



## The role of electrophysiologic tests in the early diagnosis of posterior interosseous neuropathy in patients thought to have lateral epicondylitis

### *Lateral epikondilit öntanısı konan olgularda posterior interosseöz sinir nöropatisinin elektrofizyolojik testlerle araştırılması*

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**Amaç:** Erken evreli lateral epikondilit öntanısı konan olgularda posterior interosseöz sinir (PİS) nöropatisi olup olmadığının ortaya çıkarılmasında elektrofizyolojik incelemelerin rolü araştırıldı.

**Çalışma planı:** Lateral epikondilit öntanısı konan 33 hastada (24 kadın, 9 erkek; ort. yaş 49) ve 15 sağlıklı kontrolde (10 kadın, 5 erkek; ort. yaş 48) radial, median ve ulnar sinirlerin ileti incelemeleri, seçilmiş bazı kasların elektromiyografik (EMG) değerlendirilmesi ve kavrama analizi yapıldı. Bütün hastalarda semptomların başlangıç süresi bir aydan azdı ve herhangi bir tedaviye başlanmamıştı.

**Sonuçlar:** Yirmi iki hastada (%66.7; 7 erkek, 15 kadın) PİS nöropatisi tanısı kondu. Bu olgularda yaş ortalaması 45, diğer hastalarda 51 idi. Hastalar ve kontroller arasında kavrama kuvveti açısından anlamlı fark görülmedi; aynı şekilde, sağ ve sol ellerde de kavrama kuvvetleri benzer bulundu. Tüm hastalarda konservatif tedaviye olumlu yanıt alındı.

**Çıkarımlar:** Erken evreli lateral epikondilit düşünülen olgularda tedaviye yanıt alınmaması durumunda elektrofizyolojik incelemelerle PİS ayırıcı tanısına gidilmesi gerekli ve yararlıdır.

**Anahtar sözcükler:** Atletik yaralanma/fizyopatoloji; tanı, ayırıcı; dirsek eklemi/yaralanma; elektromiyografi; önkol/inerasyon; sinir sıkışma sendromları/tanı; radial sinir.

**Objectives:** We investigated the role of electrophysiologic tests in determining posterior interosseous neuropathy (PIN) in patients with a preliminary diagnosis of lateral epicondylitis.

**Methods:** Thirty-three patients (24 females, 9 males; mean age 49 years) with a preliminary diagnosis of lateral epicondylitis and 15 healthy controls (10 females, 5 males; mean age 48 years) underwent radial, median, and ulnar nerve conduction studies, electromyography (EMG) of some selected muscles, and measurements for grip strength. The duration of symptoms was less than a month in all the patients and no therapy was instituted.

**Results:** A diagnosis of PIN was made in 22 patients (66.7%). The mean ages of the patients with and without PIN were 45 and 51 years, respectively. The mean grip strengths did not differ significantly between the patients and controls, and between the right and left hands. All the patients responded well to conservative treatment.

**Conclusion:** Electrophysiologic tests may be necessary and beneficial in the differential diagnosis of PIN in patients unresponsive to treatment for lateral epicondylitis of early stage.

**Key words:** Athletic injuries/physiopathology; diagnosis, differential; elbow joint/injuries; electromyography; forearm/innervation; nerve compression syndromes/diagnosis; radial nerve.

Lateral epicondylitis is the painful inflammation of the lateral epicondyle of the humerus<sup>[1]</sup>. The aetiology and thus the treatment is controversial. Majority of cases respond to conservative treat-

ment.<sup>[2,3]</sup> However there are patients with resistant lateral epicondylitis that cannot be cured by conservative methods.<sup>[4,5]</sup> In these patients there is slowing of neural conduction of the radial nerve suggesting

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posterior interosseous neuropathy (PIN) in the differential diagnosis.<sup>[4]</sup> Posterior interosseous neuropathy is an uncommon but well recognized condition.<sup>[1,6-12]</sup> Posterior interosseous nerve is the major terminal motor branch that passes through the supinator muscle, entering through the arcade of Frohse, and innervating the supinator, all the forearm and finger extensors except the extensor carpi radialis longus and abductor pollicis longus muscles (Fig 1).<sup>[7]</sup> Posterior interosseous nerve provides sensory branches to the annular ligament, the anterior radial humeral joint, and the periosteum of the lateral epicondyle.<sup>[7]</sup> The compression in the radial tunnel occurs most frequently at the fibrous arcade of Frohse when it passes through the supinator muscle.<sup>[7,13]</sup> Posterior interosseous neuropathy causes neurogenic weakness in muscles innervated by the nerve which is elucidated by electrodiagnostic evidence of nerve dysfunction.<sup>[7]</sup>

