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Spontaneous Activity in Abductor Digiti Minimi) Adm (As an Early Indicator of the Irritation of the Ulnar Nerve at the Elbow Joint

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Abstract: The cubital tunnel syndrome (CuTS) is a neurological disorder that affects the ulnar nerve as it passes through the elbow joint. It may induce several physical disabilities in the affected person. The early manifestation of CuTS maybe not be well recognized clearly. The abductor digiti minimi (sometimes abductor digiti quinti, ADM) muscle is located on the ulnar side of the palm in human anatomy.
The study aims to evaluate the feasibility of using the early appearance of spontaneous activity in ADM as a predictor of ulnar nerve irritation at the elbow joint.
Patients and method: 67 patients were included in the study, and all of them complained of neurological manifestations. A short segment study for the ulnar nerve at the elbow joint and the Guyon`s canal was done. In addition, needle EMG was done for the ulnar innervated muscles below the level of the elbow joint, including first dorsal interossii (FDI) and abductor digiti minimi (ADM) muscles.
Results: 18 of them show normal NCS of the ulnar nerve. 10 show spontaneous activity by needle EMG in the ADM only, and 9 show normal needle EMG.
Conclusion: the presence of spontaneous activity in the ADM muscle may be the early signs of electro diagnosis of cubical tunnel syndrome.

Keywords: Cubital Tunnel Syndrome, Spontaneous Activity in The ADM, Needle EMG, NCS.

1. INTRODUCTION

The cubital tunnel syndrome is a developing ulnar nerve entrapment neuropathy on the medial side of the elbow. The medial cord in the brachial plexus, which develops from the nerve roots C8 and T1, forms the ulnar nerve, a mixed nerve (motor and sensory). The ulnar nerve passes along the back of the arm, eventually passing via the cubital tunnel and passing posterior

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to the medial epicondyle. The cubital tunnel runs from the humerus's medial epicondyle to the ulna's olecranon process. The ulnar collateral ligament (UCL) is superficial to the nerve and extends deep to the aponeurotic attachment of flexor carpi ulnaris (FCU), commonly known as Osborne's ligament.

The ulnar nerve enters the cubital tunnel when it reaches the proximal border of Osborne's ligament. A chronic irritation and pressure lesion on the places where nerves must pass through limited anatomic gaps and fibrous structures characterize peripheral nerve compression disorders. Paresthesia, sensory impairment, and paresis are the most common clinical manifestations of this sort of compression. Other causes like traction, pressure, or even ischemia of the ulnar nerve, while running through the cubital tunnel on the medial aspect of the elbow can also induce cubital tunnel syndrome.

Cubital tunnel syndrome is the most frequent neuropathy of the ulnar nerve and the 2nd most usually reported upper extremity entrapment neuropathy. Due to the vulnerability of the ulnar nerve to traction, friction, and compression, cubital tunnel syndrome can occur as a result of direct or indirect damage. Traction injuries can occur due to long-term valgus deformity or flexion contractures, but they're most common among throwing sportsmen because of the severe valgus load they put on their arms.

Intermittent traction is a pathogenetic mechanism in which the ulnar nerve becomes locked at single or multiple locations, limiting the nerve's free gliding. In addition, reactive alterations at the MCL, adhesion within the tunnel, hypertrophy of surrounding muscle, or joint modifications can cause nerve compression in the cubital tunnel.

The ADM muscle is one of the interested muscles that receive innervation by the ulnar nerve. The ADM arises from the pisiform bone, pisohamate ligament, and flexor retinaculum. ADM tendon ends distally in 3 slips inserted in the ulnar-palmar margin of the proximal phalanx, a palmar plate of the metacarpophalangeal joint, and the sesamoid bone when present. In addition, some fibres are inserted into the dorsal aponeurosis of the finger, which is the cause that makes the ADM muscle acts similar to the dorsal interosseus muscle. In addition, the ulnar-most part of the ADM tendon is inserted into the digital cord of the little finger, and thus the ADM muscle forms part of a structure that flexes the metacarpophalangeal (MCP) joint and extends the interphalangeal joints.

