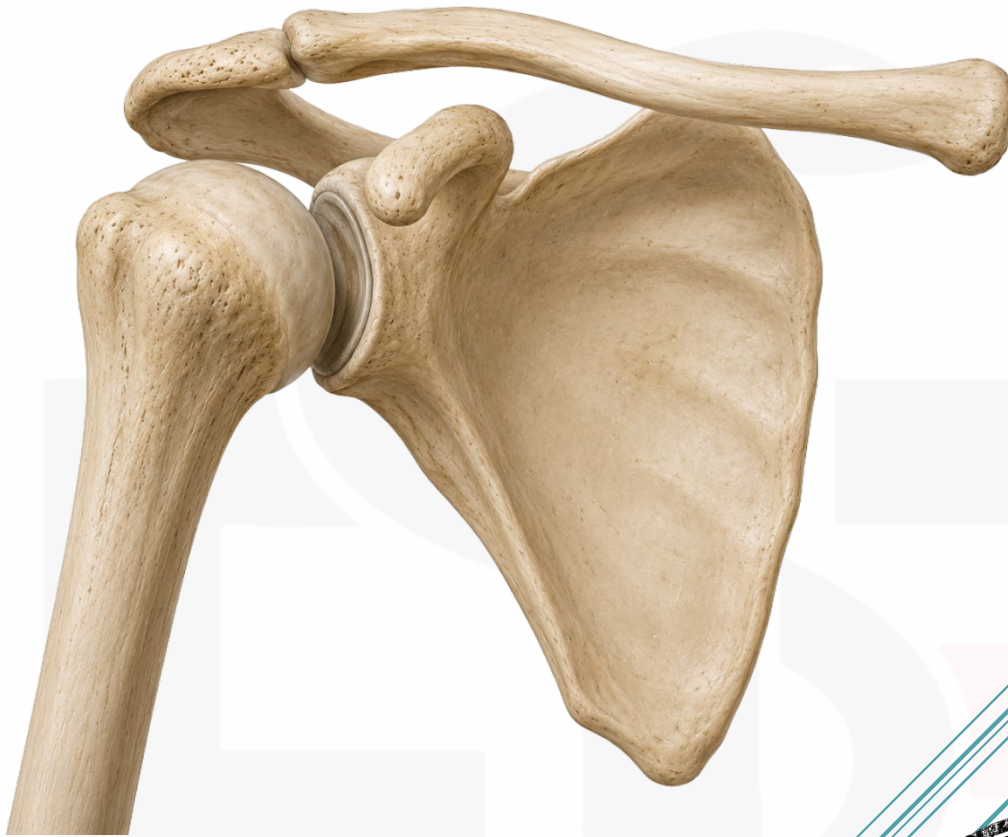




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Usage note

To better understand the content, use search engines (e.g., Google) in addition to find similar topics to read – ideally with English search terms, as there is often more and more up-to-date information available for these.

In the future, the chapters will be supplemented with more illustrations to facilitate understanding.

The content is deliberately structured in a practical way. Therefore, clinically relevant and everyday-related information takes precedence over purely theoretical details.

Good luck,
Morteza Soltani

Fachleiter

overview

Why the upper extremity is clinically important

The upper extremity is not just “arm and hand,” but a functional system for:

- grab
- hold
- support
- fine motor skills
 - Writing with a pen, signing, closing or opening buttons, Cutting with scissors, Taking a credit card out of a wallet, Inserting contact lenses, Putting on jewelry (e.g. closing earrings or a necklace), Playing the piano or violin, Laying a suture (surgery), Drawing blood
- Protective reactions during falls
- Occupational activities

Common clinical topics

Fractures after a fall

- Distal radius fracture

Fracture of the distal radius at the wrist, usually after a fall onto an outstretched hand.

- Proximal humerus fracture

Fracture of the proximal humerus, usually in the area of the surgical neck, less commonly of the anatomical neck or the tubercles.

- clavicle fracture

Fracture of the clavicle, usually after a fall onto the shoulder or the outstretched arm. the middle third is most commonly affected.

shoulder dislocation

The shoulder is “dislocated.” This usually happens after a fall or accident. The arm can hardly be moved and causes severe pain.

rotator cuff tear

One or more tendons in the shoulder have torn. Those affected often can no longer lift the arm properly and experience pain, especially at night.

carpal tunnel syndrome

A nerve in the wrist is compressed. Typical symptoms include tingling, numbness, and pain in the thumb, index finger, and middle finger, especially at night.

ulnar palsy

The ulnar nerve is damaged or pinched. There is tingling in the ring and little fingers, a weak hand, and difficulty spreading the fingers.

radial paralysis

The radial nerve is injured. A typical symptom is the so-called “drop hand” – the wrist and fingers can no longer be properly extended.

brachial plexus lesion

The nerve network that supplies the arm is injured. Depending on the extent of the injury, this can cause pain, sensory disturbances, muscle weakness, or paralysis in the arm.

tennis elbow

The tendons on the outside of the elbow are irritated due to overuse. Pain occurs mainly when gripping, lifting, or stretching the wrist – even in people who don’t play tennis at all.

tendon injuries

- Rupture of the long biceps tendon

Most often in older people or after overexertion. Sudden pain in the upper arm, often with visible bulging of the biceps (“Popeye’s sign”).

- Mallet finger (hammer finger)

Tear of the extensor tendon at the distal phalanx, usually caused by a ball bouncing off the fingertip. The distal joint hangs in a flexed position.

- De Quervain’s tenosynovitis

Inflammation of the tendon sheaths of thumb extensors and abductors. Pain on the thumb side of the wrist, especially when gripping or lifting.

Circulatory disorders

Upper extremity TVT

A blood clot has formed in a deep arm vein. The typical symptoms are painful swelling of the arm, a feeling of tightness, and sometimes a bluish discoloration.

compartment syndrome

Strong pressure in a muscle compartment cuts off blood supply and nerve function. Those affected experience very severe pain, increasing swelling, and later numbness and muscle weakness. This is a medical emergency.

Hand infections

- Paronychia (nail bed or finger infection)

Bacterial inflammation of the finger or nail. Typical symptoms include redness, swelling, throbbing pain, and sometimes pus.

- Flexor tendon sheath phlegmone

Severe infection of a tendon sheath, usually after a small puncture or cut wound. The finger is swollen, very painful, and can barely be moved. A surgical emergency.

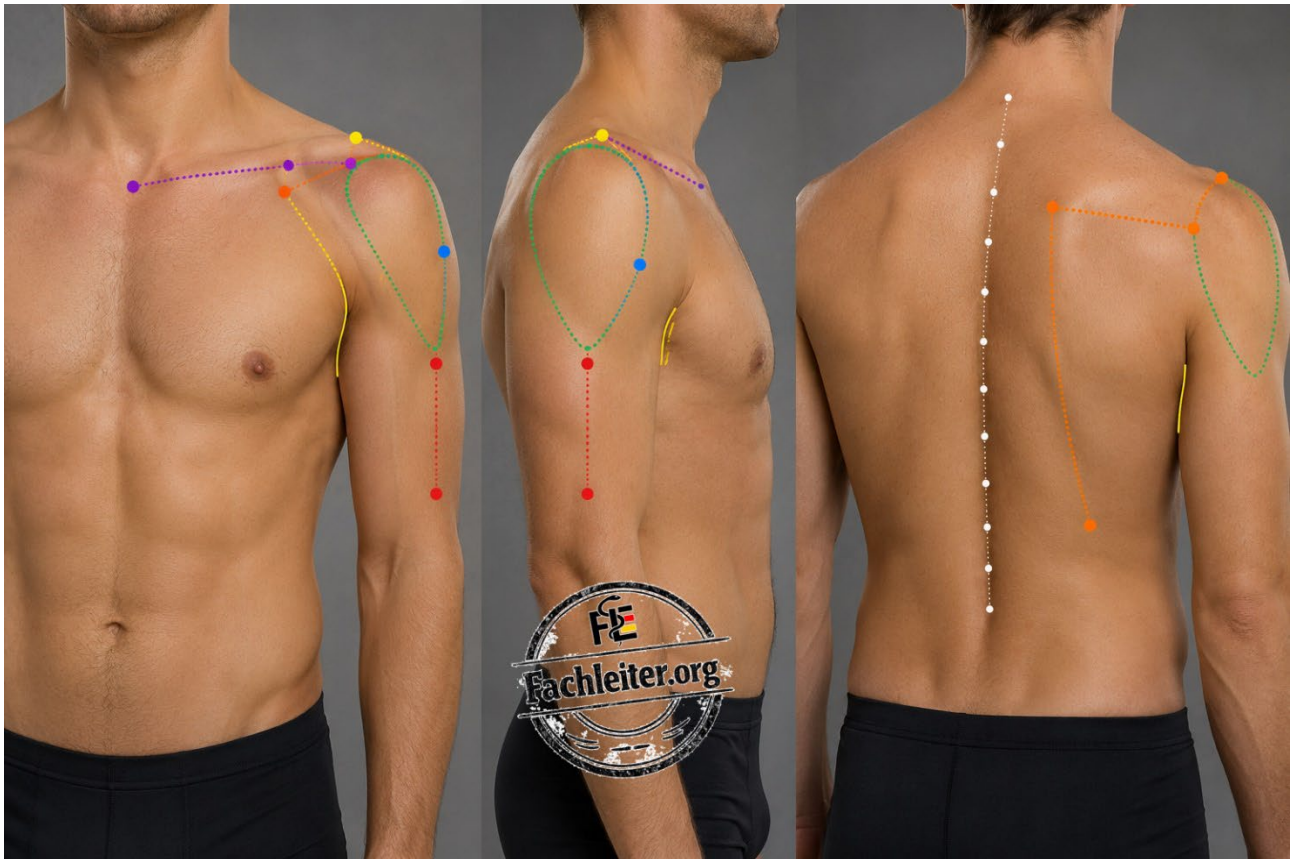
- bite wound infection

Infection after a bite from an animal or a person. Due to the high bacterial load, there is a high risk of deep infections of the hand and tendons.

