

Elbow joint imaging

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The **elbow** is a complex synovial joint formed by the articulations of the humerus, the radius, and the ulna.

GROSS ANATOMY

ARTICULATIONS

THE ELBOW JOINT IS MADE UP OF THREE ARTICULATIONS ^{2,3}:

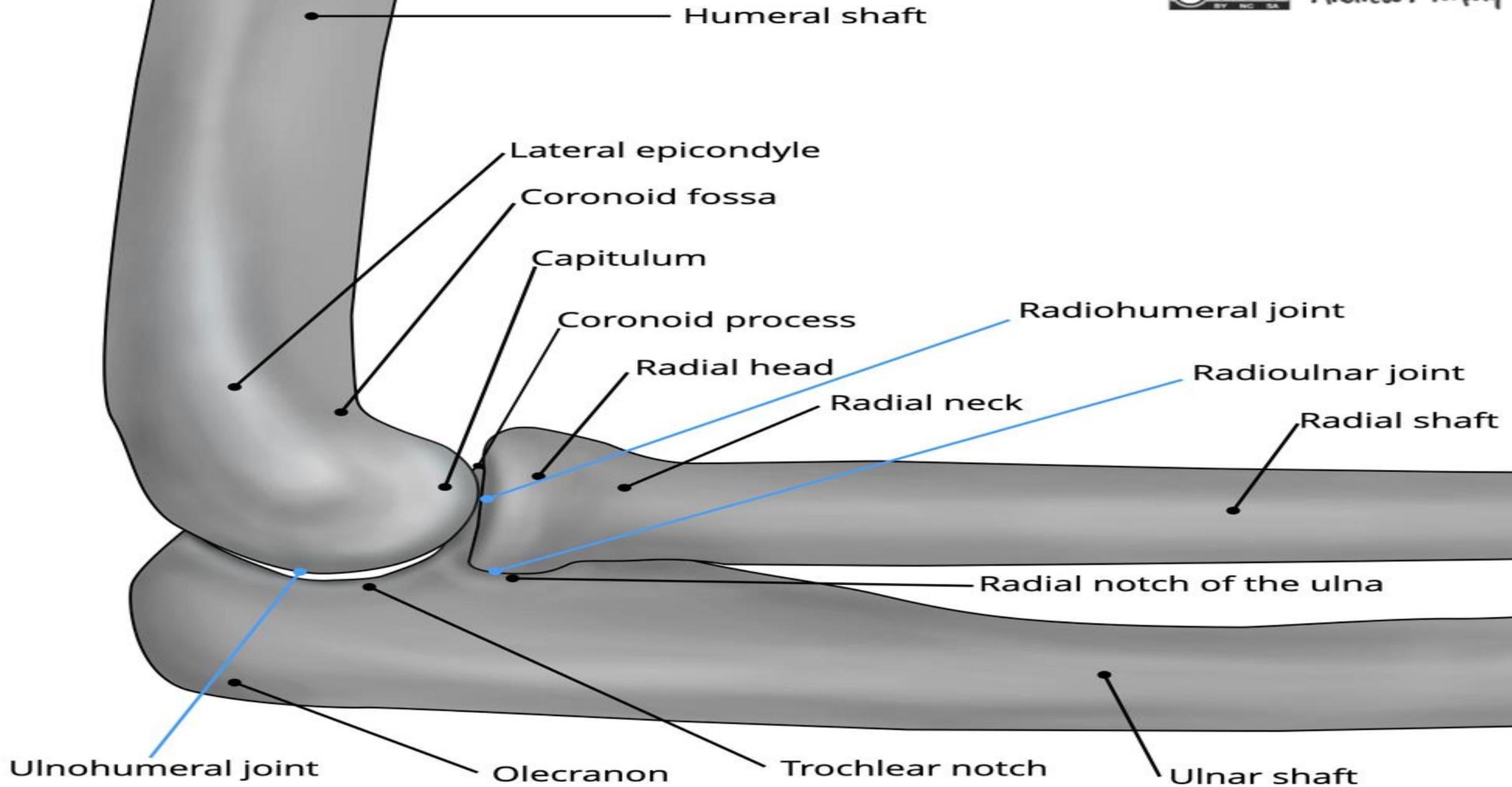
1. RADIOHUMERAL: CAPITELLUM OF THE HUMERUS WITH THE RADIAL HEAD

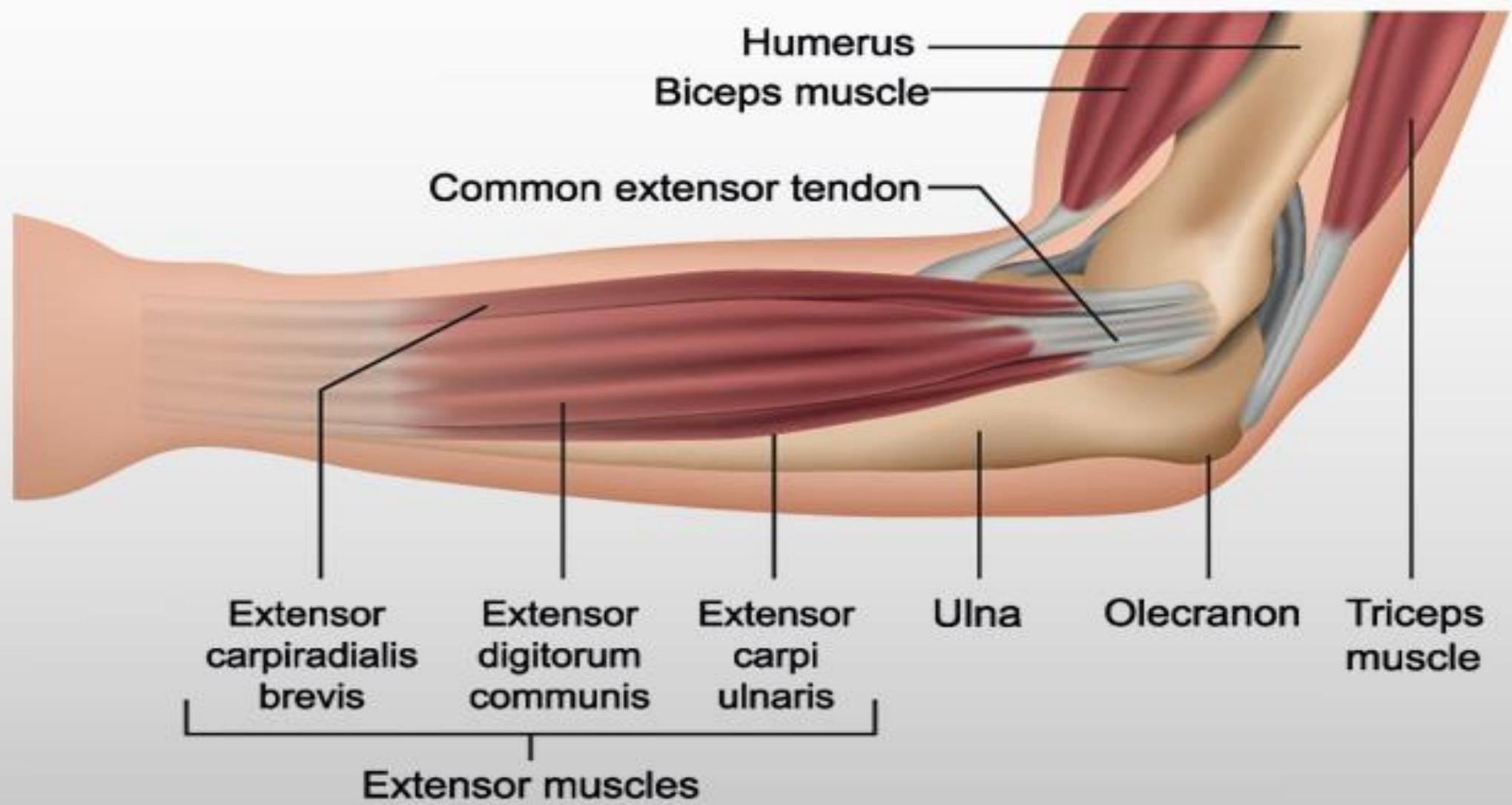
2. ULNOHUMERAL: TROCHLEA OF THE HUMERUS WITH THE TROCHLEAR NOTCH (WITH SEPARATE OLECRANON AND CORONOID PROCESS ARTICULAR FACETS) OF THE ULNA

