Elbow Ultrasonography step by step

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Learning objectives

The purpose is to describe the elbow scanning technique step by step, with didactic schemes and illustrations.

Normal US anatomy will be reviewed and a checklist protocol will be proposed.

Background

Ultrasonography has become an important imaging modality to evaluate pathologic conditions of the elbow, with the advantages of good spatial resolution, clinical correlation and dynamic assessment of disease, contralateral comparison and the ability to guide interventions.

US of the elbow is usualy directed to the clinical suspition or area of symptoms. However, a complete evaluation of the joint should always be considered. The most common approach #is to divide the elbow into anterior, lateral, medial, and posterior compartments (Fig. 1 on page 3).

Elbow compartment	Important structures
Anterior	Anterior joint recess Brachialis muscle Biceps muscle and tendon Median nerve
Lateral	Radiocapitellar joint Annular recess Common extensor tendon Lateral collateral ligamentous complex Radial nerve (including deep motor branch)
Medial	Common flexor tendon Ulnar collateral ligament (anterior band)
Posterior	Distal triceps muscle and tendon Posterior joint recess Olecranon bursa Ulnar nerve

Fig. 1: Elbow compartments and the most important structures to be evaluated. Adapted from...
References: - Coimbra/PT

Images for this section:

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Fig. 1: Elbow compartments and the most important structures to be evaluated. Adapted from...

Findings and procedure details

TECHNIQUE

The patient must be seated with the elbow placed on an examination table, or with the patient supine. A highfrequency linear transducer (12-17 MHz) should be used.

Careful scanning technique is critical to avoid anisotropy due to the curvilinear contours of the elbow joint. To avoid this pitfall, the transducer may be gently placed along the long axis of the tendon or ligament in question; if the hypoechogenicity persists, an abnormality is present.

In some cases, scanning the contralateral elbow can be useful to compare the pathologic elbow with the normal one.

The evaluation of the elbow articulation can be divided into four compartments that will be described step by step: anterior, lateral, medial and posterior (Fig. 1 on page 38).

ANTERIOR ELBOW

The anterior elbow is examined with extension and supination of the forearm. Full elbow extension can be obtained by placing a pillow under the joint (Fig. 2 on page 38).

Fig. 2
References: - Coimbra/PT

The key structures that should be evaluated are: anterior joint recess, brachialis muscle, biceps brachii muscle and median nerve, 5cm proximal and 5cm distal to the joint.

Anterior joint recess

The anterior joint recess should be evaluated in both longitudinal and transverse planes (Fig. 3 on page 40).

Fig. 3
References: - Coimbra/PT

The coronoid fossa corresponds to a concavity of the anterior surface of the humerus filled with the anterior fat pad (Fig. 4 on page 28 , Fig. 5 on page 29). A small amount of normal fluid may be seen between the fat pad and the humerus. Normal elbow bursae are not routinely visualized at US.

The radiocapitellar and ulnotrochlear joints are best scanned in the longitudinal plane (Fig. 4 on page 28).

Hyaline cartilage is hypoecoic and covers the hyperechoic subchondral bone plate of the articular surface (Fig. 6 on page 30). Hyaline cartilage is covered by a thin hyperechoic line which represents the anterior joint capsule (2 mm in average in the adult population).

Biceps and brachialis muscles

Proximal US images of the supracondylar region reveal the superficial biceps and the deep brachialis muscles. They should be imaged from 5cm above to 5cm below the elbow joint (Fig. 7 on page 40).

Fig. 7
References: - Coimbra/PT

Medial to these muscles, are the brachial artery and the median nerve: the nerve lies medially to the artery (Fig. 8 on page 30).

The brachialis can be evaluated in the transverse and longitudinal planes to its insertion on the proximal ulna. The short brachialis tendon can be followed on long-axis planes down to its insertion on the coronoid process (Fig. 9 on page 31).

The distal biceps tendon (DTB) is best evaluated with the patient's forearm in maximal supination to permit the visualization of its insertion in the radial tuberosity (Fig. 10 on page 32).

Persistent division of the short and long heads of the DBT is an important anatomic variant to be aware of to avoid incorrect diagnosis as a DBT partial tear.

US of the distal biceps tendon can be challenging due to its oblique course and it is best evaluated in the transverse plane with the transducer slightly inferolaterally, maintaining the probe parallel to the tendon to avoid anisotropy that may result in misdiagnosis a tear or tendinosis. Evaluating the abnormality with various degrees of elbow flexion and extension may also help.

Another technique is to press the distal half of the probe against the patient's skin to ensure 90° incidence between the US beam and the distal biceps tendon, thus allowing adequate visualization of its fibrillar pattern (Fig. 10 on page 32).

Median nerve

The median nerve is located medial to the brachial artery and can be followed distally in the forearm. The median nerve has a characteristic speckled appearance in the short axis due to the hypoechoic nerve fascicles and intervening hyperechoic epineurium.

LATERAL ELBOW

The lateral elbow is examined with the forearm extended (Fig. 11 on page 41) and posteriorly with flexion and the arm in internal rotation (Fig. 12 on page 42).

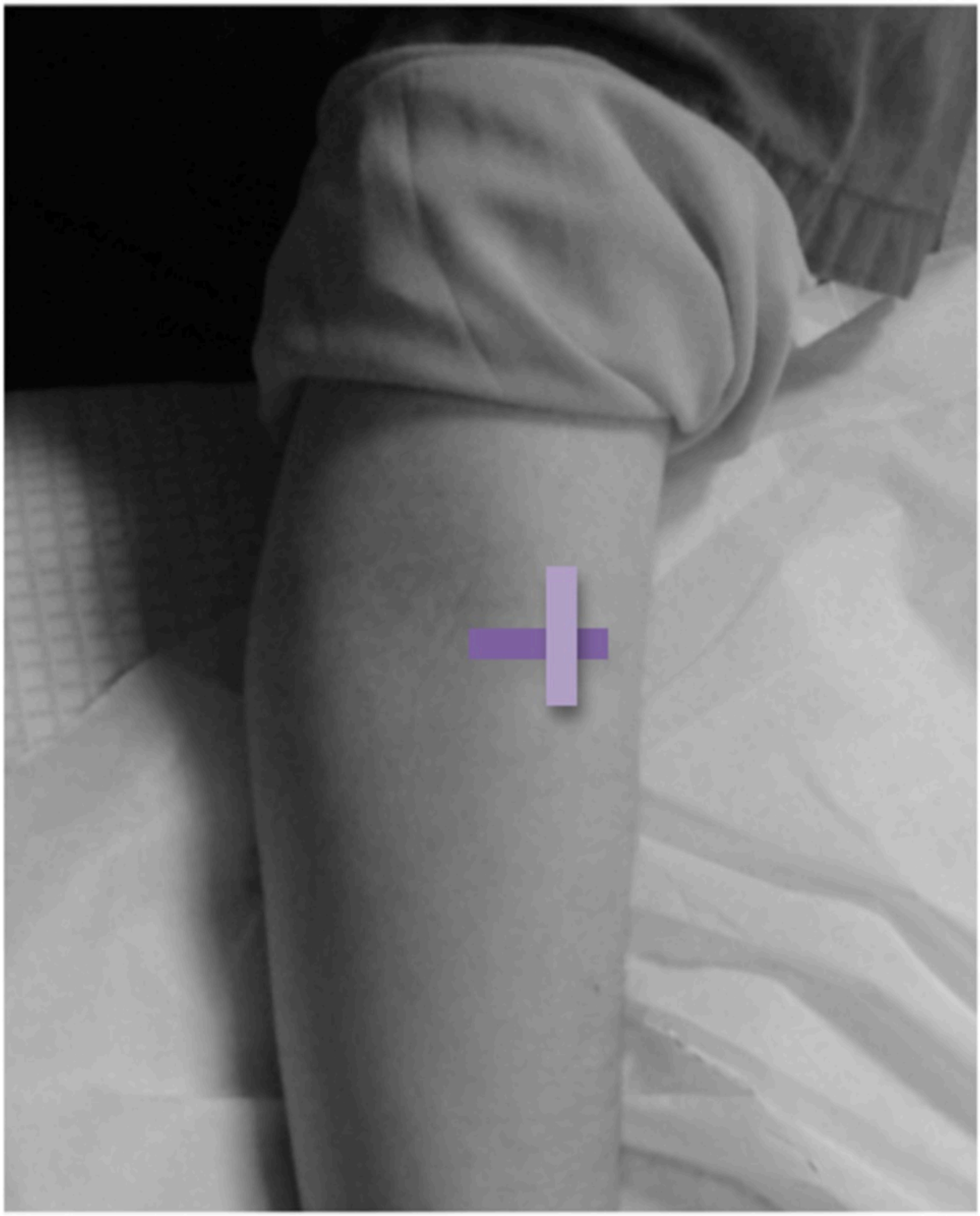

Fig. 11
References: - Coimbra/PT

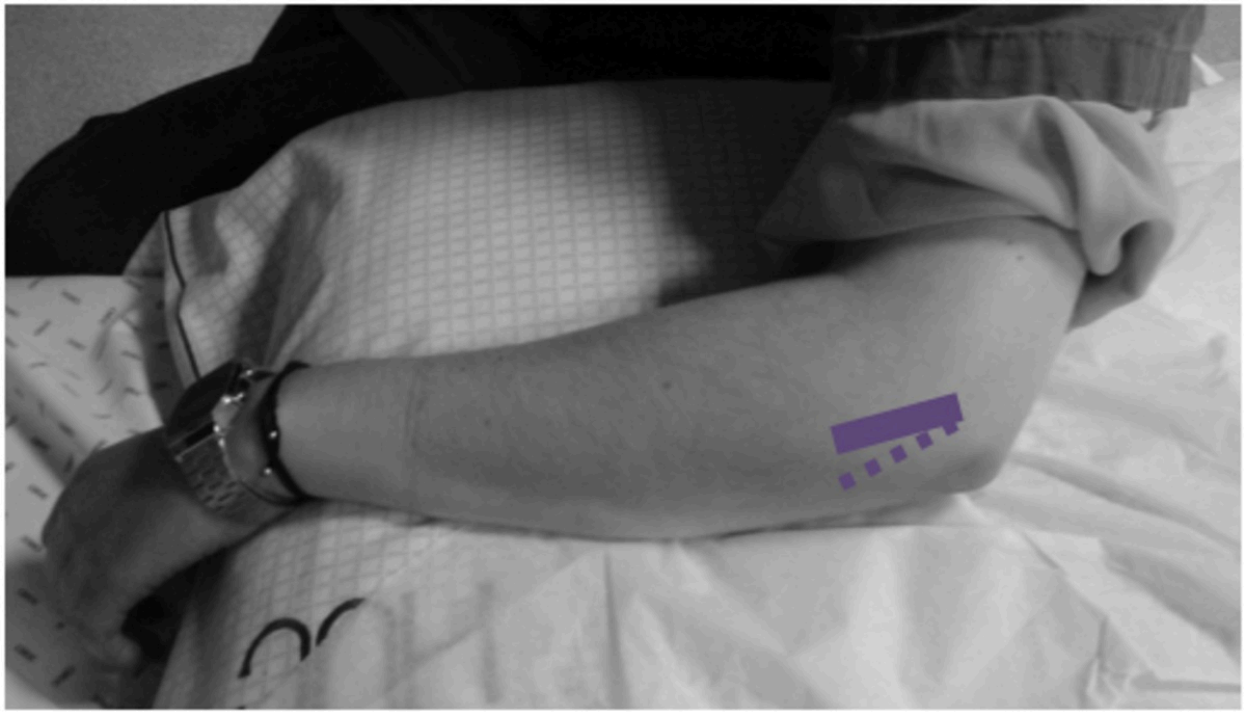

Fig. 12
References: - Coimbra/PT

The key structures that should be evaluated are: radiocapitellar joint, annular recess, common extensor tendon, lateral collateral ligamentous complex, and radial nerve (including its deep motor branch).

Radiocapitellar joint

The evaluation must be started in the longitudinal plane to scan the articulation of the radial head with the capitellum (Fig. 13 on page 32 , Fig. 14 on page 33).

Annular recess

Dynamic imaging during passive pronation and supination of the forearm may help to assess the status of the radial head and the annular ligament (Fig. 14 on page 33). The annular recess is visible only if distended by fluid.

Common extensor tendon

With the cranial edge of the transducer on the lateral epicondyle (which is proximal to the radiocapitellar joint) and slightly oblique to the long axis of the upper extremity (Fig. 12 on page 42), the common extensor tendon origin may be visualized (typically hyperechoic and fibrillar) (Fig. 15 on page 34). It must be evaluated from the hyperechoic triangular origin at the anterior aspect of the lateral epicondyle and lateral supracondylar ridge to its myotendinous junction. Transverse planes should also be obtained over the tendon insertion.

Lateral collateral ligamentous complex

The lateral collateral ligamentous complex is composed by the right collateral ligament (RCL), annular ligament (AL), and lateral ulnar collateral ligament (LUCL). The RCL originates from the inferior lateral epicondyle and inserts on the radius where it blends with the fibers of the annular ligament. (Fig. 16 on page 43).