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A1. Shoulder region

surface anatomy



color	anatomical structure
● purple	clavicle (collarbone)
● yellow	Acromion / Acromioclavicular joint
● orange	Scapula (Spina scapulae, Margo medialis, Angulus inferior)
● green	Contour of the deltoid muscle
● blue	Tuberculum majus (Greater tubercle)
● red	axis of the humerus shaft
○ white	Thoracic spine spinous processes (Processus spinosi)
■ yellow line	Deltopectoral groove (Sulcus deltopectoralis)

task

Examine your fellow student and palpate the most important anatomical structures of the shoulder region.

shoulder bone

- clavicle
- scapula
- humerus head
- acromion
- Coracoid process
- Glenoid cavity
- Tuberculum majus humeri



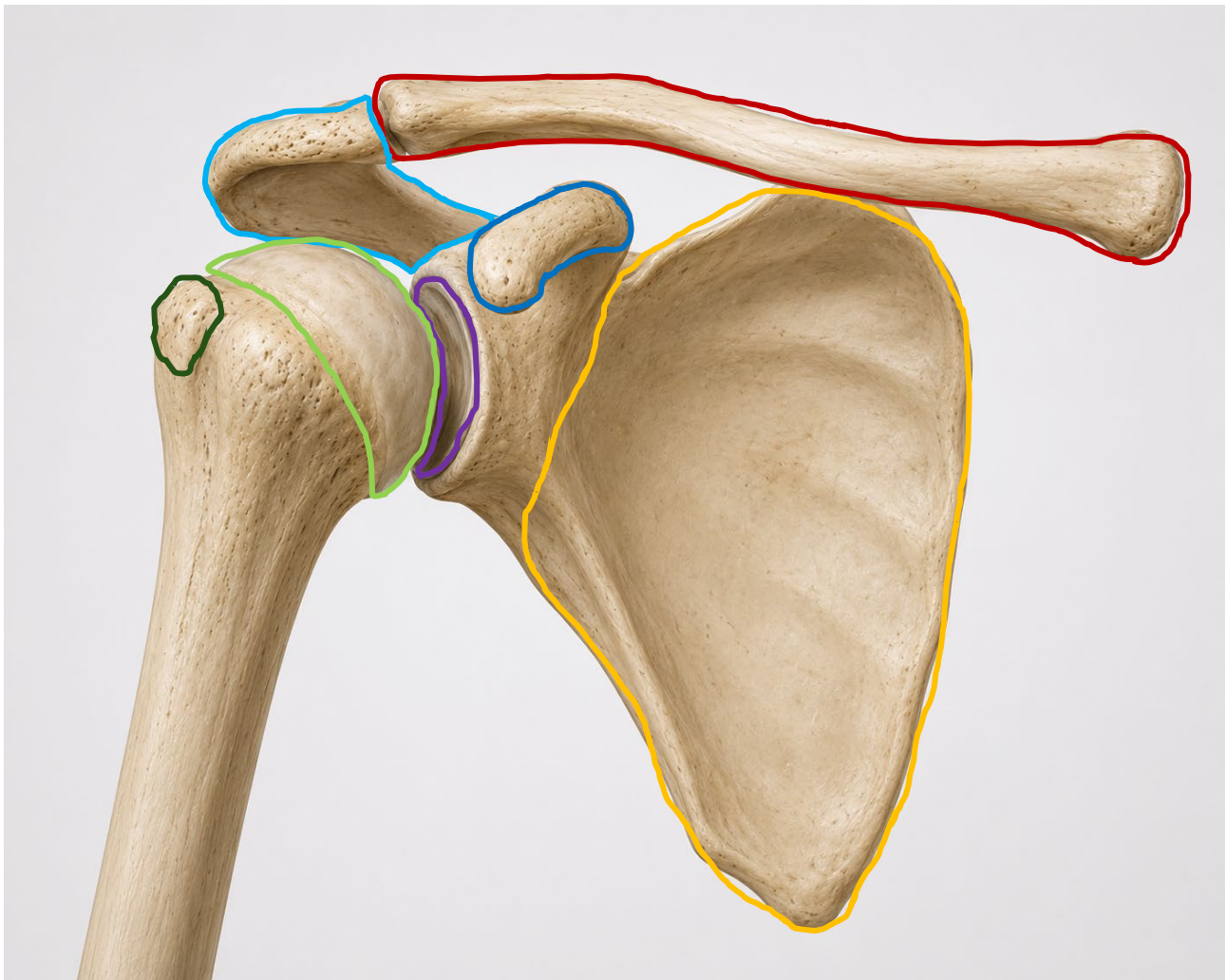


Abbildung 1 Anterior

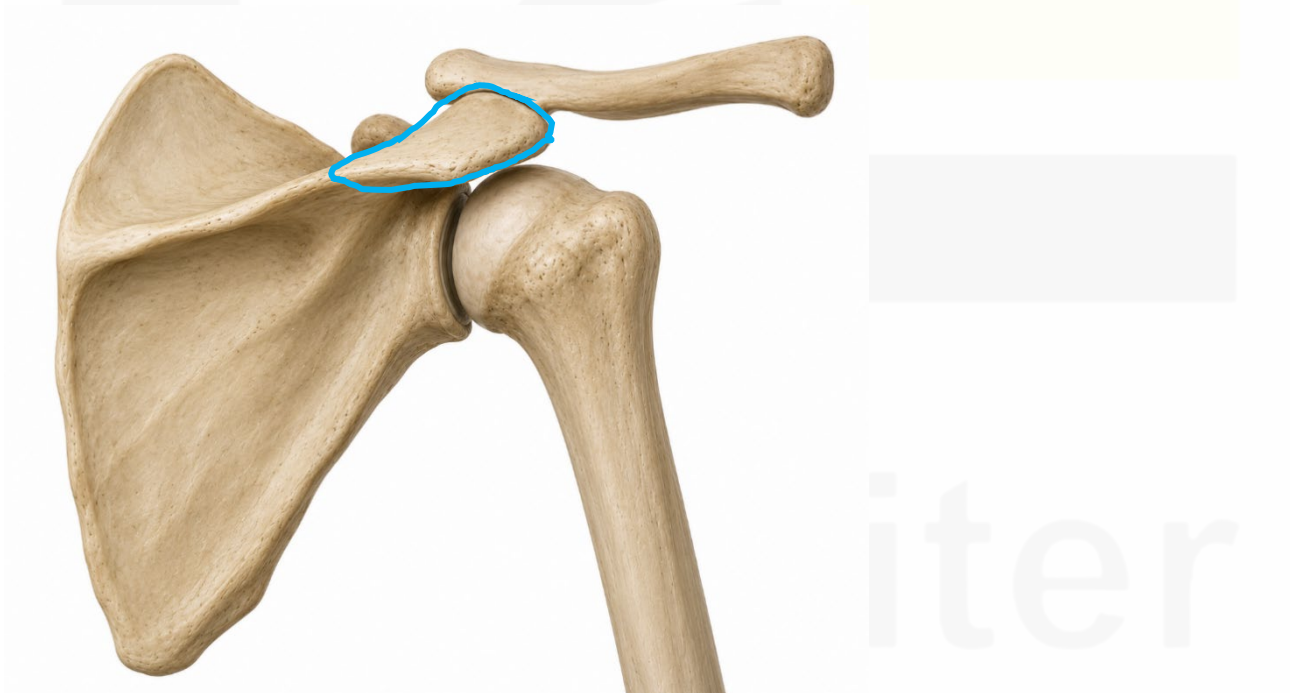


Abbildung 2 Posterior

X-ray shoulder

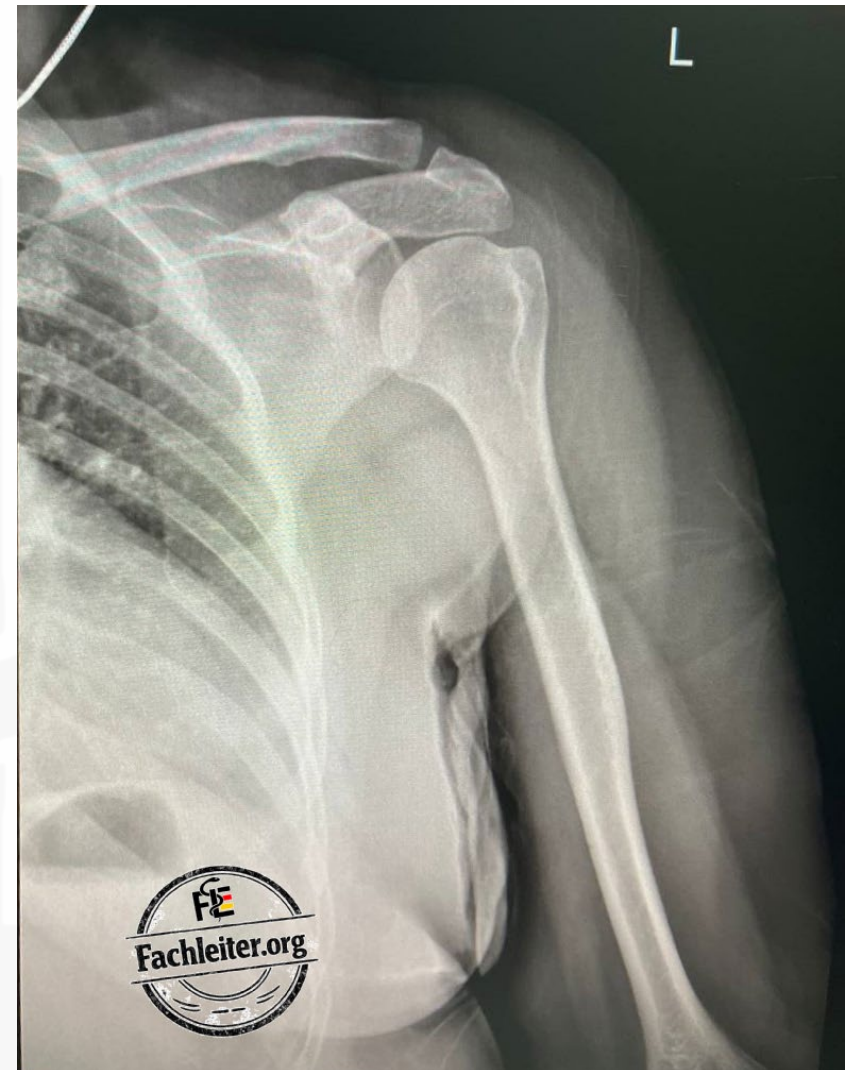
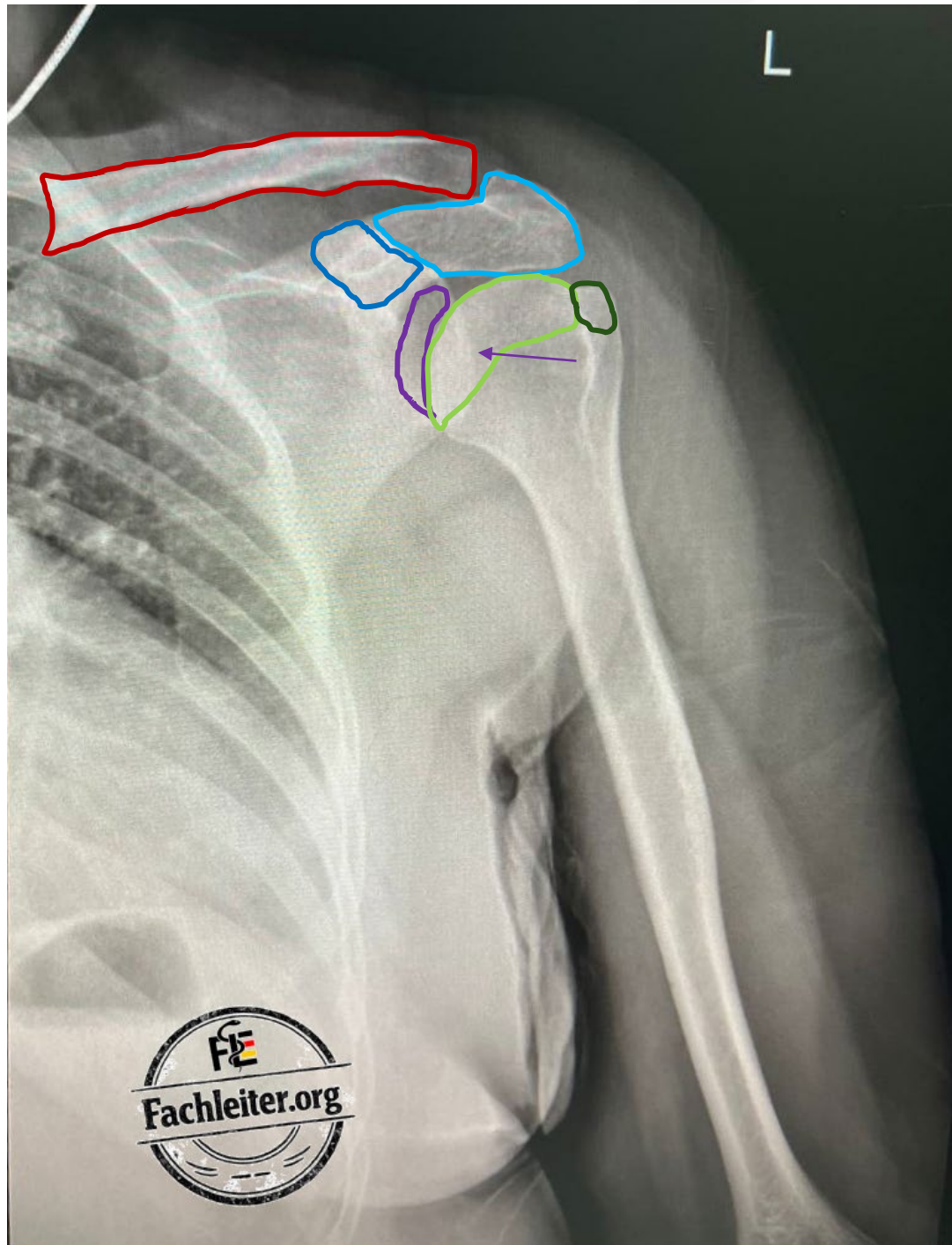
Always at least two levels

