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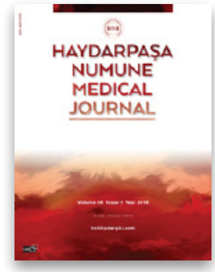

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ORIGINAL ARTICLE

Clinical and Electrophysiologic Approach to Ulnar Nerve Entrapment Neuropathies Proximal to the Elbow

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Abstract

Introduction: To evaluate the clinical and electrophysiologic features of ulnar nerve entrapment neuropathies proximal to the medial epicondyle, especially those caused by working while leaning on the elbow.

Methods: In this study, the data of 234 patients who were admitted to the EMG Laboratory of the neurology clinic with complaints of numbness in the fourth and fifth fingers, ulnar weakness, and in addition, ulnar entrapment neuropathy was detected in their electrophysiological examinations. In 175 (74.8%) of these patients, ulnar entrapment neuropathy was detected proximal to the medial epicondyle. The study was continued with these 175 patients. The findings obtained from the electrophysiological and clinical examinations of the patients were analyzed.

Results: Entrapment was in the left side in 96.57% of the patients, whereas it was right-sided in 3.43% ($p<0.001$). Ulnar nerve motor responses were investigated as above elbow, under elbow, and wrist. Above elbow latency, motor response duration, amplitude and field results were measured as 8.69±1.24 ms, 12.56±2.73 ms, 3.64±2.24 mV and 11.62±7.37 mV*ms, respectively. When compared the results of above elbow with wrist and under elbow, amplitude and field were decreased and latency were prolonged ($p<0.001$, $p<0.001$, $p<0.001$, respectively). There wasn't statistical difference between the groups in the ulnar nerve motor response duration ($p<0.001$). Above elbow to under elbow nerve conduction velocity was 33.98±8.35 m/s, and under elbow to wrist nerve conduction velocity was measured as 61.99±4.23 m/s. Above elbow to under elbow conduction velocity was found to be slower ($p<0.001$). Demyelinating lesions were detected in 83.4% and axonal lesions in 16.6%.

Discussion and Conclusion: It was shown that ulnar nerve entrapment proximal to medial epicondyle was the most common type among all ulnar nerve entrapments. This acute entrapment was associated with hand dominance and was most commonly seen in demyelinating character.

Keywords: Entrapment neuropathy; electromyography; ulnar nerve.

Ulnar neuropathy is the second most common upper limb entrapment neuropathy after median nerve entrapment at the wrist[1-3]. The literature states that the ulnar nerve is most commonly entrapped at the elbow and that it can also be entrapped at the wrist, forearm, and arm[4]. Furthermore, unlike median nerve entrapment at the wrist, it is quite difficult to locate the lesion electrophysiologically in patients with ulnar neuropathy[3,5,6]. The

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typical and most common finding of ulnar neuropathy at the elbow (UNE) is numbness and tingling in the 4th and 5th fingers[7-9]. Lower trunk or medial cord plexopathy, C8/T1 radiculopathy, early motor neuron disease, and polyneuropathy should be considered in the differential diagnosis because they may cause similar clinical symptoms[3,9].

In this study, in patients admitted to the electromyography (EMG) laboratory with symptoms of numbness in the fourth and fifth fingers and ulnar weakness, we aimed to investigate the frequency of ulnar entrapment at proximal to the medial epicondyle, the relationship between the side of ulnar entrapment and hand dominance, and the correlation between the occupation, posture of the arm in use and ulnar entrapment.

Materials and Methods

In this study, 175 patients who were admitted in our EMG laboratory with acute numbness in the 4th and 5th fingers and were diagnosed as having ulnar entrapment proximal to the medial epicondyle were retrospectively investigated. Ethics approval was obtained from the Ethics Committee of Istanbul Training and Research Hospital Hospital (Approval date: 02.05.2008, Approval number: 5/8).

