

# Shoulder Joint Techniques

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## 1. Indication/Technique

The primary reason to make a shoulder x-ray is to confirm or exclude the presence of a fracture. Additionally, the image can provide information on the position of the shoulder joint, any bone abnormalities (including bone tumors) and soft tissue disorders (think of calcifications in the rotator cuff muscles).

Many hospitals have their own protocol for shoulder imaging.

A standard image normally includes an anteroposterior (AP) image. It can be made either in endorotation or in exorotation.

Options then include a Y image (= scapulolateral image), an axial image (arm in 30-degree abduction), and an apical oblique image (AP image where the beam is aimed 45 degrees craniocaudal).

Each image has benefits and drawbacks. Axial and Y images effectively detect luxations. In the axial direction, the glenoid and humeral head can also be accurately assessed. A significant drawback is the abduction the patient must make (particularly for the axial image), which may be painful in a trauma setting. The Y image may be less painful, but the small glenoid/humeral head fragments may be missed. The benefit of the apical oblique image is that the Hills-Sach lesions and glenoid fractures are reliably detected (see Luxations section). Additionally, patients generally find this image non-painful.

### Acromioclavicular (AC) image

The AC joint is imaged from anterior to posterior. The beam is aimed caudocranial and may vary from 10-15° to 30-45°. Normal anatomy

### AP image

The humeral head is not perfectly symmetrically round. On the AP image, the head has a configuration of a wooden walking stick.

### Y image

The Y configuration is formed by the scapula (= stem), the scapular spine and the coracoid process (= legs). The central point in the Y shape is the glenoid. The humeral head should overlap the center of the Y shape.

Orientation tip: anterior is the side of the rib cage.

### Axial image

For orientation: compare the glenohumeral joint with a golf ball (humeral head) and a tee (glenoid). The acromion and the coracoid process could be visualized as the index finger and thumb respectively, always pointing towards anterior. Reminder: the ABC rule: Acromion, golf Ball, Coracoid process.

### Apical oblique image

The humeral head should be located at the level of the glenoid.

### Acromioclavicular (AC) joint

The bottom of the acromion should align with the bottom of the distal clavicle. If not, be alert for an AC luxation.

The following points may be used as a guide to assess shoulder X-rays.

- 1) Can the images be accurately evaluated? Has everything been imaged? If not, have an additional image made if you cannot reliably answer the question.
- 2) Is it the shoulder of a child or an adult? What is your general impression of the bone?
- 3) What is the position of the humeral head? Is there normal articulation with the glenoid? (Is it in a luxated position or is there e.g. osteoarthritis?).
- 4) If an AC image: can you draw a straight line at the bottom of the acromion/clavicle?
- 5) Check each cortex. Are there irregular cortical interruptions anywhere? If so, can you see a fracture line?
- 6) Are there abnormalities outside of the shoulder joint? (Think of ribs, lungs and soft tissues?)

Pathology

Fracture

Luxation

Osteoarthritis

Rotator cuff impingement

Proximal humeral fracture

Fracture (= broken bone): interruption in the continuity of the bone.

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Proximal humeral fractures occur frequently, particularly in elderly osteoporotic patients.

A commonly used classification is the Neer classification.

The humeral head is subdivided into 4 segments:

- 1) Humeral shaft.
- 2) Humeral head (the articulating segment).
- 3) Greater tubercle (where rotator cuff muscles insert except the subscapularis muscle).
- 4) Lesser tubercle (where subscapularis muscle inserts).

The anatomical neck is located between the 2 tubercles and the humeral head.

The surgical neck is a predilection site for fractures and is located between the humeral shaft and the 2 tubercles.

In a humeral fracture, fracture fragments may move away from their normal anatomical position, also known as dislocation.

In a proximal humeral fracture, there is dislocation if:

- The fracture fragment moves  $\geq 1$  cm and/or
- Angulation (= curving) of a fracture fragment of  $> 45^\circ$

Neer classification

- 1) Part: non-dislocated fractures (well over 80% of all proximal humeral fractures).
- 2) Part: dislocation with a fracture through the surgical neck or the greater tubercle or the lesser tubercle.
- 3) Part: dislocation with a fracture through the surgical neck with the greater tubercle or together with the lesser tubercle.
- 4) Part: dislocation with a fracture through the surgical neck and the greater tubercle and lesser tubercle and through the anatomical neck.

If a 3 or 4-part fracture is suspected, an additional CT scan is generally made.

Unfavorable prognostic characteristics for fracture healing & stability:

Many "parts".

$>1$  cm dislocation at the level of the medial transition of the humeral shaft to the humeral head (= disruption of the "medial hinge"). Vascularization is compromised (high risk of humeral head necrosis!).