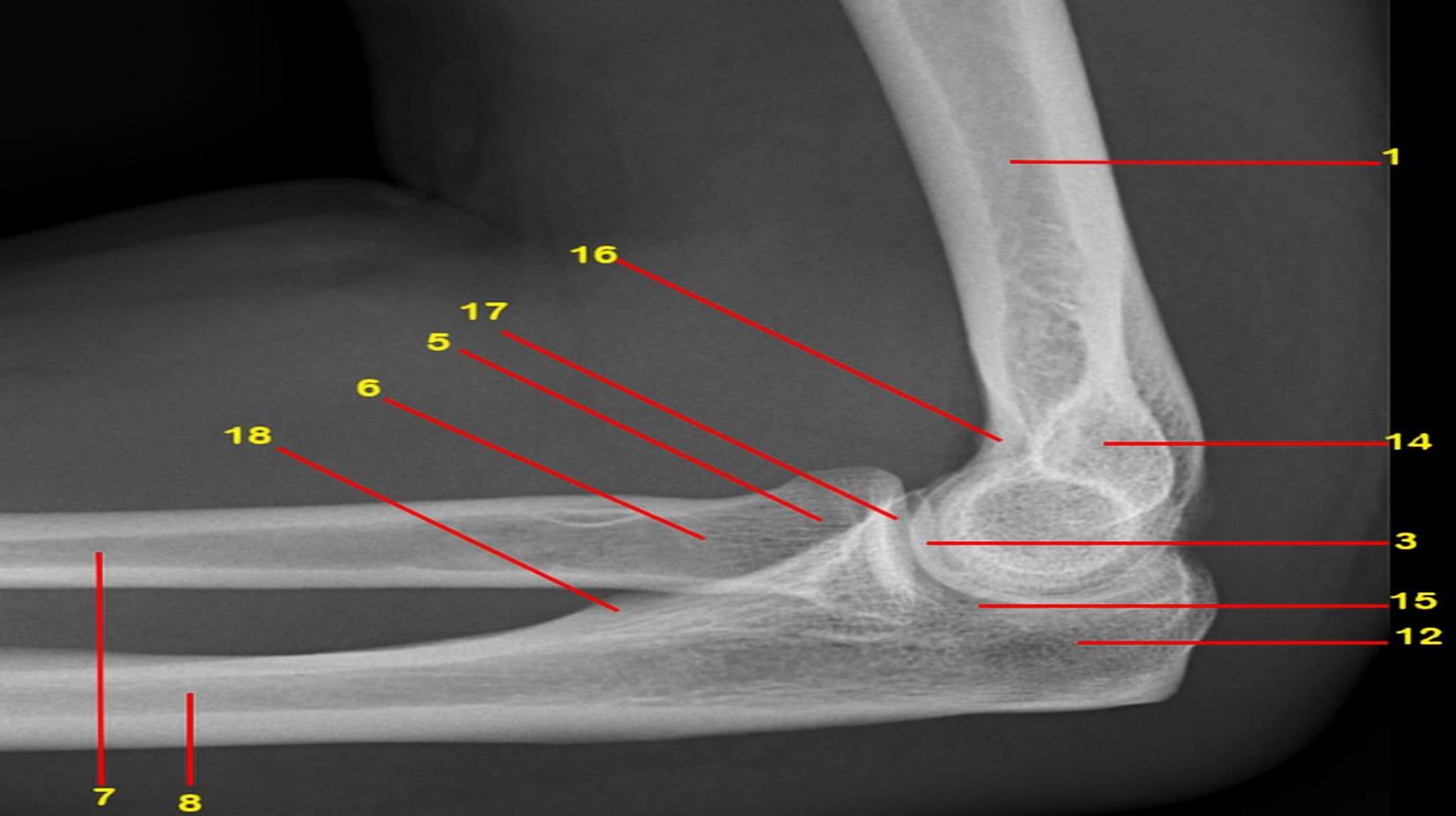
3. RADIOULNAR: RADIAL HEAD WITH THE RADIAL NOTCH OF THE ULNA (PROXIMAL . RADIOULNAR JOINT)

IN FULL FLEXION, THE CORONOID PROCESS IS RECEIVED BY THE CORONOID FOSSA AND THE RADIAL HEAD IS RECEIVED BY THE RADIAL FOSSA ON THE ANTERIOR SURFACE OF THE HUMERUS.

IN FULL EXTENSION, THE OLECRANON PROCESS IS RECEIVED BY THE OLECRANON FOSSA ON THE POSTERIOR ASPECT OF THE HUMERUS







Ligaments

- medial (ulnar) collateral ligament complex
- lateral (radial) collateral ligament complex
- oblique cord
 - inconstant thickening of supinator muscle fascia and functionally insignificant ⁵
 - runs from tuberosity of the ulna to just distal to radial tuberosity ⁵
- quadrate ligament (of Denuce)
 - thickening of the inferior aspect of the joint capsule
 - runs from just inferior to the radial notch of the ulna to insert to the medial surface of the radial neck

Joint capsule

The joint capsule has **two layers**, deep and superficial, and **attaches** proximally to the **radial, coronoid and olecranon fossae**. The volume of the joint capsule is **24-30 mL** ⁹.

There are several synovial folds of the elbow

Fat pads

There are **three fat pads** of the elbow, which sit between the two layers of the joint capsule, making them **extrasynovial**^{3,4}:

- **coronoid fossa fat pad (anterior)**
- **radial fossa fat pad (anterior)**
- **olecranon fossa fat pad (posterior)**