Patients with neurologic diseases, such as cervical discopathy, syringomyelia, brachial plexopathy, and motor neuron disease; with peripheral polyneuropathy due to diabetes or other systemic causes; with chronic ulnar neuropathy; and those with pathologies, such as a fracture in the elbow, and incising injuries and stab wounds were excluded from the study. Patients with acute numbness in the 4th and 5th fingers, sensory defects in the ulnar nerve area, and weakness of ulnar nerve innervated muscles, and positive Tinel's sign in the elbow were included in this study.

Neurologic examinations of all patients were performed. The finding of ulnar Tinel's sign, sensory impairment in ulnar nerve dermatome or reduced ulnar nerve motor strength were also evaluated. An EMG examination was performed on each patient. A Nihon Kohden EMG instrument was used for EMG recording. Ulnar nerve motor responses were achieved with the classic method by stimulating the ulnar nerve at the wrist, under-elbow, above-elbow, medial epicondyle and axilla, and by recording from the abductor digiti minimi (ADM) muscle. The ulnar nerve motor responses were also evaluated using the method of "inching" by stimulating the ulnar nerve between the wrist and axilla, beginning from 5 cm below the elbow and reaching the level where the conduction block was supposed to be found, at intervals of 1 cm. The median nerve motor responses were obtained by stimulating the median nerve at the wrist and elbow and recording from the Abductor pollicis brevis (APB) muscle. Sensory responses of the 3rd and 5th fingers, which belong to the median and ulnar nerves, respectively, were achieved by stimulating them at the wrist and recording from fingers using ring electrodes with the antidromic method. In all patients with axonal involvement, comparisons were made with the opposite side 3rd and 5th finger sensory responses. Sensory nerve conduction velocities were measured using peak latencies. SNAP amplitude was between basal line and negative peak line. Stimulation duration was set to 0.2 ms for motor stimulations and 0.1 ms for sensory stimulations. All studies were performed with supramaximal stimulation. The filter range was 20 Hz-2 kHz for sensory studies and 5 Hz-10 kHz for motor studies. The skin temperature of all patients who underwent nerve conduction studies was kept between 31 °C and 34 °C. In our EMG laboratory, surface electrodes were used for all neurographic tests. In the patients' needle EMG examination, ADM, first dorsal interosseous (FDI), and flexor carpi ulnaris (FCU) muscles were punctured using concentric needle electrodes and spontaneous and voluntary activities were recorded. After that, the patients were checked 30 days later and EMG examinations were repeated. The same protocol was applied in the follow-up studies to discover a possible pseudo-conduction block.

References and Normal Values

We used an average of ± 2 standard deviations (SD) for the control limit values of our laboratory, which equated to approximately 90% safety limits (Table 1). We used the deviation score from the normal mean (Z score), i.e., the standard deviation of the normal mean for individual patients[10,11].

Statistical Analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) Version 20 program (IBM Corporation; Armonk, NY, USA). Descriptive statistical analyses (mean, median and standard deviation) were performed. Pearson's Chi-square test was used to compare qualitative variables. For normally distributed quantitative variables, one-way analysis of variance (ANOVA) was used

Table 1. Normal values of our EMG laboratory

	Motor Response	Sensory Response
Amplitude Lower Limit	mV	µV
Ulnar	6.5	15
Median	5.4	20

to compare three groups. For abnormally distributed quantitative variables, the Kruskal-Wallis test was used to compare three groups. The statistical significance level was set at $p<0.05$.

Results

In our examination in the EMG laboratory archive, we found that in 175 (74.78%) of 234 patients who were reported as ulnar entrapment neuropathy, trapping was at the proximal of medial epicondyle (Fig. 1). This study was performed with the data of these 175 patients.

A total of 175 patients [91 (52%) women and 84 (48%) men] who presented with acute numbness in 4^{th} and 5^{th} fingers were included in this study. The mean age of the patients was 38.69 (range, 19-67) years (Table 2).

