EXTRINSIC ETIOLOGIES OF ULNAR NERVE INJURY AT THE CUBITAL TUNNEL ILLUSTRATED BY MRI CASES AND LITTERATURE REVIEW

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ABSTRACT

Background: Ulnar nerve entrapment at the elbow is the second most common upper limb neuropathy after carpal tunnel syndrome. MRI plays a pivotal role in evaluating the causes of entrapment. **Case series**: This study retrospectively reviews MRI findings in patients with ulnar neuropathy, presenting a variety of causes, including accessory muscles, osteophytes, synovitis, post-traumatic deformities, ligamentous thickening, and idiopathic/ activity-related cases without visible compressive causes. Four representative cases illustrate the clinical and imaging characteristics of each etiology, emphasizing the importance of recognizing both common and unusual causes of compression. MRI findings, such as increased signal intensity and morphological changes in the ulnar nerve, are essential for diagnosis and management. Even in cases without clear compressive pathology, MRI may reveal indirect signs of neuritis or repetitive stress injury. **Conclusions**: This case-based review highlights the diagnostic value of MRI in identifying diverse causes of ulnar nerve entrapment and underscores the importance of correlating imaging with clinical presentation to guide management strategies.

Keywords: *Ulnar nerve MRI, elbow valgus, cubital tunnel syndrome, ulnar neuropathy.*

I. INTRODUCTION:

Ulnar nerve entrapment at the elbow is the second most common nerve compression syndrome in the upper limb, following carpal tunnel syndrome.[1]The ulnar nerve passes through the cubital tunnel, making it susceptible to various compressive and non-compressive etiologies.[2] Identifying the cause of ulnar nerve dysfunction is critical for proper management and treatment planning. Prevention of compression and early diagnosis/treatment is important for its prognosis because the treatment outcome is usually disappointing once the nerve has axonal damage.[3]

MRI is an imaging modality to assess the location and extent of ulnar nerve injury while clearly revealing structures in the cubital tunnel (CT), determining the cause of nerve compression. Extrinsic causes of ulnar nerve injury in the cubital tunnel are quite diverse, most of which can be seen on MRI with anatomical abnormalities such as accessory muscles, degenerative changes, thickening of ligaments and fascia in the ulnar tunnel, elbow valgus and post-traumatic adhesions. Sometimes the causes of compression are not seen on MRI, often related to neuritis or mechanism of activity – related stresses.[3,4]

This report aims to illustrate different causes of ulnar nerve injury through case presentations and compare them with existing literature.

II. CASES PRESENTATION

Case 1: Anconeus Epitrochlearis Muscle (AE muscle).

A 43-year-old bodybuilder male, presented with progressive numbness in the ring and little fingers of both hands over one year (right>left). Symptoms increased when moving much the fingers and after waking up in the morning. In recent months, the patient felt weakness in the muscles of the fingers on both sides.

Clinical Examination: Positive Tinel's sign at the cubital tunnel, mild atrophy of the hypothenar muscles.

Imaging Findings: MRI revealed an anomalous muscle, likely an anconeus epitrochlearis, compressing the ulnar nerve in the cubital tunnel, both sides.

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Right side:

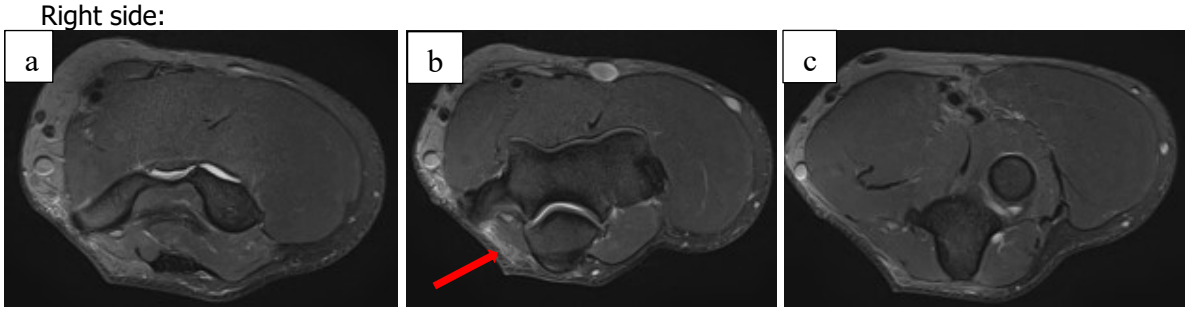

Figure 1: MRI imaging at the right elbow: above CT level (1a), CT level (1b) and below CT (1c). The AE muscle forms the roof of the CT (arrow).