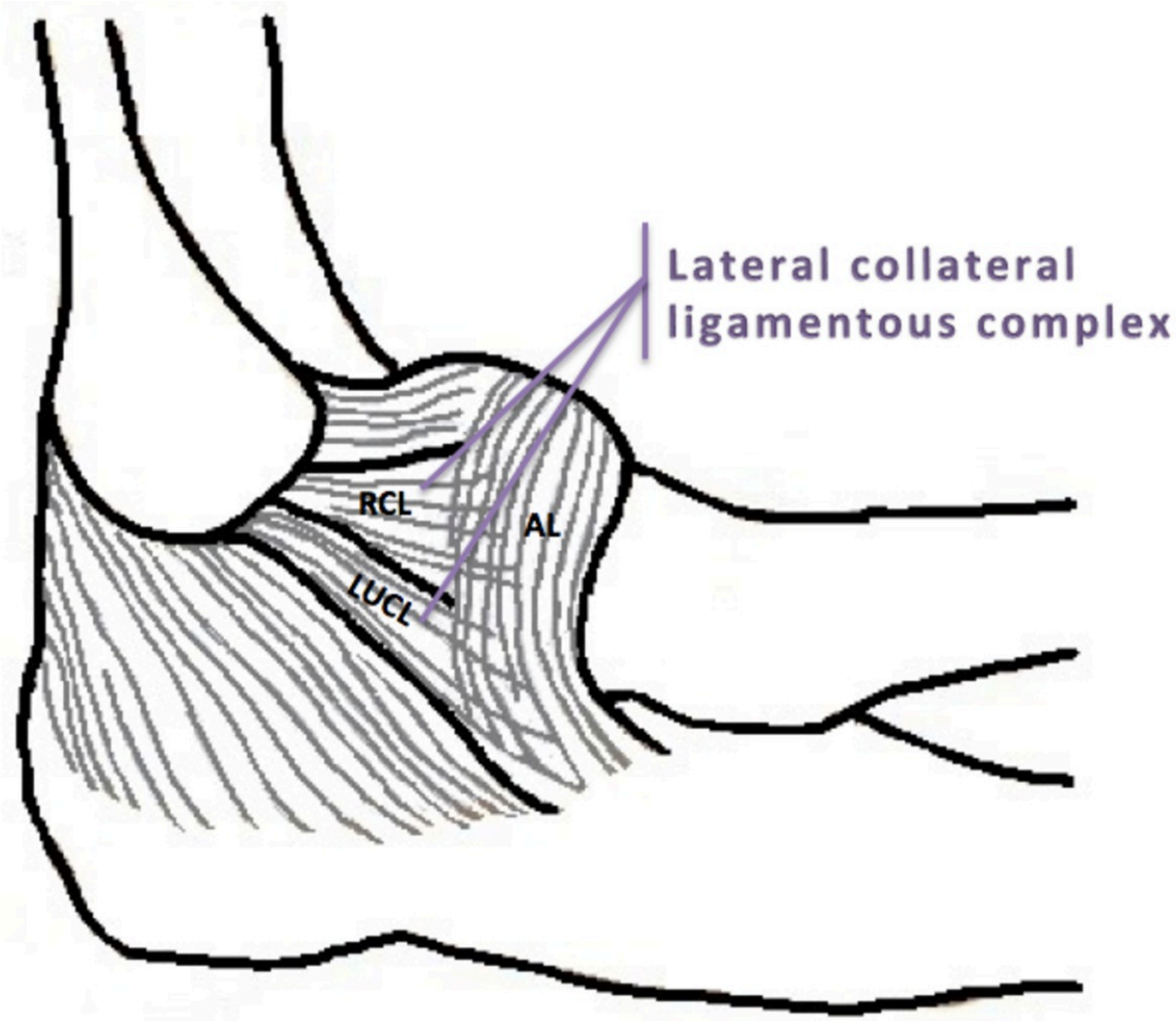

Fig. 16
References: - Coimbra/PT

The LUCL originates posterior to the RCL in the lateral epicondyle and inserts on the supinator crest of the proximal ulna and is best evaluated with the transducer placed over the proximal RCL and angled posteriorly toward the ulna (Fig. 12 on page 42 , Fig. 17 on page 34).

Radial nerve

The radial nerve may be identified over the posterior aspect of the humeral diaphysis, coursing medially to lateral. At the level of the proximal elbow, the radial nerve is located between the brachioradialis and brachialis muscles and it can be followed to its bifurcation

into a superficial sensory branch and a deep motor branch. The posterior interosseous nerve (PIN) must be imaged using transverse planes (Fig. 18 on page 44) as it enters the arcade of Frohse passing between the superficial and deep parts of the supinator muscle (Fig. 19 on page 34).

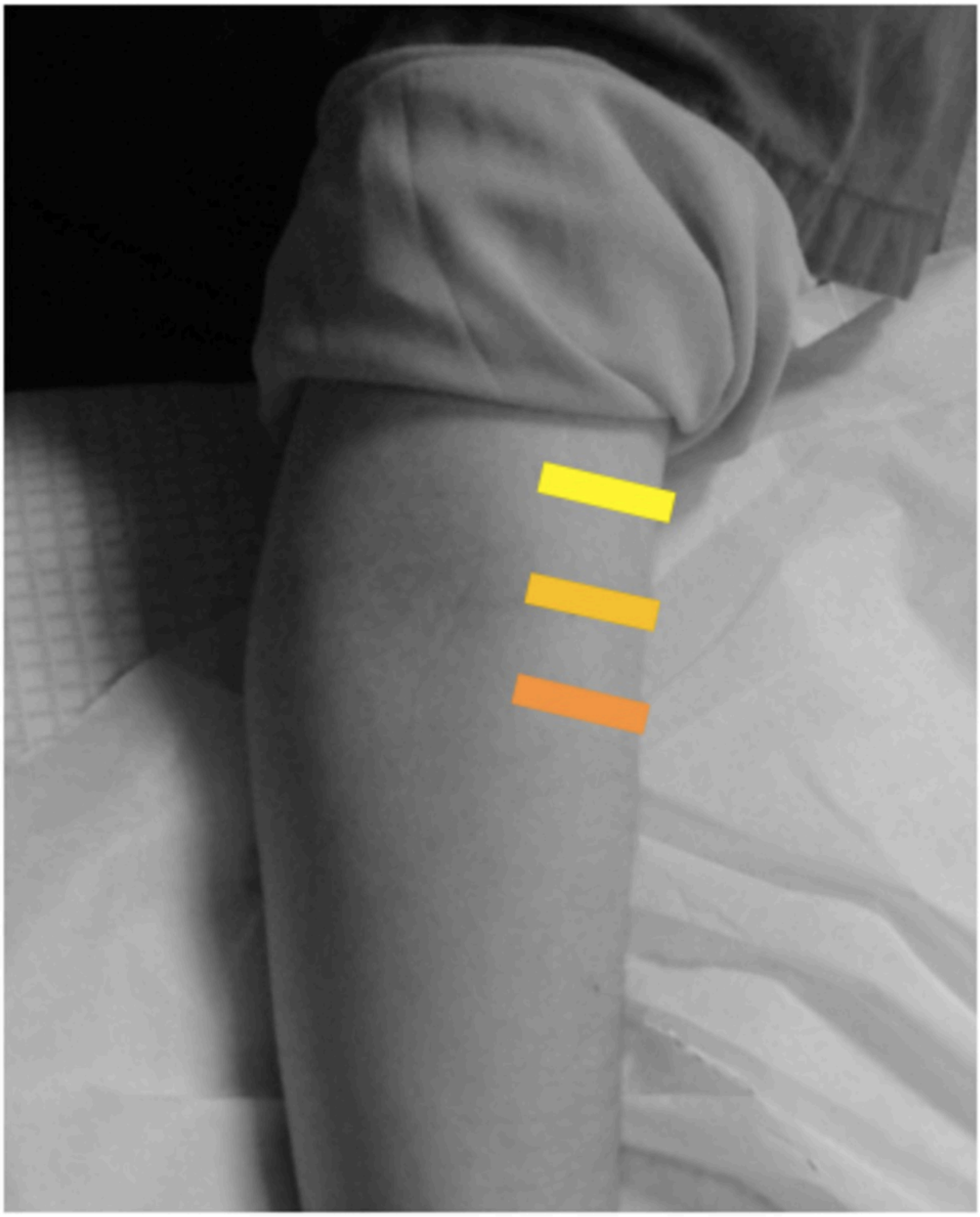

Fig. 18
References: - Coimbra/PT

The superficial sensory branch courses in the forearm anterior to the brachioradialis muscle.

To improve evaluation of the PIN, passive pronation and supination of the forearm may be performed while sweeping the probe over the supinator muscle.

MEDIAL ELBOW

The medial elbow is examined with the forearm in forceful external rotation and extension (Fig. 20 on page 45) or slight flexion, resting on a table.

The key structures that should be evaluated are: common flexor tendon and the anterior band of the ulnar collateral ligament.

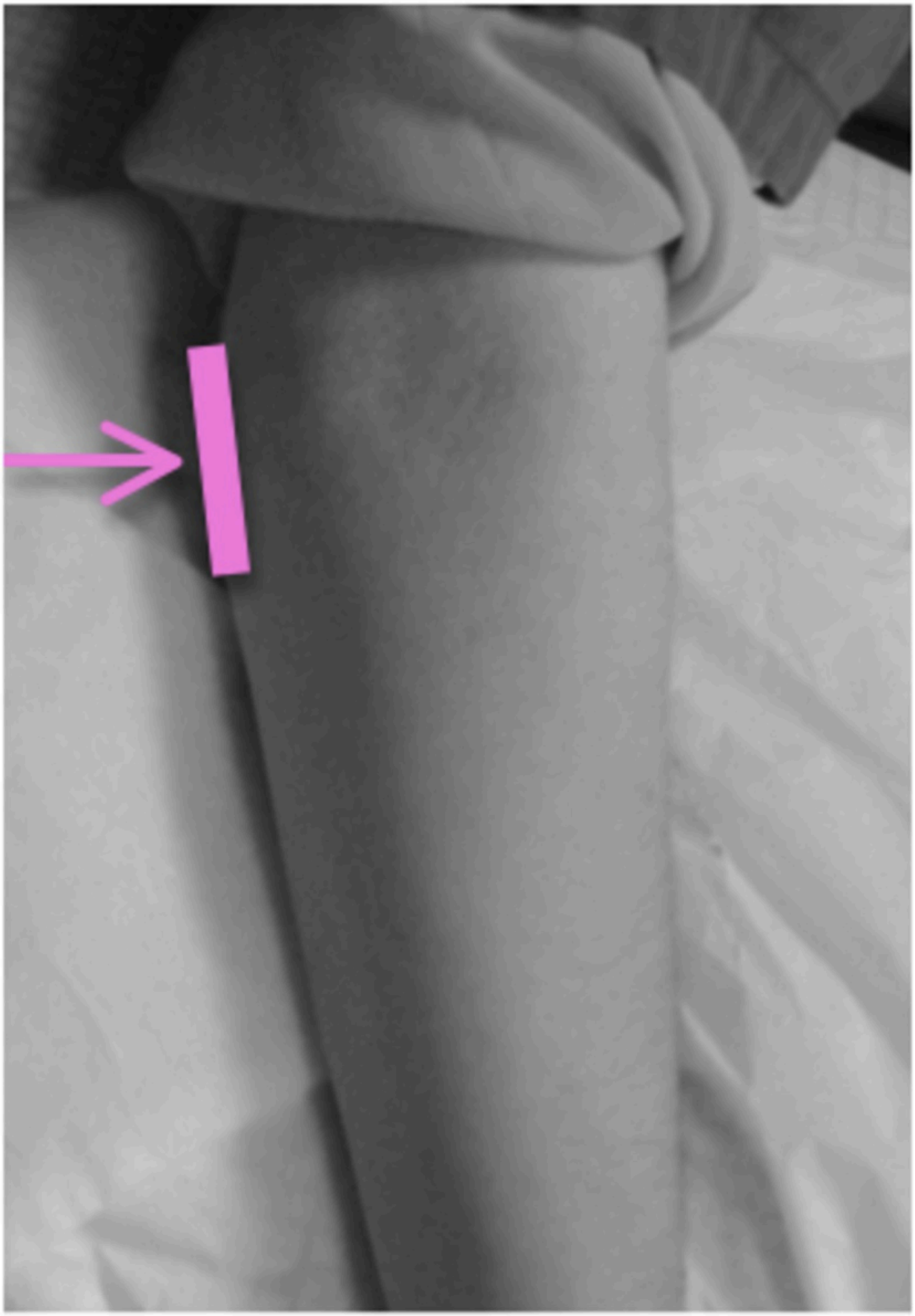

Fig. 20
References: - Coimbra/PT

Common flexor tendon

The examination begins in the longitudinal plane with its cranial aspect over the medial epicondyle to image the medial epicondyle and ulnotrochlear joint (Fig. 20 on page 45). Further assessment with transverse planes is performed if any abnormality is detected.

The origin of the common flexor-pronator mass is hyperechoic and fibrillar, siminar to that of the common extensor tendon but shorter and larger (Fig. 21 on page 35).

Anterior band of the ulnar collateral ligament

The ulnar collateral ligament (UCL) is composed by three bands/bundles (anterior, posterior and transverse) (Fig. 22 on page 47).

Fig. 22
References: - Coimbra/PT

The anterior bundle can be divided into two bands (anterior and posterior) and is the most important and the one that should be evaluated more attention. It is deep to the common flexor tendon and presents as hyperechoic, thin and fibrillar (Fig. 21 on page 35). UCL is originated in the anteroinferior aspect of the medial epicondyle and inserts on the tubercle of the coronoid process of the ulna.

Dynamic imaging in valgus stress may be useful to demonstrate partial tears.

Posterior Elbow

The posterior elbow is examined with the joint in 90° of flexion, the forearm fully pronated (internally rotated), and the palm resting on a table ("crab" position) (Fig. 23 on page

47). Alternatively, to evaluate the ulnar nerve, the patient may be supine with the arm abducted, flexed, and internally rotated.

The key structures that should be evaluated are: distal triceps muscle and tendon, posterior joint recess, olecranon bursa, and ulnar nerve.

