CLINICAL AND ELECTROPHYSIOLOGICAL FINDINGS IN THE EVALUATION OF ULNAR NEUROPATHIES AT THE ELBOW
Dirsek düzeyindeki ulnar nöropatilerin değerlendirilmesinde elektrofizyolojik bulgular

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Abstract

Purpose: *The current study was performed to evaluate clinical and electrodiagnostic findings in patients with ulnar nerve entrapment at the elbow.*

Materials and Methods: *A retrospective study was performed on patients who were evaluated at the University of Gazi, Department of Neurology, Ankara, for ulnar nerve entrapment neuropathy at the elbow. Thirty patients who were referred to our EMG laboratory over the past ten years for evaluation of possible ulnar neuropathy at the elbow were investigated.*

Results: *The results of the inching study: localization of compressive ulnar neuropathy at the cubital tunnel was documented by the inching method in 13 elbows and tardy ulnar palsy was documented in 17 elbows.*

Conclusion: *Our study showed that tardy ulnar palsy at the elbow (sulcal compression syndrome) was more common than the cubital tunnel syndrome.*

Key Words: *Elbow, Paralysis, Ulnar Neuropathies*

Özet

Amaç: *Bu çalışma dirsek düzeyi ulnar nöropatisi olan hastaların klinik ve elektrodiagnostik bulgularının değerlendirilmesi amacıyla yapıldı.*

Gereç ve Yöntem: *Bu çalışma Gazi Üniversitesi Nöroloji Kliniğinde değerlendirilerek dirsek düzeyi ulnar nöropatisi tesbit edilmiş olan hastalarda retrospektif olarak hazırlandı. EMG laboratuarında son on yılda dirsek düzeyi ulnar nöropati saptanan 30 hasta çalışmaya alındı.*

Bulgular: *Santimleme yöntemiyle değerlendirilen dirsek düzeyi ulnar nöropatili hastaların 13'ünde kubital tünel, 17'sinde tardi ulnar paralizi tesbit edildi.*

Sonuç: *Bu çalışma dirsek düzeyi ulnar nöropatilerde tardi ulnar paralizinin kubital tünel sendromundan daha sık olduğunu göstermektedir.*

Anahtar Kelimeler: *Dirsek, Paralizi, Ulnar nöropatiler*

Ulnar neuropathy at the elbow is the second most frequent entrapment neuropathy occurring in adults (2,8). Despite its clinical frequency, it is often difficult to diagnose with routine electrophsiological studies. The diagnosis of ulnar nerve entrapment at the elbow can often be made on the basis of clinical history and physical examination. The use of routine electodiagnostic techniques to evaluate ulnar neuropathy, first described by Simpson (1) in 1956, can be helpful, but localization of the lesion can be difficult and not always reliable (1). Localization of the pathological process is important, because the ulnar nerve is susceptible to injury at the wrist, elbow or upper arm. Lower trunk brachial plexus and root level lesions also may present similar symptoms and must be differentiated. The current study was performed to evaluate clinical and electrodiagnostic findings in patients with ulnar nerve entrapment at the elbow.

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MATERIALS AND METHODS

A retrospective study was performed on patients who were evaluated at the Universty of Gazi, Department of Neurology, Ankara, for ulnar nerve entrapment neuropathy at the elbow. Thirty patients who were referred to our EMG laboratory over the past ten years for evaluation of possible ulnar neuropathy at the elbow were investigated. All had paresthesias in the ulnar distrubition of greater than one weeks duration symptom, duration range from 8 days to 5 years (mean 2,4

years). Exclusion criteria were neurological symptoms, a self reported history of a systemic illness or disorder affecting the central or peripheral nervous systems, or occupational exposure to forceful or repetitive hand exertions or traumatic ulnar nerve damage.

The total study population consisted of 30 patients (18 men, 12 women). The mean age of the study population was 43 years (range 17-68 yr). Patients whose history and physical examination were consistent with ulnar entrapment neuropathy at the elbow were included in the study population. The patients were staged into Groups 1,2 or 3, according to the severity of clinical symptoms and findings as described by Dawson et al (1) (Table II). Group 1 had recent and mild symptoms of intermittent paresthesias and hypoesthesia. Group 2 had persistent symptoms and varying degrees of weakness and intrinsic muscle atrophy. Group 3 had marked intrinsic muscle atrophy, weakness and deformity of the hand.