Left side:

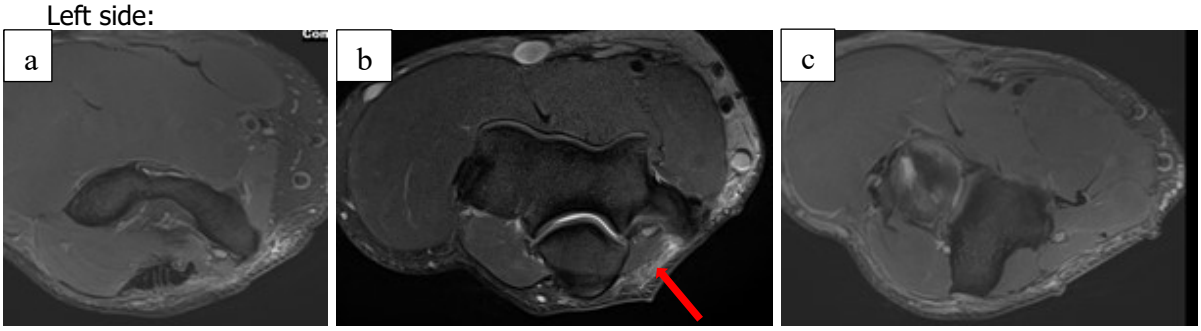

Figure 2: MRI imaging at the left elbow: above CT level (2a), CT level (2b) and below CT (2c). The AE muscle at the CT level (the lateral aspect of ulnar nerve) (arrow).

Management: The patient received conservative treatment with physical therapy for many months, but the symptoms did not improve, and even increased. Surgery was suggested, but the patient had not yet decided.

Case 2: Degenerative changes with osteophytes and synovitis.

A 66-year-old female. She has pain in the ulnar groove of the right hand for several months. The pain gradually increased and numbness spread down to the ring and little fingers on the right. Recently, the patient developed atrophy of the hypothenar muscles. She did not respond to pain medication.

Clinical Examination: The right elbow joint lost 5 degrees of extension. Pain in the ulnar groove, pain and numbness down to the 4th and 5th fingers with claw shape. Froment, Tinnel, Wartenberg tests were positive. The left elbow joint was normal.

Imaging Findings:

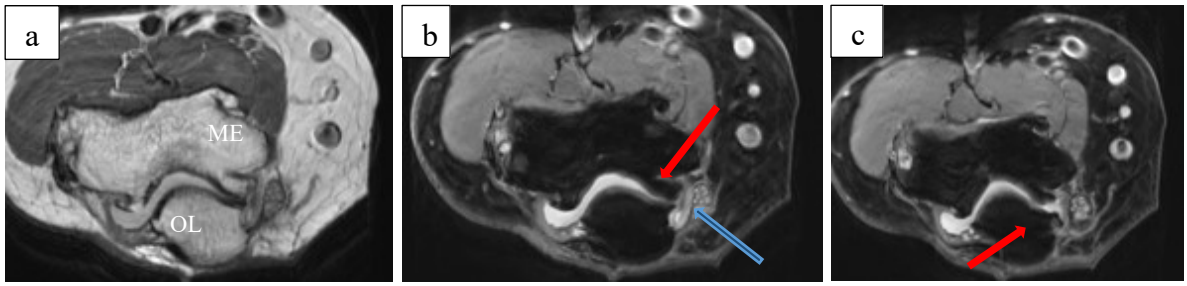

Figure 3: MRI imaging: axial T2W (3a), axial PDFS (3b, 3c) at the CT level presenting osteophytes of posterior aspect of medial epicondyle and medial aspect of olecranon combine with synovitis that compressing the ulnar nerve. The nerve increases the SI and size.

Management: Surgical excision of the osteophyte was performed, bring the ulnar nerve forward. After surgery, the patient no longer had symptoms of ulnar neuropathy.