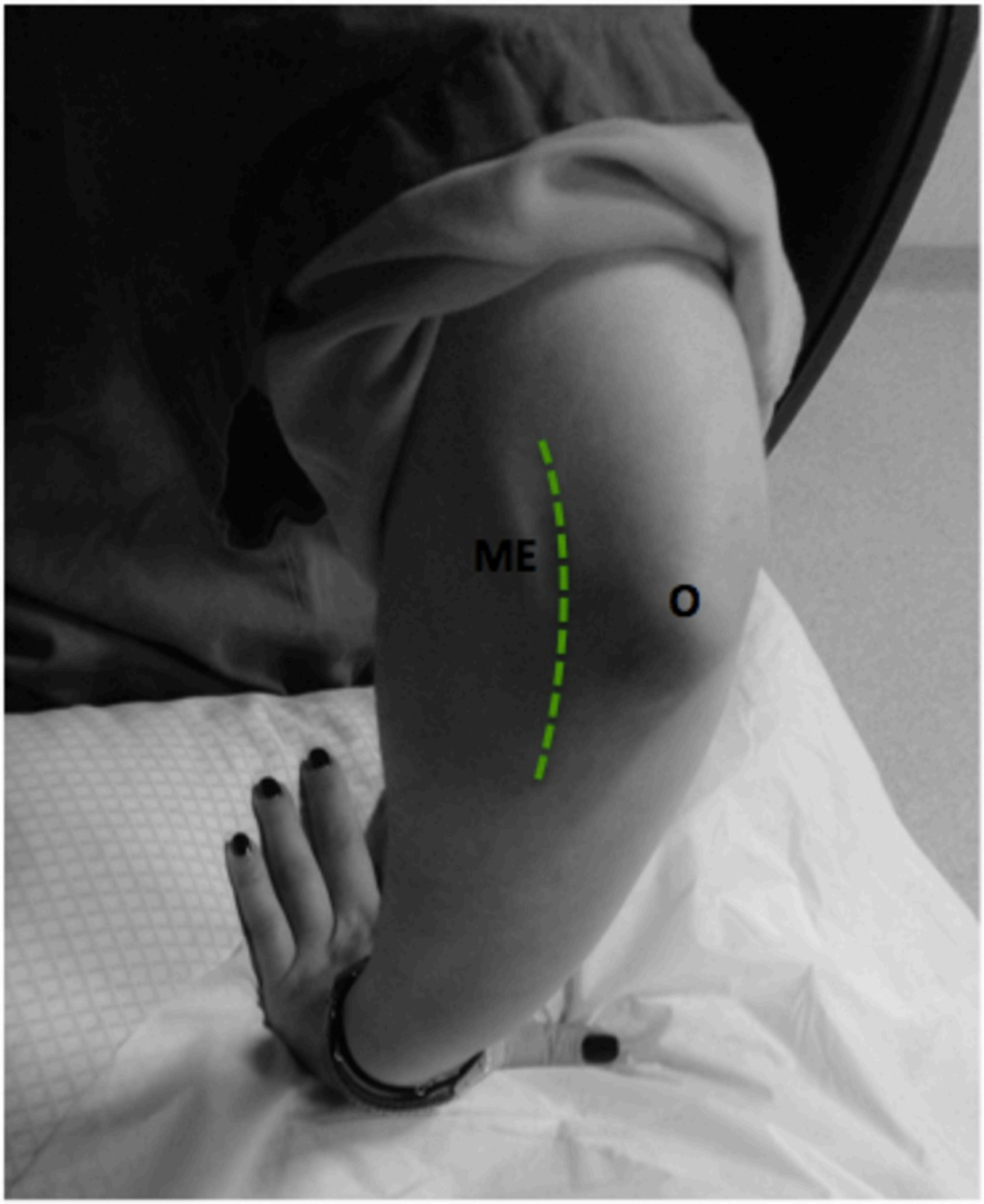

Fig. 23
References: - Coimbra/PT

Distal triceps muscle and tendon

The evaluation starts in the longitudinal plane over the proximal elbow posteriorly (Fig. 24 on page 48).

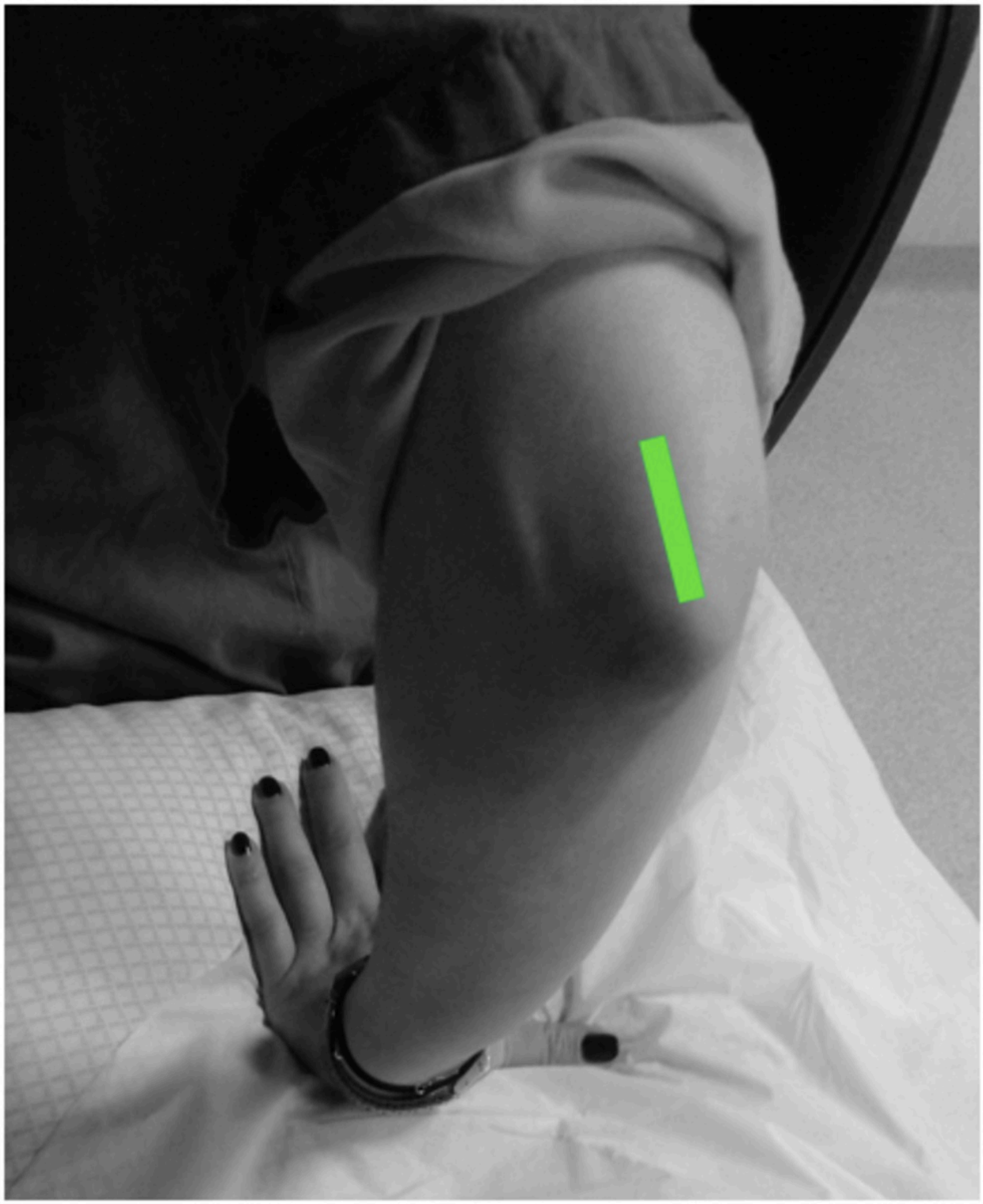

Fig. 24
References: - Coimbra/PT

The triceps muscle (hypoechoic) and the distal triceps tendon (hyperechoic) should be evaluated in both transverse and longitudinal planes (Fig. 25 on page 35). The distal triceps tendon inserts approximately 1 cm distal to the apex of the olecranon of the ulna. The most distal portion of the triceps tendon needs to be carefully examined to rule out enthesitis.

Posterior joint recess

Deep to the tríceps, the olecranon fossa is a concavity at the distal humerus and is filled with the hyperechoic posterior elbow fat pad (Fig. 25 on page 35). This is the best site for evaluation of joint fluid and intraarticular bodies.

While examining the joint at 45° flexion, intra-articular fluid tends to move from the anterior synovial space to the olecranon recess, thus making the identification of small effusions easier.

Dinamic imaging with gentle rocking motion (backward and forward) of the patient's elbow may be helpful to shift elbow joint fluid into the olecranon recess.

Olecranon bursa

The olecranon bursa is superficial to the olecranon process and distal triceps tendon and is best imaged with elbow extension. Care should be taken not to apply excessive pressure with the probe when evaluating the superficial olecranon bursa because small bursal effusions may be squeezed away.

Ulnar nerve

The ulnar nerve proximally is located in the cubital tunnel and distally runs deep to the arcuate ligament (an aponeurotic ligament of the two heads of the flexor carpi ulnaris muscle).

To evaluate the cubital tunnel the transducer is placed in a transverse plane between the olecranon process and the medial epicondyle. The patient's elbow should be placed in forceful internal rotation with extended elbow (olecranon facing the examiner) (Fig. 26 on page 36 , Fig. 27 on page 36).

Fig. 26
References: - Coimbra/PT

Dynamic US of the ulnar nerve should also be performed with the patient seated and the elbow placed on a stiff pillow or, with the patient supine and the arm abducted, hanging over the table. The patient is asked to flex the elbow, permitting the visualization of abnormal anterior and medial translation of the ulnar nerve over the medial epicondyle, with or without the medial head of the triceps muscle, to evaluate for subluxation with or without snapping triceps syndrome (Fig. 28 on page 49). Gentle pressure should be applied to not inhibit the abnormal translation of the ulnar nerve.

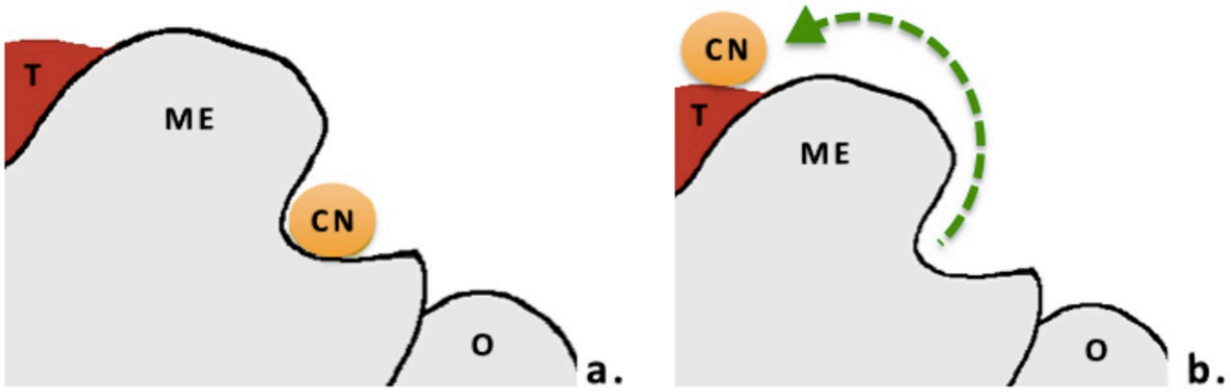

Fig. 28
References: - Coimbra/PT

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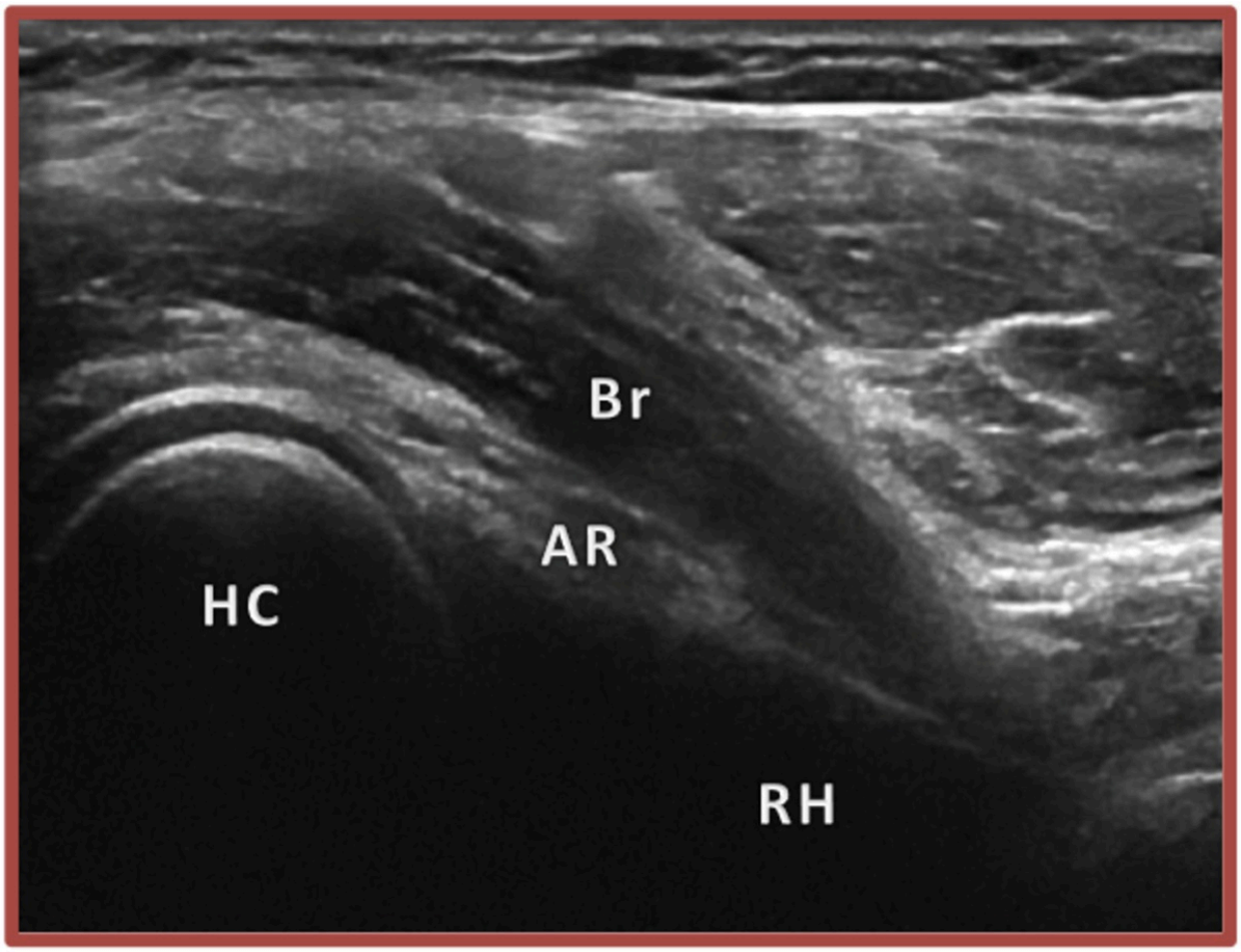