Dislocation of greater tubercle in subacromial space (= space immediately under the acromion).

### **Luxation**

Luxation: dislocation, interruption of the normal interrelation between the components of a joint.

Anterior shoulder luxation ( $> 95\%$ )

### **Findings in anterior luxation**

AP image: the humeral head is located under the coracoid process.

Axial image: the humeral head (golf ball) is anterior of the glenoid (tee).

Y image: the humeral head is no longer located centrally in the Y configuration, it has moved to anterior (= towards the rib cage).

Posterior shoulder luxation ( $< 5\%$ )

In a posterior shoulder luxation, the shoulder is luxated backward. Posterior luxation is rare and usually arises as a result of electroshock therapy or muscle spasm in an epileptic seizure. It is a condition that is frequently missed.

### **Findings in posterior luxation**

AP image: the humeral head has lost its characteristic walking stick configuration. The head looks rounder now, like a lightbulb. This is called the light bulb sign. The patient cannot exorotate the arm, which is in mild endorotation. If the humeral head is rotated internally with sufficient force against the back rim of the glenoid, the trough line sign can be seen (fig. 19). This is an additional line projecting over the humeral head (directly lateral from the inside of the humeral head contour). This additional line corresponds with an indentation fracture (see Shoulder luxation complications section).

Axial image/apical oblique image: the humeral head (golf ball) is posterior of the glenoid (tee).

Y image: the humeral head is posterior of the Y configuration (= away from the rib cage).

### **Pitfalls:**

If a patient is in pain, he/she will not always be able to exorotate the shoulder, holding it in an endorotation position. This could give rise to a lightbulb sign. So always check in the other directions whether this is actually a posterior luxation.

Trauma/fracture may cause hemorrhage in the joint, pushing the humeral head downward (caudal dislocation, termed drooping shoulder). This is a pseudo-luxation. Once the hemorrhage is resorbed, the pseudo-luxation will resolve (usually within 1-2 weeks).

### **Shoulder luxation complications**

The shoulder joint socket surface (= glenoid) is enlarged by a cartilage ring, the so-called labrum. The labrum consists of cartilage and connective tissue. This outer socket ring increases shoulder joint stability.

In an anterior shoulder luxation, the humeral head is dislocated forward/downward with great force. In a traumatic luxation, this movement will usually damage the labrum at the caudoanterior side, also known as the Bankart lesion. With sufficient force, a part of the bony glenoid may be involved (= bony Bankart lesion).

A traumatic luxation will usually cause an impaction fracture ('indentation') on the outer-far side of the humeral head, the so-called Hill-Sachs lesion. As the lesion is on the

posterolateral side, an AP image in endorotation is the most effective way to detect the lesion.

**Mechanism:** an anterior luxation is caused by a forceful movement in the antero-caudal direction. The (soft) cartilage of the posterolateral humeral head is forced against the front of the glenoid, causing an indentation.

The (rare) posterior shoulder luxations may cause similar complications, but then at the exact opposite location. The reversed Bankart lesion (posterior glenoid side) and the reversed Hill-Sachs lesion (anterior humeral head side). The reversed Hill-Sachs lesion presents on a shoulder x-ray as the so-called trough line sign.

Both the Hill-Sachs lesion and the Bankart lesion may be difficult to detect on a conventional x-ray. Therefore a CT or MRI of the shoulder is frequently opted for if one of these lesions is suspected.

#### **Acromioclavicular (AC) luxation:**

The AC joint is most reliably assessed on the AC image. The joint can be imaged under various angles. The underside of the acromion should align with the underside of the distal clavicle. If there is a dislocation of more than 8 mm, be alert for an AC luxation (note: 8-10 mm may still be normal in some adults). The clinic, including the piano key phenomenon, is key to the diagnosis of AC luxation.

When in doubt, imaging the other AC joint may be helpful.

#### **Osteoarthritis**

Osteoarthritis gives rise to diverse symptoms. Patients may complain about progressive load-dependent pain and/or reduced shoulder function.

The osteoarthritis may be primary with no obvious identifiable cause. Secondary osteoarthritis may develop following a fracture or a rotator cuff muscle rupture.