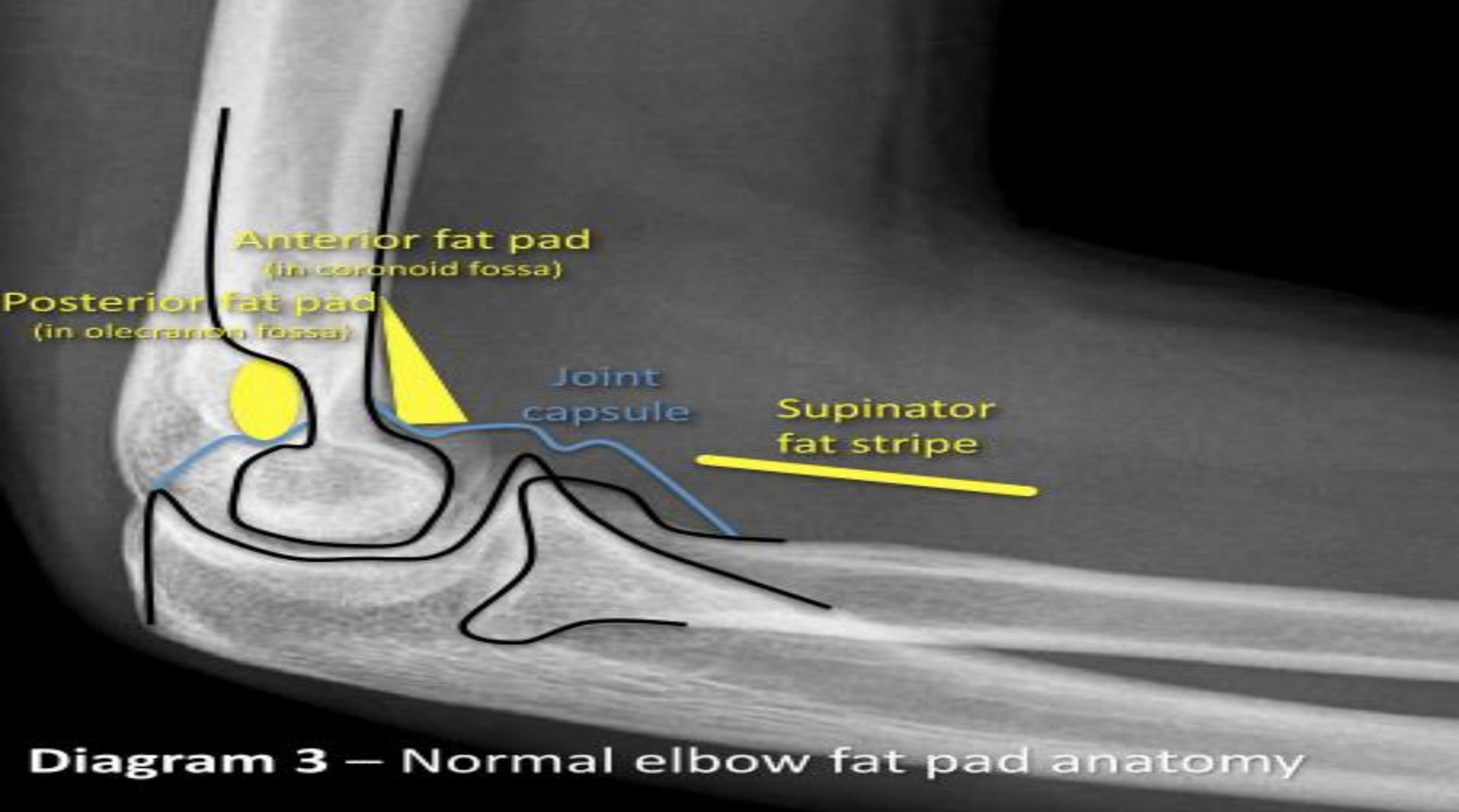


Diagram 3 – Normal elbow fat pad anatomy

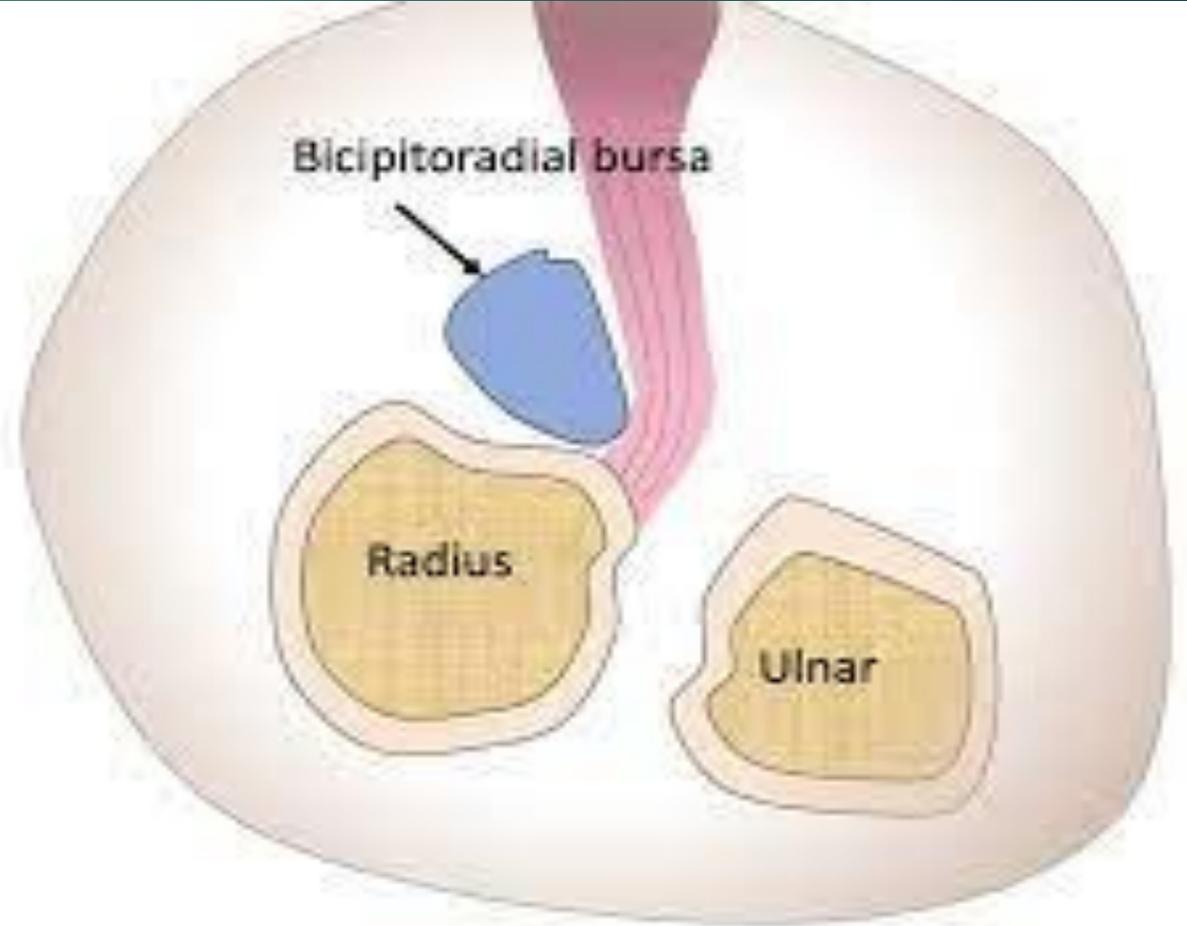
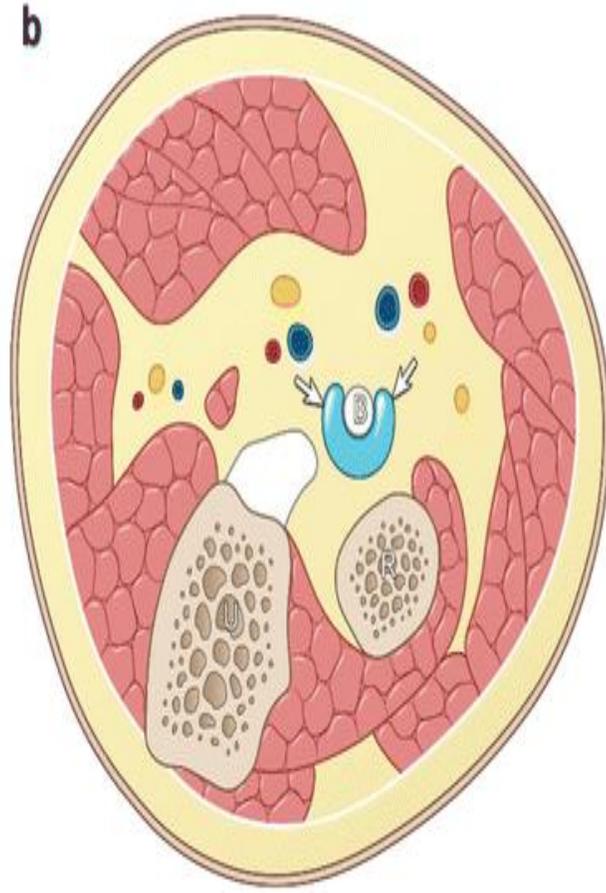
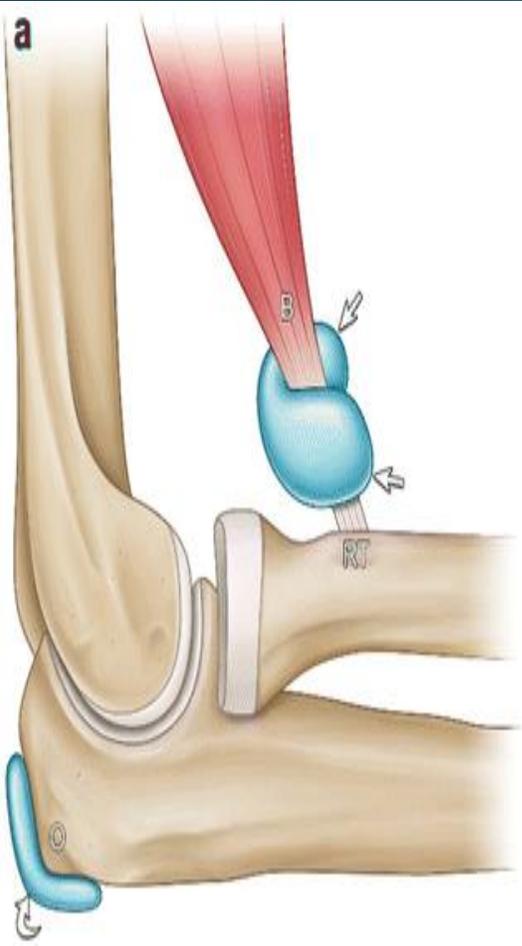
Fat Pad Sign

- Posterior fat pad is normally buried in olecranon fossa and not visible
 - Becomes elevated and visible with joint effusion
 - Effusion (acute capsular swelling) can be from any origin (hemorrhagic, inflammatory, infectious, traumatic, etc.)
- Ant. fat pad may be obliterated, so post. Fat pad is more reliable when visible



Bursae

- olecranon bursa
- bicipitoradial bursa



Imaging modalities

(RADIOGERAPHY, MDCT, MRI, ARTEROGERAPHY SONOGERAPHY)

Most evaluations of the elbow begin with radiographs because of their screening value and relatively low cost. 1. Lateral and anteroposterior 2. (AP) radiographs are essential in the basic evaluation of disease. 3. Oblique radiographs or additional views, such as the radial head view, may be utilized for further evaluation of occult trauma or early arthropathy

Advancement in technology has allowed multiplanar imaging with multidetector computed tomography (MDCT). Osseous structures are best evaluated using "bone" algorithm reconstructions

Magnetic resonance imaging (MRI) of the elbow can clearly define normal bone, soft tissue anatomy, and pathology.

MRI

1. The **axial** image plane is useful to assess **neurovascular, tendon, and muscle** anatomy.
2. The **sagittal** plane is useful as a second plane for **biceps and triceps tears** or to define the extent of a lesion identified on axial images.
3. The **coronal** plane is useful for evaluating **articular surfaces, common extensor and flexor tendons, and collateral ligaments**.

Elbow **arthrography**-either conventional, or **followed by CT or MRI**-is helpful

The elbow can be injected laterally (radiocapitellar joint) or posteriorly with 8 to 12 mL of solution.

Sonography is useful in evaluating a variety of structures, such as the **common extensor and flexor origins, collateral ligaments, nerves, and bursa**

Nuclear medicine imaging is **occasionally** used

Bone scintigraphy with technetium-99m methylene diphosphonate (^{99m}Tc -MDP) is helpful to identify areas of **active bony turnover**

Osseous trauma

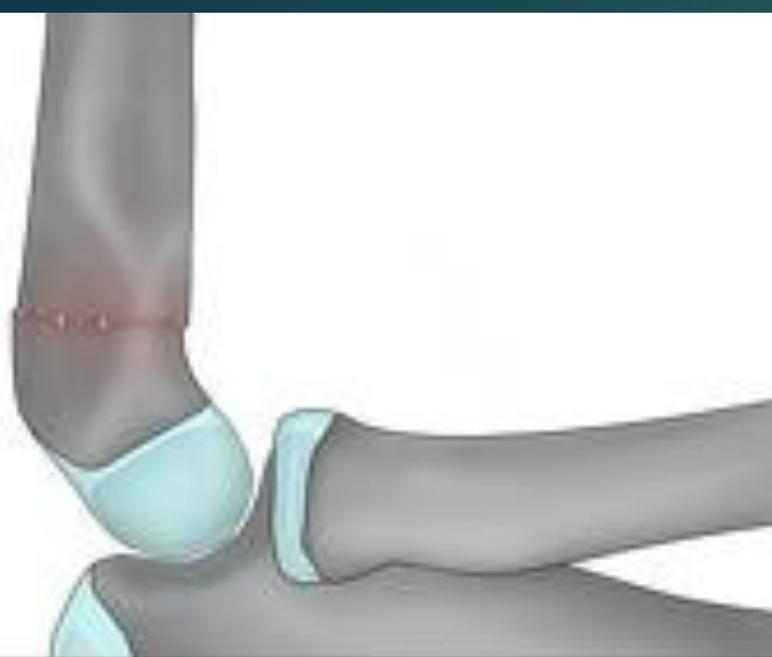
Elbow fractures and other injuries are common in infants, children, adolescents, and adult throwing athletes