Electrophysiologic examinations of the patients were performed on average 16.1 days after their symptoms started (standard deviation: 4.55). According to their anamneses, 52 patients (29.7%) said they could not remember how their symptoms began, and all other patients reported that they worked by leaning on the elbow at the beginning of their symptoms. Of those, 28 (16%) reported that they leaned on the elbow while they were working with a computer, 48 reported (27.4%) leaning on the elbow because of their occupation, and 47 patients (26.9%) reported that they leaned on the elbow while they were thinking (Fig. 2).

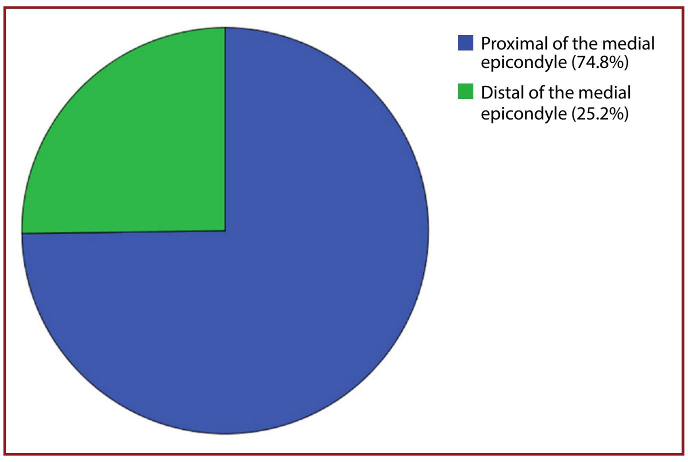

Figure 1. Localization of trapping in ulnar nerve entrapment neuropathies (n=234).

Table 2. Demographic features of participants (n=175)	
Demographic features	**n=175**
Sex (M/F); n	84/91
Side (R/L);	6/169
Age (year)	
Mean±SD	38.7±10.34
Median (Range)	37 (18-67)
Time (day)	
Mean±SD	16.16±4.55
Median (Range)	15 (8-35)

n: number of the samples; M: Male; F: Female; R: Right; L: Left.

In 169 (96.57%) patients, the entrapped side was the left arm, whereas entrapment was right-sided in six (3.43%) patients.

When the side of the entrapment was examined according to hand dominance, all six patients (100%) with right-sided entrapment were left-handed, and only one (0.6%) of the 169 patients ($p<0.001$) with left-sided entrapment were left-handed. Proximal ulnar nerve entrapment showed significant association with hand dominance.

Motor Responses

Latency: The mean distal latency of the ulnar nerve (wrist) was 2.58±0.38 ms. Under elbow and above elbow latency averages were 4.30±0.90 ms and 8.69±1.24, respectively. The averages of above elbow latency were found to be statistically significantly longer (Table 3).

Duration: The ulnar nerve motor response duration averages of the patients were 12.22±2.87 ms in the wrist, 12.59±2.89 ms under elbow, 12.56±2.73 ms above elbow. There was no statistical difference between nerve conduction duration averages ($p>0.05$).

Velocity: The average of ulnar nerve conduction velocity was measured as 61.99±4.23 m/s wrist – under elbow. In addition, it was found as 33.98±8.35 m/s under elbow - above