2. PATIENTS AND METHOD

The study was conducted from April 2020 to November 2021. A total of 67 randomly selected patients with a minor neurological manifestation of ulnar nerve entrapment were enrolled in this study. A cervical spine MRI was done for all of them to exclude any cervical spine problem. A traditional nerve conduction study was done for the upper and lower limbs' sensory and motor fibres to exclude peripheral polyneuropathy. A short segment study for the ulnar nerve along the elbow joint and the Guyon's canal was done for all participants, searching for any ulnar nerve entrapment across the cubital tunnel.

Needle EMG was done for the ulnar innervated muscles below the level of the elbow joint, including the first dorsal interossii (FDI) and (ADM) muscles. The results were analyzed statistically by Q-square calculation using SPSS v.20

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3. RESULTS

Traditional NCS of the ulnar nerve sensory and motor fibres were normal for all the patients. 49 patients were found to have very mild delayed conduction across the elbow joint by a short segment study. Of these, 32 show spontaneous activity by needle EMG in the ADM (SA ADM) only, of which 18 of them show normal NCS of the ulnar nerve. A control groupof additional 100 patients with no neurological manifestations of CuTS were engaged, from which only 2 of them showed SA ADM. There was a significant association between the presence of SA ADM with early diagnosis of CuTS, as shown in table (1):

Table (1): show the statistical significance of SA ADM with early diagnosis of CuTS as compared to patients with no CuTS.

	SA ADM	**No SA ADM**	**P value**
CuTS	18	49	< 0.00261*
Non CuTS	100	2	3.1444

4. DISCUSSION

In general practice, the early diagnosis of CuTS provides a feasible, effective and more beneficial treatment. The likely underlying pathogenesis of CuTS may be (1) A fibrous aponeurosis between two heads of the muscle flexor carpi ulnaris (FCU) that makes the lateral wall of the cubital tunnel thickens when the elbow is in flexion, narrowing the cubital tunnel lacuna and compressing the ulnar nerve (2) Compression of the ulnar nerve while it crossesthe elbow joint by hyperosteogeny or osteophyma, that increase the narrowing of the tunnel (13). (3) Induce that increasing pressure in the cubital tunnel and ulnar nerve tension simultaneously may limit the ulnar nerve's blood supply, resulting in ischemia necrosis, demyelination, and Wallerian degeneration. In the early stages of severe cubital tunnel syndrome, transient ischemia develops into persistent ischemia and intraneural damage in severe cubital tunnel syndrome. First, the ulnar nerve becomes demyelinated. The elbow's motor nerve conduction velocity is slowed (50 m/s). Axonal loss can occur if nerve compression is not addressed. Symptoms will be permanent at this stage, and motor loss willbe gradual. On NCS, the amplitude will be reduced, and electromyography (EMG) will reveal abnormal activity during the needle insertion phase; there may be positive sharp waves/fibrillations during the resting phase, and overall decreased motor unit action potential (MUAP) volitional activity within ulnar-innervated hand muscles (i.e., ADM).

In one investigation, short segment NCS (SSNCS)-detected compressed lesions were also proved by the gross anatomy and the surgery, with the most prevalent location matching the anatomy characteristic. As a result, the short segment NCS can pinpoint precise lesion sites for surgery. In diagnosing and assessing CubTS treatment effects, 2 cm above the medial epicondyle level should be given special attention. It aids clinicians in diagnosing, prognosis, and evaluating CubTS treatment effects.

The CubTS was identified in all of the individuals in a study who exhibited limb numbness due to a standard nerve conduction test. Routine motor NCS testing revealed 41 asymptomatic limbs to be normal, whereas an inching test revealed 17 limbs to be aberrant. According to the study, short segment NCS may be more sensitive in identifying CubTS and

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can detect mild and subclinical abnormalities. SSNCSs had an 81 per cent sensitivity in the Azrieli et al. The investigation, while conventional MNCS had a 24 per cent sensitivity. SSNCS has a sensitivity of 76 to 90%, according to Omejec et al., which was greater than the standard long-segment nerve conduction study.
On the other hand, some studies believe that false-positive findings of SSNCSs over the elbow are caused by a technical mistake due to ulnar nerve displacement. The elbow's position was the cause of nerve displacement and measuring inaccuracy of nerve distance In conclusion, we recommend that patients with symptoms of ulnar nerve deficits perform a neural electrophysiological study.

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