Routine radiographs and CT are generally sufficient

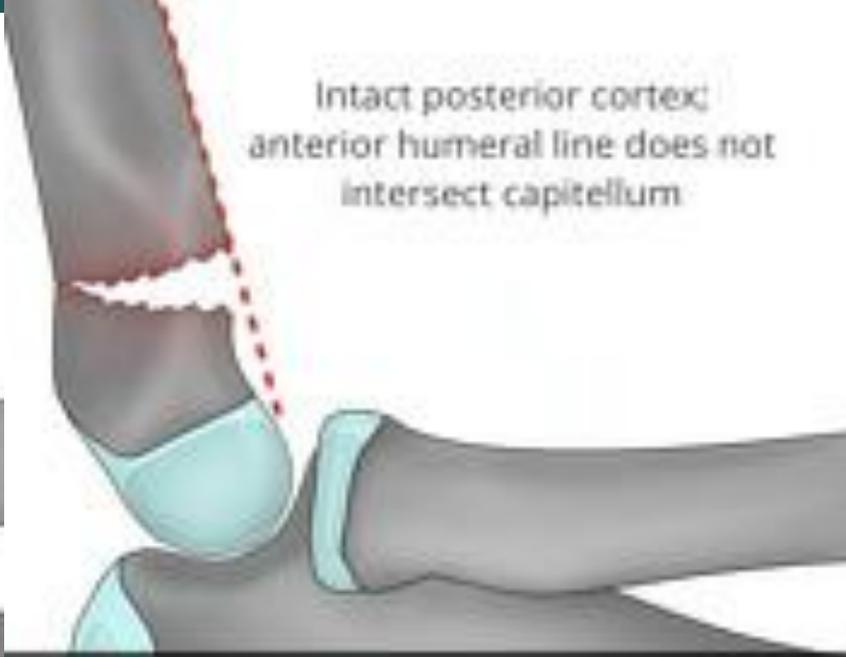
In children, supracondylar humeral fractures account for 50% to 60% of all fractures and have high complication rates.

Classification

- **type I:** undisplaced or minimally displaced
- **type II:** displaced but with intact cortex
- **type III:** completely displaced
- **type IV :** displaced, with periosteal disruption, unstable in flexion and extension

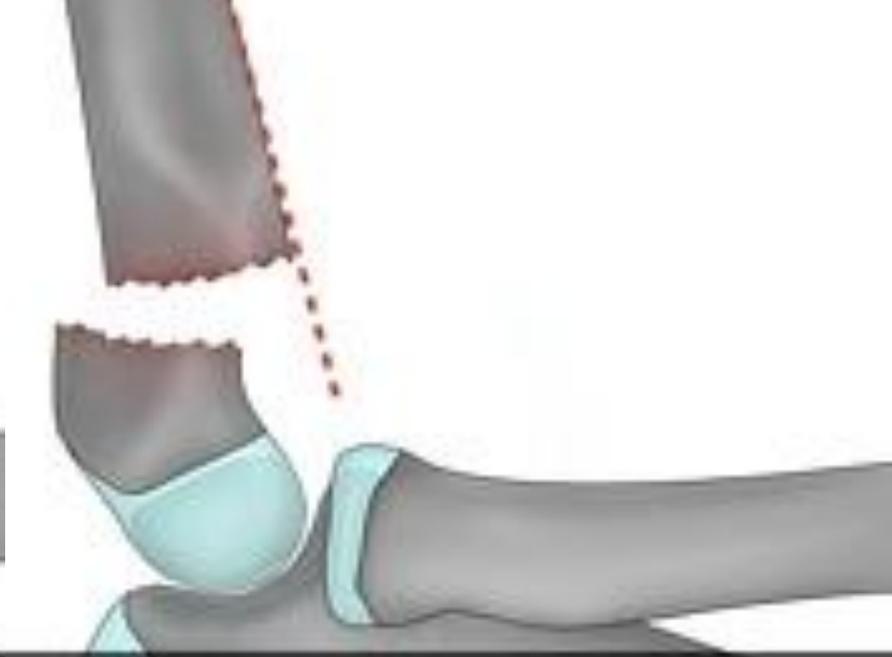


Type I



Intact posterior cortex;
anterior humeral line does not
intersect capitellum

Type II



Type III



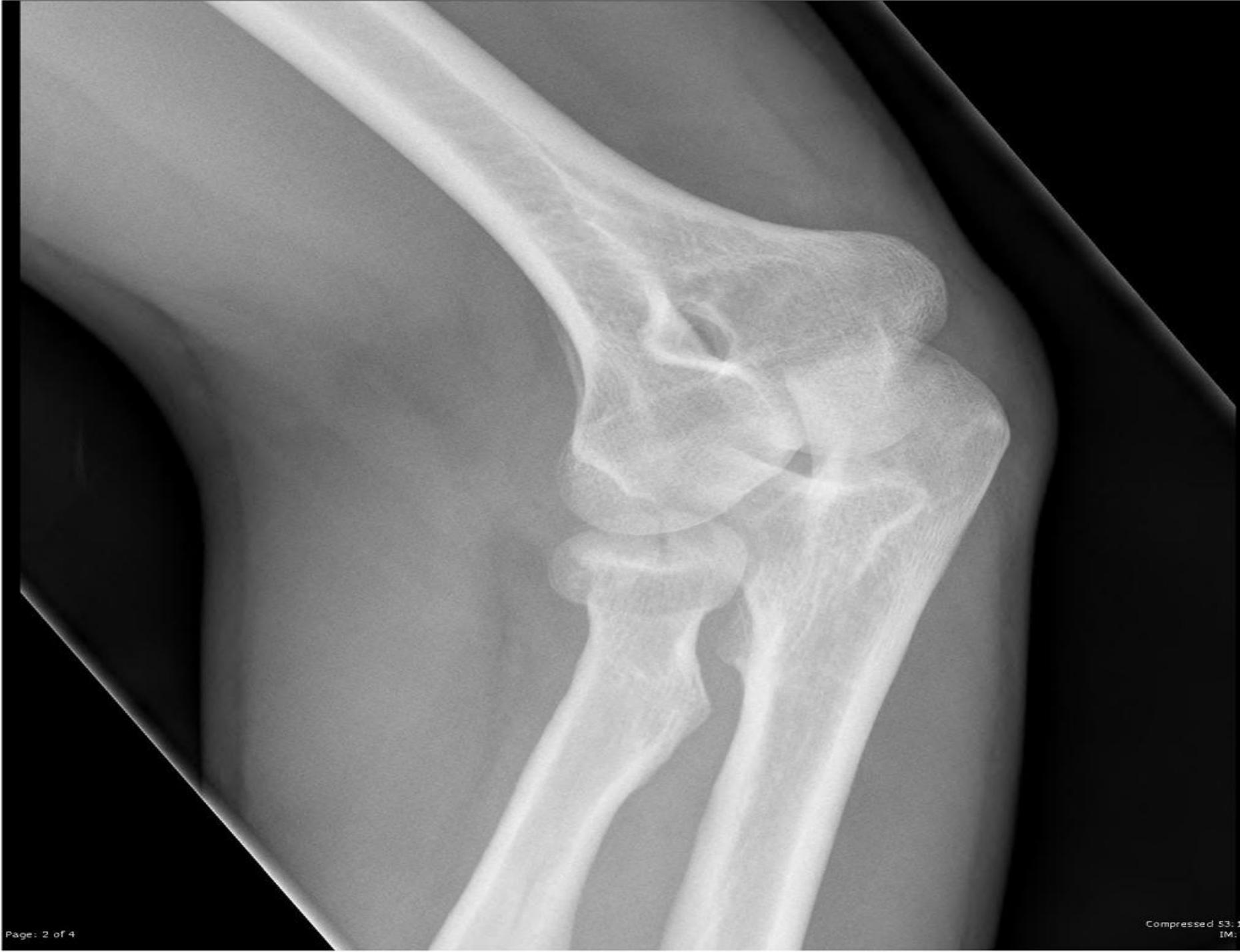
The radial head and neck fractures:

Together are the most common elbow fracture in adults, resulting from a fall on an abducted arm with minimal or moderate flexion of the elbow joint. Trauma evaluation should begin with radiographs but may be supplemented with CT or MRI.

Radial head fractures can be subtle and easily missed on radiographs. It is important to assess the radiograph for a joint effusion and where one exists, to take extra care in the assessment of the radial head. Even when a fracture cannot be identified, the presence of joint effusion in adults should be treated as a non-displaced radial head fracture.