Case 3: Post-traumatic Elbow Valgus and thickened ligaments.

A 40-year-old female patient, admitted to hospital because of numbness in the right 4th

and 5th fingers lasting 2-3 years, initial symptoms were mild but gradually increased, the more the elbow was flexed, the more the numbness increased.

History: fracture of the right lateral epicondyle of the humerus since the age of 4, currently has elbow joint deformity.

Clinical examination: Elbow valgus. Tinel (+), mild atrophy of the hand intrinsic muscles.

MRI findings: Ulnar nerve has increased the signal intensity and flattening at the CT level. Presence of small AE muscle and thickening of medial collateral ligament and Osborn ligament.

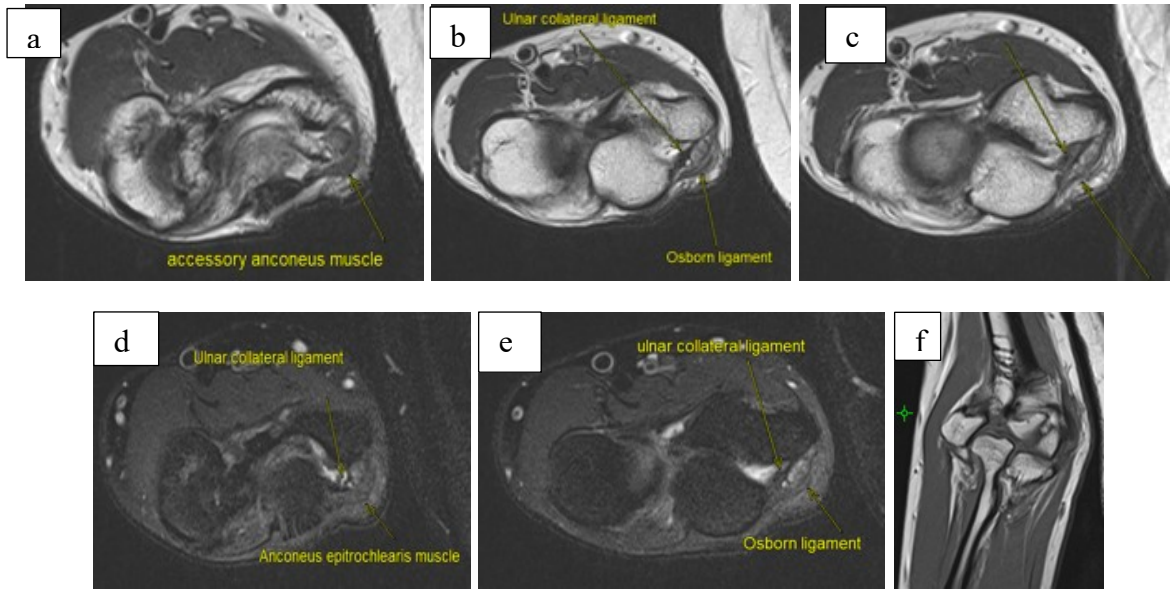

Figure 4: MRI images: axial T2W at CT (4a, 4b, 4c) and axial PDFS at CT (4d, 4e), coronal T1W (4f).

Management: Surgery to separate the nerve from the ulnar groove and bring it forward. About 1 month after surgery, the symptoms subsided. Currently, 5 years after surgery, there is no recurrence of ulnar neuropathy.

Case 4 and case 5: Idiopathic/Activity-induced Cases.

Case 4: A 56-year-old female, writer. Numbness from the right ulnar groove down to the little finger, appears when bending the elbow to write or lying on the elbow area. The patient presented atrophy of the right hypothenar muscles.