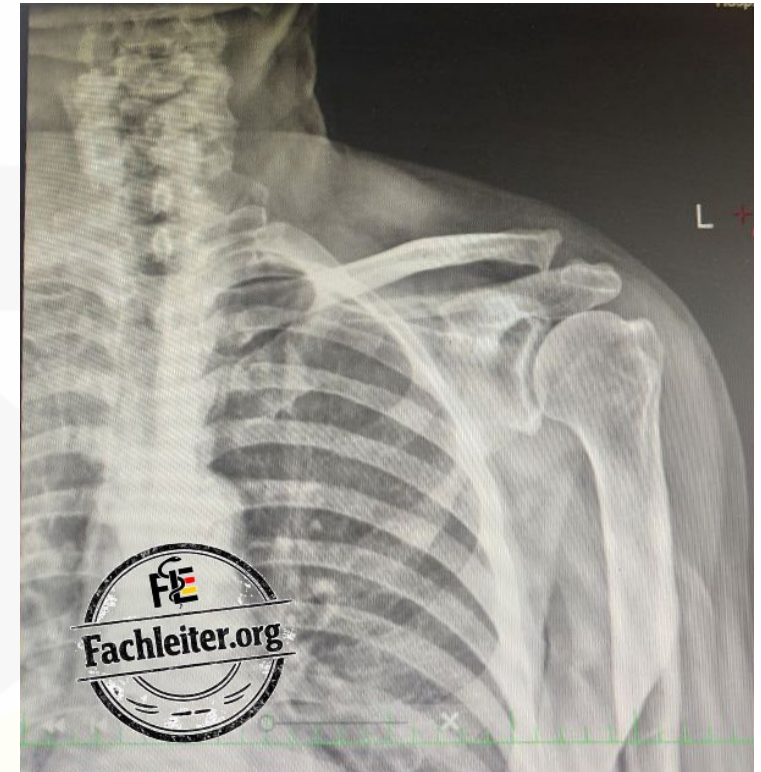
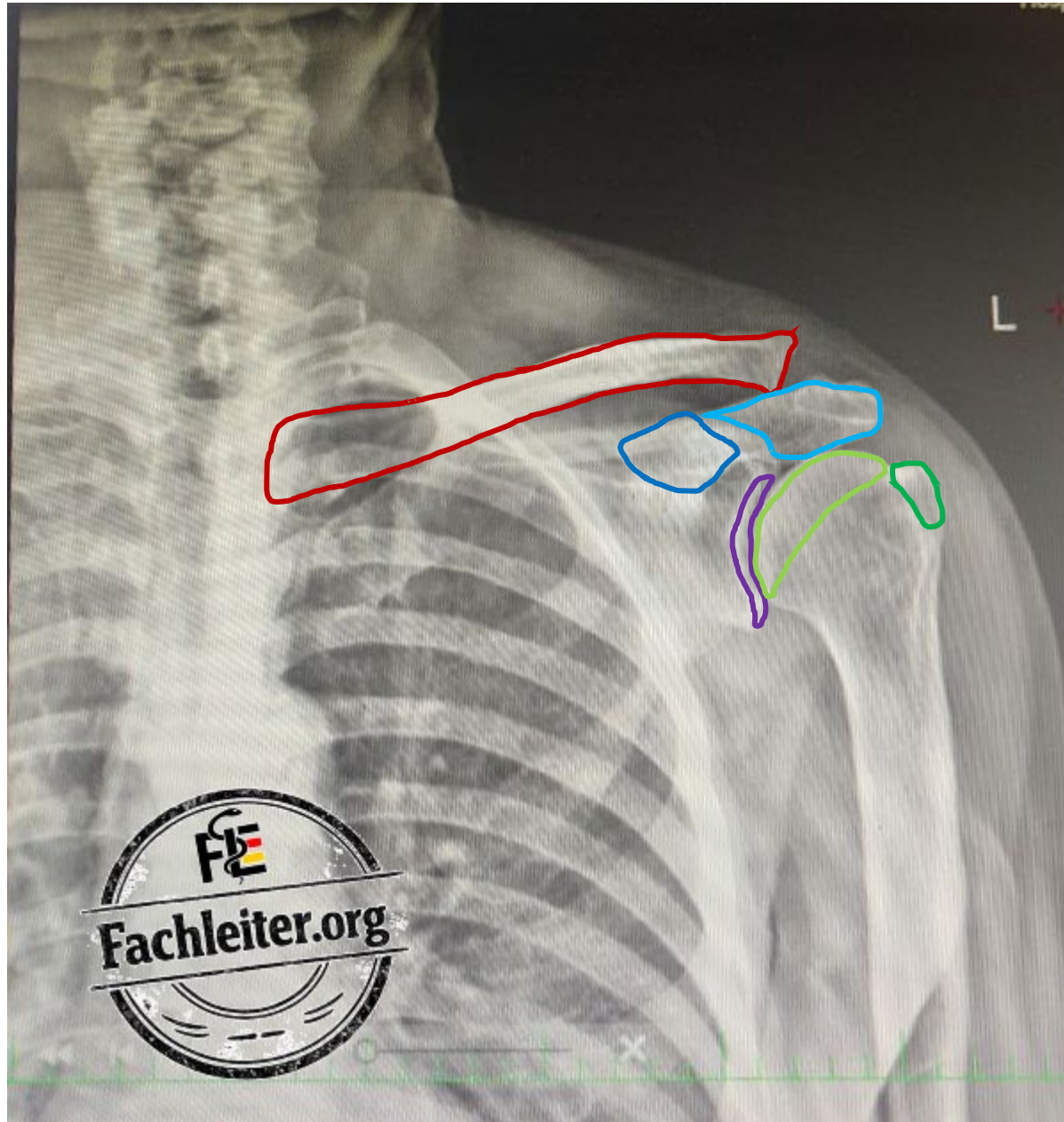
- a.p. admission
- Y-view / Transscapular view
- axial view, if possible

Important questions in X-ray:

- Is the humeral head centered?
- Is there a dislocation?
- Is there a fracture?
- Is the AC joint enlarged?
- Is there evidence of a Hill-Sachs lesion?
(Impression on the posterolateral humeral head as a result of an anterior shoulder dislocation.)
- Is there a Bankart lesion?
(Tear of the anteroinferior glenoid labrum, typical after anterior shoulder dislocation.)

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Shoulder joint

- glenohumeral joint
 - joint
 - ball joint
 - Normal range of motion (ROM)
 - Flexion (lifting the arm forward): 180°
 - Extension (arm behind the body): 40-60°
 - Abduction (lifting the arm to the side): 180°
 - Adduction (bringing the arm back towards the body): 30-50°
 - External rotation (arm rotated outwards): 60-90°
 - Internal rotation (turning the arm inward): 70-90°

The glenohumeral joint is very mobile, but relatively unstable.

stability through

- rotator cuff
- glenoid labrum
- joint capsule
- ligament
- long biceps tendon

disease	Brief description	Typical restricted movement
shoulder dislocation	The head of the humerus pops out of the socket.	Especially abduction and external rotation, later often all movements painful.
Frozen Shoulder (Adhesive Capsulitis)	The joint capsule becomes inflamed and stiff.	All movements are restricted, with external rotation being the most limited, followed by abduction and flexion.

- AC joint
 - joint
 - hinge (planes)
 - Normal range of motion (ROM)
 - No clinically separately measurable ROM; movements occur together with the scapula during shoulder movement.
- sternoclavicular joint
 - joint
 - Saddle joint (functional ball joint)
 - Normal range of motion (ROM)
 - Elevation (shoulder up): about 30-45°
 - Depression (pressing the shoulder down): about 10°
 - Protraction (shoulder forward): about 15-30°
 - Retraction (pulling the shoulder back): about 15-30°
 - Axial rotation (rotating the clavicle around its own axis): about 30-45°