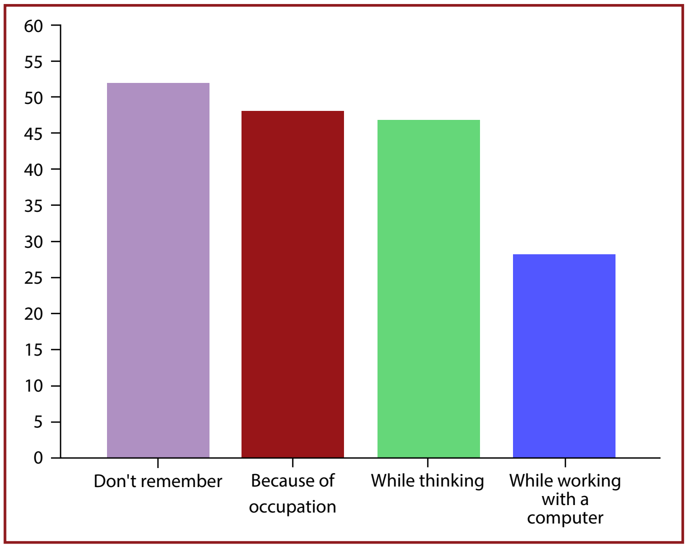

Figure 2. The reason for the occurrence of ulnar entrapment neuropathy according to the detailed clinical history (n=175).

Table 3. Ulnar nerve motor responses (n=175)

	Ulnar nerve motor responses			
	Wrist	Under Elbow	Above the Elbow	p
Latency (ms)				
Mean±SD	2.58±0.38	4.30±0.90	8.69±1.24	[b]<0.001*
Median	2.50	4.15	8.60	
(Min-Max)	(1.75-4.0)	(2.15-7.40)	(5.85-14.10)	
Duration (ms)				
Mean±SD	12.22±2.87	12.59±2.89	12.56±2.73	[b]0.30
Median	11.60	11.80	11.9	
(Min-Max)	(6.4-20.6)	(6.85-21.9)	(6.1-21.4)	
Amplitude (mV)				
Mean±SD	6.92±2.31	6.93±2.31	3.64±2.24	[a]<0.001*
Median	6.62	6.76	3.44	
(Min-Max)	(2.16-15.0)	(1.46-14.6)	(0.07-11.7)	
Field (mV*ms)				
Mean±SD	23.18±8.09	21.99±7.96	11.62±7.37	[a]<0.001*
Median	22.10	21.0	11.4	
(Min-Max)	(5.6-57.4)	(6.4-56.4)	(0.10-43.6)	

[a]One-way Anova; [b]KruskalWallis Test; *p<0.05.

elbow. Under elbow-above elbow conduction velocity was statistically significantly decreased (p<0.05) (Table 4).

Amplitude: The amplitude averages of the ulnar nerve motor responses were 6.92±2.31 mV at the wrist, 6.93±2.31 mV under elbow, and 3.64±2.24 mV above elbow. The mean amplitude above elbow was statistically significantly lower than the wrist and under the elbow (p<0.05) (Table 3).

Field: The mean field of ulnar nerve motor responses was 23.18±8.09 mV * ms at the wrist, 21.99±7.96 mV * ms under elbow, 11.62±7.37 mV * ms above elbow. The mean field of above elbow was statistically significantly lower than the wrist and under the elbow (p<0.05) (Table 3).

The mean ulnar nerve conduction block was 48.56±24.23% in the patients.

Table 4. Ulnar nerve conduction velocity (n=175)

	Wrist-Under Elbow	Under Elbow-Above Elbow	p
Conduction velocity (m/s)			
Mean±SD	61.99±4.23	33.98±8.35	
Median	62.3	33.3	[a]<0.001*
(Min-Max)	(51.1-69.9)	(16.1–48.8)	

[a]Independent Sample t-test; *p<0.05.

Sensory Responses

The mean ulnar nerve sensory latency was 2.26±0.29 ms, the mean ulnar nerve sensory duration was 2.93±0.58 ms, the mean ulnar nerve sensory amplitude was 42.83±22.82 μV, and the average ulnar nerve sensory field was 32.70±17.47 μV*s in the fifth finger (Table 5).

When the distribution of our patients according to lesion type was examined, it was observed that there were demyelinating lesions in 146 (83.4%) patients and axonal lesions in 29 (16.6%) patient In the other words, it was observed that 29 (16.6) of the patients had gone through the axonal involvement process in follow-up examinations performed 30 days later.