There is a mildly displaced intra-articular fracture of the radial head, with a ~2mm articular step-off. **Joint effusion noted.**



Oblique

Practical points in radial head fx

In addition to reporting the presence of a radial fracture a number of specific features should be sought +/- commented upon:

- fracture

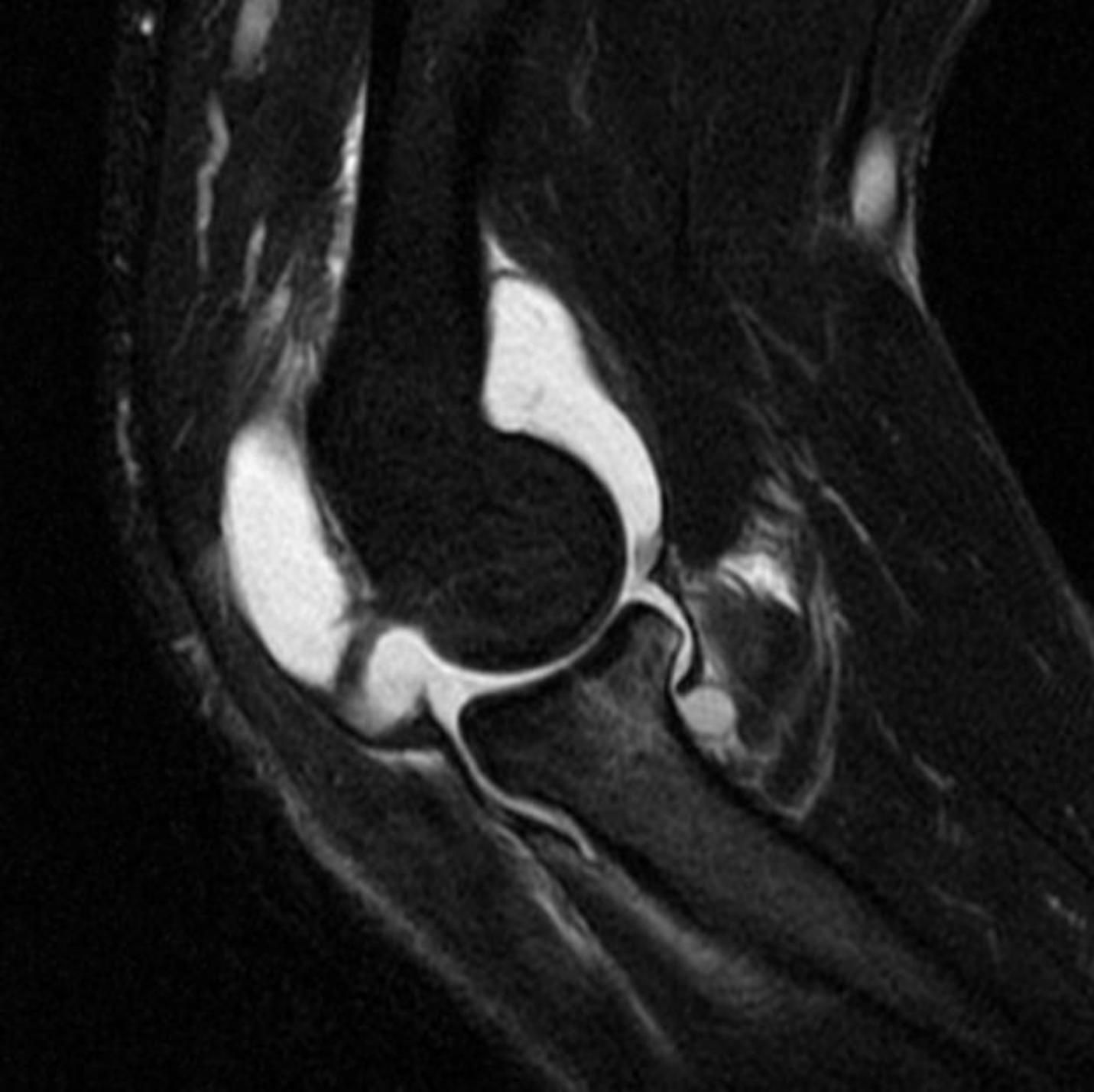
- location
- involvement of the articular surface
- articular step-off/gap
- comminution
- displacement and impaction

- associated injuries

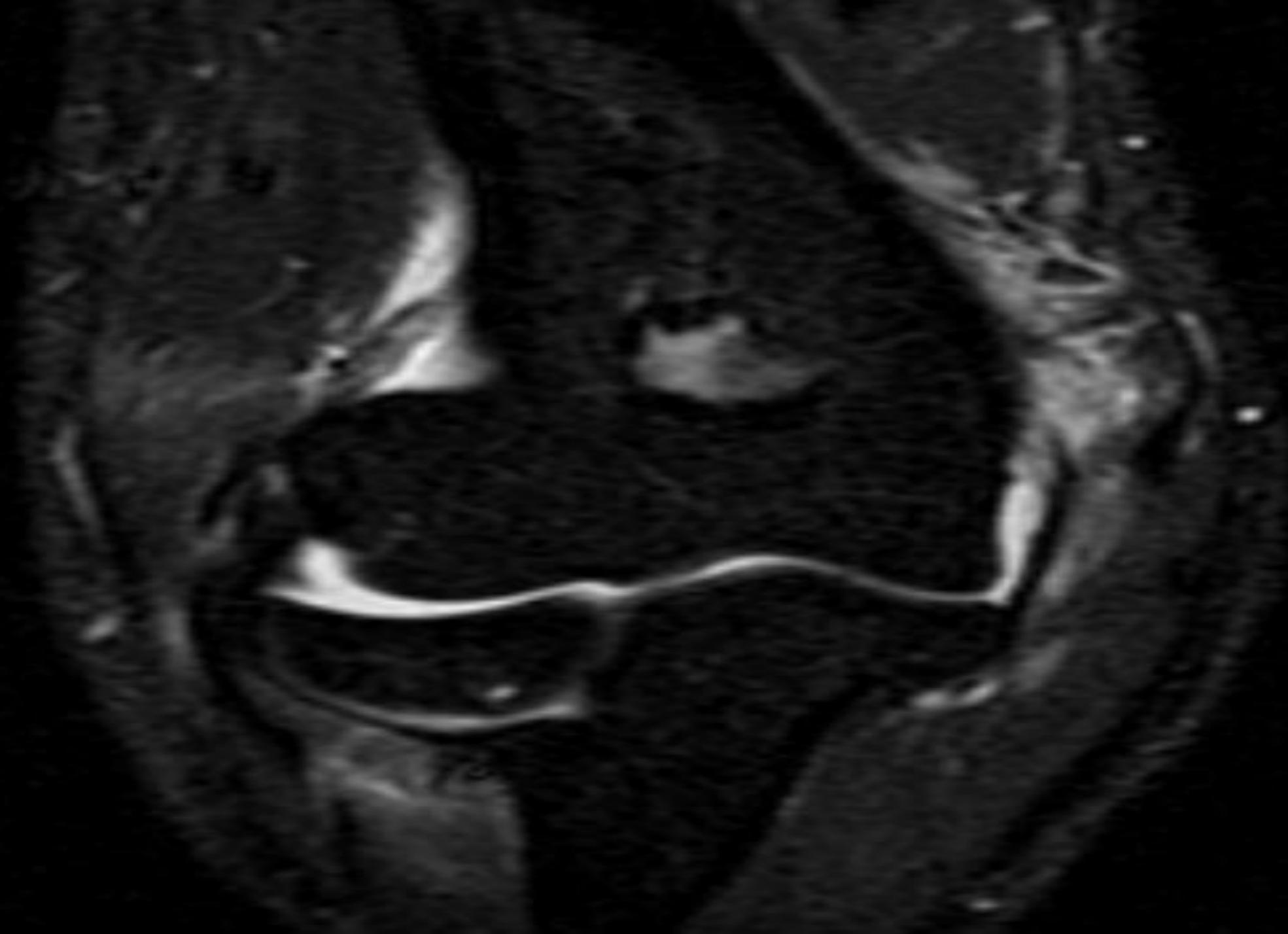
- evaluate rest of elbow for
 - coronoid process fractures
 - capitulum osteochondral injuries
 - elbow dislocations
 - [olecranon fracture](#)
 - ligamentous injury (widening of joint space due to medial collateral tear)

- evaluate wrist

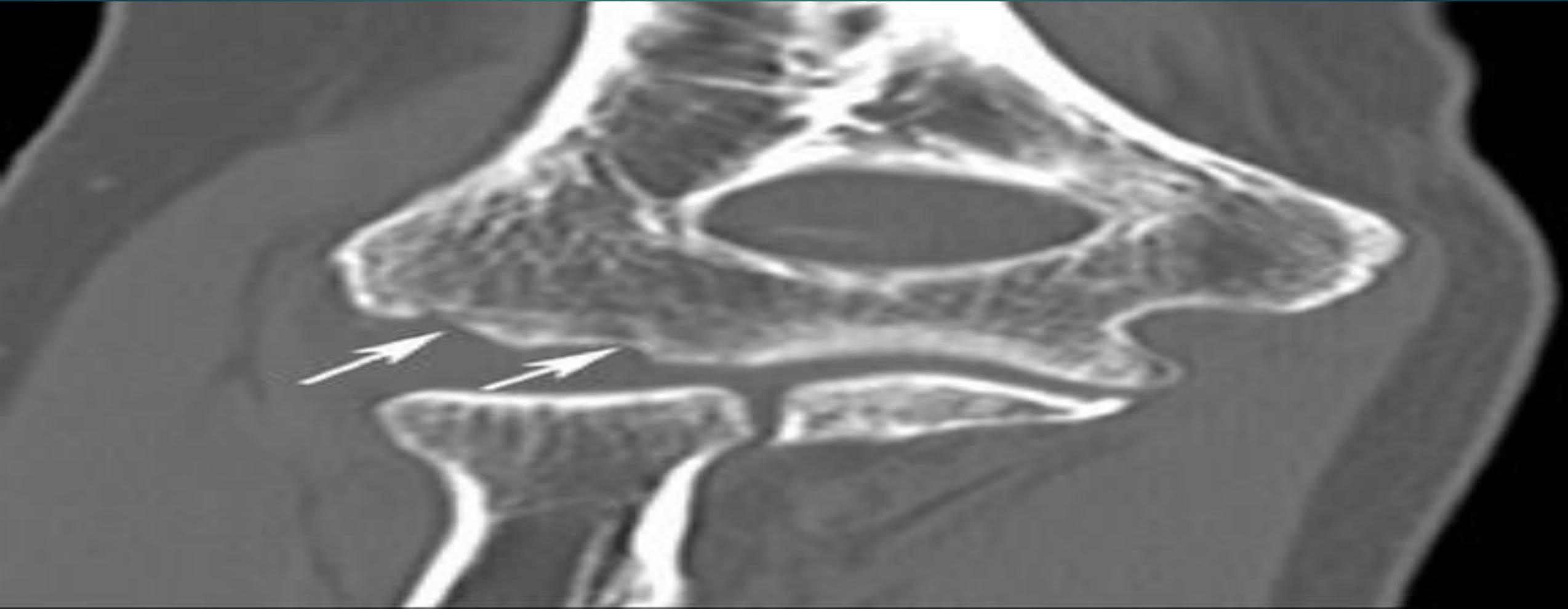
- wrist x-rays should be obtained if any clinical suspicion exists or where assessment is difficult to assess for the presence of [Essex-Lopresti fracture-dislocation](#)