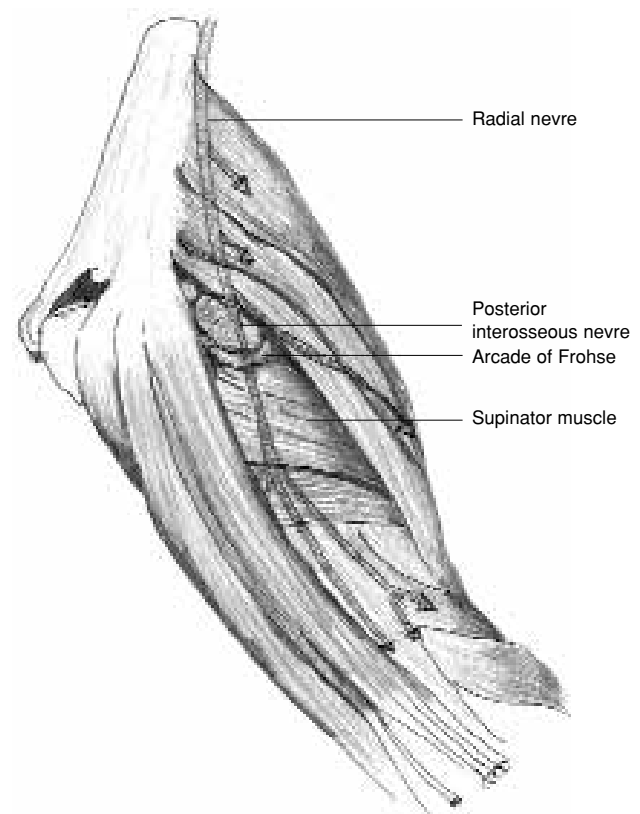
Various causes of the posterior interosseous neuropathy have been described, the most common being trauma. The other causes are masses compressing the nerve (such as lipomas, ganglions, pseudogout or bursa), exuberant inflamed synovium in patients with rheumatoid arthritis, and by compression of the structures of the radial tunnel.<sup>[4,5,12,13]</sup> Mild neural compression simply presenting as pain in the lateral elbow region without any neurological deficit renders it difficult if not impossible to distinguish between PIN and lateral epicondylitis.<sup>[6]</sup>

As far as we are acquainted with the literature, there are only a few series reporting true PIN in the initial stage of lateral elbow pain. In our study PIN was elucidated with electrophysiologic tests in patients with a preliminary diagnosis of lateral epicondylitis.

### Patients and methods

In this study 33 patients (24 females, 9 males; mean age  $49 \pm 7$  years) with a preliminary diagnosis of lateral epicondylitis and 15 healthy controls (10 females, 5 males; mean age  $48 \pm 7$  years) were investigated. The duration of symptoms was less than a month in all patients, and no treatment had been initiated. None of the patients had diabetes mellitus, renal failure, alcoholism or connective tissue disease.

In electromyography (EMG) studies selected muscles (brachioradialis, extensor carpi radialis longus, abductor pollicis longus, extensor carpi ulnaris and extensor indicis proprius) of the involved upper extremity, and that of a randomly selected upper extremity in controls were evaluated. Nerve conduction studies and concentric needle EMG measurements were performed with Medelec Synergy Equipment (Oxford, England). In addition, motor radial nerve conduction velocity determinations were performed. Stimulations and recording were made with surface electrodes. The compound muscle action potentials (CMAPs) were obtained with bipolar surface electrodes on the extensor indicis proprius muscle. The radial nerve stimulated at two sites, first in the forearm, 8-10 cm distal to the lateral epicondyle between the bellies of the extensor digitorum communis and extensor carpi ulnaris muscles, and second at the elbow, 2-3 cm above the lateral epicondyle of the humerus between the brachioradialis and brachial biceps tendons. The electromyography settings adjusted as gain: 5 mV/div, sweep speed: 5 msec/div and frequency: 5 Hz to 10 kHz. Conduction velocity of the upper and below



**Figure 1.** Anatomy of Posterior Interosseous Nerve

elbow segment of the radial nerve was calculated. The distal latency was measured from the stimulus onset to the initial deflection of the CMAP. Median and ulnar nerve conduction studies were performed in the involved extremities to exclude polyneuropathy. The patients who had any median or ulnar nerve abnormalities were excluded from the study. Skin temperature of the forearm was kept at 32-34 °C.

Values were expressed as a mean  $\pm$  standard deviation.  $P < 0.01$  was accepted significant; all values exceeding the 3 standard deviation of the control values were accepted as abnormal.

The diagnosis of posterior interosseous neuropathy was made when normal or mild increased distal motor latency of radial nerve ( $>3.54$  msec), slowed nerve conduction velocity of the elbow segment ( $<50.2$  m/s), abnormal needle electromyography findings of the extensor indicis proprius, and the supinator accompanying normal EMG findings of the brachioradialis, the extensor carpi radialis longus and the abductor pollicis longus, and reduction of the amplitude over the 50% of the proximal values were present.

## Results

All patients had pain in the lateral epicondyle. Pain was exacerbated with resisted supination. There was not any limitation of range of motion of the elbow or the wrist, or there was any weakness of finger extensors at the metacarpophalangeal joints.

