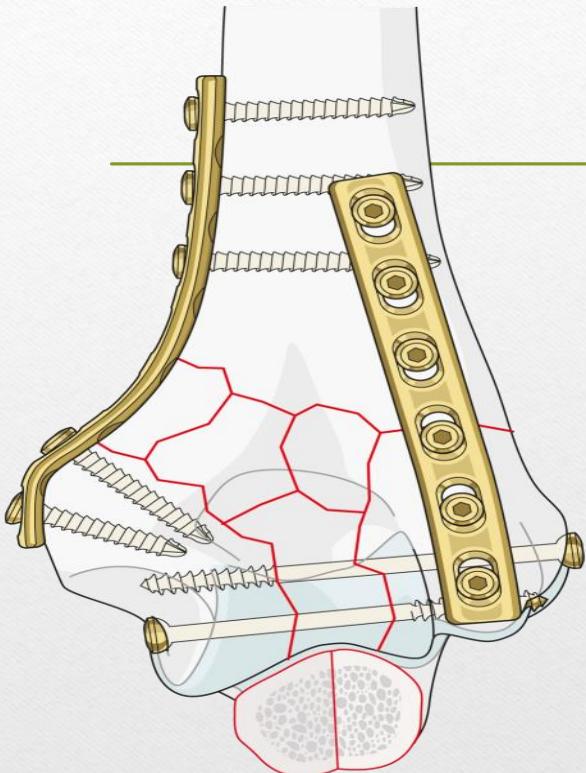
# Reduction

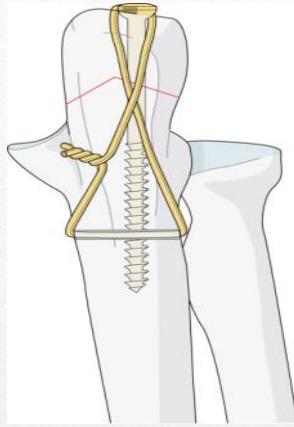


# Temporary fixation

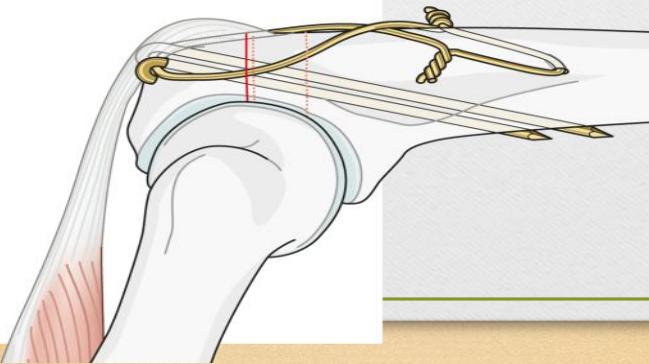
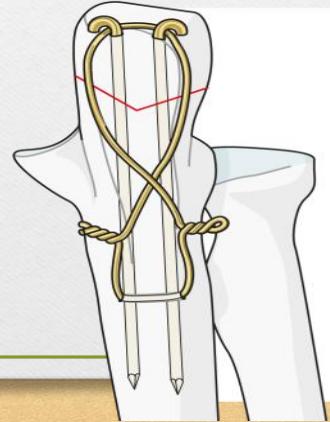
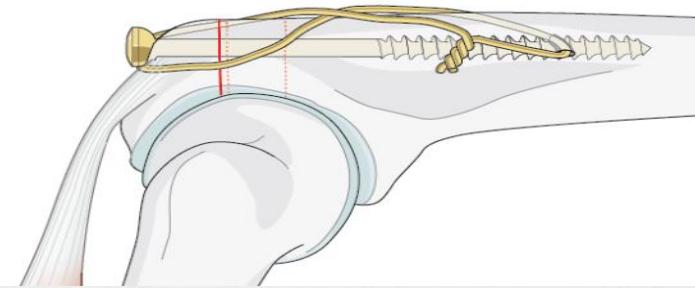