In 13 of the 175 (3 men, 10 women) patients, two-sided carpal tunnel syndrome (CTS) was also detected. The mean ulnar nerve motor conduction block was 57.72±20.74% in 13 patients with CTS. There was no significant relationship between the severity of ulnar motor conduction block in these patients with mild-to-moderate CTS compared with the other patients (p=0.588).

Discussion

In our study, unlike other studies, we found the distribution of sexes to be approximately equal[12].

When we looked at the distribution of the 175 patients by age, in contrast to previous studies, we found that the mean age was younger and the age range reflected younger ages[13,14].

Table 5. Sensory responses of ulnar nevre (n=175)

	Sensory responses of ulnar nerve Wrist
Latency (ms)	
Mean±SD	2.26±0.29
Median	2.3
(Min-Max)	(1.6-3.5)
Duration (ms)	
Mean±SD	2.93±0.58
Median	3.0
(Min-Max)	(1.3-5.0)
Amplitude (μV)	
Mean±SD	42.83±22.82
Median	39.8
(Min-Max)	(3.40-112.0)
Field (μV*sn)	
Mean±SD	32.71±17.47
Median	31.0
(Min-Max)	(3.1-86.6)

The most important finding in our study was the distribution of the patients according to the side of entrapment; the most entrapped side was the left arm. In addition, when the side of entrapment was examined according to hand dominance, we found entrapment on the left in the right-handed patients and on the right in the left-handed patients. When we looked at the literature, although there were many studies on UNE, there were very few studies on the side distribution of entrapment[13]. Based on all these data, we believe that proximal ulnar nerve entrapment has a significant relationship with hand dominance. As can be easily observed in daily life, people with right-hand dominance usually place their left arm on their chin and lean on their elbows on tables or similar items (deep thinking position). They listen, read, write or use computers leaning on their left elbows. In the same way, they use the phone with their left-hand and keep their right-hand idle to take notes. People with left-hand dominance have the opposite situation.

Of the 175 patients enrolled in this study, detected in 123 (70.2%) that they were working leaning on their elbows at the beginning of their symptoms. We think that repetitive and continuous flexion causes ulnar neuropathy by stretching the ulnar nerve and increasing the pressure. Previous studies reported that heavy labor was a risk factor in the development of ulnar nerve entrapment neuropathy[15, 16]. This view was also supported in musicians using string instruments with a high risk of developing ulnar nerve entrapment neuropathy in the arm (usually on the left) due to performing repetitive strong grip movements[17]. However, to our knowledge, there is no study in the literature exploring the relationship of ulnar nerve entrapment neuropathies with prior occupation and hand dominance.

The most common lesion type in the ulnar nerve was the demyelinating type lesion. In these patients, motor conduction block was detected with above-elbow stimulation and 5th finger sensory responses were obtained with normal amplitude. Studies have shown ulnar nerve entrapment neuropathies proximal to the elbow. However, to our knowledge, there is no study in the literature that examines the medial epicondyle proximal entrapment clinically and electrophysiologically[18,19].

Entrapment proximal of the elbow usually occurs due to acute and long-term leaning, and demyelinating involvement is predominantly seen.

Conclusion

Ulnar nerve entrapment neuropathy proximal to the elbow was frequently identified in ulnar nerve entrapment neuropathies. If electrophysiologic examinations are not conducted in the early period, it can be easily missed and patients may receive misdiagnoses. We think that our study is significant concerning showing the relationship between ulnar nerve entrapment neuropathies proximal to the elbow and hand dominance, occupation, and posture of the arm with symptoms.

Ethics Committee Approval: Istanbul Training and Research Hospital Ethics Committee. Approval date: 02.05.2008, Approval number: 5/8.

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Conflict of Interest: None declared.

