Pathologies, Pitfalls and Pearls
Reference guide to common pathologies of the Elbow

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The purpose of this guide is to provide a quick reference resource for use in the clinical department when pathology is suspected. The aim is to assist the sonographer to assess for all sonographic appearances, avoid associated sonographic pitfalls, and to provide helpful tips where appropriate.

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Tendinopathies and Ethesopathies

Lateral Epicondylitis

Epicondylitis (Tennis elbow) presents clinically as a focal tenderness and pain over the lateral epicondyle of the humerus that may be enhanced by gripping and activation of the extensor muscles of the forearm such as during extension and supination of the wrist (Bianchi and Martinoli, 2007). The condition consists of progressive degeneration of the common extensor tendon (CET), with or without partial thickness tearing, and/or ethesopathy (Bianchi and Martinoli, 2007). Sonographic appearances of lateral epicondylitis include CET thickening and hypoechogenicity at the tendon insertion, adjacent bony irregularity, focal or diffuse areas of decreased echogenicity within the tendon with loss of fibrillar pattern, increased heterogeneity and intratendinous calcifications (Radunovic et al., 2012). Peritendinous soft tissue thickening and thickening of peritendinous bursae (appearing as a thin layer of overlying fluid) may be seen and are associated with partial thickness tears (Bianchi and Martinoli, 2007). These may be represented by anechoic or hypoechoic clefts, or focal tendon thinning (Beggs, 2006, Maeseneer et al., 2012). Bony spurring, hyperostosis, cortical erosions and underlying collateral ligament damage may be seen in advanced cases (Radunovic et al., 2012, Maeseneer et al., 2012). Power or colour Doppler may demonstrate hypervascularity as a result of local inflammation, and the condition is not usually associated with a joint effusion (Radunovic et al., 2012, Bianchi and Martinoli, 2007). Complete tears of the CET appear sonographically as a fluid filled collection separating the tendon from the bony insertion (Bianchi and Martinoli, 2007).

Pitfall: The CET is susceptible to anisotropic artifact caused by loss of signal due to changes in the angle of isonation (Maeseneer et al., 2012). Additionally, if tendinosis or partial thickness tear is suspected, the sonographer must alter the angle of incidence in an attempt to maximise received echoes. The heel-toe manoeuvre and angling the transducer may assist.

Pearl: It may be helpful to compare the appearance and thickness of the CET to the contralateral elbow (Maeseneer et al., 2012).

![Image 1. CET demonstrates decreased echogenicity, increased heterogeneity, intratendinous microcalcifications and partial thickness tear (Ultrasoundcases, 2015).](image-url)
Medial Epicondylitis

Medial epicondylitis (Golfer’s or Pitcher’s elbow) presents as a focal tenderness and pain over the medial humeral epicondyle that may be enhanced by gripping and activation of the flexor muscles of the forearm such as during flexion and pronation of the wrist (Bianchi and Martinoli, 2007). Like lateral epicondylitis, the condition consists of progressive degeneration of the common flexor tendon (CFT), with or without partial thickness tearing, and/or ethesopathy (Bianchi and Martinoli, 2007). The sonographic appearances of medial epicondylitis are similar to those of lateral epicondylitis and may include CFT thickening and hypoechogenicity, adjacent bony irregularity, focal or diffuse areas of decreased echogenicity within the tendon with loss of fibrillar pattern, increased heterogeneity, intratendinous calcifications, peritendinous soft tissue thickening, thickening of peritendinous bursae, partial thickness tears, bony spurring, cortical erosions, hypervascularity and underlying ulnar collateral ligament damage (Radunovic et al., 2012, Maeseneer et al., 2012). The condition is not usually associated with an effusion and there is usually preservation of normal range of movement (Bianchi and Martinoli, 2007). In some cases, tendon thickening and surrounding soft tissue oedema may lead to ulnar nerve neuropathy (Bianchi and Martinoli, 2007).
Pitfall: Anisotropic artefact may be especially prominent in the CFT and care must be taken not to misdiagnose the reduced signal with tendinosis (Maeseneer et al., 2012). As with the CET, if tendinosis or partial thickness tear is suspected, the sonographer must alter the angle of incidence in an attempt to maximise received echoes. The heel-toe manoeuvre and angling the transducer may assist.