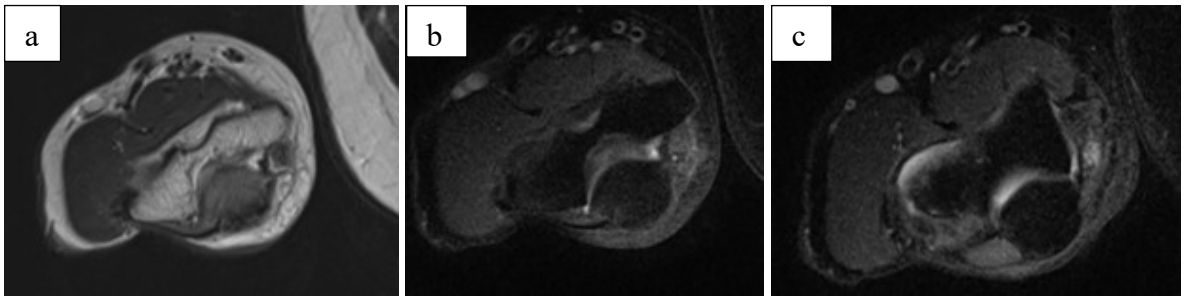

Figure 5: axial T2W (5a), axial PDFS (5b, 5c) showed increasing the ulnar nerve size and SI on PDFS at the CT level. Thickening of the medial collateral ligament (posterior band).

Management: Surgery was indicated but the patient did not agree, so conservative treatment was given, limiting movements that cause numbness (writing in a long time). After 5 years of follow-up, the symptoms did not increase, and the hand and fingers were still able to move well.

Case 5: A 15 years old boy, basketball player, numbness from wrist down to little finger for about 2 weeks. No pain in wrist and fingers.

Clinical examination: Tinel (+), no weakness of muscles innervated by the ulnar nerve.

MRI findings: increased size and signal intensity of the ulnar nerve at the level of the medial epicondyle of the humerus, above the ulnar groove (where the nerve runs most superficially), loss of differentiation of nerve fiber bundles. Surrounding soft tissue edema.

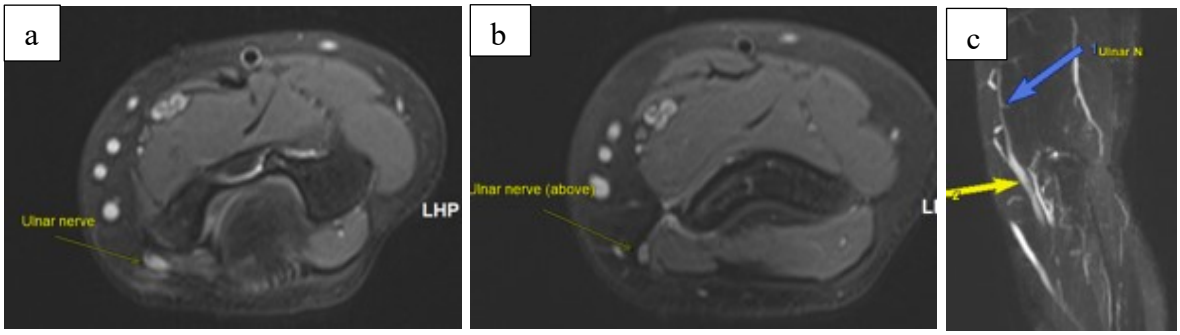

Figure 6: axial PDFS at the CT (6a) and above the CT (6b), coronal STIR 3D with reconstructed the ulnar nerve (6c).

Management: Conservative treatment with limited elbow flexion. Symptoms subsided after 1 month.

III. DISCUSSION

AE muscles, is an anatomical variant present in approximately 4–34% of the population, which originates from the medial humeral epicondyle and attaches to the olecranon, protects the ulnar nerve and prevents subluxation, but it can also be viewed as a potential cause of ulnar nerve compression. When hypertrophied or located in a tight tunnel, it can be a significant source of dynamic or static ulnar nerve compression.[5–8]

Unlike more common etiologies such as Osborne's ligament thickening or osteophyte formation, compression by the anconeus epitrochlearis tends to occur in younger, active individuals, particularly athletes or manual workers, and may present with activity-related symptoms due to dynamic entrapment.[9]

On MRI, the AE appears as a well-defined muscle bundle located posterior to the medial epicondyle, superficial to the ulnar nerve. Its identification is critical for accurate diagnosis, particularly in patients with unexplained ulnar neuropathy and no bony abnormality or ligamentous thickening.