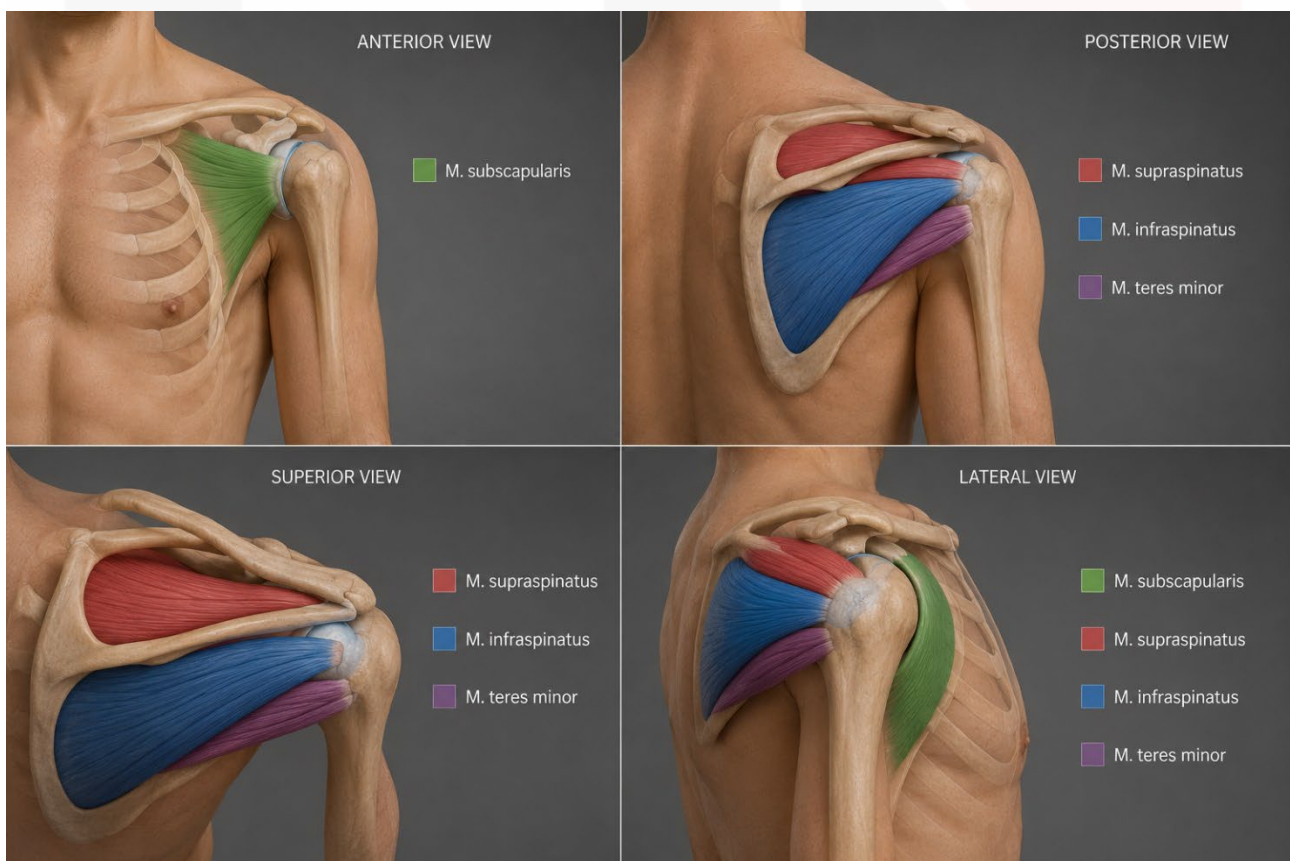
color	structure
● blue	Glenohumeral joint (Articulatio glenohumeralis)
● yellow	Acromioclavicular joint (AC joint, Articulatio acromioclavicularis)
● purple	Sternoclavicular joint (Articulatio sternoclavicularis) <i>(only in the anterior view)</i>

shoulder muscle

rotator cuff

consist of

- **M. supraspinatus**
Initiates arm abduction (approx. 0-15°) and stabilizes the shoulder joint.
- **M. infraspinatus**
Performs the external rotation of the arm and stabilizes the shoulder joint.
- **M. teres minor**
Supports the external rotation and adduction of the arm, as well as the stabilization of the shoulder joint.
- **M. subscapularis**
Performs internal rotation and adduction of the arm and stabilizes the shoulder joint.



Three rotator cuff muscles attach to the Tuberculum majus (Greater Tubercle):

- Supraspinatus muscle – upper (superior) facet
- Musculus infraspinatus – middle facet
- Teres minor muscle – lower (inferior) facet

Clinical significance:

Since three tendons of the rotator cuff attach to the tuberculum majus, fractures or bony avulsions at this site can lead to pain, loss of strength, and restricted shoulder mobility – especially during abduction and external rotation. In addition, the tendons, especially those of the supraspinatus muscle, may be affected or injured.

investigation

1. M. supraspinatus – Jobe test (Empty-Can-Test)

- execution

The patient raises both arms approximately 90° in the scapular plane. The thumbs point downwards (“pouring out an empty can”).

The examiner presses the arms downwards while the patient resists.

- positive finding

Pain or loss of strength.

- hint

Supraspinatus tendinopathy

rotator cuff tear

Subacromial impingement syndrome

2. M. infraspinatus – External rotation against resistance

- execution

The elbow is bent at 90° and is pressed against the body. The patient turns the forearm outward against the resistance of the examiner.

- positive finding

Pain or decreased strength.

- hint

Infraspinatus tendinopathy

rotator cuff tear

Lesion of the suprascapularis nerve

3. M. teres minor – External rotation with abducted arm

- execution

The arm is abducted 90°, the elbow is flexed 90°. The patient performs an external rotation against the resistance of the examiner.

- positive finding

Pain or loss of strength.

- hint

teres minor rupture

rotator cuff tear

Axillary nerve lesion

4. M. subscapularis – Lift-off test / Belly-press test

- Lift-off test – execution

The patient places the back of the hand on the lower back and attempts to lift the hand away from the back actively.

- Belly-press test – procedure

The patient presses the palm of the hand against the abdomen, keeping the elbow as far forward as possible.

- positive finding

The hand cannot be lifted from the back, the elbow moves backwards, or the strength is reduced.

- hint

Subscapularis rupture

rotator cuff tear

5. M. deltoideus – abduction against resistance

- execution

The patient raises the arm to the side to about 90°. The examiner presses the arm down while the patient resists.

- positive finding

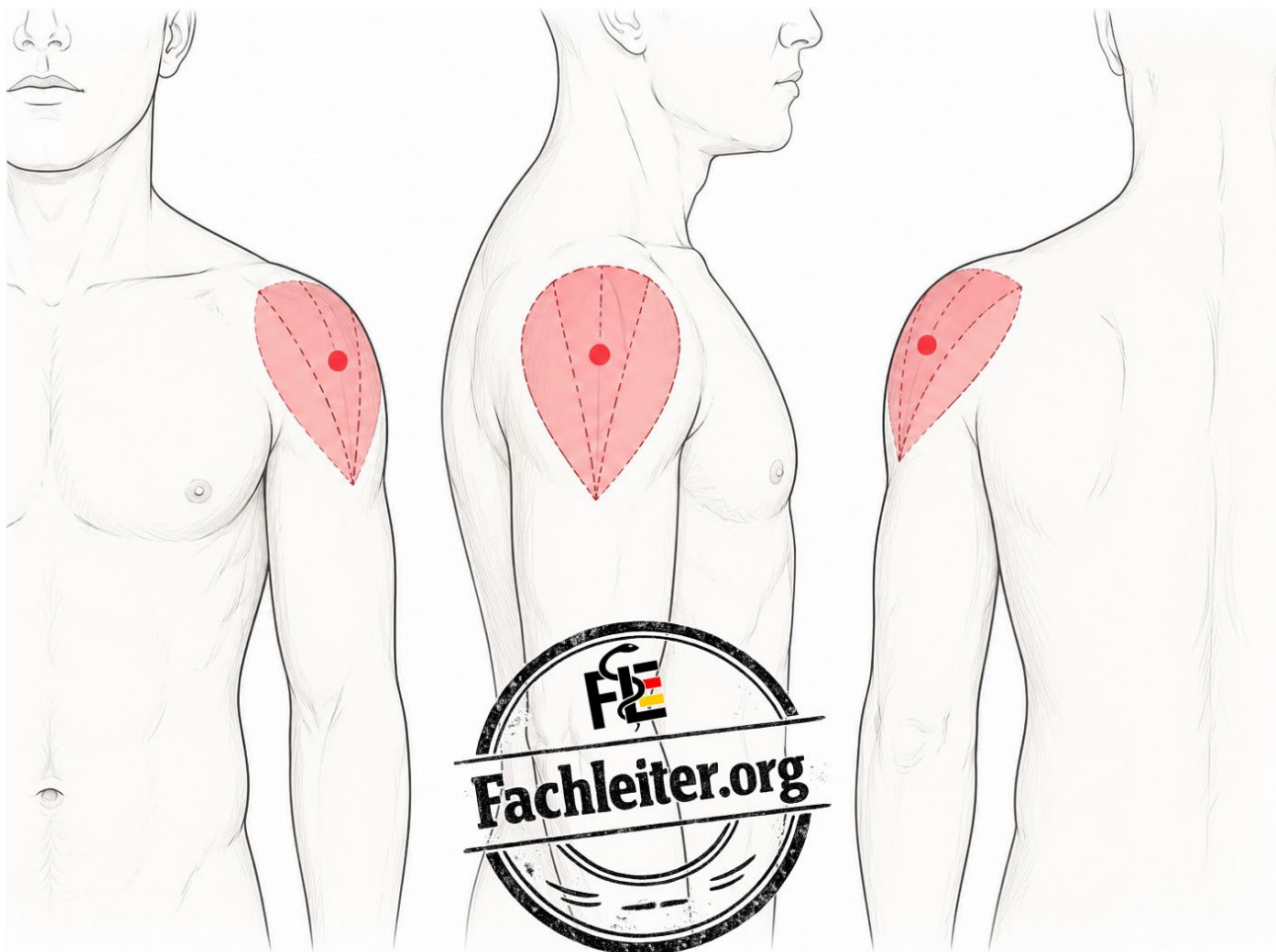
Pain or loss of strength during abduction.

Clinical note: If the patient can no longer raise the arm against resistance from about 15°, damage to the m. deltoideus or the n. axillaris should be suspected. (The first approximately 0-15° of abduction are initiated primarily by the m. supraspinatus.)



task

Instruct your fellow student to check the range of motion (ROM) of the shoulder muscles.



Injection site for intramuscular injections (M. deltoideus)

The intramuscular injection is given into the middle part of the deltoid muscle, approximately 2-3 finger widths below the acromion. This minimizes the risk of injury to the axillary nerve and surrounding vessels. This injection site is particularly suitable for vaccinations and the administration of small volumes of medication.