Pearl: It may be helpful to compare the appearance and thickness of the CFT to the contralateral elbow (Maeseneer et al., 2012).


Image 5. Hypervascular CFT. Neovascularity visualised with colour Doppler within and surrounding the CFT (Ultrasoundcases, 2015).
Distal Biceps Brachii Pathology

Tendinosis and partial thickness tears of the distal biceps tendon are uncommon (Radunovic et al., 2012). Partial thickness tears demonstrate tendon thickening or thinning, increased hypoechoogenicity and contour distortions (Martinoli et al., 2001). Tendinosis demonstrates a similar appearance and is often indistinguishable to a partial thickness tear (Beggs, 2006).

Clinically, rupture of the distal biceps tendon presents with localised pain and a palpable defect along the anterior arm with bunching of the retracted muscle (Martinoli et al., 2001, Radunovic et al., 2012). Rupture most commonly occurs at the distal insertion into the radial tuberosity, however may also occur mid-substance or at the myotendinous junction (Bianchi and Martinoli, 2007). Sonographically, rupture at the distal insertion appears as complete absence of the tendon distal to the elbow joint with marked retraction, associated haematoma within the tendinous bed and surrounding oedema (Radunovic et al., 2012). Fluid is often seen within the defect adjacent to the radial tuberosity (Beggs, 2006). Following surgical repair, the tendon appears thickened and hypoechoic with internal linear foci representative of sutures (Bianchi and Martinoli, 2007).

Pitfall: Anisotropy may cause the distal biceps tendon to appear hypoechoic mimicking tendinosis or partial thickness tear (Bird, 2007).

Pearl: Reduce the effects of anisotropy by utilising the overlying pronator teres muscle as a sonographic window (Bird, 2007). Use the heel-toe technique to assist.

Image 6. Tendinosis of the distal biceps tendon.

Thickening, decreased echogenicity and increased heterogeneity of the distal biceps tendon. There is an accompanying effusion within the bicipitocubital bursa (Ultrasoundcases, 2015).
Image 7. Complete rupture of the distal biceps tendon. Fluid is seen within the defect between the ruptured tendon and the radial tuberosity (Ultrasoundcases, 2015).

**Distal Triceps Pathology**

As with the distal biceps tendon, tendinosis and partial thickness tears of the distal triceps tendon result in a sonographically thickened, hypoechoic tendon (Beggs, 2006, Radunovic et al., 2012). Intratendinous calcifications are associated with chronic tendinosis (Bianchi and Martinoli, 2007). Complete rupture demonstrates a retracted, lax tendon and a fluid-filled defect (Radunovic et al., 2012, Beggs, 2006). Avulsion of the distal insertion may result in visualisation of an echogenic bone fragment at the free margin of the triceps tendon (Beggs, 2006). An acute tear of the distal triceps tendon and associated local haematoma may lead to ulnar nerve compression (Radunovic et al., 2012). Partial thickness tears and tears at the myotendinous junction are rare (Bianchi and Martinoli, 2007).

Image 8. Complete rupture of the distal triceps tendon with avulsion of the olecranon. There is also some accompanying overlying haematoma (Ultrasoundcases, 2015).
Ligament Disorders

Ligament Pathologies of the Medial Elbow

The stabilising ligament of the medial elbow is comprised of the anterior, transverse/oblique and posterior bands of the ulnar collateral ligament (UCL), though the anterior bundle is most readily visualised with ultrasound (Maeseneer et al., 2012). UCL strain or partial thickness tear may appear sonographically as thickening and reduced echogenicity of the ligament, and there may be an associated surrounding effusion. Calcifications are also reported to be associated with partial thickness tears (Bianchi and Martinoli, 2007). Degeneration and tearing of the UCL as a result of microtrauma is common in throwing athletes due to repeated valgus stress on the UCL (Martinoli et al., 2001, Bodor and Fullerton, 2010). Ligament rupture appears as a hypo- or anechoic defect in the ligament with discontinuity of fibres and there is often an associated surrounding haematoma (Radunovic et al., 2012, Martinoli et al., 2001). In adolescents, the bony origin of the UCL may avulse from the medial epicondyle and be seen at the proximal attachment of the UCL (Beggs, 2006).