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References

1. Katirji B. The clinical electromyography examination. An overview. Neurol Clin 2002;20:291–303. [CrossRef]
2. Mondelli M, Giannini F, Ballerini M, Ginanneschi F, Martorelli E. Incidence of ulnar neuropathy at the elbow in the province of Siena (Italy). J Neurol Sci 2005;234:5–10. [CrossRef]
3. Preston DC, Shapiro BE. Electromyography and Neuromuscular Disorders. Ulnar Neuropathy at the Elbow. 2nd ed. Pennsylvania: Butterworth-Heinemann Pub, 2005: 291–313.
4. Omejec G, Podnar S. Precise localization of ulnar neuropathy at the elbow. Clin Neurophysiol 2015;126:2390–6. [CrossRef]
5. Nainzadeh NK, Ilizarov S, Piligian G, Dropkin J, Breyre A. Ulnar neuropathy at the elbow in computer keyboard operators. Work 2011;39:93–101. [CrossRef]
6. Bolster MA, Zöphel OT, van den Heuvel ER, Ruettermann M. Cubital tunnel syndrome: a comparison of an endoscopic technique with a minimal invasive open technique. J Hand Surg Eur Vol 2014;39:621–5. [CrossRef]
7. Kincaid JC. AAEE minimonograph #31: the electrodiagnosis of ulnar neuropathy at the elbow. Muscle Nerve 1988;11:1005–15. [CrossRef]
8. Logigian EL. Entrapment and other focal neuropathies. Neurology Clinics. 1999;17:447–461. [CrossRef]
9. Katirji B. The clinical electromyography examination. An overview. Neurol Clin 2002;20:291–303. [CrossRef]
10. Tankisi H, Pugdahl K, Fuglsang-Frederiksen A, Johnsen B, de Carvalho M, Fawcett PR, et al; Esteem Project. Pathophysiology inferred from electrodiagnostic nerve tests and classification of polyneuropathies. Suggested guidelines. Clin Neurophysiol 2005;116:1571–80. [CrossRef]
11. Fuglsang-Frederiksen A, Pugdahl K. Current status on electrodiagnostic standards and guidelines in neuromuscular disorders. Clin Neurophysiol 2011;122:440–455. [CrossRef]

12. Pelosi L, Tse DMY, Mulroy E, Chancellor AM, Boland MR. Ulnar neuropathy with abnormal non-localizing electrophysiology: Clinical, electrophysiological and ultrasound findings. Clin Neurophysiol 2018;129:2155–2161. [CrossRef]
13. Omejec G, Podnar S. What causes ulnar neuropathy at the elbow? Clin Neurophysiol 2016;127:919–924. [CrossRef]
14. Scheidl E, Böhm J, Farbaky Z, Simó M, Bereczki D, Arányi Z. Ultrasonography of ulnar neuropathy at the elbow: axonal involvement leads to greater nerve swelling than demyelinating nerve lesion. Clin Neurophysiol 2013;124:619–25. [CrossRef]
15. Bartels RH, Verbeek AL. Risk factors for ulnar nerve compression at the elbow: a case control study. Acta Neurochir (Wien) 2007;149:669–74. [CrossRef]
16. Svendsen SW, Johnsen B, Fuglsang-Frederiksen A, Frost P. Ulnar neuropathy and ulnar neuropathy-like symptoms in relation to biomechanical exposures assessed by a job exposure matrix: a triple case-referent study. Occup Environ Med 2012;69:773–80. [CrossRef]
17. Lederman RJ. AAEM minimonograph #43: neuromuscular problems in the performing arts. Muscle Nerve 1994;17:569–77. [CrossRef]
18. Beekman R, Wokke JH, Schoemaker MC, Lee ML, Visser LH. Ulnar neuropathy at the elbow: follow-up and prognostic factors determining outcome. Neurology 2004;63:1675–80. [CrossRef]
19. Visser LH, Beekman R, Franssen H. Short-segment nerve conduction studies in ulnar neuropathy at the elbow. Muscle Nerve. 2005;31:331–8. [CrossRef]