Fig. 4: Br - brachialis muscle; AR - anterior recess and fat pad; HC - humeral capitellum; RH - radial head

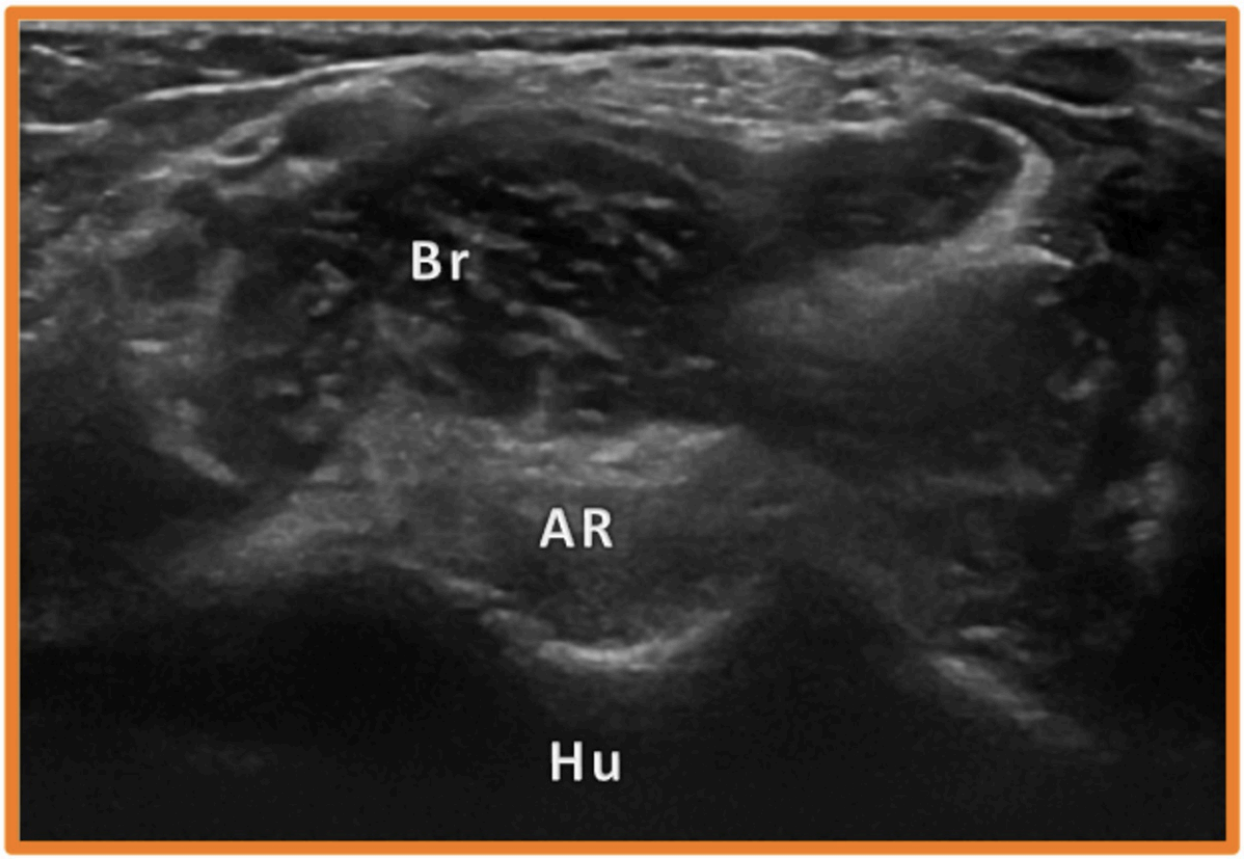

Fig. 5: Br - brachialis muscle; AR - anterior recess and fat pad; Hu - humerus

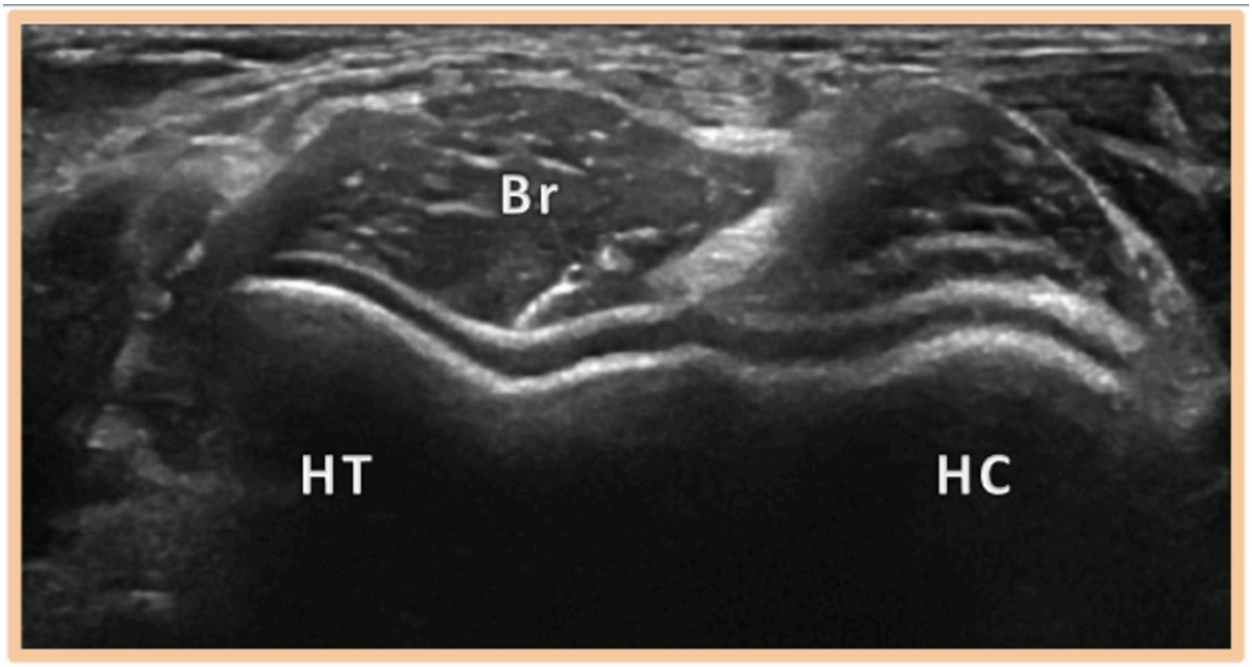

Fig. 6: Br - brachialis muscle; HC - humeral capitellum; HT - humeral trochlea

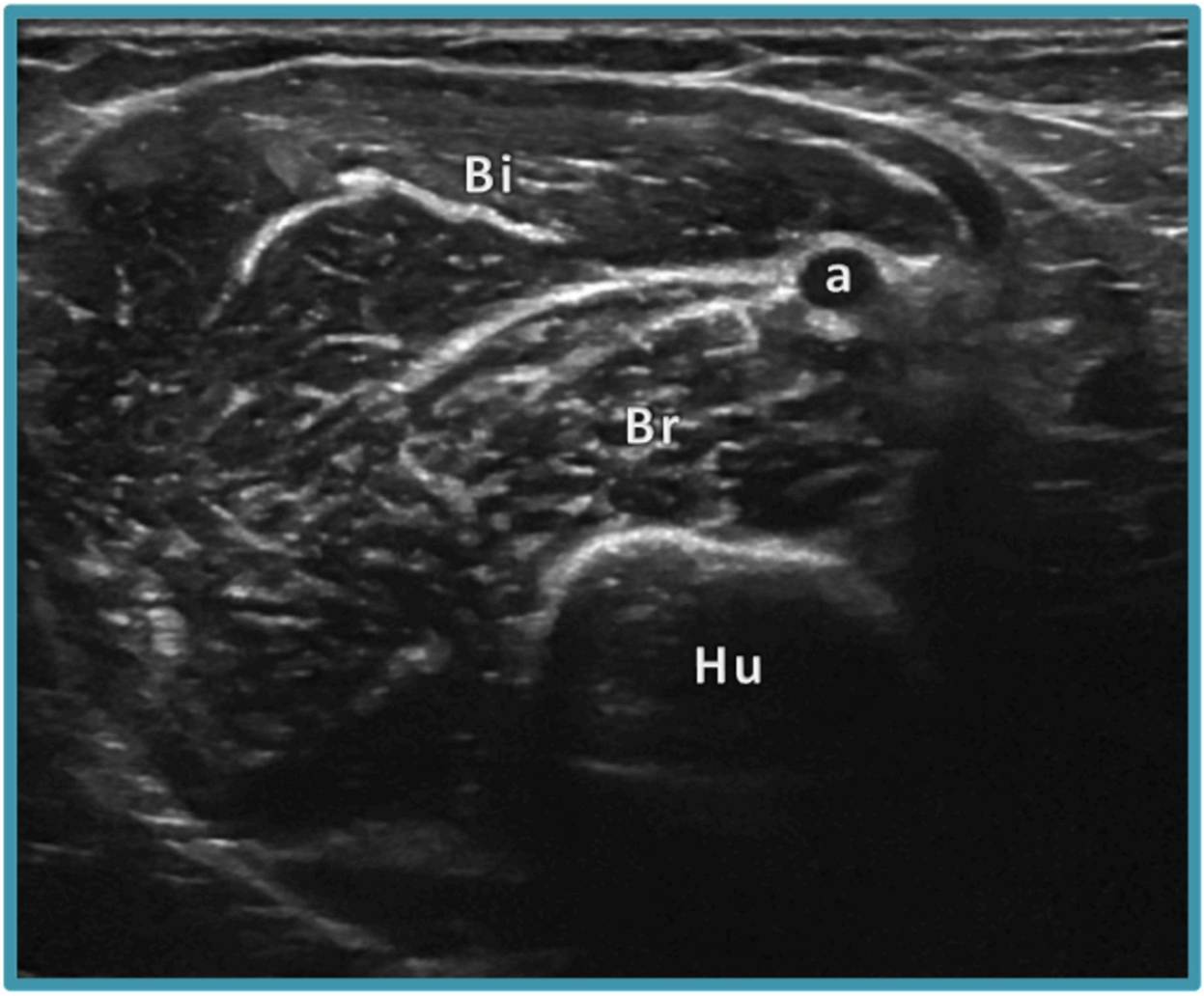

Fig. 8: a - brachial artery; Bi - biceps muscle; Br - brachialis muscle; Hu - humerus