**Radiological characteristics of osteoarthritis:**

- Narrowing of the joint space (secondary to labrum disorders and loss of cartilage).
- Subchondral sclerosis (increased bone production secondary to increased pressure with cartilage loss).
- Osteophyte formation (bone exostoses attempting to increase the joint surface).
- Subchondral cysts (secondary to microfractures of the subchondral bone and pressure of the synovial fluid).
- Synovitis

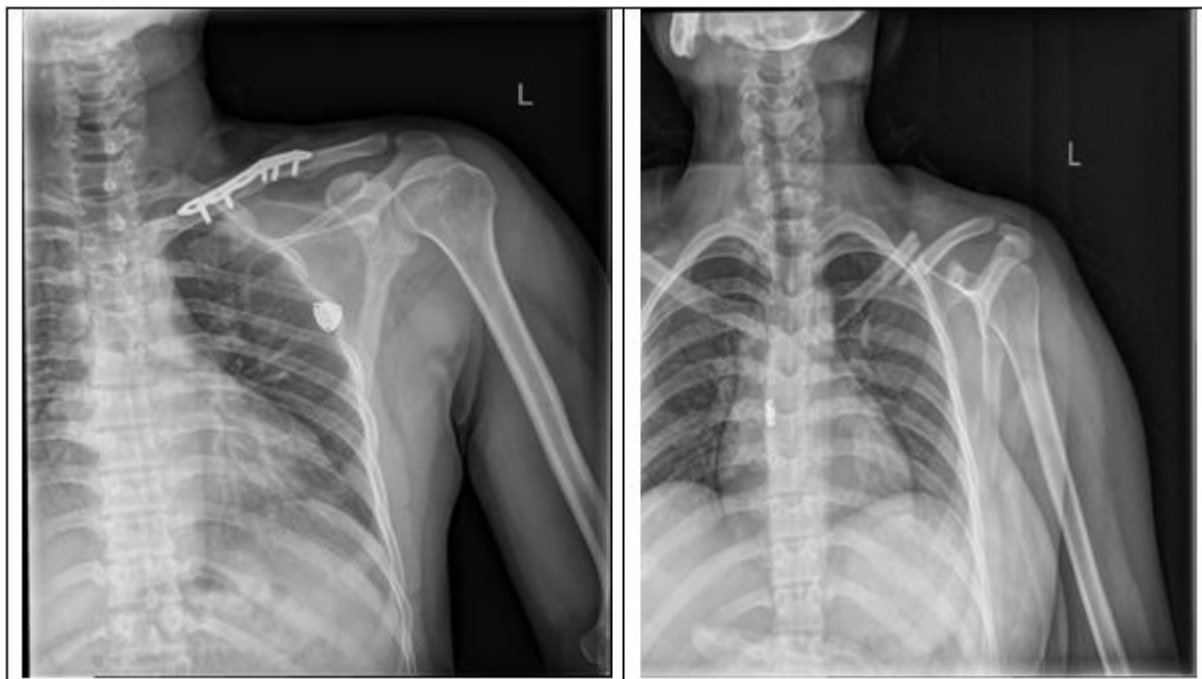
#### **Rotator cuff impingement**

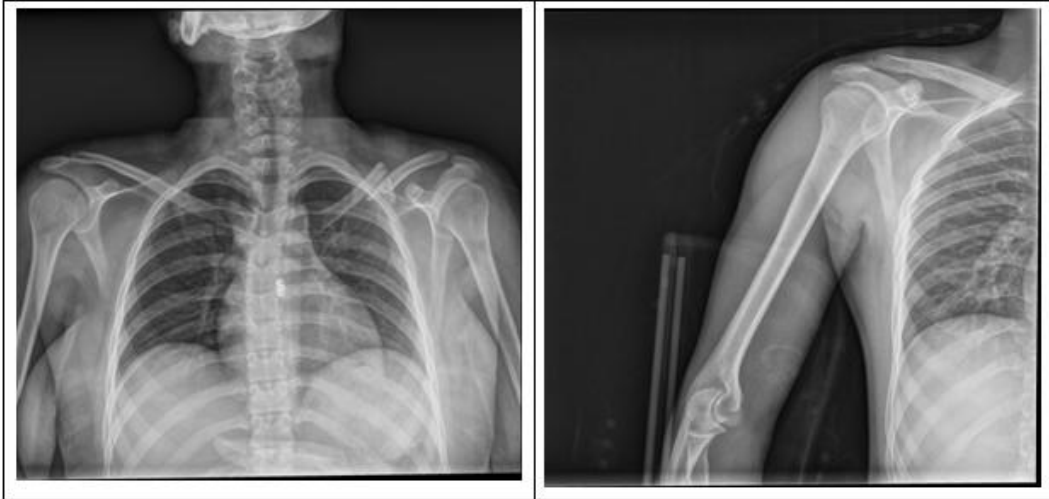
Impingement (= pinching) of the rotator cuff muscles, biceps brachii longus and the subacromial bursa is the most common cause of rotator cuff pain. The pain is generally located at the front and lateral side of the shoulder. Lifting the upper arm (= abduction) can be particularly painful.