Non-displaced [radial head fracture](#) affecting about one third of the joint surface. [Hemarthrosis](#) and partial rupture of the ulnar collateral ligament also are noted



The capitellum is less commonly injured than the radial head. Fractures often occur from valgus force, with impaction of the radial head against the capitellum (Figure 5)



In adults, dislocations of the elbow are second only to those of the shoulder in frequency. In children, it is the most common dislocation. Simple posterior elbow dislocations usually result in complete disruption of all of the capsuloligamentous structures, with variable adjacent muscular injury.²⁷ Persistent instability after closed reduction of a simple dislocation may be secondary to soft tissue interposition or entrapment of an intra-articular chondral or osteochondral fragment.²⁷ MRI and MR arthrography may assist in diagnosis in these circumstances. Fracture-dislocations take various forms in the elbow and forearm

. The **Monteggia** fracture-dislocation is composed of a fracture of the proximal ulnar and a dislocation of the radial head.



Tendons

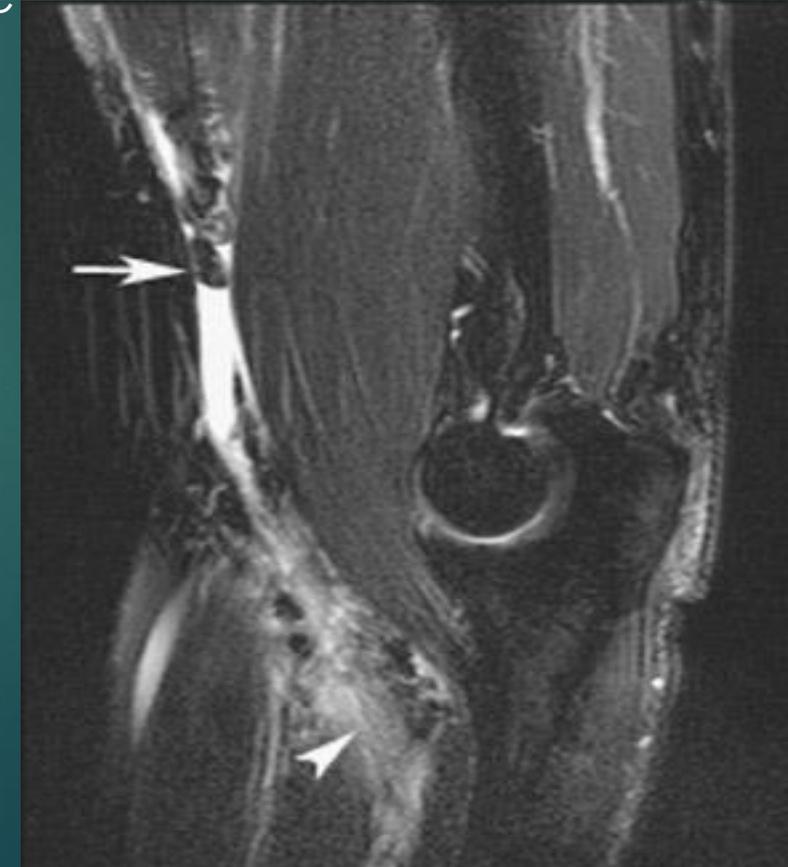
Biceps tendon

Radiographs may exhibit irregularity of the radial tuberosity in chronic biceps tendon injuries, obliteration of the supinator fat stripe, or, rarely, acute avulsion fractures.

MR imaging is ideally suited to evaluate **injuries of the biceps tendon**. **T2-weighted**, gradient-echo, or short tau inversion recovery (**STIR**) images are best for showing the high signal abnormality of hemorrhage as well as the inflammation and fluid seen against the normal low signal intensity of the tendon.

The distal biceps tendon is the most commonly injured tendon in the elbow. Ruptures of the biceps tendon

Proximal biceps tendon injuries account for about 96% of all biceps injuries



LS BICEPS



RADIUS

DISTAL >>

ASYMPTOMATIC BICEPS



DISTAL >>

Proximal biceps tendon injury

usually affect the [long head biceps tendon](#)

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Associations

Proximal biceps tendon injuries are associated with other shoulder pathologies including:

[SLAP lesions](#)

[biceps pulley injuries](#)

[massive rotator cuff tears](#)

Location

The most common sites of proximal biceps tendon injury are ¹:

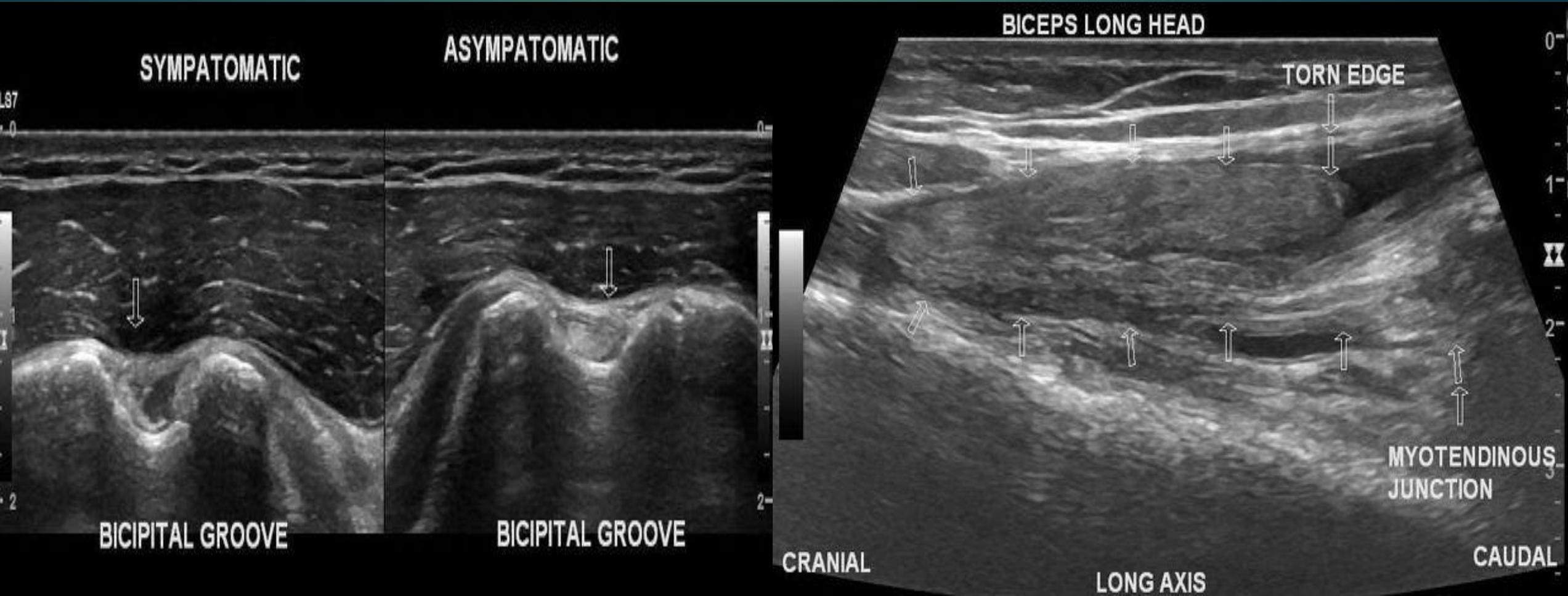
tendon origin **at the superior glenoid labrum**