Fachleiter

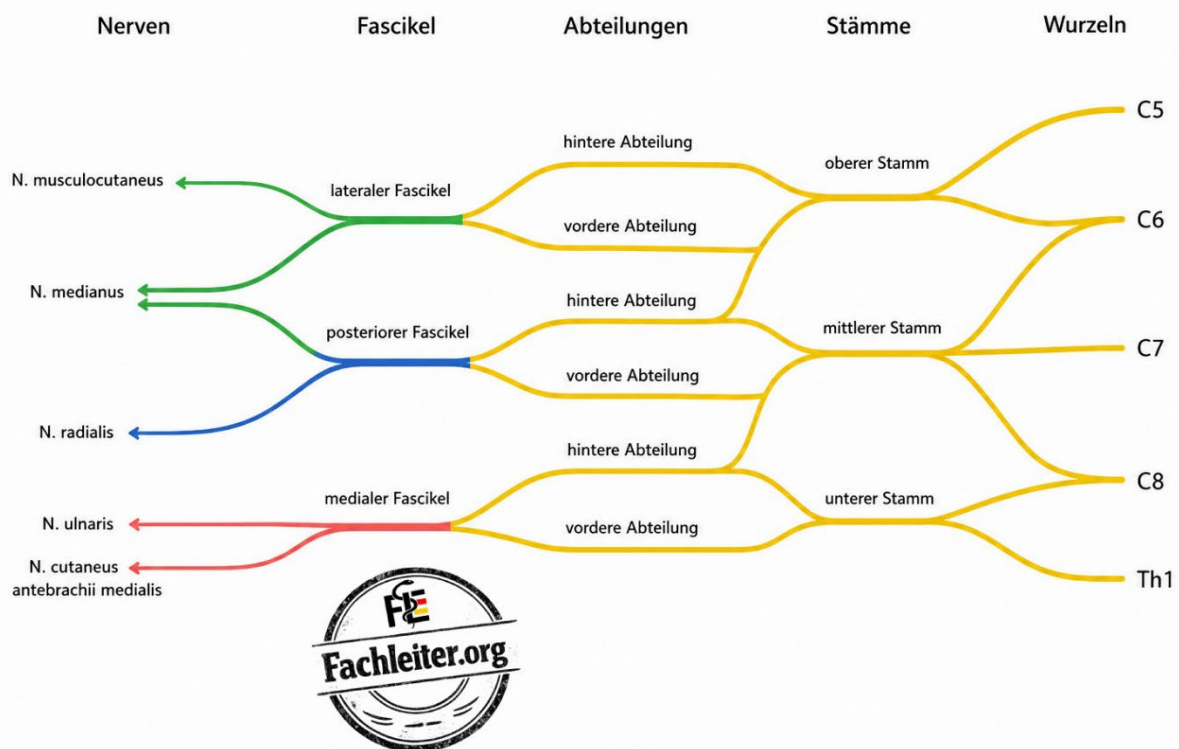
shoulder nerve

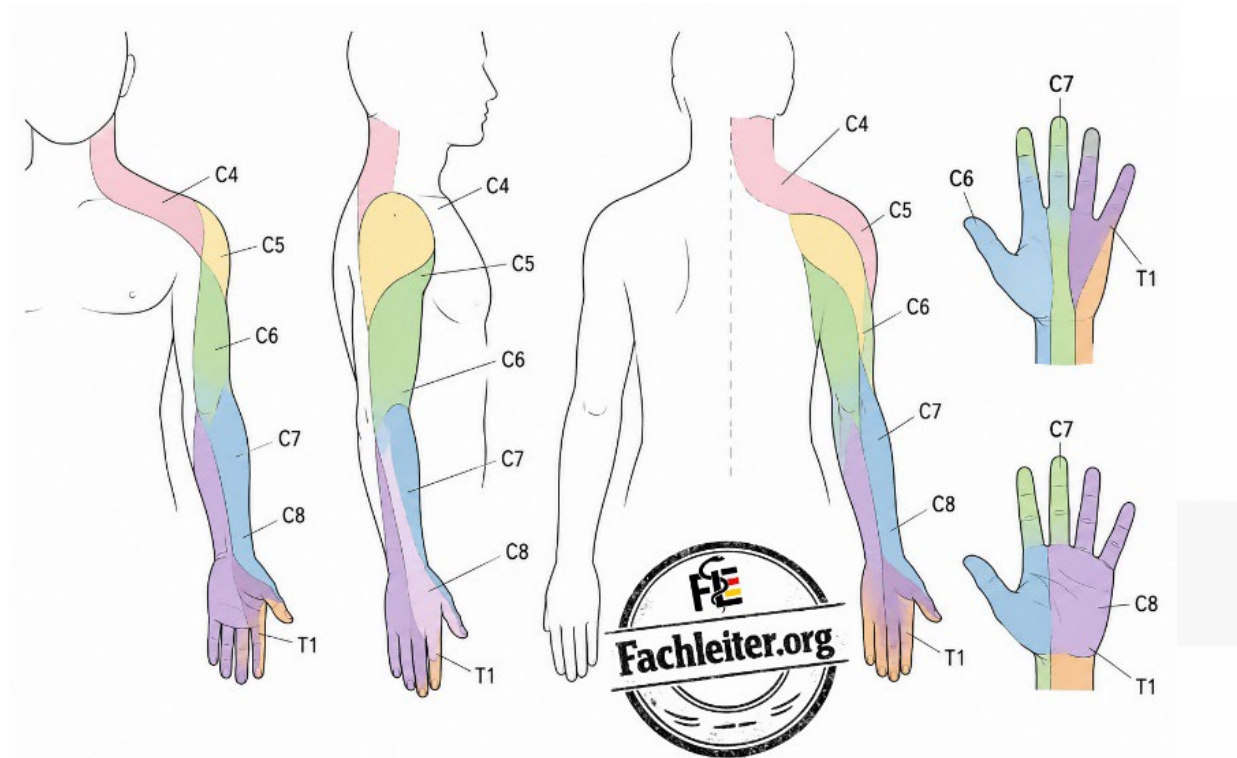
brachial plexus

The brachial plexus is a network of nerves that arises from the anterior branches of the spinal nerves C5 to Th1. It provides motor and sensory innervation to the entire upper extremity. The plexus runs between the scalene muscles anterior and medius, passes through the axillary cavity, and divides there into its terminal branches.

Clinical significance

Brachial plexus injuries can occur after accidents, shoulder dislocations, or birth injuries. Depending on the affected region, there may be pain, sensory disturbances, muscle weakness, or paralysis in the arm. Common injuries include upper plexus lesions (Erb-Duchenne paralysis) and lower plexus lesions (Klumpke paralysis).





N. axillaris

course

- from Fasciculus posterior
- through the lateral axillary gap
- around the collum chirurgicum humeri

motor skills

- M. deltoideus
- M. teres minor

sensitivity

- lateral shoulder region

typical lesion

- Shoulder dislocation (especially anterior)
- proximal humerus fracture

clinical failure

- Abduction weakened from about 15 degrees
- Sensory disturbance over the deltoid area

Dermatomes Shoulder/Arm

- C4 (N. supraclaviculares): shoulder height
 - C5 (N. axillaris): upper arm, lateral
 - C6 (N. musculocutaneus / N. radialis / N. medianus): Thumb and radial forearm
 - C7 (N. medianus): middle finger
 - C8 (N. ulnaris): little finger and ulnar forearm
 - Th1 (N. intercostobrachialis, partly N. ulnaris): medial upper arm
- Note: Dermatomes are defined by spinal nerves (C4-Th1), not by peripheral nerves. The information in parentheses names the most important peripheral nerves whose sensory supply areas lie in these regions. However, the skin areas overlap, so there is no exact 1:1 correspondence.

task

Show the dermatomes on the upper extremity of your classmate.

Myotome shoulder

- C5: Shoulder abduction (M. deltoideus, M. supraspinatus)
- C5/C6: External rotation (M. infraspinatus, M. teres minor)
- C6: Elbow flexion (M. biceps brachii, M. brachialis)
- C7: Elbow extension (M. triceps brachii)
- C8: Finger flexion (M. flexor digitorum profundus, M. flexor digitorum superficialis, M. flexor pollicis longus)
- Th1: Finger abduction (Mm. interossei dorsales)

reflex	segment	nerve	significance
biceps tendon reflex	C5/C6	N. musculocutaneus	elbow flexion
brachioradialis reflex	C5/C6	N. radialis	forearm flexion
triceps tendon reflex	C7/C8	N. radialis	elbow extension

arteries

- A. subclavia

trunk

right: from the truncus brachiocephalicus

left: directly from the arcus aortae

course

runs under the clavicle

lies between M. scalenus anterior and medius

continues as the a. axillaris at the lateral border of the 1st rib

service area

shoulder belt

thorax

neck

entire upper extremity (including its branches)

pulse palpable

deep behind the clavicle (clinically rarely palpable)

- A. axillaris

trunk

Continuation of A. subclavia

course

begins at the lateral edge of the 1st rib

runs through the armpit

medial to the humeral head

at the lower edge of the M. teres major transitions into the A. brachialis

Important branches

A. thoracoacromialis: chest, shoulder and deltoid region

A. thoracica lateralis: chest wall, breast, m. serratus anterior

A. subscapularis: Scapula, M. subscapularis, M. latissimus dorsi

A. circumflexa humeri anterior: humeral head, shoulder joint

A. circumflexa humeri posterior: deltoid muscle, teres minor muscle, shoulder joint, humeral head

pulse palpable

deep in the armpit (axillary pulse)

The axillary pulse is often harder to feel because of its deep location

Clinical significance

At risk of injury in shoulder dislocation and proximal humerus fracture

Runs in close proximity to the brachial plexus: Since the axillary artery and the brachial plexus run directly next to each other through the axilla, both the artery and the nerves can be damaged in the same injury.

- brachial

trunk

Continuation of A. axillaris

course

begins at the lower edge of the m. teres major

runs along the inside of the upper arm through the elbow

divides at the elbow into the a. radialis and a. ulnaris

Important branches

A. profunda brachii: dorsal upper arm muscle

Upper and lower ulnar collateral artery (Aa. collaterales ulnares superior et inferior): elbow joint

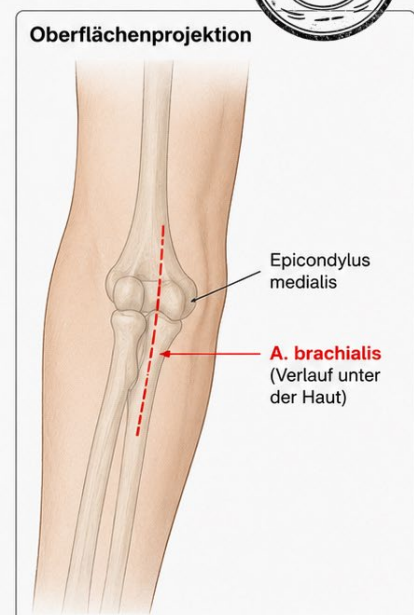
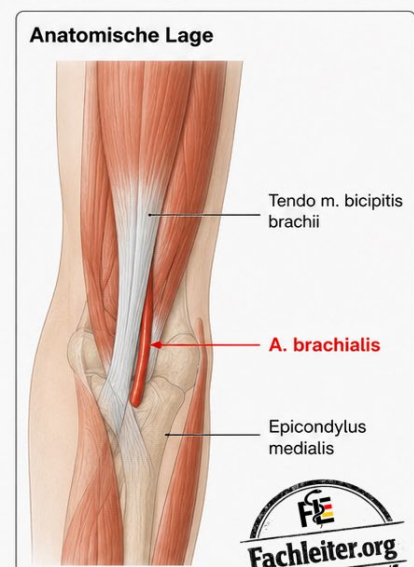
pulse palpable

medial in the elbow

medial to the biceps tendon

Clinical significance:

Main artery for blood pressure measurement with a stethoscope.



At risk of injury in supracondylar humerus fractures and elbow dislocations.

An injury can lead to acute ischemia of the forearm and hand.

Runs in close proximity to the N. medianus, so vascular and nerve damage can occur together.

task

Examine your fellow student and palpate the pulse of the A. brachialis in the elbow crease.

- A. circumflexa humeri anterior/posterior
trunk

Branches of A. axillaris

course

A. circumflexa humeri anterior: pulls laterally before the collum chirurgicum humeri.

A. circumflexa humeri posterior: runs with the n. axillaris through the lateral axillary foramen behind the collum chirurgicum humeri.

service area

A. circumflexa humeri anterior: humeral head, shoulder joint, adjacent joint capsule.

A. circumflexa humeri posterior: deltoid muscle, teres minor muscle, humeral head, shoulder joint, and parts of the rotator cuff.

pulse palpable

Not tangible.

Clinical significance

In particular, the A. circumflexa humeri posterior can be injured in an anterior shoulder dislocation or a fracture of the surgical neck of the humerus.