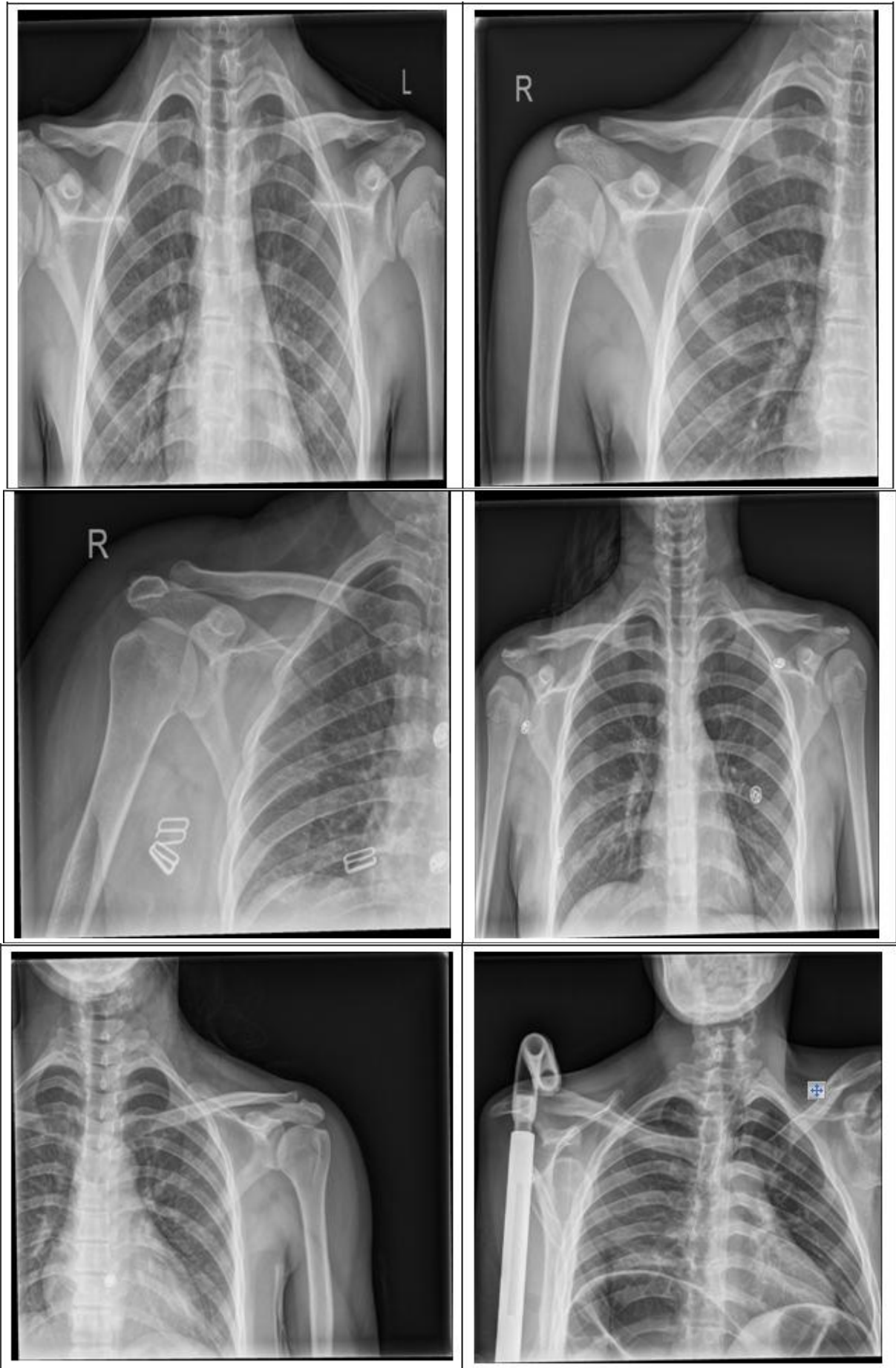
In impingement, the tendons and/or bursa have become pinched between the summit of the shoulder (= acromion) and the humeral head.