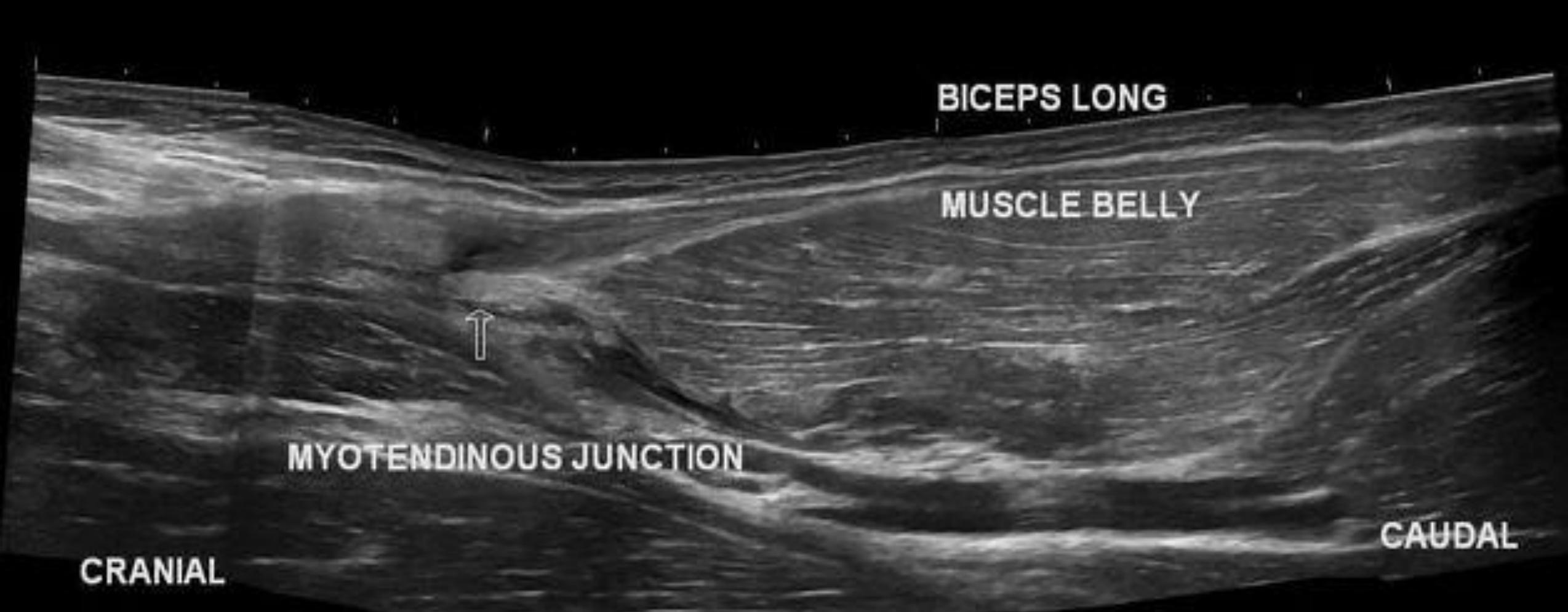
the **musculotendinous junction** at the exit of the bicipital groove

MRI

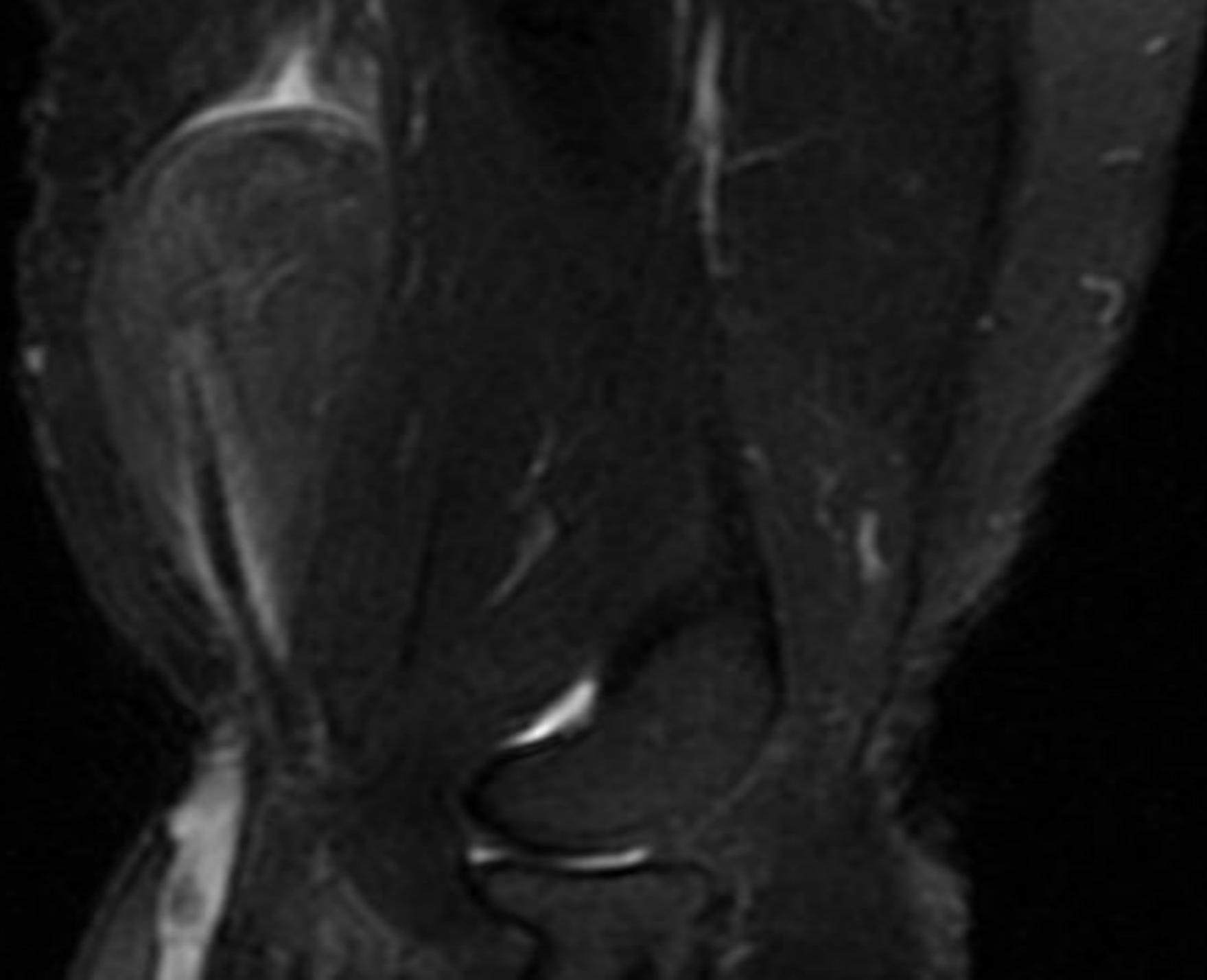
Features that can help diagnose proximal biceps tendon ruptures include:

- absence of the tendon or tendon retraction
- fluid-filled tendon sheath
- muscle edema: non-specific
- muscle atrophy: non-specific





There is **absent long head of bicipital tendon in bicipital groove** as well as cranial to groove level. There is **sagging of myotendinous junction of long head biceps**. **Torn end of long head biceps tendon** is present in anterior mid arm level. The long tendon is folded upon itself



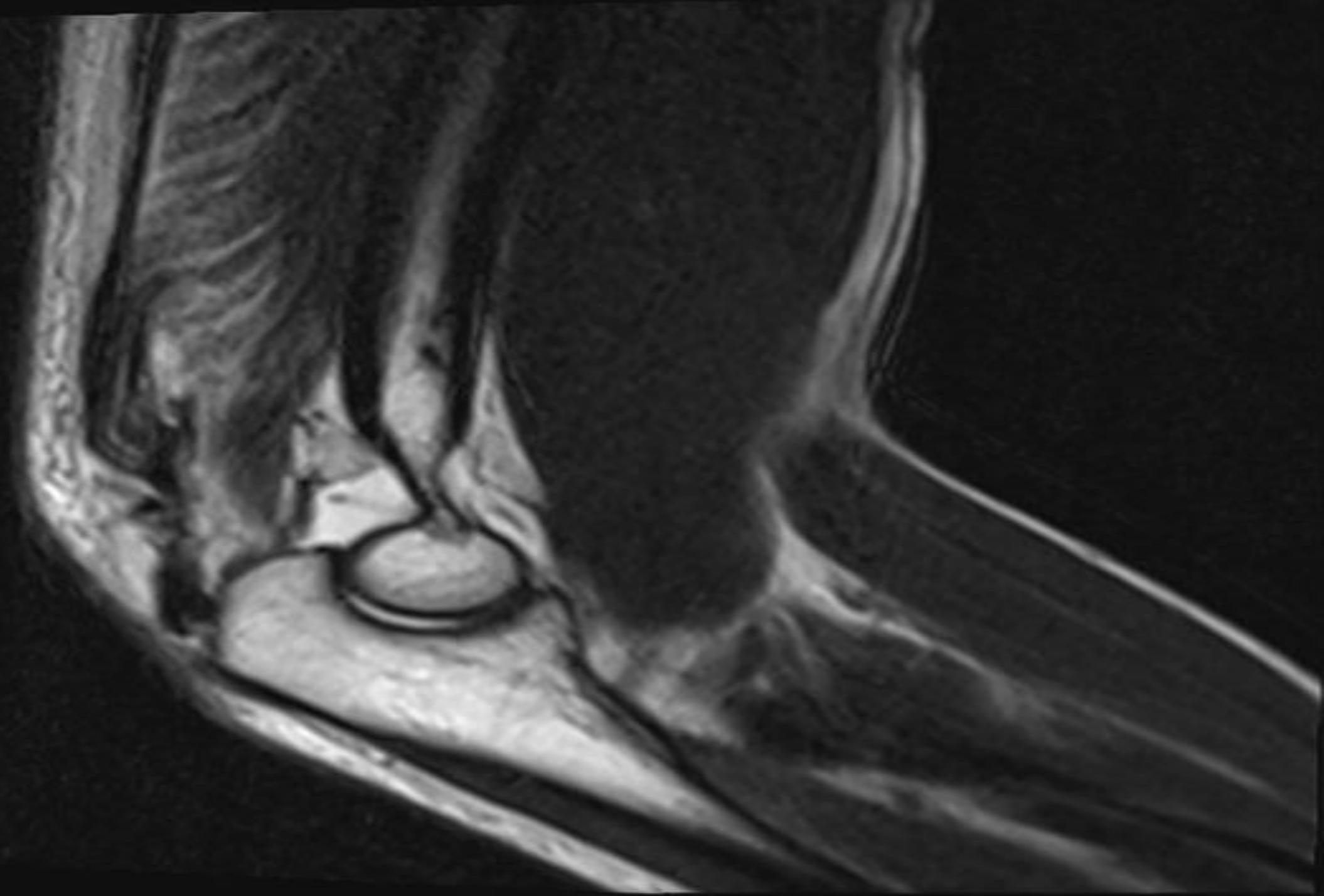
Triceps tendon

Although inflammation of the triceps is fairly common, **ruptures** of the triceps tendon are **rare**