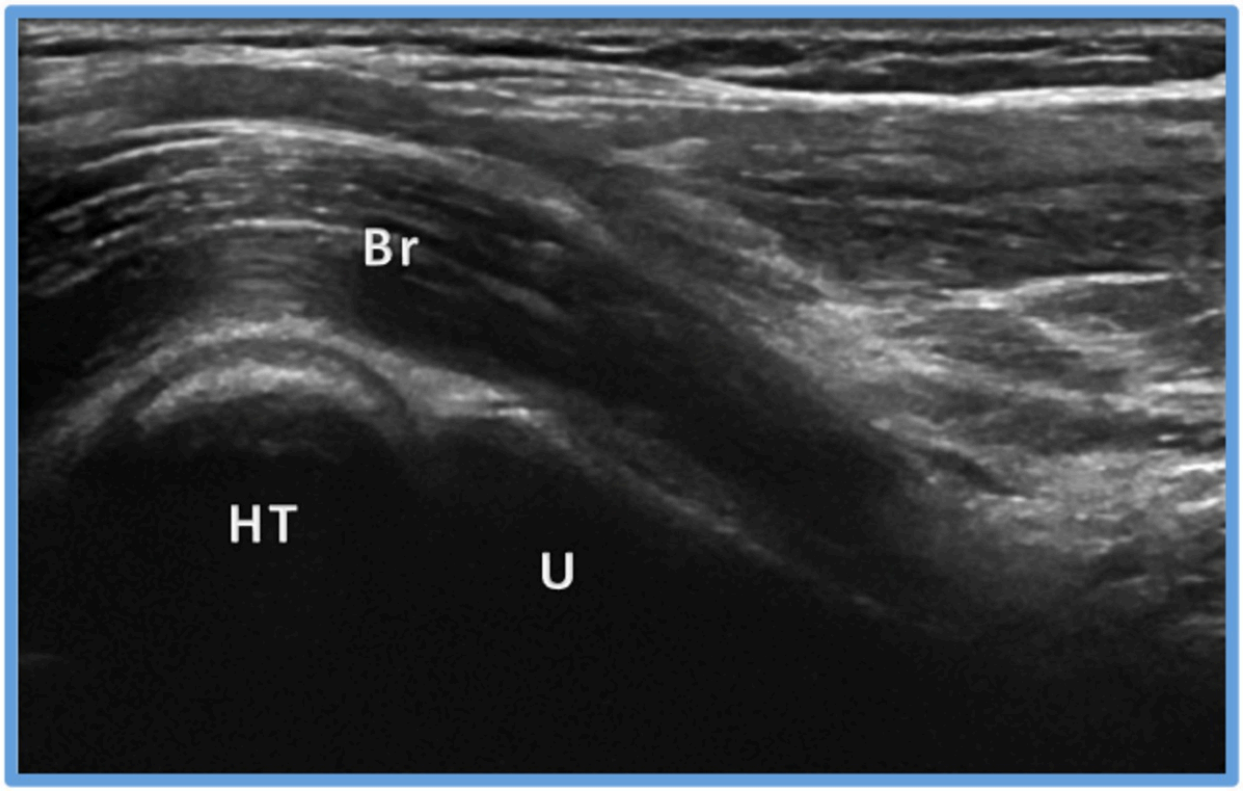

Fig. 9: Br - brachialis muscle; HT - humeral trochlea; U - ulna

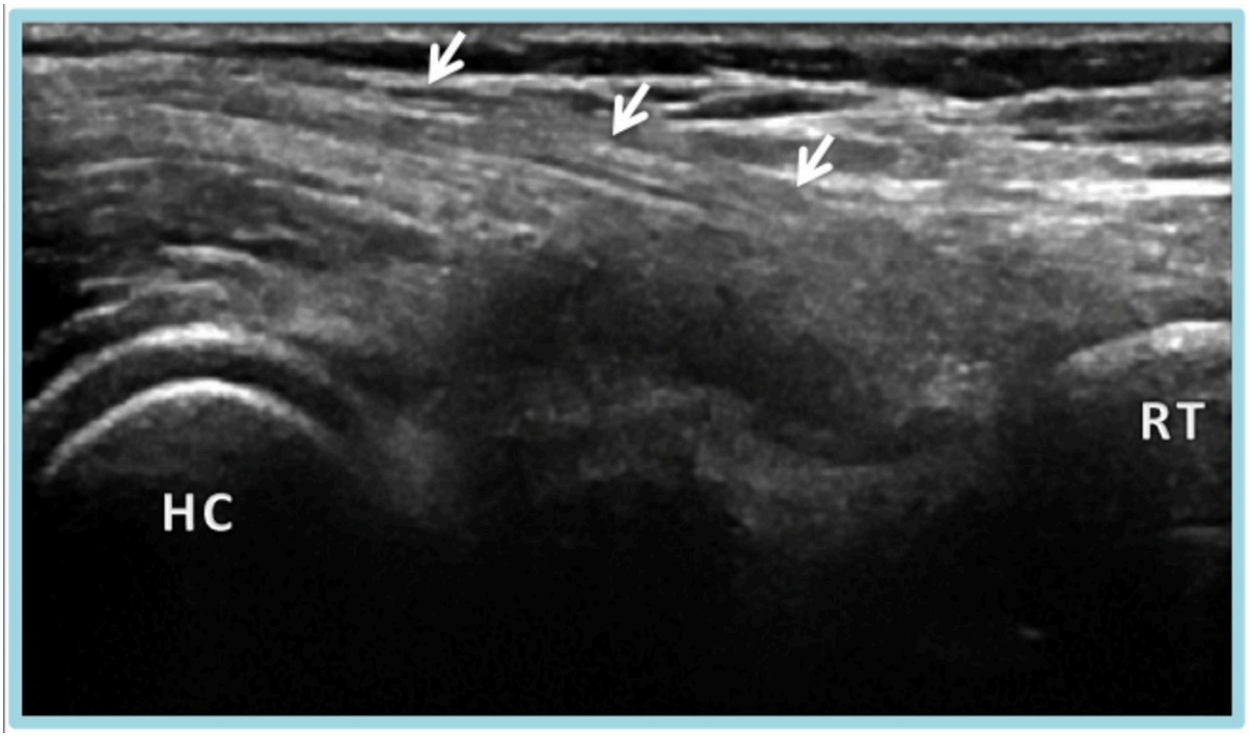

Fig. 10: HC - humeral capitellum; RT - radial tuberosity; arrows - distal biceps tendon

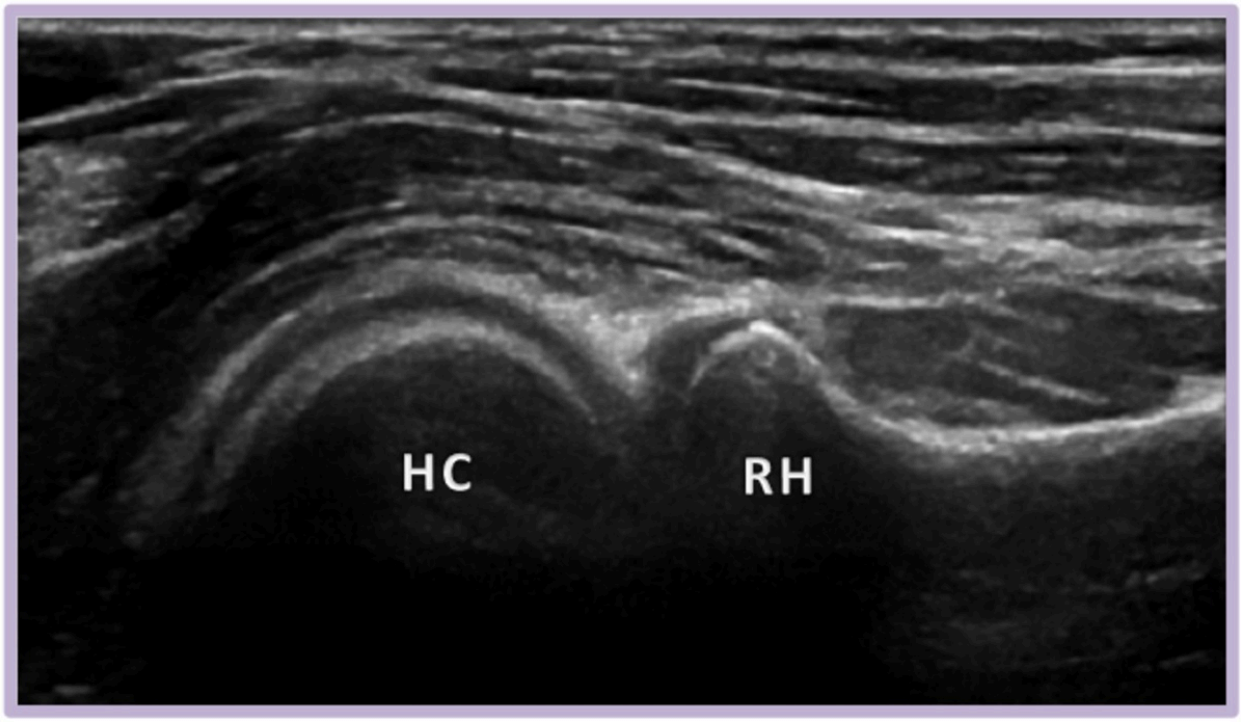

Fig. 13: HC - humeral capitellum; RH - radial head

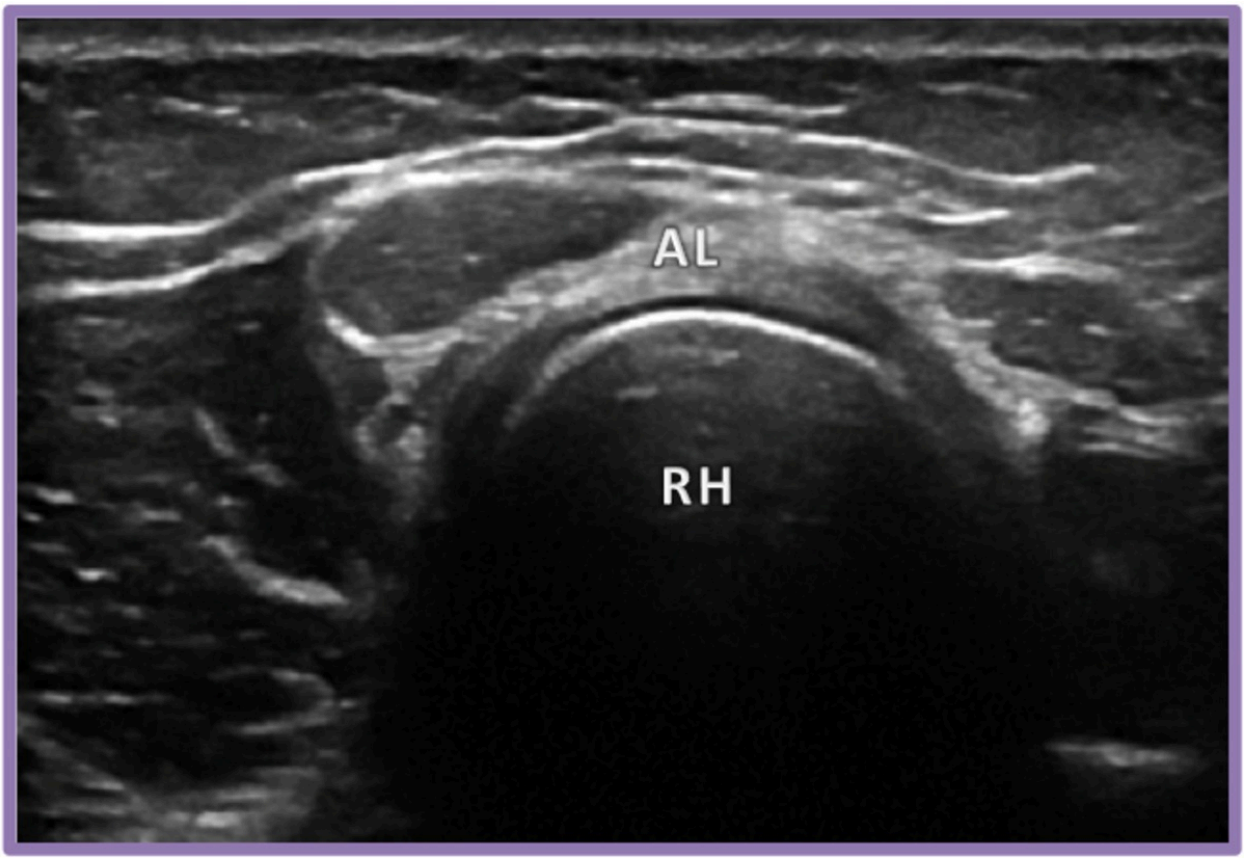

Fig. 14: AL - annular ligament; RH - radial head.

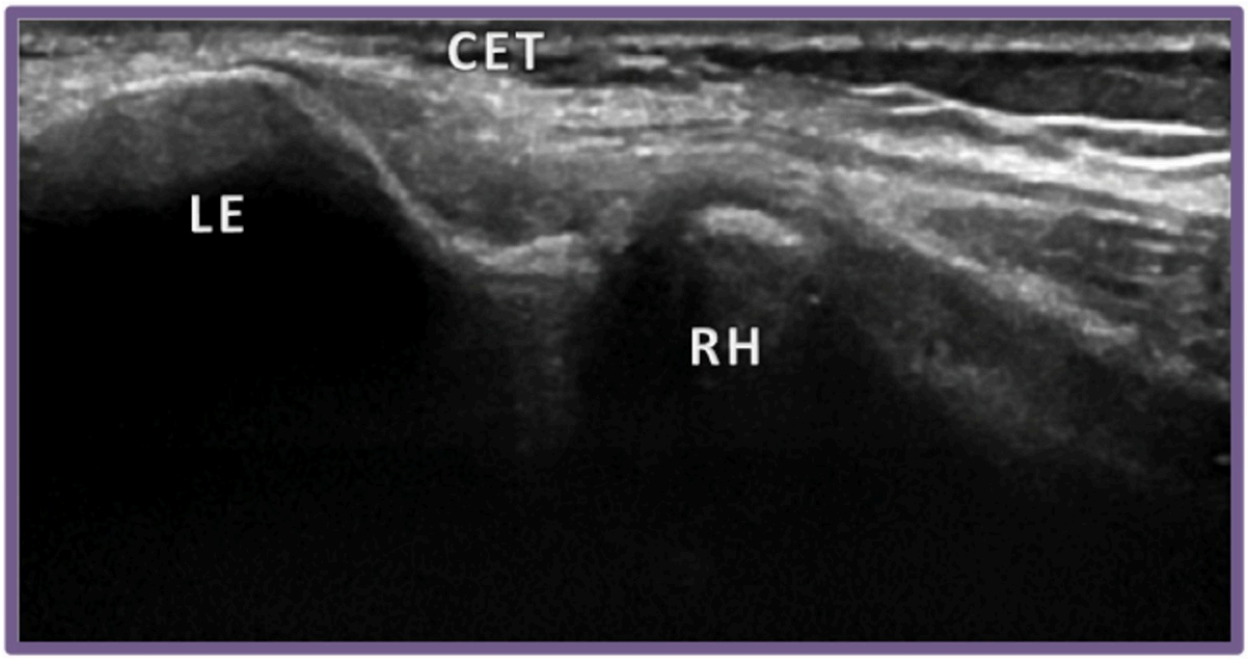

Fig. 15: CET - common extensor tendon; LE - lateral epicondyle; RH radial head.