Symptoms that were considered compatible with a diagnosis of ulnar nerve entrapment at the elbow included numbness and paresthesias of the fourth and fifth digits and weakness and clumsiness of the hand. The physical examination was consistent with sensory and motor dysfunction in the ulnar nerve, occurring proximal to the wrist and distal to the brachial plexus. Criteria included sensory dysfunction in the fourth and fifth digits and dorso-ulnar aspects at the wrist, as well as weakness of muscles that are innervated by the ulnar nerve, including the flexor carpi ulnaris, the flexor digitorum profundus of the fifth digit, the dorsal and palmar interossei and the adductor longus muscles.

All patients in the study population underwent electrodiagnostic evaluation of the ulnar nerve, including sensory and motor conduction velocities, inching studies across the elbow and electromyography of the muscles innervated by the ulnar nerve. The presence of ulnar neuropathy, the site of compression and the denervation of muscles innervated by the ulnar nerve were documented (Table I). All studies were performed using a Medelec 4- channel Electromyograph. Temperature of the limb was maintained at >31°C using a feedback- controlled infrared heating lamp with the sensor placed in the palm of the hand.

Motor Conduction Studies: Compound muscle action potentials were recorded from the abductor digiti quinti using surface electrodes placed over the muscle belly (G1) and its tendinous insertion (G2). Percutaneous supramaximal stimuli were delivered with a Medelec bipolar stimulator. Stimulating cathodes were placed at 3 standard points along the length of the ulnar nerve. Wrist (5 cm proximal to G1), below elbow (at least 3.5 cm distal to medial epicondyle), and above elbow (at least 10 cm from above elbow site). Latency to the onset of the evoked compound muscle action potential was measured as well as amplitude from baseline to the negative peak. The ulnar nerve was stimulated supramaximally at the wrist and then at each of 5 points, 2 cm apart, spanning the elbow ("inching" technique) (9).

The "short segment stimulation (SSS) technique" (or "inching" technique) of the motor conduction has become a standard method of testing for ulnar neuropathy at the elbow. This technique can pinpoint a lesion to the exact site of compression and can distinguish cubital tunnel syndrome from tardy ulnar nerve palsy (retrocondylar compression). If the lesion is localized to more than 2 cm distal to the medial epicondyl, the diagnosis of cubital tunnel syndrome can be made . On the other hand, if the lesion is localized to the medial epicondyl or proximal to it, retrocondylar compression syndrome can be diagnosed. This distinction is important in determining therapeutic strategy: In cubital tunnel syndrome decompression of the cubital tunnel is required, whereas for retrocondylar compression syndrome anterior transposition of the ulnar nerve is recommended (4,7).

Sensory Conduction Studies: Sensory nerve action potentials were obtained by orthodromic techniques. Latency to the onset of the negative

peak was measured. Amplitudes were measured from peak to peak. Segmental conduction velocities were calculated for the wrist to below elbow and the below to above elbow segments.

Mixed Nerve Conduction Studies: Mixed nerve potentials were recorded from the below elbow and above elbow sites. Latency and amplitude measurements and segmental conduction velocities were determined as described for sensory studies.
Electromyography: Concentric needle electrodes were used for examination of abductor digiti quinti (ADQ), first dorsal interosseous (FDI), and flexor carpi ulnaris (FCU) muscle. Insertional activity, spontaneous activity, motor unit potential configuration and recruitment pattern were recorded.

RESULTS

The mean age for men was 47.7 (cubital tunnel: 47.3 yr, tardy ulnar palsy. 48.1 yr) years and for women 41.9 years (cubital tunnel: 48.4 yr, tardy ulnar palsy. 35.4 yr). The results of the clinical evaluation of all patients in the study population were consistent with a diagnosis of ulnar nerve entrapment at the elbow. Staging the degree of entrapment on the basis of the classification proposed by Dawson et al. (1) revealed that 11 (37%) elbows of 30 patients were staged as Group 1 (mild) (2 cubital tunnel syndrome, 9 tardy ulnar palsy), 13 (43%) of 30 patients were in Group 2 (moderate) (7 cubital tunnel syndrome, 6 tardy ulnar palsy), 6 (20%) of 30 patients were in group 3 (severe) (4 cubital tunnel syndrome, 2 tardy ulnar palsy) (Table I).

Electrodiagnostic evaluation confirmed ulnar neuropathy at elbow. The results of the " inching" study: localization of compressive ulnar neuropathy at the cubital tunnel was documented by nerve conduction studies in 13 elbows (43%) of 30 patients, and denervation on the basis of electromyographical examination was seen in 10 (33%) of the 30 elbows in the study population (Table I). Tardy ulnar palsy was documented by nerve conduction studies in 17 elbows (57%) of 30 patients, and denervation on the basis of electromyographical examination was seen in 9 (30%) of the 30 elbows in the study population.