Surgical decompression involving resection of the muscle has been shown to yield excellent outcomes, often superior to simple decompression when the muscle is involved. Therefore, recognizing this variant preoperatively is crucial to optimize treatment planning.[10]

Our case (case 1) is the man with bilateral ulnar neuropathy and presenting both sides of AE muscle hypertrophy. Other muscles in the elbow seem to be larger in a man who is bodybuilder. MRI showed obvious ulnar nerve compression by the AE muscle and physical therapy was unresponsive, however unfortunately the patient did not consent to surgery.

While Osborne's ligament thickening and anatomical variants are frequent causes, degenerative changes such as osteophyte formation and synovial inflammation are also recognized contributors, particularly in middle-aged and elderly individuals.[1 2 11]

Osteophytes at the posteromedial aspect of the trochlea or olecranon may narrow the cubital tunnel and exert direct pressure on the ulnar nerve, especially during elbow flexion. Inflammatory synovial hypertrophy, as seen in chronic joint degeneration or overuse, can further exacerbate compression by increasing soft tissue volume within the tunnel.[12 13]

In our case (case 2), MRI revealed prominent osteophytes encroaching on the ulnar groove along with synovial thickening, leading to visible nerve deformation and signal hyperintensity. These findings are consistent with compressive neuropathy and highlight the importance of imaging in identifying structural causes of ulnar nerve entrapment.

Valgus deformities resulting from previous elbow injuries created chronic traction. Tardy ulnar nerve palsy is a known complication of cubitus valgus. Any increase in a valgus

deformity at the elbow joint would lead to stretching of the nerve resulting in neuropraxia.[14]

The common elbow deformity following an untreated lateral humeral condyle fracture is cubitus valgus. It is a sequela of non-union or malunion of the lateral humeral condyle. Patients with post-traumatic cubitus valgus may present in several ways including limitation of elbow motion, pain, joint instability as well as tardy ulnar nerve palsy.[14]

The Osborne's ligament is variably called the Osborne's fascia, Osborne's band, the arcuate ligament of Osborne, the humeroulnar aponeurotic arcade (HUA), or simply the cubital tunnel retinaculum.[15] The medial collateral ligament (MCL) and elbow joint capsule (JC) form the floor of the cubital tunnel. Osborne reported the ligament as a 2.2-cm (length) by 4 mm (width) structure. James, et al. measured the thickness of the ligament in eight of their 11 cadaver specimens and found that the mean thickness was 0.15 mm with a standard deviation of 0.08 mm.[16] Macchi et al. measured a mean thickness of 0.178 mm [17], and on a magnetic resonance imaging (MRI)-based study, Husarik, et al. found Osborne's ligament to be thickened in eight percent (five of 60) of subjects.[18]

Our patient (case 3) has post traumatic elbow valgus combine with narrowing of the cubital tunnel caused by thickening of the roof (Osborn ligament and AE muscle) and the floor (medial collateral ligament) of tunnel. Two risk factors together cause the ulnar neuropathy. This is a case of complex entrapment parttern.

While MRI is a useful tool to identify structural causes of ulnar neuropathy such as osteophytes, thickened Osborne's ligament, or accessory muscles, some patients demonstrate clinical and electro-physiologic signs of UNE without any obvious compressive lesion on imaging.[13]

In several of our cases, the only notable finding was thickening of the medial collateral ligament (MCL). Although the MCL is not a direct component of the cubital tunnel, its hypertrophy may alter the biomechanical environment of the ulnar nerve. Repetitive valgus stress can cause traction or frictional irritation, especially in patients with prior trauma, instability, or heavy elbow use.[19,20]

Moreover, dynamic or positional compression may not be captured on static MRI. The ulnar nerve can sub-luxate or be compressed transiently during elbow flexion, and peri-neural fibrosis, low-grade synovitis, or adhesions may also play a role in the absence of a distinct compressive mass.[21] In such cases, dynamic ultrasound or intraoperative findings may reveal pathology that MRI misses.[22]

IV. CONCLUSION

Ulnar nerve injury at the elbow can result from various anatomical and pathological conditions. A thorough clinical evaluation combined with imaging studies is essential for accurate diagnosis and appropriate management.

MRI provides valuable diagnostic insights into the diverse etiologies of ulnar nerve entrapment at the elbow. Familiarity with the range of MRI appearances, including subtle or indirect signs and occupational risk factors, aids radiologists and clinicians in accurate diagnosis and optimal management strategies.

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