It runs alongside the N. axillaris, so vascular and nerve damage often occur simultaneously.

An injury can compromise the blood supply to the humeral head and increase the risk of avascular necrosis of the humeral head.

- Clinically in the arteries of the shoulder

Vascular injury in dislocation

Check for signs of ischemia

Pain (pain): severe, increasing pain

pallor (paleness): pale skin

Pulselessness (absence of pulse): Pulse not palpable

Paresthesia (sensory disturbance): tingling or numbness

Paralysis (paralysis): motor disorder or muscle weakness

Compare pulses

Check the recapillarization time

Press on the fingernail or fingertip for about 5 seconds until the skin turns white.

Let go and observe how quickly the normal color returns.

normal finding

≤ 2 seconds

pathological finding

> 2 seconds → indicates reduced peripheral circulation or ischemia.

vein

- V. cephalica
 - course
 - begins at the radial (thumb) edge of the back of the hand
 - runs superficially on the radial side of the forearm
 - runs along the lateral side of the upper arm
 - lies in the sulcus deltoideopectoralis
 - drains into the V. axillaris
 - puncture site
 - back of the hand

- radial forearm (thumb side)
 - cubital fossa
- V. basilica
 - course
 - begins on the ulnar (little finger) side of the back of the hand
 - runs superficially on the ulnar side of the forearm
 - crosses the medial side of the upper arm
 - pierces the fascia in the middle of the upper arm and then goes deep
 - unites with the vv. brachiales to form the v. axillaris
 - puncture site
 - ulnar forearm (pinky side)
 - cubital fossa
 - medial upper arm (with a visible vein)
- V. mediana cubiti
 - lies superficially in the cubital fossa
 - connects the V. cephalica (radial/lateral) with the V. basilica (ulnar/medial)
 - runs diagonally across the front of the elbow
- V. brachialis
- V. axillaris
- V. subclavia
 - classic central venous access (CVA)

Clinical

- access
- Thrombosis of the upper extremity
- arm swelling
- Thoracic outlet syndrome

In thoracic outlet syndrome, nerves or blood vessels are compressed between the neck and shoulder. Typical symptoms include pain, tingling, numbness, muscle weakness, or swelling of the arm, which often occurs with certain arm positions, especially when raising the arms above the head or during prolonged overhead work.

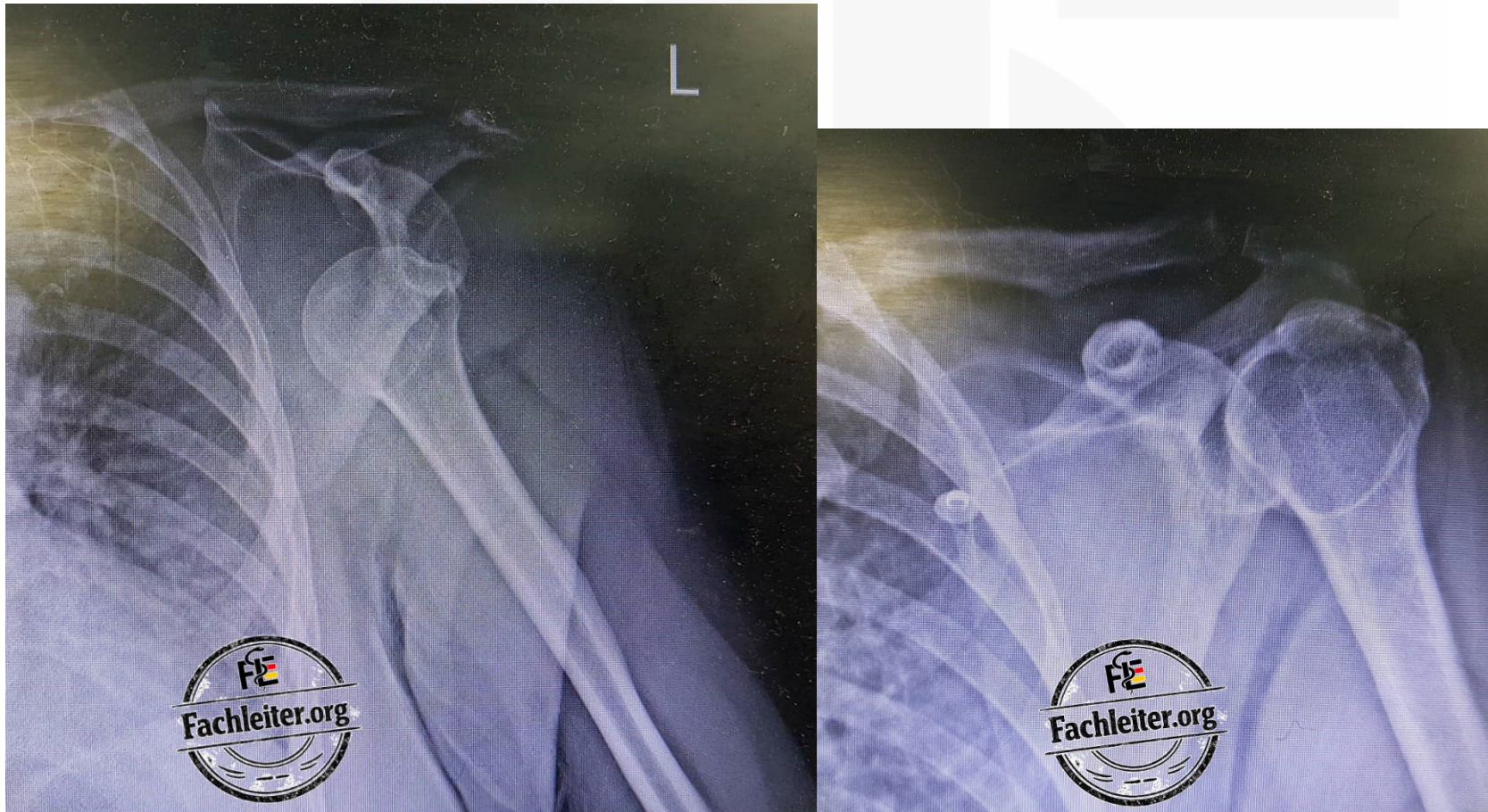
task

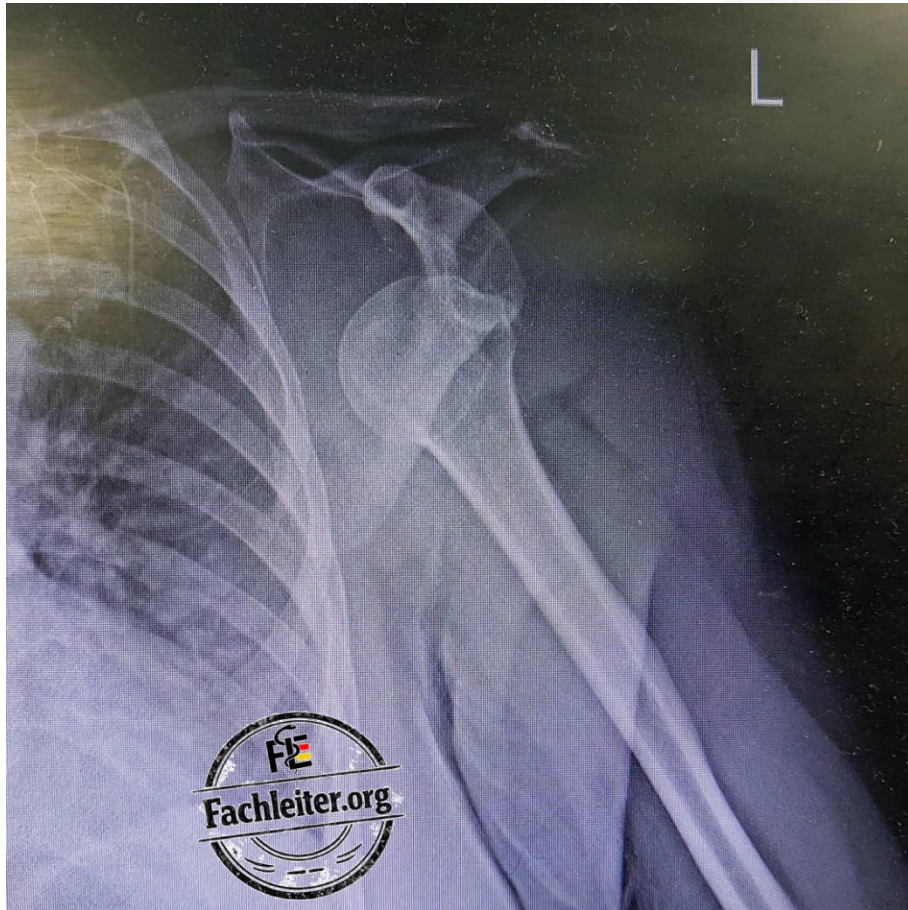
Examine your fellow student and palpate the superficial veins of the upper extremity.

clinical cases

anterior shoulder dislocation (front shoulder dislocation)