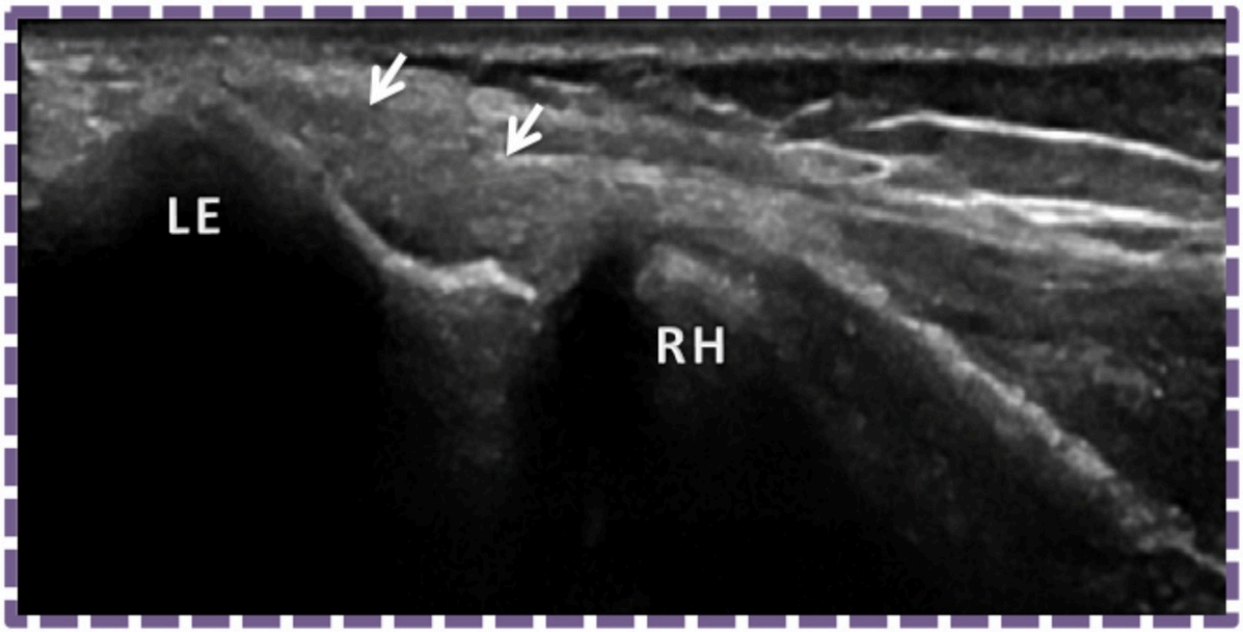

Fig. 17: LE - lateral epicondyle; RH - radial head; Arrows - lateral ulnar collateral ligament.

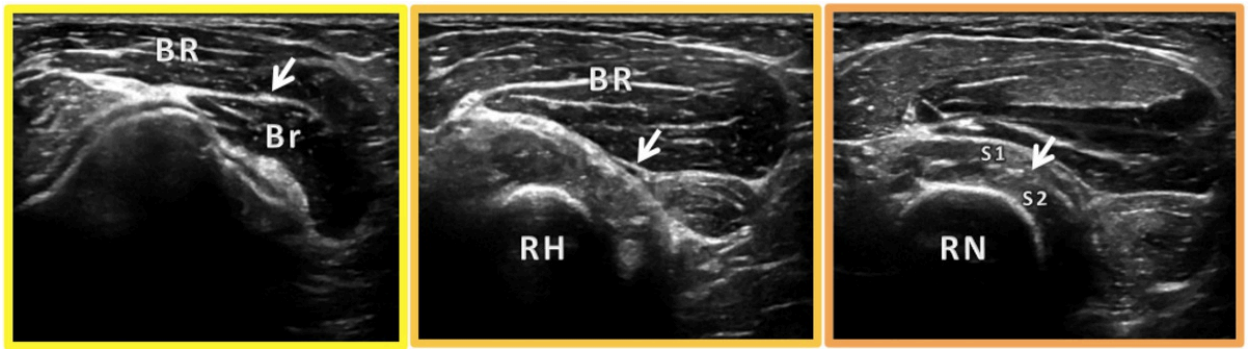

Fig. 19: BR - brachioradialis muscle; Br - brachialis muscle; S1 - superficial head of the supinator muscle; S2 - deep head of the supinator muscle; RH radial head; RN radial neck; Arrow - posterior interosseous nerve (PIN).

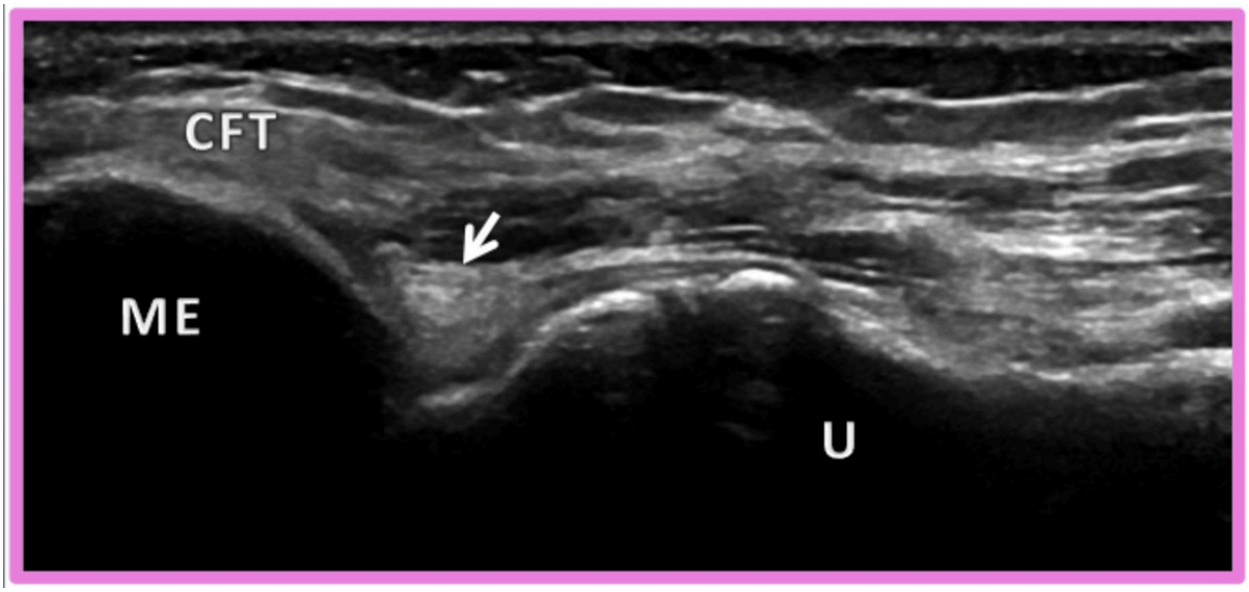

Fig. 21: CFT - common flexor tendon origin; ME medial epicondyle; U - ulna; Arrows - anterior bundle of the medial collateral ligament.

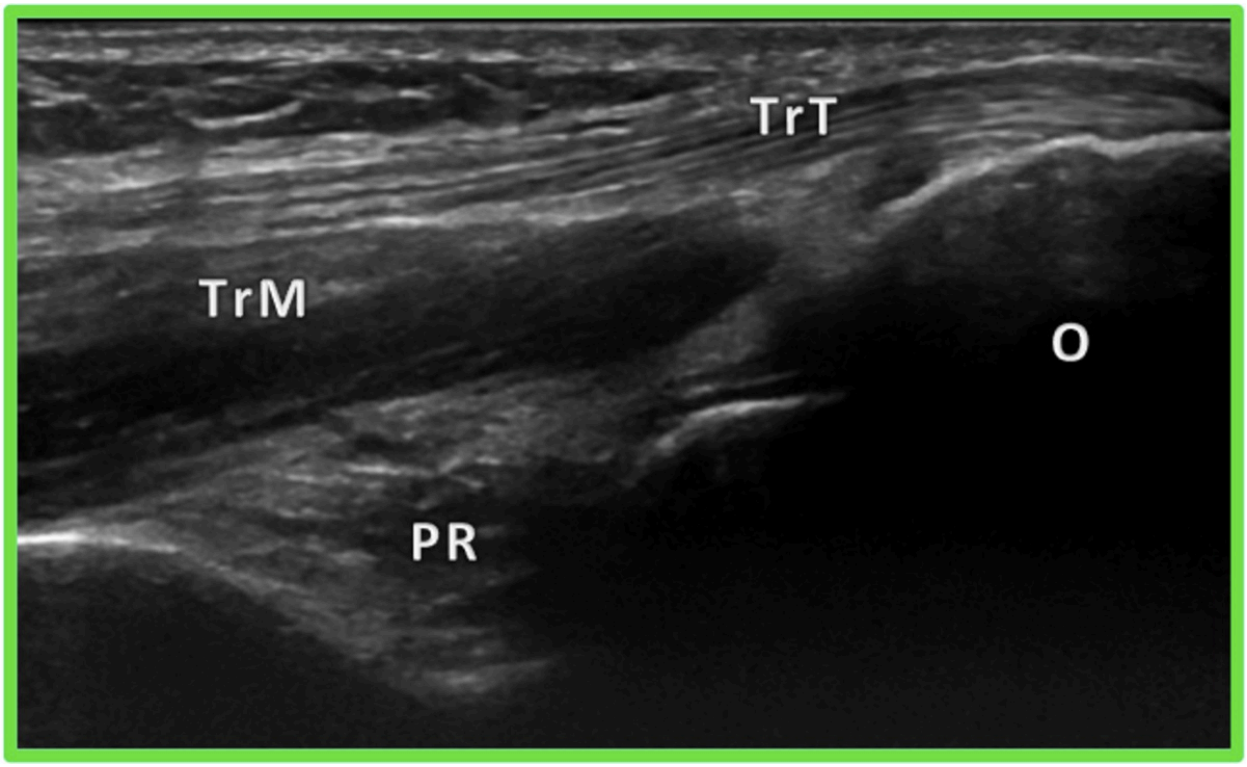

Fig. 25: O - olecranon; PR - posterior recess; TrM - triceps muscle; TrT - triceps tendon.

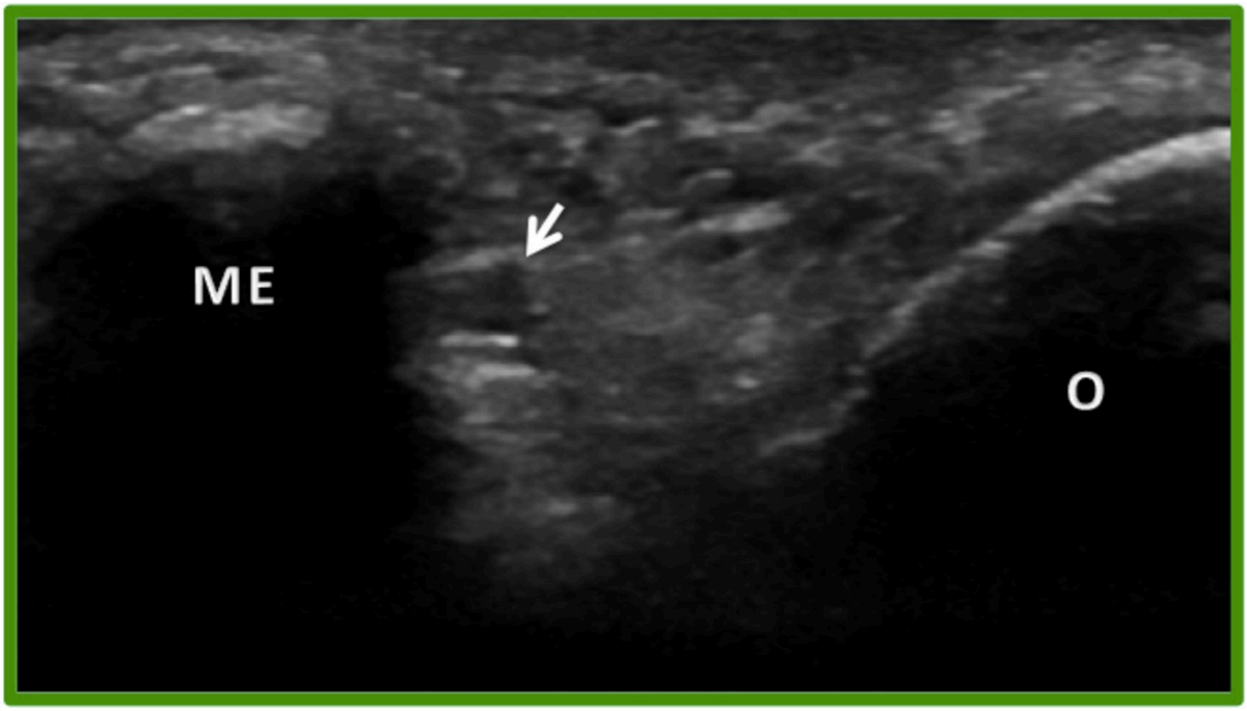

Fig. 27: ME - medial epicondyle; O - olecranon process; Arrow - ulnar nerve.

Fig. 26

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Anterior	Anterior joint recess Brachialis muscle Biceps muscle and tendon Median nerve
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Fig. 1: Elbow compartments and the most important structures to be evaluated. Adapted from...