Plain film

Non specific but may show an appearance of a "flake sign" or "fleck sign" on a lateral radiograph

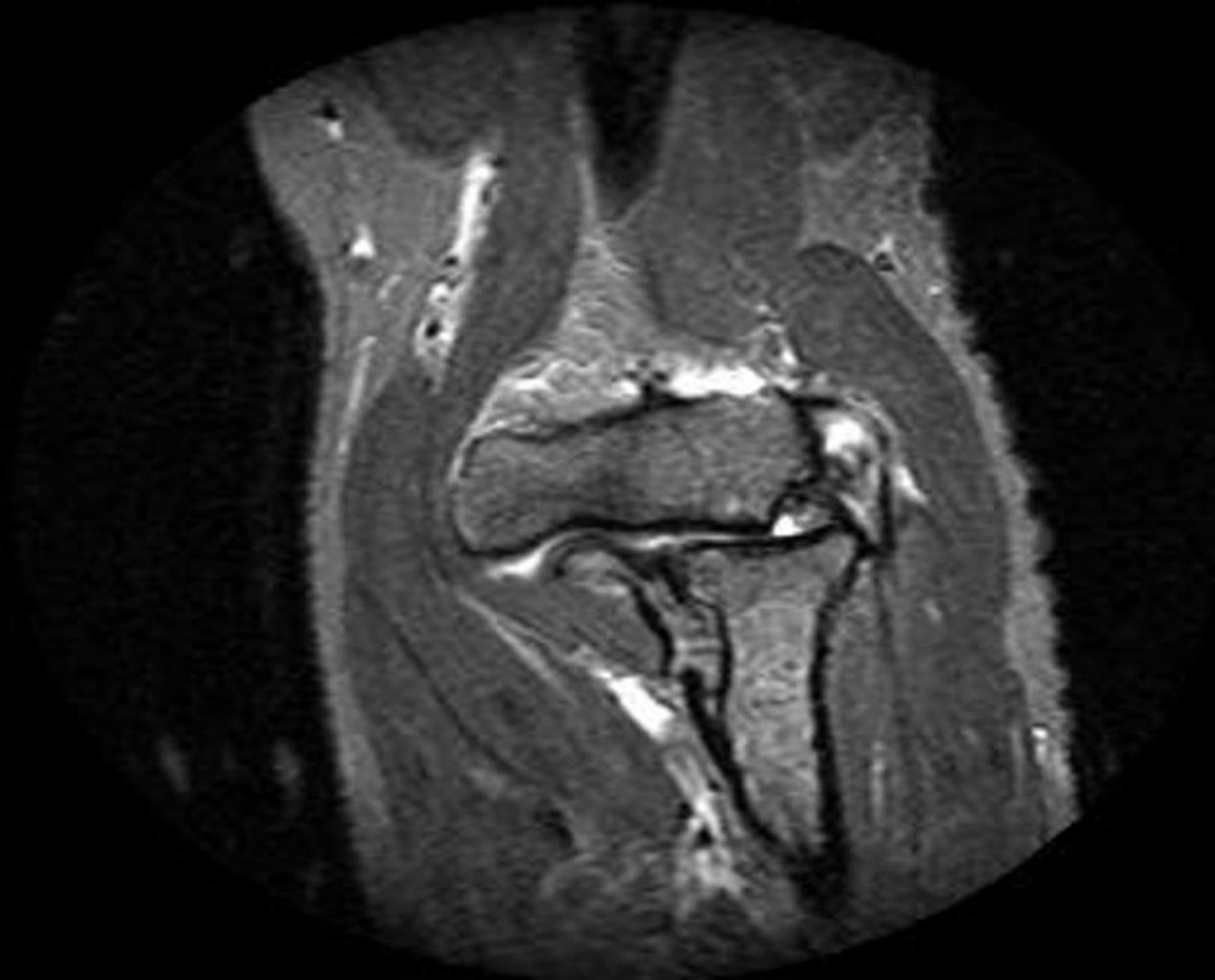


Common extensor and flexor tendons

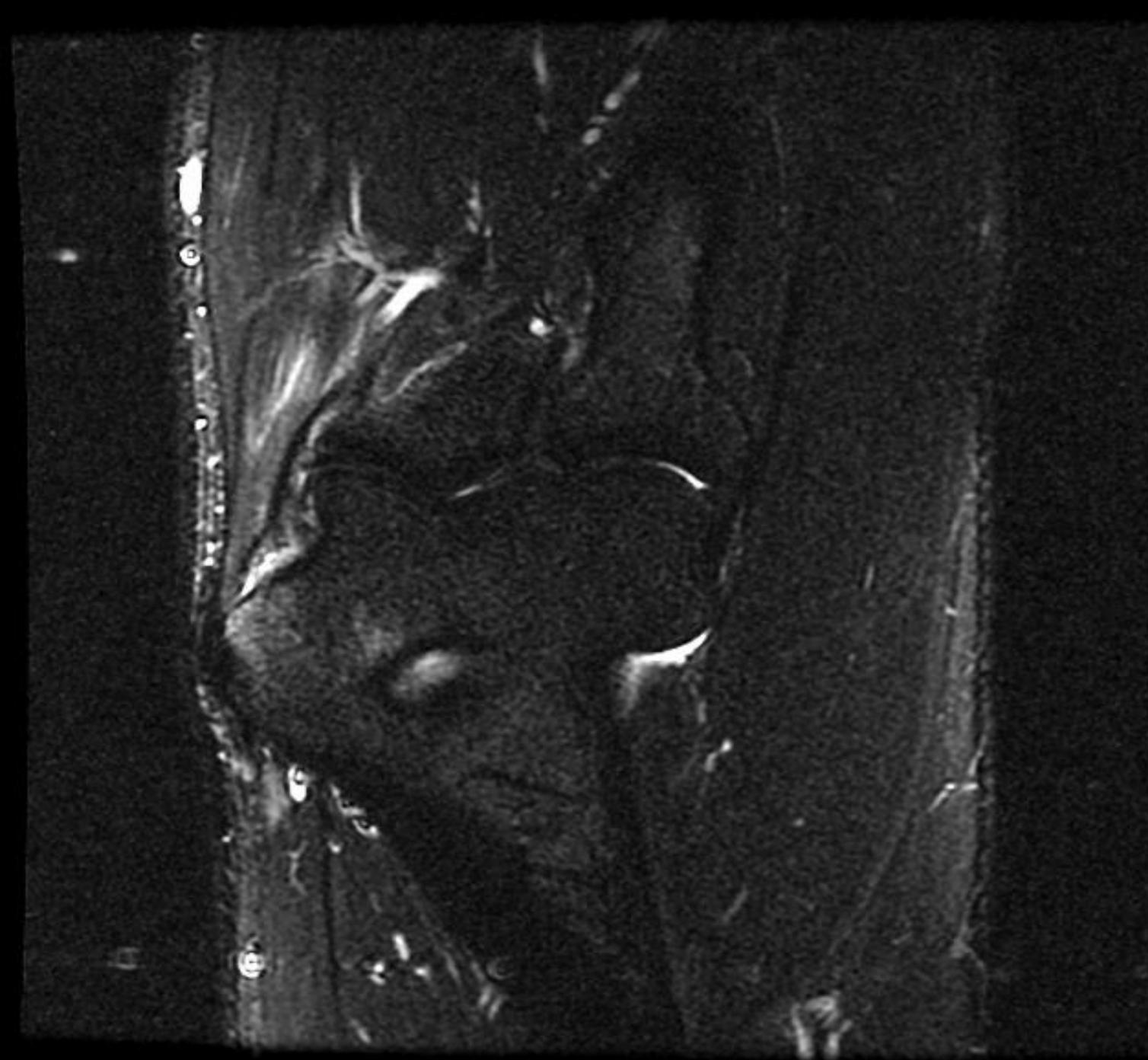
Tendinopathy or tears of the common extensor and flexor tendons can be evaluated with MRI or sonography. Typically, imaging studies are not performed unless the patient has failed conservative treatment.

1. In patients with lateral tennis elbow, the primary site of involvement is the common extensor tendon origin. MRI reveals thickening and intermediate signal within the tendon origin in cases of tendinopathy. Partial tears are depicted by thinning or partial disruption of the tendon, and increased T2W signal within and adjacent to the tendon origin. Complete rupture of the tendons will lead to a tendinous gap containing fluid signal, and distal retraction of the involved muscle(s). Dystrophic calcifications can arise adjacent to the lateral epicondyle and are best depicted on gradient-echo images. Lateral epicondylitis is evident as a focal hypoechoic area in the deep part of the tendon or a discrete cleavage plane with sonographic evaluation.

2. Injuries to the common flexor tendon origin (golfer's elbow or medial tennis elbow) are less common than injuries of the common extensor tendon origin. Common flexor tendon injury occurs at the origins of the flexors and pronator teres. This syndrome occurs in 1% to 3% of adults who are 35 to 55 years of age, and it is often seen in golfers, high-performance throwers, swimmers, racketball and squash players, and bowlers. MR arthrography has been advocated for the detection of partial tears. The diagnosis of partial tears is critical to throwing athletes, because these patients will likely undergo surgery.



Partial thickness
tear of the
common
extensor
tendons with
small fluid filled
gap.



hyperintense signals are seen at the medial epicondyle and extending along the common flexor tendon fibers