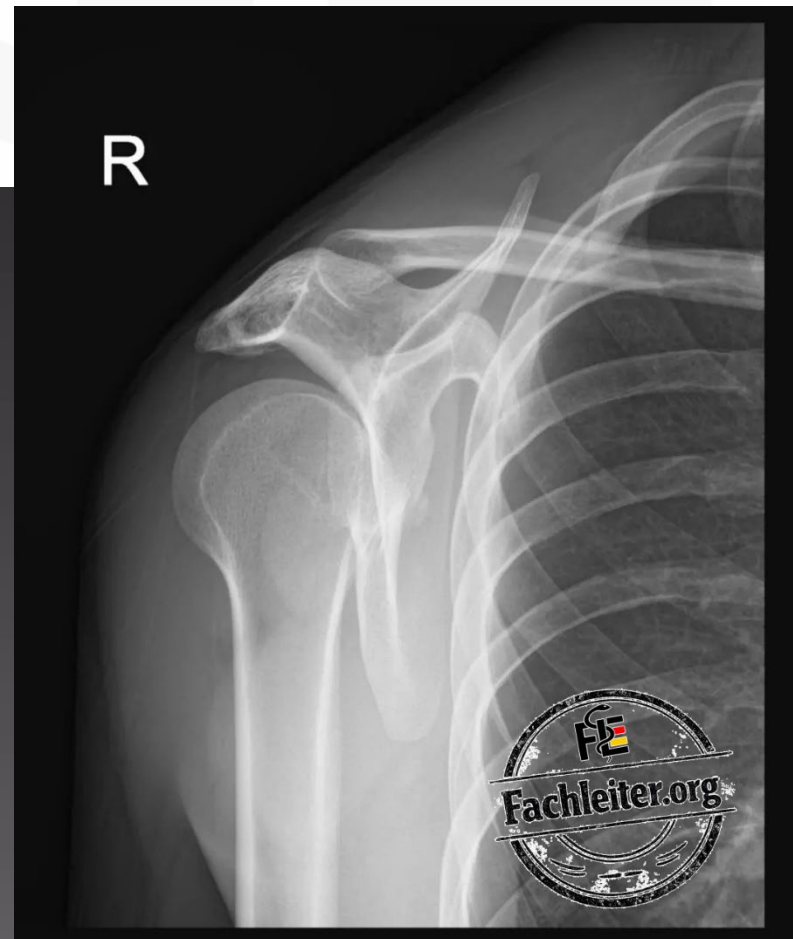
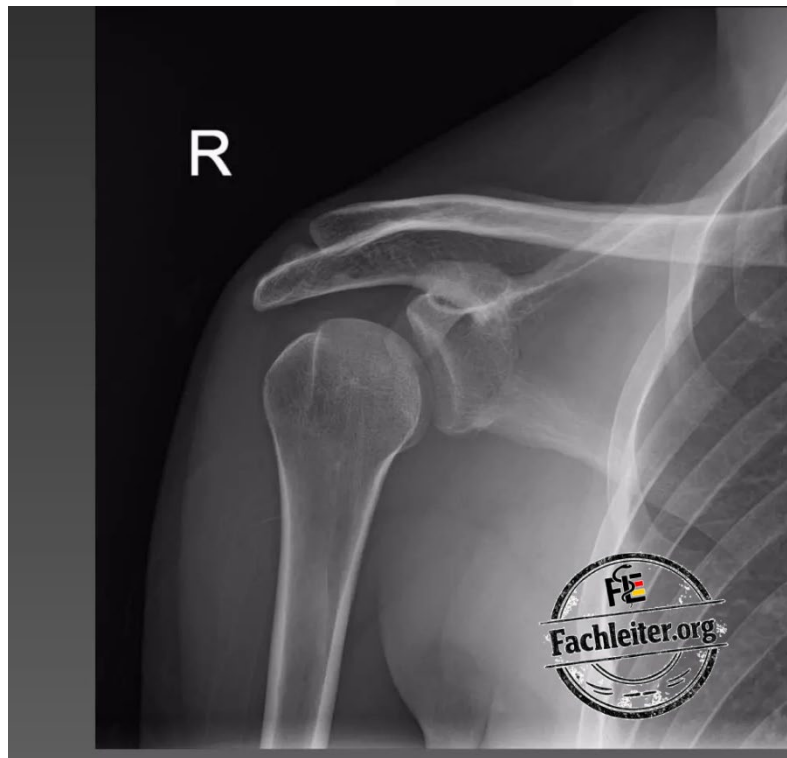
In the AP X-ray, the humeral head is no longer centered in the glenoid fossa, but usually lies subcoracoidally. In the scapula-Y view, the humeral head is anterior to the glenoid center.

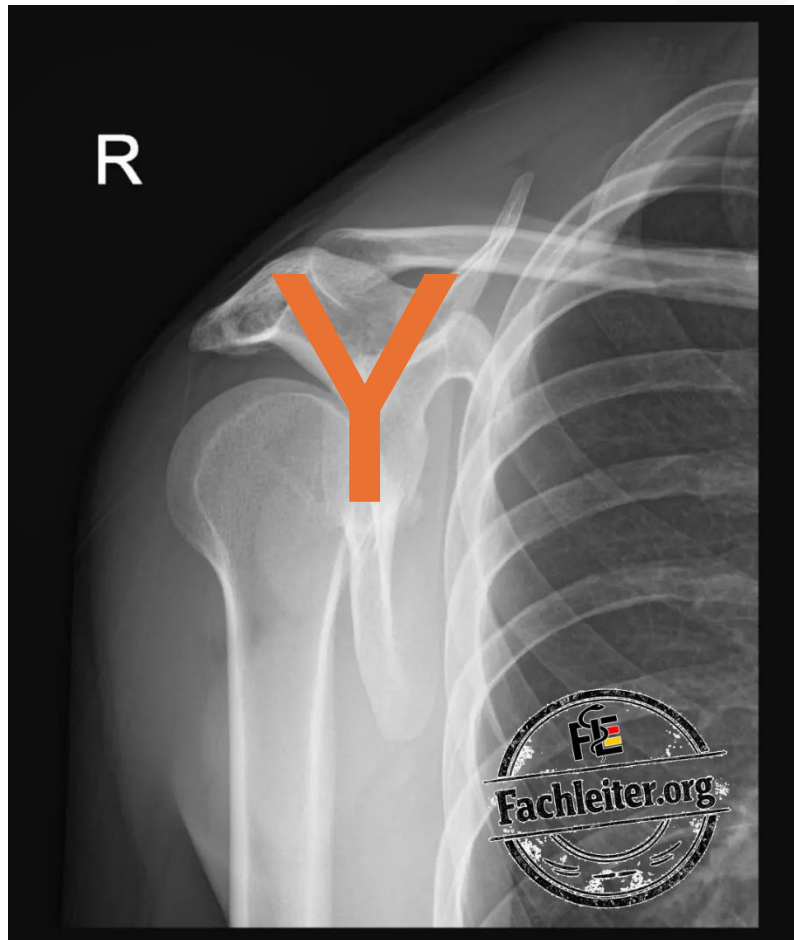




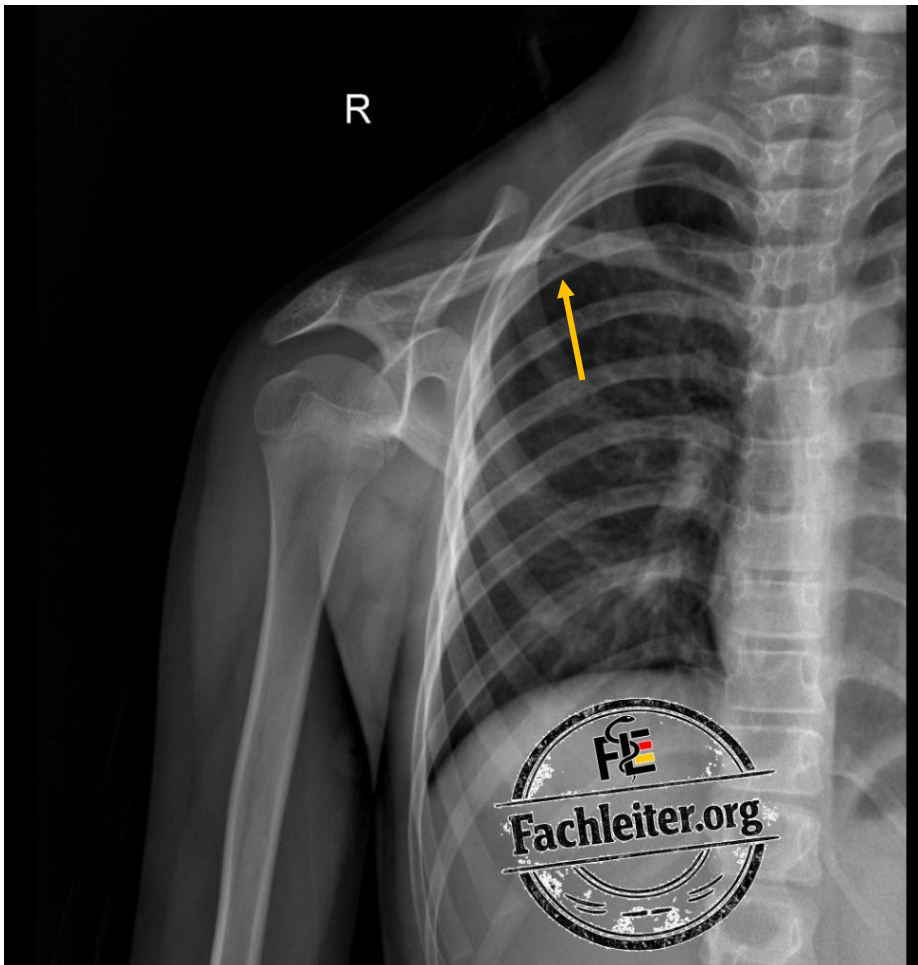
posterior shoulder dislocation

In the AP X-ray, the humeral head is no longer centered in the glenoid fossa and appears to be dislocated posteriorly. Typical indirect signs include a symmetrically round-appearing humeral head ('lightbulb sign') and a widened joint space ('rim sign'). In the scapula-Y view, the humeral head is posterior to the center of the glenoid.