Pitfall: The UCL is susceptible to anisotropy and may appear hypoechoic depending on the angle of isonation (Maeseneer et al., 2012).

Pearl: Dynamic assessment of the UCL may assist in demonstrating UCL rupture or laxity as a result of strain or partial thickness tear (Beggs, 2006). Widening of the ulnotrochlear joint space may be visualised as valgus stress is applied to the joint. Dynamic comparison with the contralateral UCL is necessary to gauge the degree of widening (Bianchi and Martinoli, 2007).

Image 9. Rupture of the UCL. There is a large, heterogenous fluid filled defect at the site of rupture (small arrows). The distal UCL is indicated by the large arrow (Applied Radiology, 2014).
Ligament Pathologies of the Lateral Elbow

The lateral collateral ligament complex is comprised of the radial collateral ligament (RCL), annular ligament and lateral ulnar collateral ligament (LUCL) (Radunovic et al., 2012). The RCL is a dense fibrillar structure located deep to the CET that extends from the lateral epicondyle to the radial head (Martinoli et al., 2001). As with the UCL, RCL strains/partial thickness tears present as a thickened hypoechoic ligament while complete tears appear as discontinuity of ligament fibres with associated haematoma (Bianchi and Martinoli, 2007, Radunovic et al., 2012). LUCL injury is frequently associated with lateral epicondylitis and when torn demonstrates a hypoechoic cleft/discontinuity with associated underlying haematoma (Bianchi and Martinoli, 2007).

A “pulled elbow” injury is a condition that affects infants whereby there is subluxation of the radial head and associated displacement of the annular ligament over the radial head to become trapped within the radiocapitellar joint. This appears on ultrasound as an increased distance between the radial head and capitellum (Martinoli et al., 2001). Comparison with the contralateral radiocapitellar joint is essential.

**Pitfall:** The LUCL is frequently difficult to visualise and often requires MRI for full assessment.

**Pearl:** Dynamic assessment of the RCL and LUCL during varus stress of the radiocapitellar joint may assist in demonstrating tears. Comparison with the contralateral side is helpful (Bodor and Fullerton, 2010).

![Image 10. Rupture of the radial collateral ligament. Anechoic fluid-filled defect is seen in the RCL (arrow) (Applied Radiology, 2014).](image-url)
Arthropathies

Articular Capsule and Joint Space Abnormalities

Joint Effusions

Joint effusions and synovitis appear as anechoic or hypoechoic fluid within the joint resulting in joint space widening of more than 2mm when measured between the anterior aspect of the humeral bone and the joint capsule (Radunovic et al., 2012). Increased synovial fluid is often detected in the anterior joint, coronoid and radial fossae, olecranon fossa and annular recess (Bianchi and Martinoli, 2007). In the presence of a joint effusion, the anterior fat pad within the coronoid fossa may be displaced anterosuperiorly while the posterior fat pad within the olecranon fossa may become displaced posterosuperiorly (Maeseneer et al., 2012).

Pitfall: Paediatric elbows may require careful scanning to ensure articular humeral cartilage is not confused with joint effusion (Bianchi and Martinoli, 2007). Joint fluid may be displaced with transducer pressure.

Pearl: Flexion and extension of the elbow may encourage joint fluid to pocket in synovial recesses (Martinoli et al., 2001). Pronation and supination of the wrist may prompt fluid to pool in the annular recess.


Image 12. Olecranon fossa effusion. There is also a loose calcific body seen within the olecranon fossa (The Ultrasound Site, 2014).
**Inflammatory Arthropathy**

Synovial pannus associated with inflammatory arthritis appears as a mass of hypoechoic, non-displacable tissue located within the joint cavity and may or may not be associated with a joint effusion and bony erosions (Martinoli et al., 2001, Radunovic et al., 2012, Bianchi and Martinoli, 2007). Inflammatory conditions such as rheumatoid or psoriatic arthritis can also lead to large fluid collections in the olecranon fossa (Bodor and Fullerton, 2010).

**Pearl:** Use colour or power Doppler to demonstrate inflammatory hyperaemia within thickened synovium. Graded compression also assists in delineating joint effusion from synovial pannus (Martinoli et al., 2001).