# Final fixation

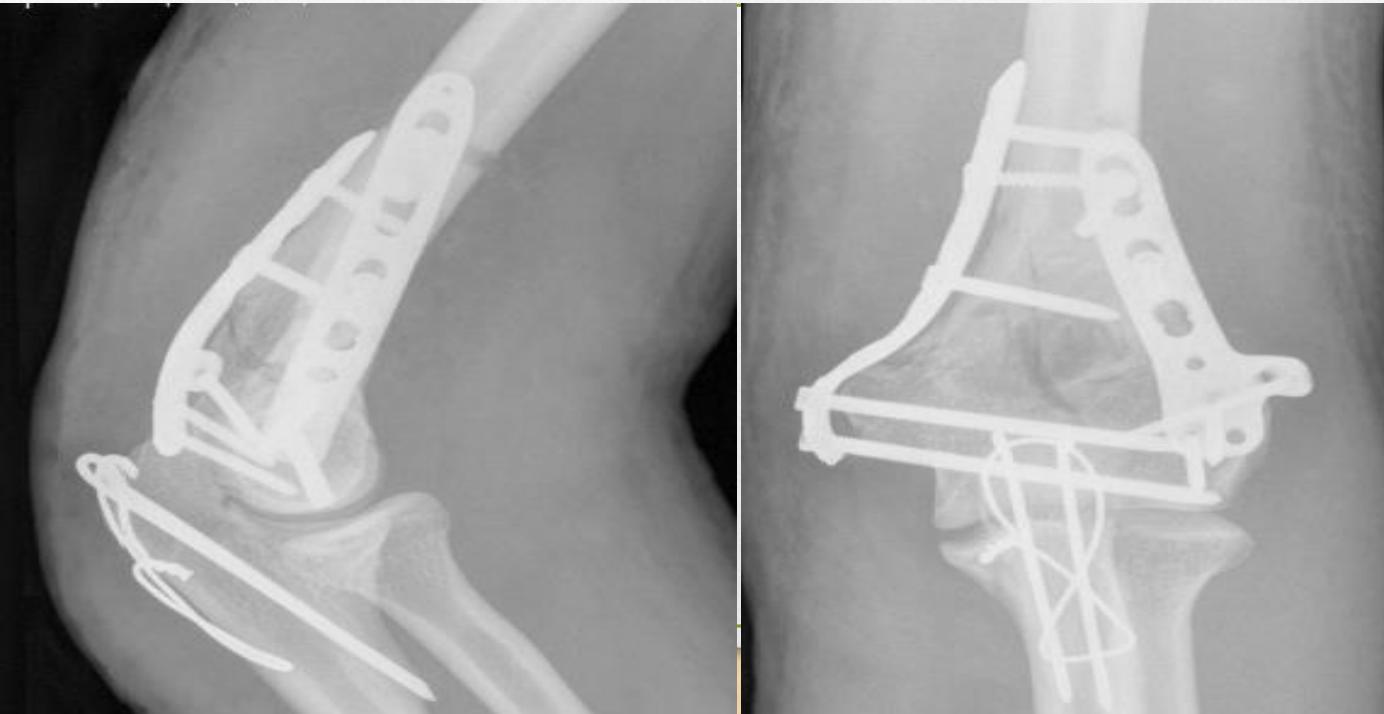




# Osteotomy fixation



# Postoperative result

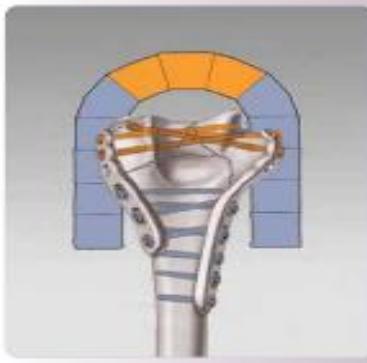
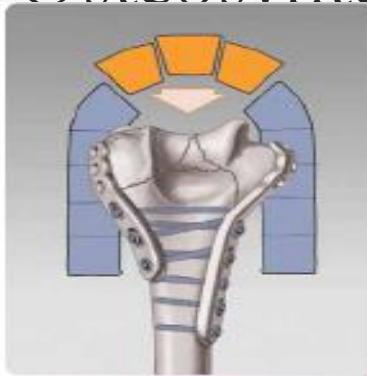


# Bilag: Dist. humerus anatomi, Osteosynteseprincipper og frakturlære.

- 180 gr plating



# Dist. humerus anatomi, Osteosvntesepincipper og frakturlære.



# Dist. humerus anatomi, Osteosynteseprincipper og frakturlære.

- ”7 regler” for 180 gr plating:
- 1) Alle skruer gennem en skinne
- 2) Alle skruer skal nå over i andet fragment som også er fæstet til en skinne
- 3) Alle skruer så lange som muligt
- 4) Alle skruer skal nå så mange fragmenter som muligt
- 5) Skruerne i de distale fragmenter skal ”låse” ved ”interdigitation”.
- 6) Der tilstræbes supracondylær kompression over begge skinner / søjler
- 7) Skinnerne skal være kraftige nok til ikke at bøje / knække før heling.



# Dist. humerus anatomi, Osteosynteseprincipper og frakturlære.