In our study group, 63% of patients (33% cubital tunnel syndrome, and 30% tardy ulnar palsy) showed needle exam abnormalities (fibrillations and positive sharp waves) in ADQ muscle. Thirty three percent patients with cubital tunnel syndrome had ADQ abnormalities. Of these, 50% was in Group 2 and 30% in Group 3 and 20% in Group 1. Thirty percent patients with tardy ulnar palsy had ADQ abnormalities. Of these, 44% was in Group 2, 22% in Group 3 and 33% in Group 1.

Sixteen percent of patients (60 % cubital tunnel syndrome, and 40 % tardy ulnar palsy) showed needle examination abnormalities (fibrillations and positive sharp waves) in FDI muscle. Half of the patients with tardy ulnar palsy and FDI muscle neddle abnormalities were in Group 2, the other half was in Group 3. All the cubital tunnel syndromes with FDI needle abnormalities were in Group 3.

Thirty percent of the total group also had abnormalities in the FCU abnormalities (55% cubital tunnel syndrome, and 45% tardy ulnar palsy). All of the patients with FCU abnormalities had reduced motor unit potential recruitment (Table I).

Electrophysiological abnormalities were detected in 3 muscles. Denervation and MUAP abnormalities were more frequently found in the ADQ than FDI muscles.

Table I. *Summary of the Clinical and Electrodiagnostic Evaluation of the Patients in the study population (Cubital tunnel and tardy ulnar palsy)*

Patient No	*Age*	*Sex*	*Time*	*History*	*Examination*	*Clinical stage*	*ADQ*	*FDI*	*FCU*
1 (CT)	*32*	*M*	*8 days*	*Paresthesia of the 4th,5th digits*	*Moderate weakness, hypoesthesia*	*II*			*normal*
2 (CT)	*43*	*M*	*3 monts*	*Paresthesia of the 4th,5th digits*	*Hypothenar atrophy*	*II*			*MUAP ↓*
3 (CT)	*46*	*M*	*10 days*	*Paresthesia of the 4th,5th digits*	*Hypoesthesia Moderate weakness,*	*II*	*Fib.*	*N*	*N*
4 (CT)	*42*	*M*	*5 years*	*Paresthesia of the 4th,5th digits*	*Moderate weakness, hypoesthesia*	*II*	*Fib.*	*N*	*MUAP ↓*
5 (CT)	*42*	*F*	*1 year*	*Paresthesia of the 4th, 5th digits*	*Moderate weakness, hypoesthesia*	*II*	*Fib.*	*N*	*MUAP ↓*
6 (CT)	*42*	*F*	*2 years*	*Paresthesia of the limb*	*Hypothenar atrophy*	*III*	*N*	*Fib. PSW*	*N*
7 (CT)	*68*	*F*	*2 years*	*Paresthesia of the limb*	*Moderate weakness, hypoesthesia*	*II*	*Fib. PSW*	*N*	*MUAP ↓*
8 (CT)	*42*	*F*	*3 years*	*Paresthesia of the 4th, 5th digits*	*Moderate weakness, hypoesthesia*	*II*	*Fib.*	*N*	*N*
9 (CT)	*27*	*M*	*3 monts*	*Paresthesia of the 4th, 5th digits*	*Hypothenar atrophy hypoesthesia*	*III*	*PSW*	*Fib. PSW*	*MUAP ↑*
10 (CT)	*65*	*M*	*1 year*	*Paresthesia of the 4th, 5th digits*	*Hypothenar atrophy hypoesthesia*	*III*	*Fib. PSW*	*Fib. PSW*	*N*
11 (CT)	*61*	*M*	*6 monts*	*Paresthesia of the 4th,5th digits,*	*Hypothenar atrophy hypoesthesia*	*III*	*Fib. PSW*	*N*	*N*
12 (CT)	*63*	*M*	*5 monts*	*Paresthesia of the4th,5th digits,*	*Normal*	*I*	*Fib. PSW*	*N*	*MUAP ↓*
13 (CT)	*48*	*F*	*3 monts*	*Pain of the hand*	*Hypoesthesia*	*I*	*PSW*	*N*	*N*
14 (TUP	*39*	*F*	*2 monts*	*Pain of the hand*	*Hypothenar atrophy,*	*II*	*Fib. PSW*	*Fib. PSW*	*N*