![Image 13. Mass of synovial pannus of the elbow joint.](image)

**Intra-articular Loose Bodies**

Loose intra-articular bodies are common and are most often visualised at the anterior and posterior elbow joint recesses (Beggs, 2006, Martinoli et al., 2001). Sonographically, they appear as highly reflective hyperechoic foci with posterior acoustic shadowing (Martinoli et al., 2001). They are more easily delineated in the presence of a joint effusion when surrounded by fluid (Beggs, 2006).

**Pitfall:** Occasionally an os supratrochleare dorsale may be located within the olecranon fossa, and is clinically identical to a loose body (Bianchi and Martinoli, 2007).

**Pearl:** Gentle minor flexion and extension of the elbow during examination of the posterior joint recess may increase the visibility of loose bodies by displacing the articular fluid (Martinoli et al., 2001).

![Image 14. Loose intra-articular body within the coronoid fossa (arrow).](image)
**Ganglia**

Ganglion cysts may arise from the joint capsule, usually the anterior aspect, and may expand into the soft tissue of the forearm. A thin neck connecting the ganglion to the joint space may be visualised (Martinoli et al., 2001).

Image 15. Ganglion cyst arising from the anterior aspect of the radiocaitellar joint. An internal septation is visible. In this case the ganglion in displacing the radial nerve and its branches (Ultrasoundcases, 2015).
**Bony Abnormalities**

**Fractures**
Fractures may appear as sharp cortical defects or bony interruptions (Martinoli et al., 2001).

**Pearl:** Dynamic assessment can be useful in detecting radial head fractures during active pronation and supination of the wrist (Martinoli et al., 2001).

![Image 16. Radial Head fracture. Cortical interruption indicated by the arrow (Ultrasoundcases, 2015).](image)

**Osteoarthritis**
Osteoarthritis may appear as a loss of the smooth hypoechoic articular cartilage contour and is often associated with osteophytic changes and joint effusion (Bodor and Fullerton, 2010). Bone erosions appear as intra-articular discontinuities of the bony surface (Radunovic et al., 2012).

**Osteochondritis Dissecans**
Osteochondritis dissecans of the capitellum may occur in adolescents due to excessive valgus loading (for example during throwing). Sonographically, it appears as separation of bone from the normal contour of the capitellum (Bodor and Fullerton, 2010).
Neuropathies

Medial and radial nerve entrapment is uncommon at the elbow however may occur due to a supracondylar process or hypertrophy of the pronator teres muscle respectively (Martinoli et al., 2001). Large collections within the bicipitocubital bursa may also lead to compression of the median or radial nerves (or their branches)(Beggs, 2006).

Ulnar Neuropathy

The ulnar nerve lies within the cubital tunnel of the elbow and appears as an ovoid, speckled structure (Maeseneer et al., 2012). Clinical symptoms of ulnar nerve compression include medial elbow pain, parasthesia or anaesthesia of the distal nerve territory, weakness and muscle atrophy (Radunovic et al., 2012). There are multiple causes of ulnar nerve entrapment such as nerve subluxation/snapping, olecranon injuries, bony deformities/spurring in the condylar groove, intraarticular loose bodies, thickened retinaculum, tumour, or ganglion cyst (Radunovic et al., 2012). Ulnar nerve instability is usually related to an incomplete or absent cubital tunnel retinaculum and is seen in up to 30% of asymptomatic individuals (Martinoli et al., 2001, Bodor and Fullerton, 2010). Ulnar nerve subluxation can also occur secondary to triceps snapping, whereby the distal fibres of the long head of the triceps muscle sublux, displacing the ulnar nerve over the medial epicondyle (Bodor and Fullerton, 2010). Repeated friction against the bony epicondyle can lead to neuritis and functional loss (Martinoli et al., 2001). Neuritis as a result of entrapment or instability usually appears sonographically as marked thickening and hypoechogenicity of the nerve proximal to the point of entrapment, Radunovic et al., 2012). There is often loss of the normal fascicular pattern and there may be hypervascularity with colour/power Doppler imaging (Bianchi and Martinoli, 2007). An enlarged cross-sectional area is a reliable ultrasonic measure of neuritis (Radunovic et al., 2012).