Fig. 2

Fig. 3

Fig. 7

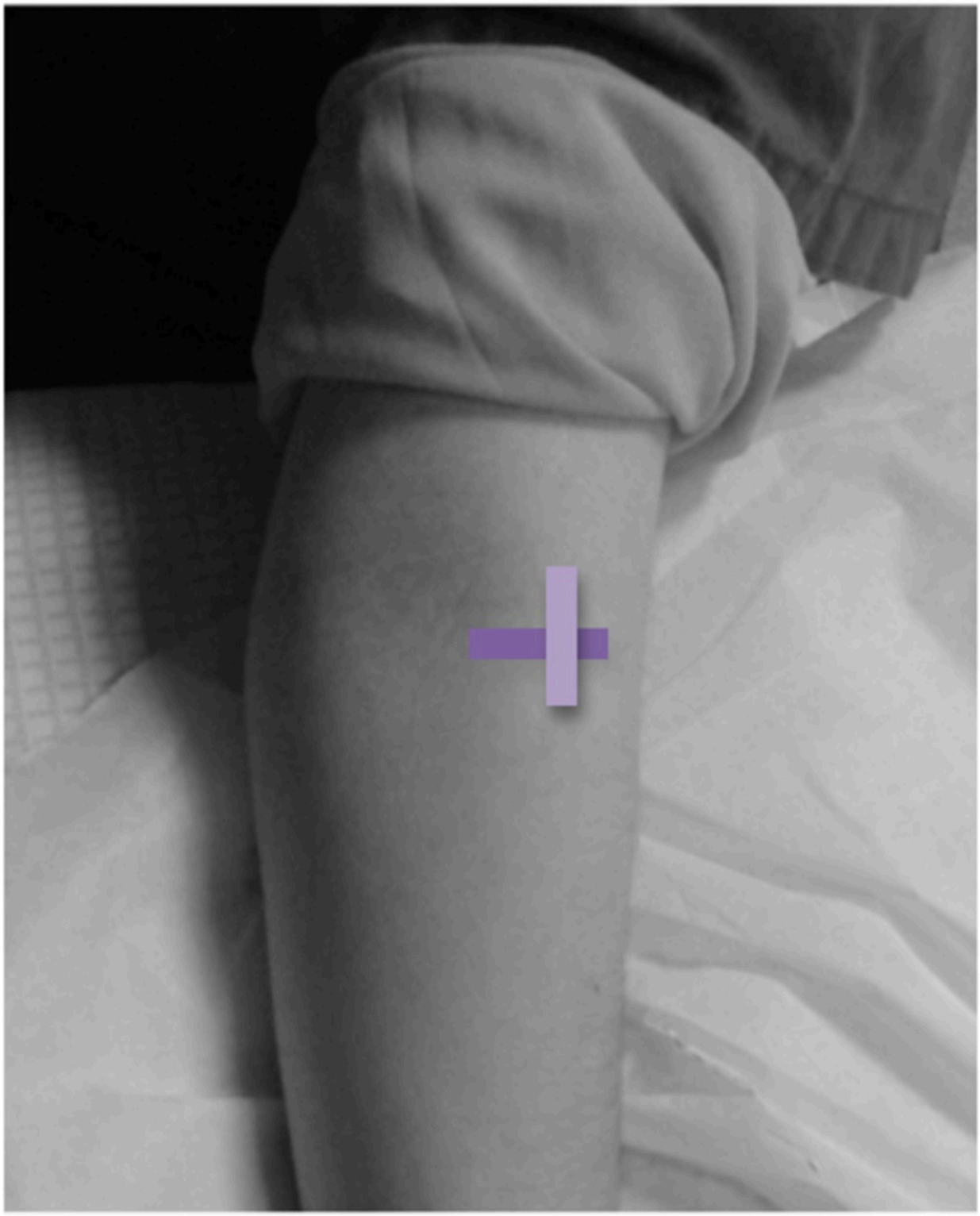

Fig. 11

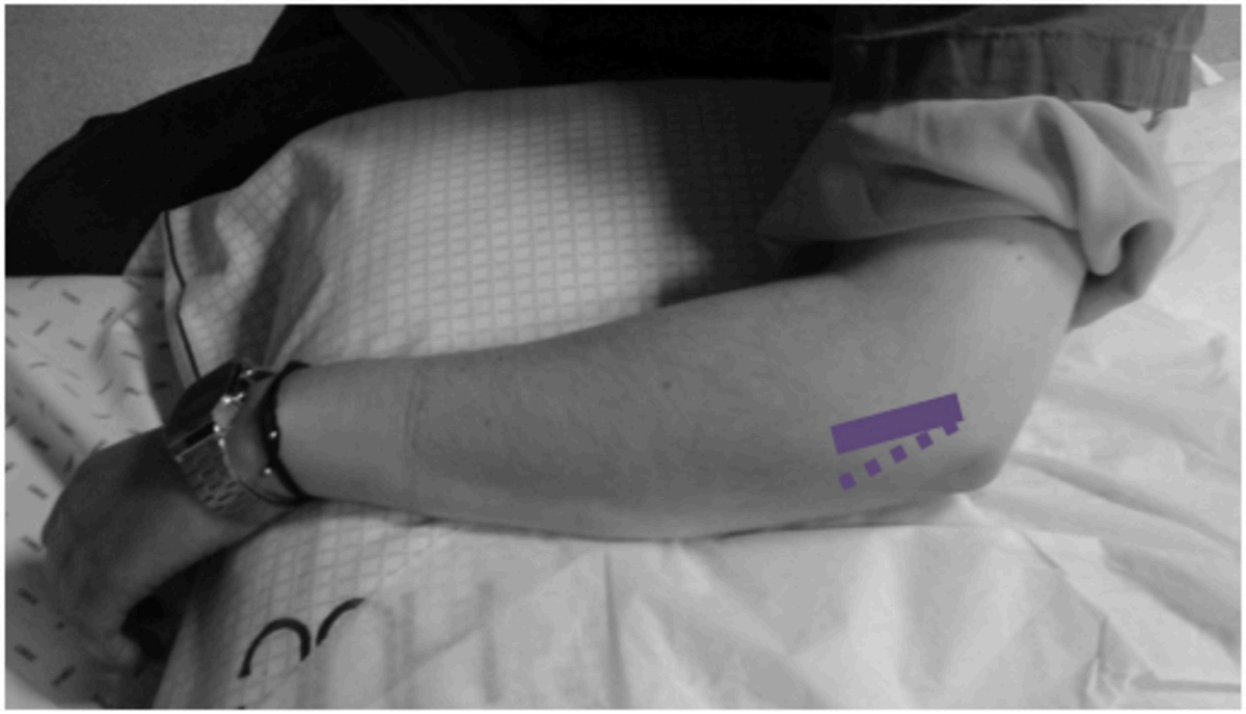

Fig. 12

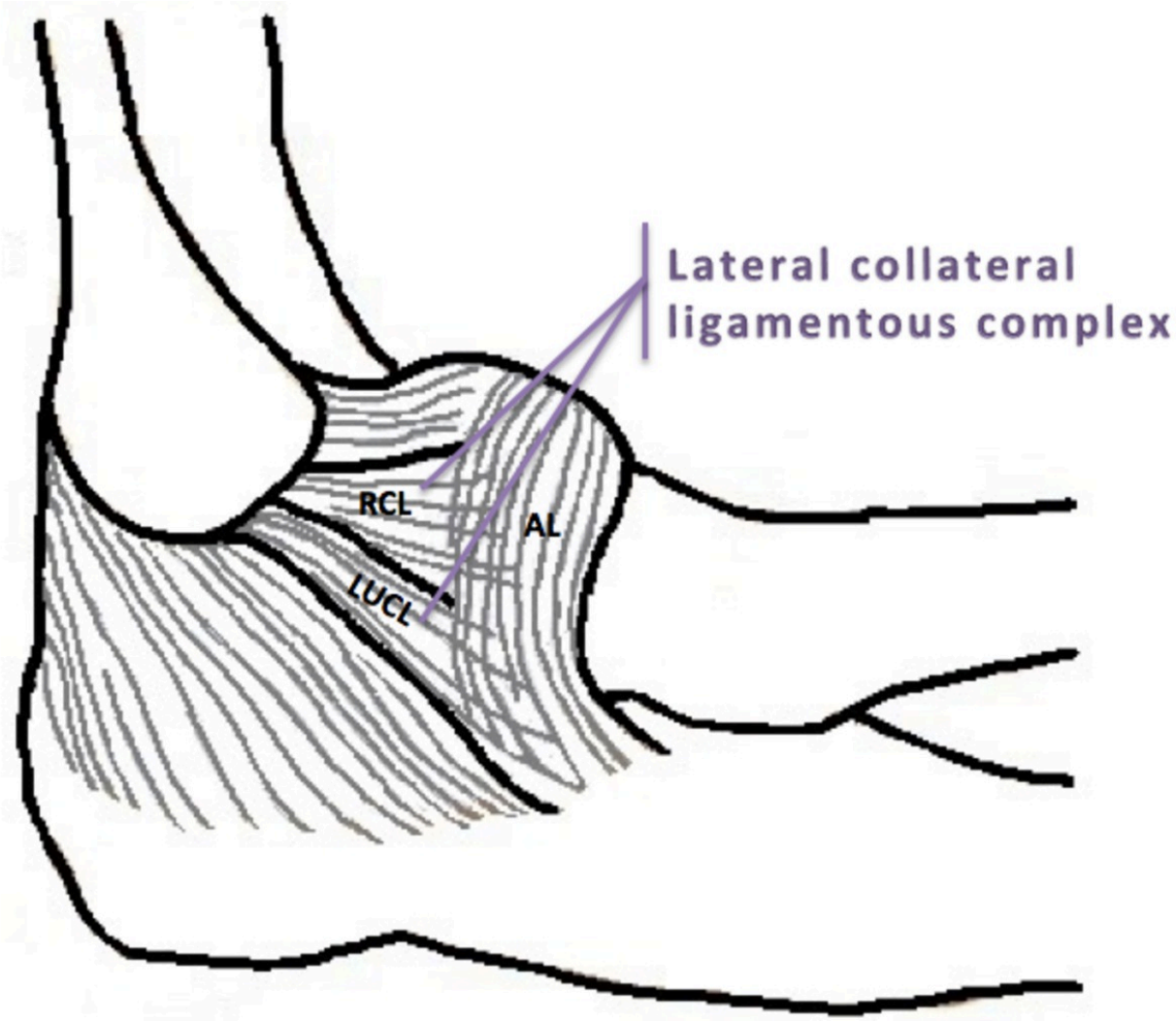

Fig. 16

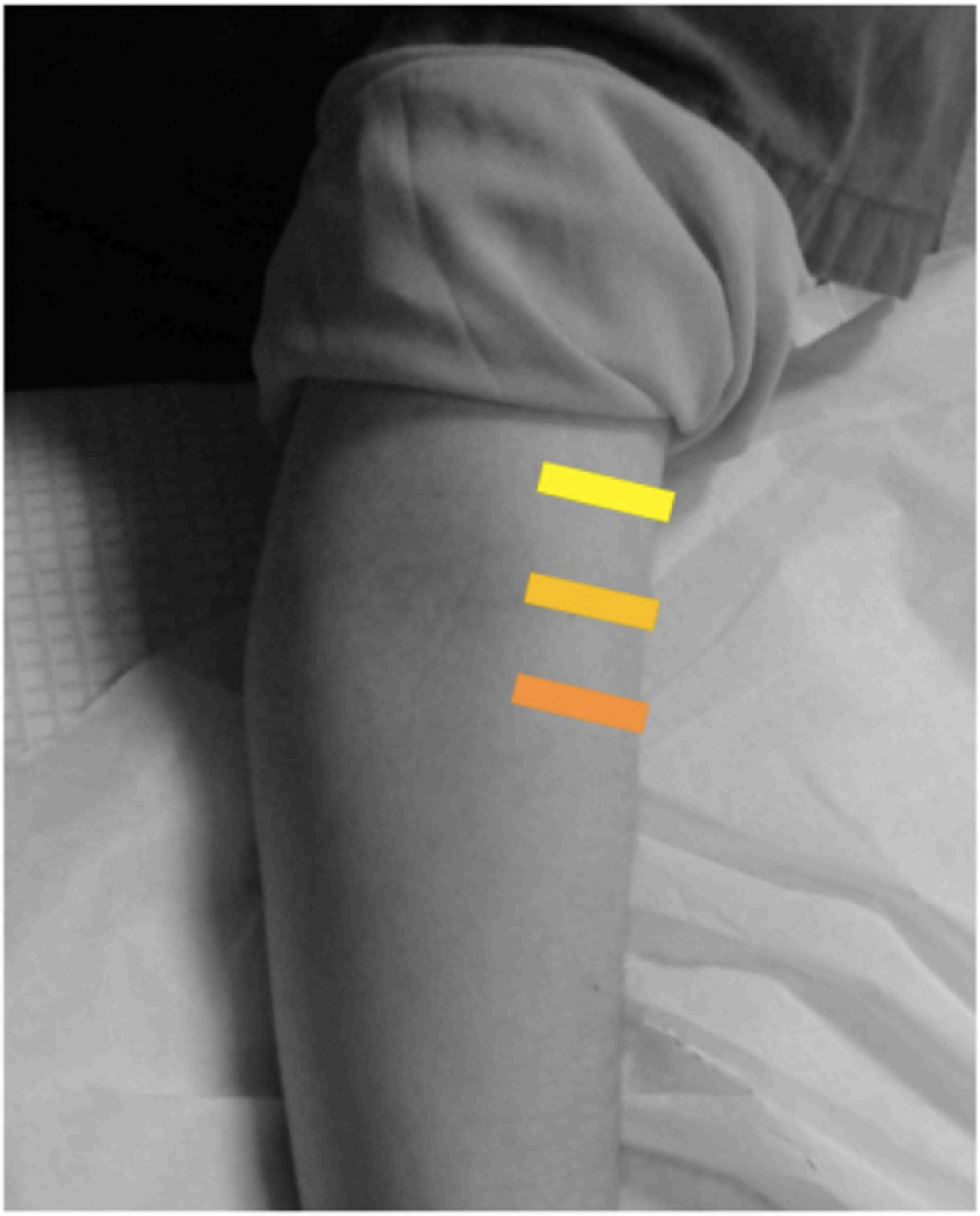

Fig. 18

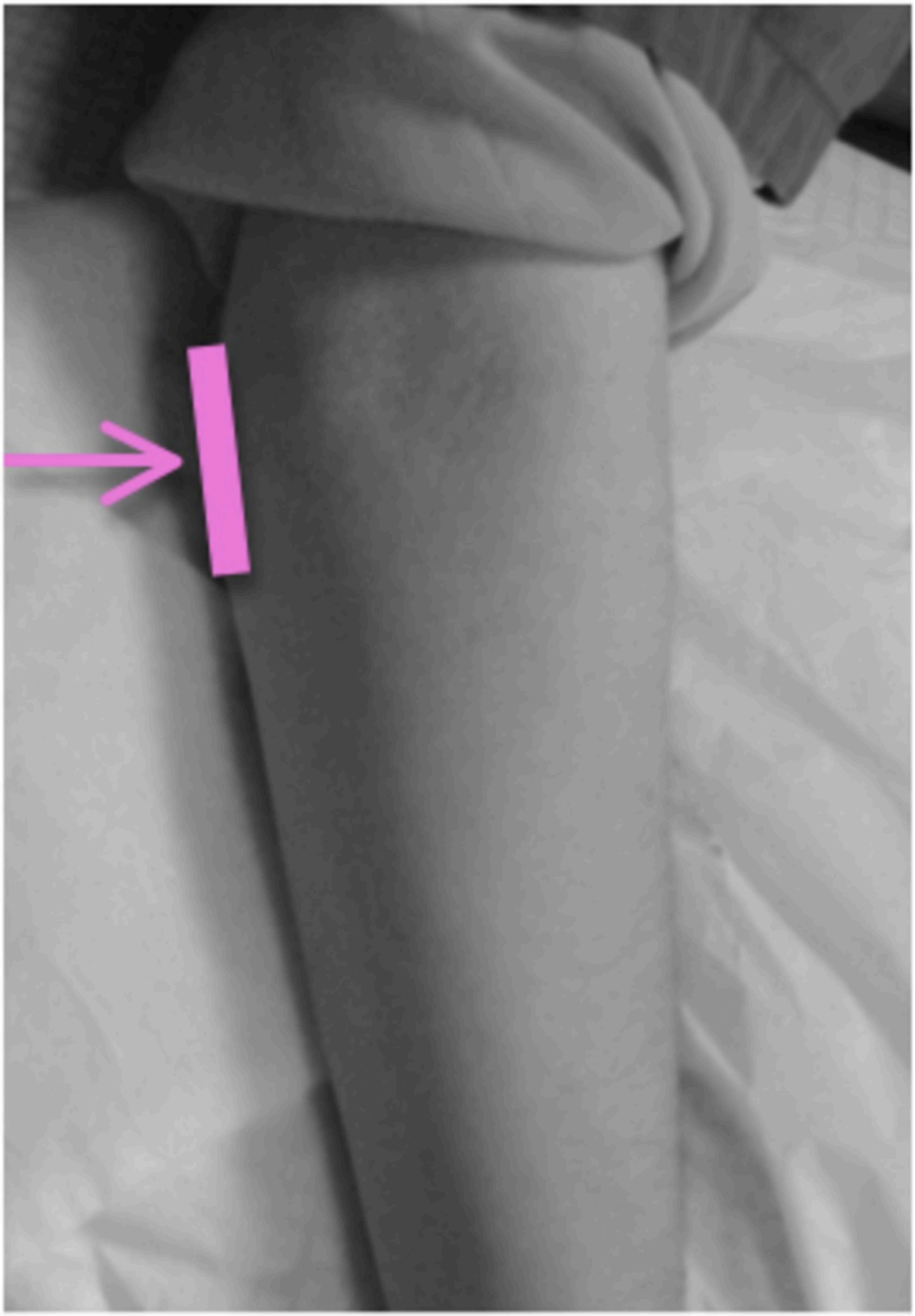

Fig. 20

Fig. 22

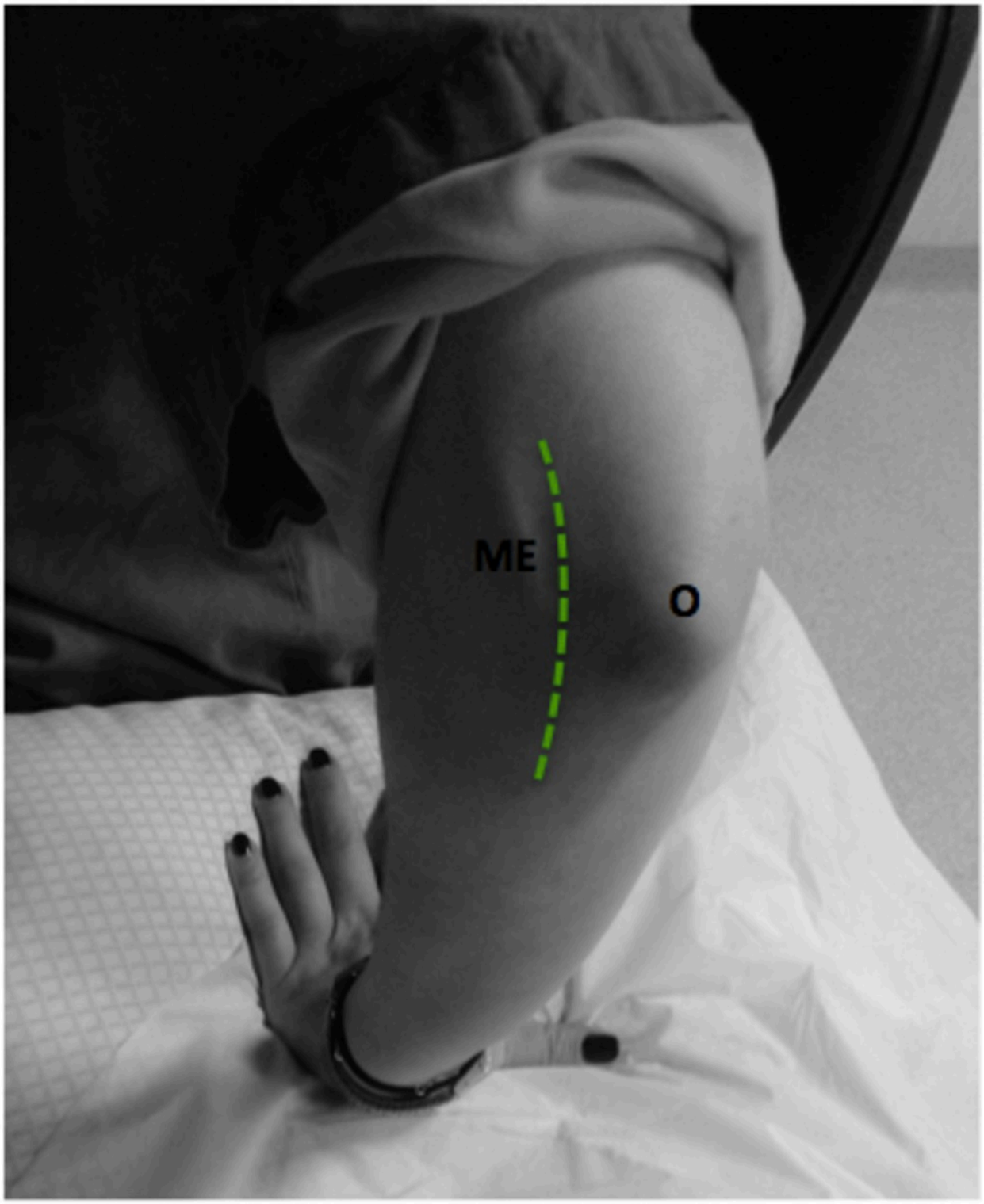

Fig. 23

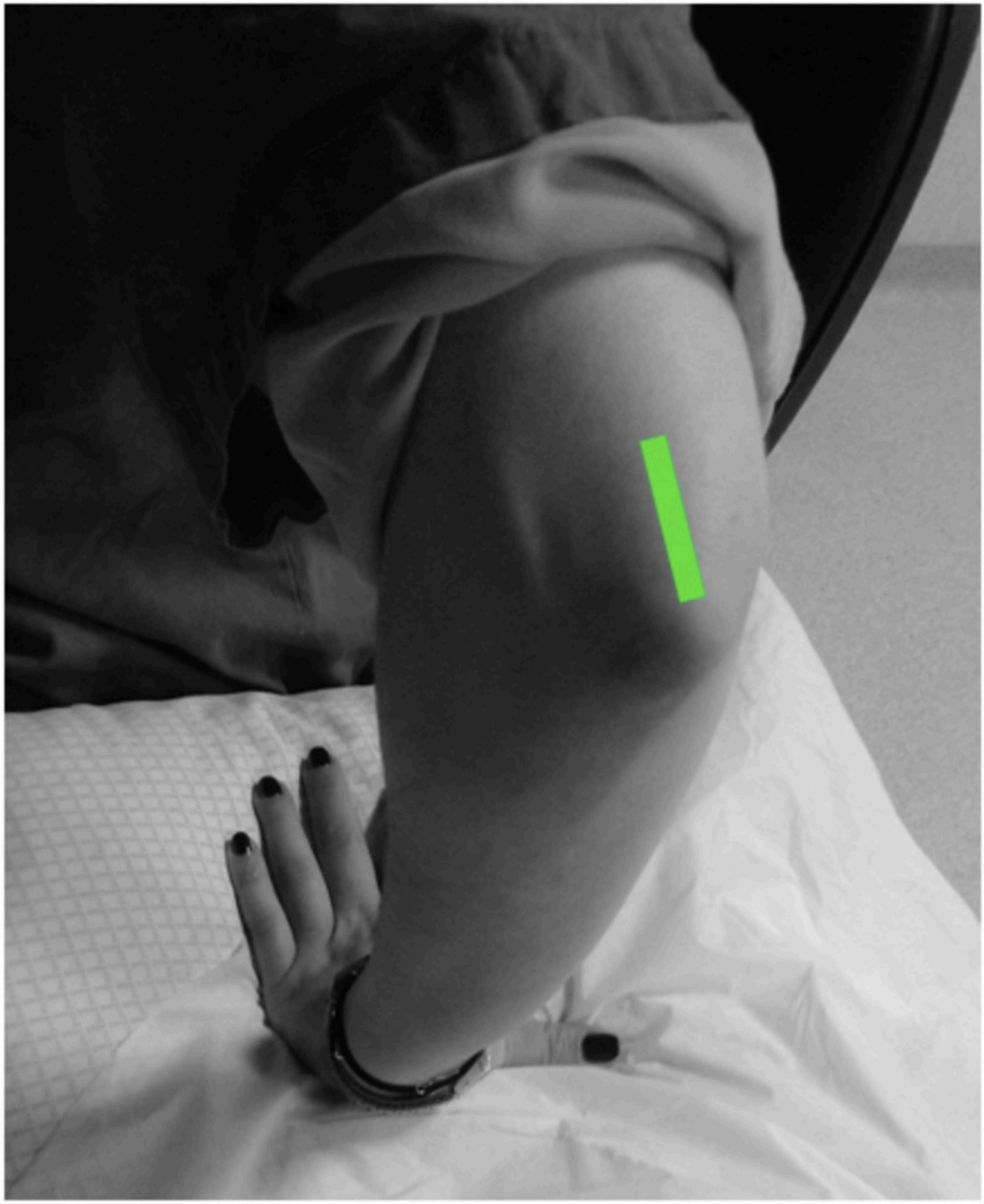

Fig. 24

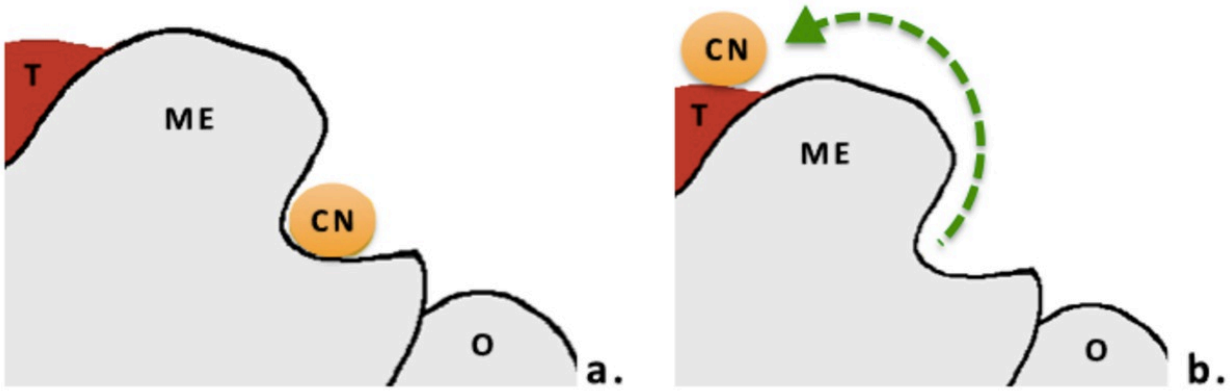

Fig. 28

Conclusion

Elbow ultrasonography is an excellent diagnostic imaging modality for a large spectrum of diseases that affect this articulation, performed in real-time and also permitting guided intervention. The radiologist should be familiar with proper US technique, normal elbow anatomy, and common pathologic conditions of the elbow.

Personal information

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