DISCUSSION

15 (TUP)	36	M	10 days	Paresthesia of the4th,5th digits,	Hypothenar atrophy Moderate weakness,	II	N	N	N
16 (TUP)	43	M	2 weeks	Paresthesia of the 4th,5th digits	Normal	I	N	N	N
17 (TUP)	28	F	1 month	Paresthesia of the 4th,5th digits	Hypothenar atrophy Moderate weakness,	II	Fib. PSW MUAP ¯	N	N
18 (TUP)	62	M	2 years	Paresthesia of the 4th,5th digits	Hypothenar atrophy Moderate weakness,	III	Fib. PSW	Fib.	N
19 (TUP)	62	M	10 days	Paresthesia of the4th,5th digits	Normal	I	N	N	N
20 (TUP)	25	F	15 days	Paresthesia of the 4th,5th digits	Normal	I	Fib. PSW	N	N
21 (TUP)	50	F	20 days	Paresthesia of the 4th,5th digits	Hypothenar atrophy Moderate weakness,	II	N	N	N
22 (TUP)	24	M	3 monts	Paresthesia of the 4th,5th digits	hypoesthesia	I	Fib.	N	MUAP ↓
21		F	1 monts	Paresthesia of the4th,5th digits	Normal	I	Fib.	N	N
24 (TUP)	58	F	1 year	Paresthesia ofthe hands,	Hypothenar atrophy Moderate weakness,	II	Fib.	N	N
25 (TUP)	24	M	20 days	Paresthesia of the 4th,5th digits	Moderate weakness, hypoesthesia	II	Fib. PSW	N	MUAP ↓
26 (TUP)	41	M	15 days	Paresthesia of the 4th, 5th digits	Normal	I	N	N	N
27 (TUP)	27	F	4 years	Paresthesia of the 4th, 5th digits	Hypothenar atrophy hypoesthesia,severe weakness	III	Fib. PSW	N	MUAP ↓
28 (TUP)	62	M	2 years	Paresthesia of the4th,5th digits	Normal	I	N	N	N
29 (TUP)	62	M	2 years	Paresthesia of the 4th, 5th digits	Normal	I	N	N	N
30 (TUP)	17	M	4 monts	Paresthesia of the 4th,5th digits	Hypoesthesia	I	N	N	MUAP ↓

(Fib: Fibrillation, MUAP: Motor unit action potential, PSW: Positive sharp wave, N: Normal, CT: Cubital tunnel syndrome, TUP: Tardy ulnar palsy)

Table II. *Severity of clinical semptoms and findings (1)*

	CLINICAL FINDINGS
GROUP 1	Recent and mild symptoms of intermittant paresthesias and hypoesthesia
GROUP 2	Persistent symptoms and varying degrees of weakness and intrinsic muscle atrophy.
GROUP 3	İntrinsic muscle atrophy, weakness and deformity of hand.

After carpal tunnel syndrome, ulnar nerve entrapment at the elbow is the second most commonly diagnosed entrapment neuropathy (2,10). It has been recognized as a clinical entity for more than a century (1). Although the clinical evaluation is still the most important and reliable to the physician, electrodiagnostic tests remain the most sensitive tool for definite diagnosis.

The localization means ulnar nerve compression at the elbow, however, can be difficult clinically and electrodiagnostically, but the inching technique is usually helpful in pinpointing the lesion, above or below the elbow.

The "short segment stimulation (SSS) tecnique" (or "inching" technique) of the motor conduction has become a standard method of testing for ulnar neuropathy at the elbow. Campbell et al. used 1cm. segments (5), and others have used 2 cm. segments (7). Campbell et al. were able to localize the lesion at the cubital tunnel in 6 of 19 cases, and to the retrocondylar sulcus in 8 cases. In one case, the cubital tunnel and retrocondylar sulcus were equally involved. In 4 cases, the test was nonlocalizing. Kanakamedala et al. (7) localized the lesion by the 2 cm- SSS technique to the cubital tunnel in 3 cases and medial epicondyl in 9. Campbell et al. found retroepicondylar compression neuropathies (tardy ulnar palsy) more prevalant than humeroulnar aponeurotic arcade (cubital tunnel syndrome) compression neuropathy (3). These studies and our study clearly showed that there are 2 distinct compression syndromes involving the ulnar nerve at the elbow: a) cubital tunnel syndrome, and b) tardy ulnar palsy, and that tardy ulnar palsy is more common.

The needle EMG in ulnar compression neuropathy at the elbow should theoretically show denervation in all the ulnar innervated muscles. The examination should include the FDI and hypothenar muscle, a forearm muscle innervated by the ulnar nerve (FCU). Payan(11) found hand muscle fibrillations in 57% of his cases. Eisen (12) noted fibrillations or positive waves in the FDI in 50 %, hypothenar in 37 %, and FCU in 6 % of patients with sensory and motor deficit MUAP abnormalities were present in hand muscles in all patients and in the FCU in 27%.

As a conclusion, we found electrodiagnostic studies to be more sensitive than clinical examination in diagnosing ulnar nerve entrapment at the elbow. We also found that tardy ulnar palsy was more common than cubital tunnel syndrome.

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