Pitfall: In longitudinal section, the ulnar nerve may appear hypoechoic due to anisotropy (Beggs, 2006). Ensure that the angle of isonation is varied to minimise such artefacts and compare to the contralateral elbow.

Pearl: Dynamically assess ulnar nerve instability relative to the medial epicondyle in transverse section as the elbow is flexed (Martinoli et al., 2001). Compare to the contralateral elbow in order to assess for variations in calibre.

Image 17. Ulnar nerve neuritis. The ulnar nerve appears focally thickened and hypoechoic (Ultrasoundcases, 2015).
Posterior Interosseous Neuropathy

Posterior interosseous nerve (PIN) compression (also Radial tunnel syndrome or Supinator syndrome) occurs at the “arcade of Frohse”, a fibrous tunnel through which the PIN travels as it passes through the superficial and deep heads of the supinator muscle. PIN compression may result in lateral elbow and forearm pain mimicking lateral epicondylitis, and appears sonographically as a thickened, hypoechoic nerve proximal to or within the supinator muscle (Bianchi and Martinoli, 2007).

Pearl: Compare to the contralateral PIN.


Image 19. Focal thickening of the PIN immediately proximal to the level of entrapment (arrowheads)(AIUM, 2015).
Soft Tissue Disorders

Olecranon Bursitis

Olecranon bursitis often develops in response to acute trauma or chronic injury (Bodor and Fullerton, 2010). Sonographically, it appears as bursal wall distention with an intra-bursal collection of hypo- or anechoic material located between the olecranon process and the skin of the posterior elbow (Radunovic et al., 2012, Martinoli et al., 2001). In haemorrhagic and septic bursitis, and crystal deposition disorders, the intrabursal fluid may appear echogenic (Bianchi and Martinoli, 2007). Thickened bursal walls, internal septations and increased vascularity on colour or power Doppler interrogation are associated findings (Martinoli et al., 2001).

Pearl: Note that in some cases, a sub-olecranon bursa may become inflamed and demonstrate similar appearances to olecranon bursitis (Bianchi and Martinoli, 2007).

*Image 20. Olecranon bursitis.*
There are some internal septations visible within the anechoic fluid (Ultrasoundcases, 2015).

**Bicipitocubital Bursitis**

Bicipitocubital (cubital) bursitis appears sonographically as a hypoechoic mass located between the distal biceps tendon and the radial tuberosity, though in some cases it may completely surround the distal biceps tendon (Martinoli et al., 2001, Beggs, 2006, Radunovic et al., 2012). It is often the result of repetitive mechanical injury and may demonstrate thickened walls and internal septations (Radunovic et al., 2012, Martinoli et al., 2001). Echogenic intrabursal bodies have also been reported (Martinoli et al., 2001). Large collections may result in radial or median neuropathy (Beggs, 2006).

**Pitfall:** Care must be taken to differentiate between cubital bursitis and synovial or ganglion cysts and other soft tissue masses (Bianchi and Martinoli, 2007).

![Image 22. Bicipitocubital bursitis. Anechoic fluid can be seen distending the bicipitocubital bursa deep to the brachial artery (Ultrasoundcases, 2015).](image)

**Epitrochlear Lymphadenopathy**

Inflammatory or septic conditions of the upper extremity may lead to reactive enlargement of epitrochlear lymph nodes superior to the medial humeral epicondyle (Martinoli et al., 2001). These appear as ovoid hypoechoic masses with echogenic hila and usually increased vascularity with colour/power Doppler. Central necrosis and liquefaction is also a common finding (Bianchi and Martinoli, 2007).

**Pearl:** It may be helpful to extend the examination to the axilla to determine the extent of affected lymph nodes (Bianchi and Martinoli, 2007).

**Solid Tumours**

Sonographically, solid tumours appear to demonstrate varied echogenicity relative to surrounding tissues, contain internal echoes, and lack posterior enhancement as seen with cystic structures. Benign solid tumours may include lipomas, giant cell tumours of the tendon sheath and pigmented villo-nodular synovitis, while malignant tumours such as synovial sarcomas, myxoid liposarcoma or metastases may occur in the soft tissues (Bodor and Fullerton, 2010).
References


Images


