Magnetic resonance imaging of the elbow

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Learning objectives

The elbow is a complex joint characterized by two degrees of freedom: flexion-extension and pronation-supination. This joint can be divided into four compartments: anterior, posterior, medial and lateral. The purpose of our educational exhibit is to describe our magnetic resonance (MR) imaging approach to several pathological conditions of the elbow. In addition, we will illustrate the cases where MR imaging should be performed with the elbow flexed.
Background

Different MR imaging protocols can be used in the study of the elbow. Our routine protocol include three-plane turbo spin echo (TSE) T1-weighted, fat-saturated axial proton density (FS PD), and short tau inversion recovery sequences. Additional acquisitions with the elbow flexed are performed occasionally, according to findings on conventional sequences.

Some considerations may be done about the scanning planes used in the evaluation of the elbow. Axial planes are very useful to evaluate the neurovascular bundles, the lateral and medial collateral ligamentous complexes, the distal insertion of biceps tendon, brachioradialis tendon and muscle, and the insertion of both extensor and flexor common tendons. However, many of these structures can be effectively assessed on the coronal plane: the lateral and medial collateral ligamentous complexes, the insertion of both extensor and flexor common tendons, and the ulnar nerve. The sagittal plane should be used to study the distal insertion of the triceps brachialis tendon, the coronoid process, the myotendineous junction of the flexors and extensors, the radial-capitellar and the ulnar-humeral joints. Finally, we should be aware that there are some critical zones, such as the ulnar notch and the radial head, that are called 'bare areas' and can be difficult to assess in all planes.
Imaging findings OR Procedure details

The elbow has a very complex anatomy and biomechanic. Its degrees of freedom (pronation-supination and flexion-extension) contribute to the fine mobility of the upper limb. Recently, arthroscopy helped to improve the knowledge of elbow anatomy, without contributing with new information about diseases and their treatment. On the other hand, technical improvement of MR systems, with new surface coils and advanced sequences, resulted in both a reduction of examination time and image quality increase.

Several clinical experiences confirmed the usefulness of MR imaging and MR arthrography in detecting and characterizing elbow disorders with no or very low invasivity.

Pain and functional impairment of the elbow joint have often a traumatic or overload origin and can have a difficult management. Epicondylitis and epitrocleitis are the most common causes of lateral and medial pain. Medial epicondylitis is caused by degeneration of common flexor tendon secondary to overload of the flexor-pronator muscle group. Lateral epicondylitis, also known as “tennis elbow”, is caused by degeneration and tearing of common extensor tendon. In these conditions, histological studies demonstrated the presence of an angiofibroblastic tendinosis. However, other conditions can mimic such affections, such as arthritis, chondropathy or osteochondromatosis. The elbow is a common location of idiopathic synovial osteochondromatosis. It is typically a condition of a middle-age men. Nerve entrapment may be associated with this lesion. Non-ossified nodules may mimic fluid on MR, characterized by metaplasia of the subsynovial soft tissue resulting in cartilage formation within the synovium. Bicipitoradial bursitis are a cause of functional impairment and are particularly frequent in patients who often perform pronation-supination movements. The distal bicipital tendon, is covered by an extrasinovial paratenon and is separated from the radial tuberosity by the bicipital radial bursa. Intravenous gadolinium is helpful in the recognition of this enlarged bursa on MR imaging and may allow differentiation of this benign entity from a solid neoplasm. In the assessment of bursitis, MR imaging can also demonstrate the presence of bone marrow edema or cortical erosions.

Finally, MR arthrography plays a very important role in the surgical planning of patients where instability is suspected. In addition, this imaging technique is valuable in the grading of both tendon damage in lateral and medial epicondylitis and chondropathy.
Fig. 0: Infected olecranic bursitis. Figure 1a. Axial turbo spin-echo T1-weighted sequence. Posteriorly to the olecranon, a gross lesion in the skin is visible, with inhomogeneous signal in the middle (asterisk) and high peripheric signal (arrows). Figure 1b. Sagittal proton density-weighted sequence. High signal intensity is clearly demonstrated inside the lesion (black asterisks), without bone edema or erosion. Note that the enthesis of the triceps tendon is normal (white asterisk).

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Fig. 0: Figure 2a. Axial turbo spin-echo T1-weighted sequence. Patient affected by rheumatoid arthritis. Bone (black arrow) and soft tissues (white arrows) edema are clearly visible. Figure 2b. Axial STIR sequence. High intensity signal can be seen in the olecranon (black arrow) and in the soft tissues (asterisks). Figure 2c. Fat-saturated axial turbo spin-echo T1-weighted and subtracted image sequence (Figure 2d) after intravenous contrast agent administration. White arrow indicate contrast uptake of the distal portion of the olecranon and of the preinsertional portion of the triceps tendon with erosions of the superficial profile (black arrow). Figure 2e. Intensity/time curve show a typical diagram of active inflammation.

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**Fig. 0:** MR arthrography. Patient with functional impairment and suspected instability after a fall on the extended elbow. Figure 3a. Double-echo steady state (DESS) three-dimensional sequence, axial reformating. Complete tear of the lateral collateral ligament of the elbow (arrow) and capsular edema. Figure 3b. Double-echo steady state (DESS) three-dimensional sequence, axial reformating. Irregular appearance of the anterior profile of the radial head. Post-traumatic edema can also be seen (asterisks). Figure 3c. Double-echo steady state (DESS) three-dimensional sequence, sagittal reformating. Sagittal reformating. The lateral collateral ligament is completely torn (arrow). Figure 3d. Axial gradient-echo T1-weighted sequence performed with the elbow flexed. Integrity of the anular ligament can be demonstrated.

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Fig. 0: Epicondylar pain not responsive to medical therapy, epicondylitis. Figure 4a. Sagittal short-tau inversion recovery sequence. Tear and edema of lateral collateral ligament (arrow). Figure 4b, c. After intravenous administration of contrast agent, a relevant uptake can be seen (arrows), given by the presence of granulation tissue.

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Fig. 0: Pain and functional impairment during pronation-supination resistant to medical therapy. Figure 5a. Axial short-tau inversion recovery sequence. A hyperintense nodular area can be seen above the radial tuberosity (asterisk). Figures 5b, c. After intravenous administration of contrast agent, the nodular lesion shows a peripheral contrast uptake. This finding could be referred to a bicipitoradial bursitis.

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**Fig. 0:** Figure 6a. Axial proton density sequence-weighted sequence. Elbow luxation. Relevant edema of both lateral and medial compartment (asterisks) with abundant joint effusion. Subchondral bone edema can be seen also on the capitulum humeri. Figure 6b. Axial fat-saturated proton density sequence-weighted sequence. Full-thickness tear of the ulnar lateral collateral ligament (arrow). Figure 6c. Sagittal turbo spin-echo T2-weighted sequence. The ulnar lateral collateral ligament is completely torn (arrow). Figure 6d. Coronal short tau inversion recovery sequence. Tear of the flexor digitorum superficialis tendon and the anterior band of medial collateral ligament (arrow). Figure 6e. Coronal short tau inversion recovery sequence. Tear of the lateral collateral ligament and of the common extensor tendons (arrow).

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Conclusion

In conclusion, MR imaging and MR arthrography are two imaging techniques that represent the standard of reference in the evaluation of both acute traumatic and chronic degenerative diseases of the elbow.
References