Clavicle fracture 1

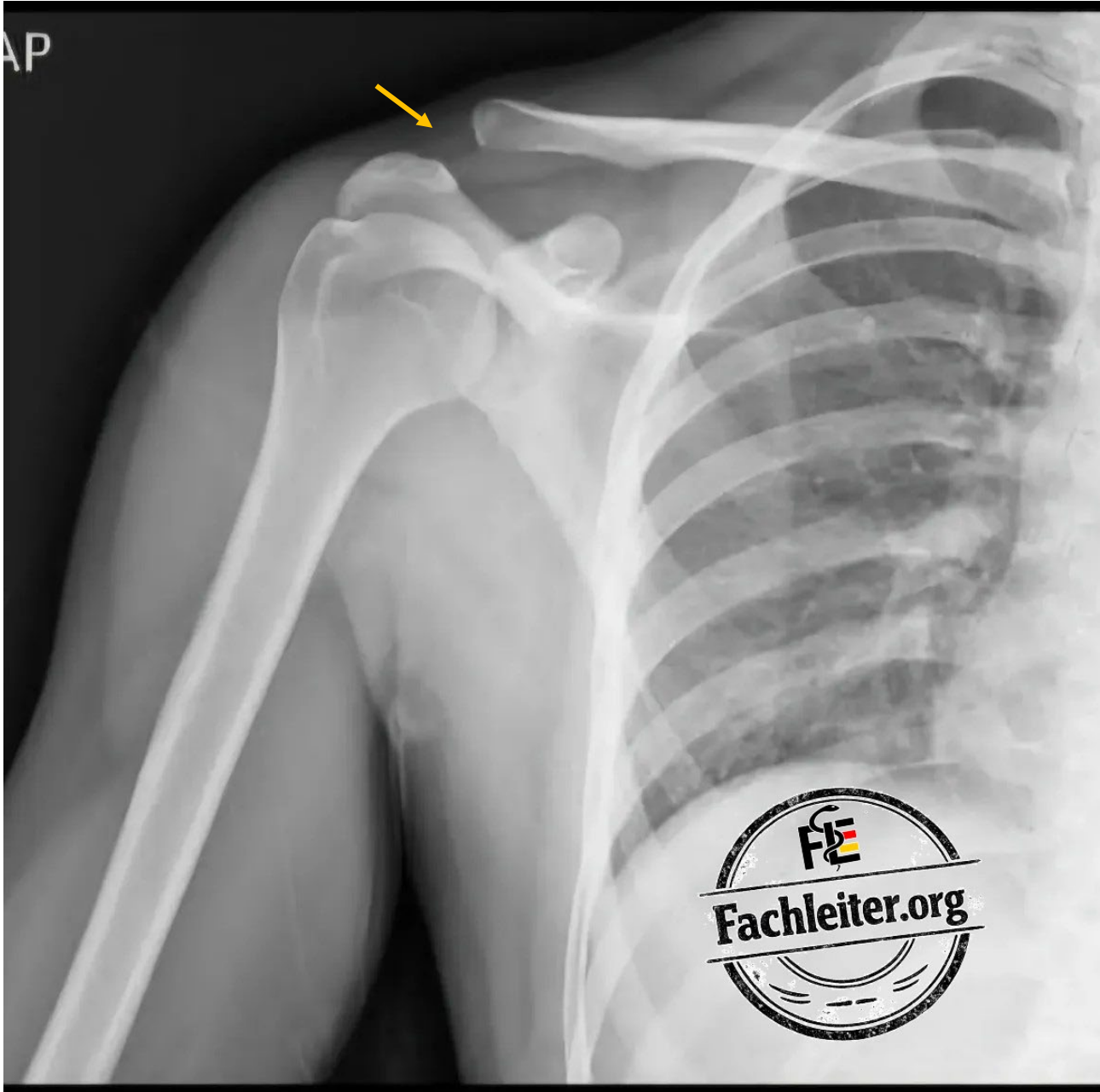


Clavicle fracture 2



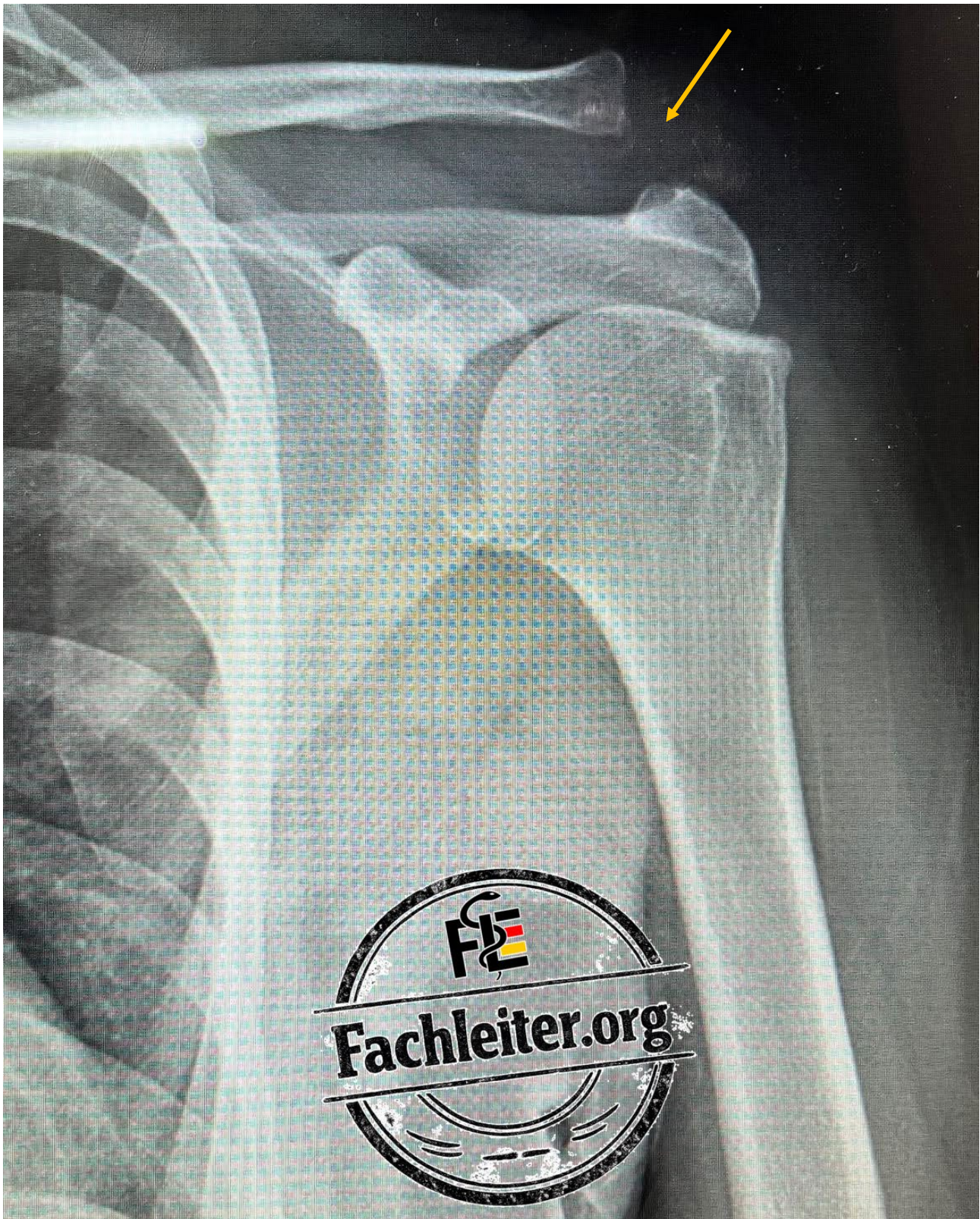
Acromioclavicular joint dislocation 1

On X-ray, there is a widened AC joint space with cranial displacement of the lateral clavicular end. In more severe injuries, the coracoclavicular distance is also increased.

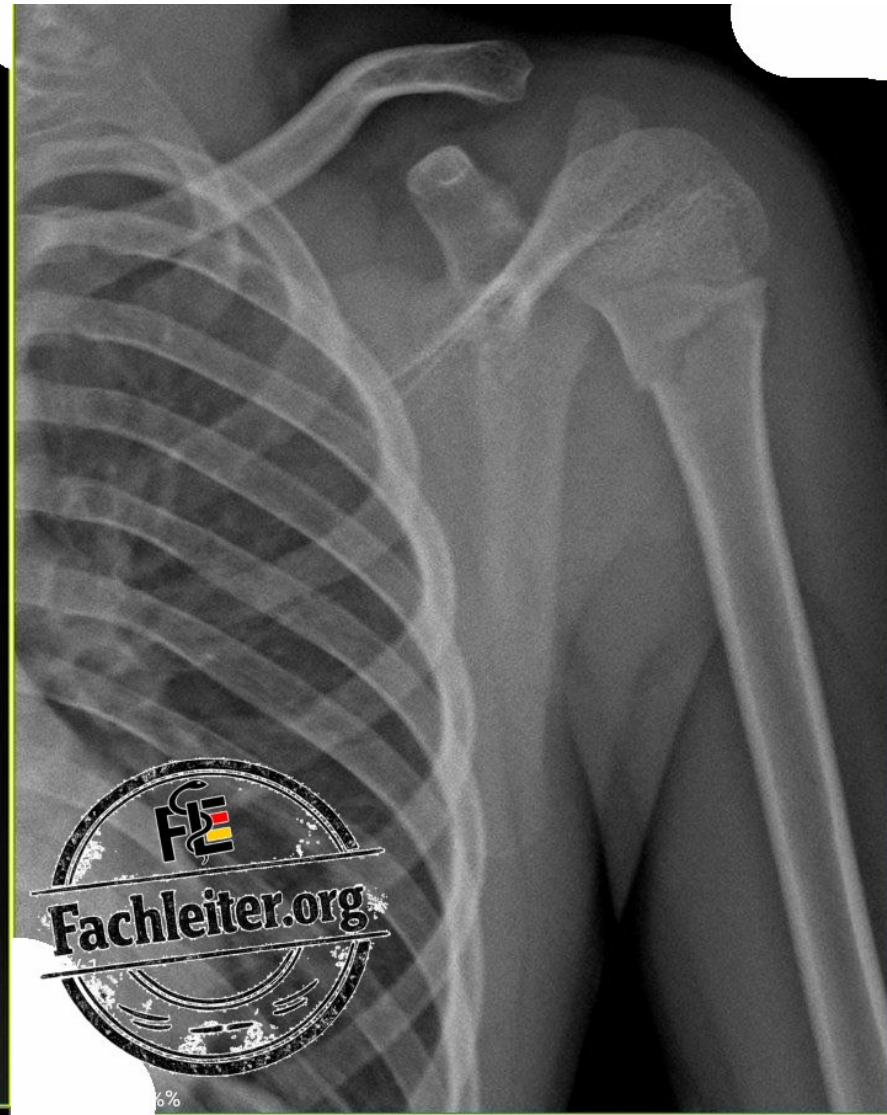
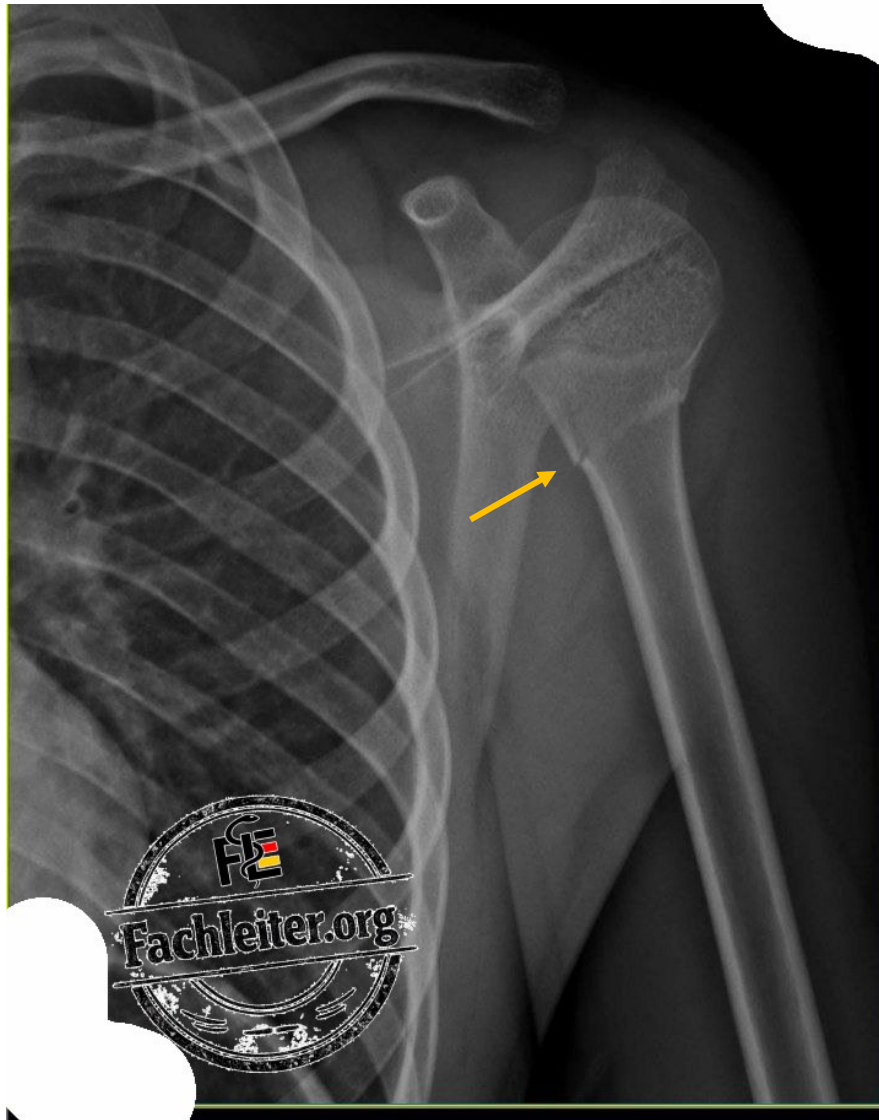


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Acromioclavicular joint dislocation 2



proximal humerus fracture 1



humerus fracture