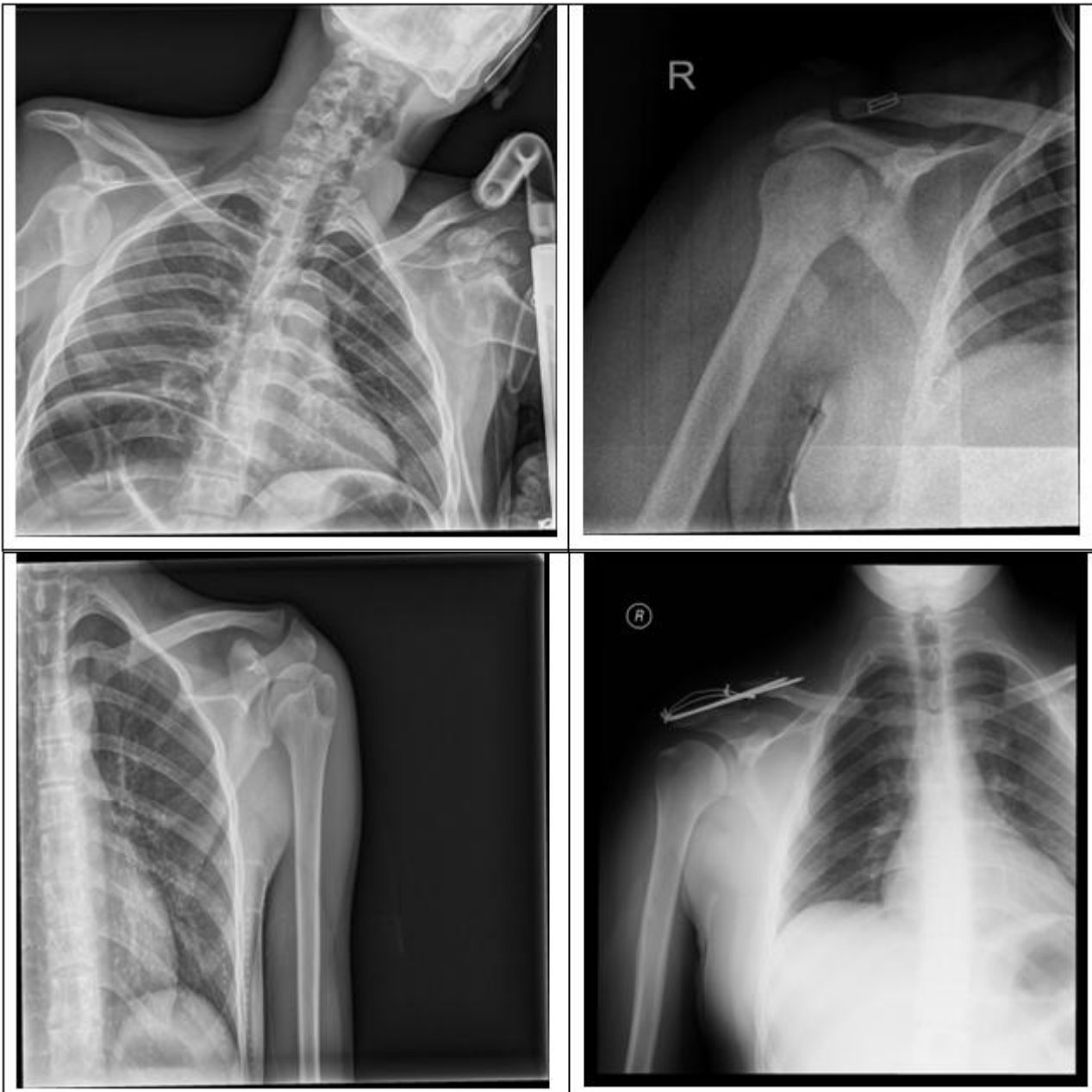
Chronic impingement may lead to weakening or degeneration (= tendinopathy) of the tendons. In view of its location and vascularization, the supraspinatus tendon is the most susceptible to impingement.

Even though this is soft tissue pathology, the shoulder x-ray may provide evidence for rotator cuff impingement. Chronic impingement may give rise to calcifications in the tendon, particularly the supraspinatus tendon. This process is also known as tendinitis calcarea. The exact cause of this accumulation of calcium is unknown.









## References

- [1] B.J. Manaster et al. The Requisites – Musculoskeletal Imaging. 2007.
- [2] N. Raby et al. Accident & Emergency Radiology – A Survival Guide. 2005.
- [3] R.W.Bucholz Rockwood & Green’s Fractures in Adults. 2006.
- [4] Richtlijn Acute primaireschouderluxatie: diagnostiek en behandeling. 2005, Nederlandse Orthopaedische Vereniging.
- [5] RichtlijnenRegio West Richtlijnenvoorbehandeling van Letsels van het steun- en bewegingsapparaat.
- [6] R.F. Kilcoyne et al. The Neer classification of displaced proximal humeral fractures spectrum of findings on plain radiographs and CT scans. AJR Am J Roentgenol 1990.

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