Posterior interosseous neuropathy was diagnosed in 22 patients (64.7%; 7 males, 15 females). The mean age of patients was  $45 \pm 8$  years, and that of the controls was  $51 \pm 7$  years. There was no statistically significant difference between the grip strength of patients and controls. The grip strength of the left and right hand was not significantly different either. The grip strength of the patients with PIN was  $26.66 \pm 9.9$  kg and that of the controls was  $26.22 \pm 9.1$  kg. All the patients responded well to conservative treatment.

## Discussion

The complaint of pain in the lateral elbow and lateral forearm can be diffuse and sometimes hard to localize. Radial tunnel syndrome and entrapment neuropathy of the posterior interosseous nerve (PIN)

should be kept in mind especially in resistant lateral epicondylitis.<sup>[6]</sup>

Radial tunnel syndrome is a controversial entrapment neuropathy originating from where the radial nerve pierces the lateral intermuscular septum to lie between the brachioradialis and the brachialis muscles before entering the supinator muscle. Objective motor weakness or sensory loss along the distribution of the radial nerve is not observed. Resisted extension of the third digit during elbow extension reproduces pain. Local tenderness along the course of the radial nerve can be elucidated. In both lateral epicondylitis and radial tunnel syndrome weakness of finger extensors or any electromyography changes are not present. Lateral epicondylitis is evidently present if the patient responds to an injection at the lateral epicondyle.<sup>[6]</sup>

Entrapment neuropathy of the posterior interosseous nerve is an uncommon but a well-recognized condition. Tenderness is not always an accompaniment of true PIN.<sup>[7, 12]</sup> The typical pattern of weakness spares the extensor carpi radialis so that wrist drop is absent, because of weakness of the extensor carpi ulnaris patients may radially deviate the wrist during the wrist extension. In contrast to the wrist drop seen in radial nerve palsy, this neuropathy produces "finger drop": an inability of extension of the metacarpophalangeal joint. Additionally, full pronation of the forearm may exert pressure on the nerve at the sharp, tendinous edge of the extensor carpi radialis brevis muscle.<sup>[4]</sup> Partial paralysis of the nerve may cause inability to extend the fourth and fifth digits leading to pseudoclaw hand.<sup>[6]</sup> In mild neural compression dorsal proximal forearm pain especially with resisted supination is present. There are no definite physical findings of muscle wasting or weakness. This category of patients is difficult to differentiate from lateral epicondylitis.<sup>[6]</sup> Nerve conduction studies or needle EMG examination was preferred in establishing the diagnosis, and thus electrophysiological diagnosis was also supported.<sup>[9-11]</sup> In our 22 cases with PIN involvement utilisation of the aforementioned methods contributed to the electrophysiological diagnosis and enhanced the diagnosis of PIN.

Patients may have prolonged radial nerve distal motor latencies measured by stimulation at the elbow and recording over the extensor digitorum

communis.<sup>[1]</sup> They may have neurogenic alterations on EMG needle examination limited to muscles innervated by the PIN.<sup>[7]</sup>

In the radial nerve conduction test with a needle in the extensor indicis proprius muscle and stimulation above the elbow, Carfi and Ma<sup>[9]</sup> found normal response in three of eight patients, and prolonged latency or absent response in five patients with PIN involvement.

Some patients in the series of Cravens and Kline<sup>[11]</sup> had diffuse deep forearm pain or discomfort. Intraoperative nerve conduction examination displayed slowed conduction across arcade of Frohse.

Jalovaara and Lindholm<sup>[14]</sup> decompressed posterior interosseous nerve in 111 patients and observed complete relief in the 30% of the patients, thus revealing the real incidence of the neuropathy.

Kaplan<sup>[1]</sup> reported eight racquetball or tennis players who had gradual onset of weakness in the distribution of posterior interosseous nerve. All patients had tenderness over the lateral epicondyle. Stimulation at the elbow and recording over the extensor digitorum communis displayed significant prolongation in the distal motor latency to the extensor digitorum communis muscle compared with the normal side. The patients responded well to conservative treatment during a five-year follow-up period. Likewise, in our series the symptoms of all patients resolved with conservative treatment.

Oztuna et al.<sup>[5]</sup> have detected objective weakness limited to muscles innervated by the nerve in PIN. In our study, in accordance with the literature all patients had pain in the lateral epicondyle, and 22 patients had additional positive electromyography findings associated with PIN involvement. In patients with PIN grip strength was not altered, or any objective muscle weakness was present. We believe that this condition is associated with early detection of the neuropathy.

In conclusion, electrophysiological tests performed in the early stage of preliminary diagnosis of lateral epicondylitis may reveal PIN entrapment

neuropathy. We believe that it is appropriate and also helpful if electrophysiological tests are utilised in establishing the differential diagnosis of lateral epicondylitis, keeping in mind PIN when persistence of symptoms arises.

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