



Abstract

Radial Nerve Neuropathies: A Retrospective Study

Bekir Enes Demiryürek¹, Ufuk Emre², Esra Acıman Demirel³, F. Nida Taşçılar³, H. Tuğrul Atasoy³, Özgür Ortancıl⁴, Osman Korucu⁵

Objective: Radial nerve neuropathy is a rare neuropathy between upper extremity entrapment neuropathies developed because of various etiological factors. This study aimed to retrospectively evaluate patients referred to our EMG laboratory with a diagnosis of radial nerve neuropathy.

Methods: In the study, the files of 41 patients who referred to our electromyography (EMG) laboratory with the radial nerve lesion diagnosis between 2004 and 2013 were retrospectively investigated.

Results: Forty-one patients were included in this study. Of the patients, 36 were male (87.8%), five were female (12.2%), and the mean age was 42.36±15.21. Of the patients, 39% were referred by Orthopedics, 34.1% by Neurology, 24.4% by Physical Therapy and Rehabilitation, and 2.4% by Plastic and Reconstructive Surgery departments to our laboratory. Studying the relationship between the shape of nerve injury for etiological reasons shows that the humerus and radius fractures occur most frequently after falling.

Conclusion: Therefore, the variety of etiological factors leading to the radial nerve lesions is remarkable. The higher incidence in male patients may be associated with more common factors such as trauma and work accidents in this gender. The electrophysiological examinations can provide valuable contributions to the diagnosis and follow-up of radial nerve neuropathy. On examining the EMG results of patients, the findings consistent with axonal lesion of radial nerve in the spiral groove after the triceps muscle were the most common (34.1%). The average recovery time of the patients could not be recorded because of the referred patients from other centers and the lack of control visits of the patients. It was found that five of the 10 patients contacted by phone had complete recovery, and there was no recovery in the other five patients.

Keywords: Trauma, radial nerve, EMG

Introduction

Radial nerve C5-T1 root leaves the brachial plexus posterior cord and passes through the spiral grooves on the rear surface of the humerus; after innervating the *brachioradialis*, *extensor carpi radialis longus*, and *brevis* muscles, the radial nerve is divided as superficial and deep branches at the forearm level. The superficial branch goes down to hand back passing through the bottom of the *brachioradialis* muscles (1-3). Deep motor branch, the posterior interosseous nerve (PIN), travels deep and passes through the fibrous arcade of Frohse that is on the surface of the supinator muscle. PIN, which also innervates the supinator muscle, innervates the forearm and all the extensors of the hand except the *extensor carpi radialis longus* and *brachioradialis* (2, 4).

Radial nerve neuropathies may occur depending on PIN damage in the proximal branch or forearm or on superficial branch lesions that are caused by trauma-induced humeral fractures (3, 5). There are a limited number of studies in the literature regarding the causes of the development and prognosis of radial nerve neuropathies. Blunt trauma of the forearm may be because of a firearm injury or stab wound, and it may as well develop because of different causes, such as falling, watch band tightening, and wrists being firmly tied (2).

This study aimed to evaluate patients who were referred to our electromyography (EMG) laboratory with a diagnosis of radial nerve neuropathy in terms of age, gender, application complaints, etiological causes, and EMG findings.

Methods

In this study, records of 41 patients, who were referred to our EMG laboratory between 2004 and 2013 with a diagnosis of radial nerve lesions, were retrospectively examined. The data regarding the age, sex, symptoms, neurological examination findings, etiological reasons (such as traffic accidents, work accidents, firearm or stab wounds, falling or spontaneous), type of nerve damage (such as idiopathic, cut, compression, or post-fracture), department that claimed EMG, EMG results, whether the patients were included in the PTR program or not, healing process, and prognosis were recorded.

¹Clinic of Neurology, Bağcılar Training and Research Hospital, İstanbul, Türkiye

²Clinic of Neurology, İstanbul Training and Research Hospital, İstanbul, Türkiye

³Department of Neurology, Bülent Ecevit University Faculty of Medicine, Zonguldak, Türkiye

⁴Department of Physical Medicine and Rehabilitation, Bülent Ecevit University Faculty of Medicine, Zonguldak, Türkiye

⁵Clinic of Neurology, Keçiören Training and Research Hospital, Ankara, Türkiye

Address for Correspondence:
Bekir Enes Demiryürek
Phone: +90 533 550 88 72
E-mail: bekirenes@mynet.com

Received:
02.02.2015

Accepted:
09.07.2015

© Copyright 2015 by Available online at
www.istanbulmedicaljournal.org

Statistical analysis

Statistical analysis was performed with the software program Statistical Package for the Social Sciences 17.0 (SPSS Inc.; Chicago, IL, USA). Continuous variables, which were expressed by measurement, were specified with the values of mean, standard deviation, median, minimum, and maximum values; variables of the categorical values were specified with frequencies and percentages. Compliance with the normal distribution of continuous variables was analyzed by the Shapiro–Wilk test. In two group comparisons of normally distributed variables, the significance test of difference between the two averages was used. In two group comparisons of the variables that were not distributed normally, the Mann–Whitney U test was used, and in the comparisons of three groups or more, the Kruskal–Wallis test was used. In group comparisons of categorical variables, Yates-corrected chi-square and Fisher's exact chi-square tests were used.

Results

Forty-one patients were included in the study. Of them, 36 were male (87.8%), five (12.2%) were female, and mean age was 42.36 ± 15.21 . Of the patients, 39% were referred to our laboratory by orthopedics, 34.1% by neurology, 24.4% by PTR, and 2.4% by plastic and reconstructive surgery departments.

Considering the etiological reasons, 31.1% of patients were because of falling (13), 17.1% were traffic accidents (7), 9.8% were occupational accidents (4), 14.6% were spontaneous (6), 14.6% were in an unknown group (6), 7.3% were stab wounds (3), and 4.9% were firearm injuries (2). Considering the type of nerve damage, 24.4% of patients (10) were humeral fractures, 22% were compression (9), 17.1% were unknown cause (7), 14.6% were radius fractures (6), 14.6% were because of cutting (6), 4.9% were idiopathic (2), and one (2.4%) were radial nerve lesion related to compartment syndrome (Figure 1).

When the relationship between etiological reasons and the type of nerve damage was monitored, it was observed that humeral and radius fractures occurred most often after falling. When the relationship between neural damage and EMG diagnostics was examined, axonal damage of the motor–sensory branches of the radial nerve (4) and spiral groove damage after the triceps muscle (6) mostly developed after humeral fractures. After radius fractures, axonal damage of the motor–sensory branches of the radial nerve (3), damage in the spiral groove after the triceps muscle (1), and PIN injury (2) developed.

With respect to the background of 90.2% of patients, a significant history of disease was not recorded. Considering neurological examination findings, majority (87.8%) was patients with mallet finger–hand. The average time that had passed from the beginning of complaints until EMG examination was 68.41 ± 10.84 days.

When EMG results of patients were evaluated, the highest rate was 34.1% with the findings consistent with axonal lesion after the triceps muscle of the radial nerve in the spiral groove. EMG diagnoses are reported in Table 1. In 36.6% of patients, other nerve lesions (ulnar and median nerves) existed.

The average recovery time of the patients could not be recorded because of the absence of a control and because some patients

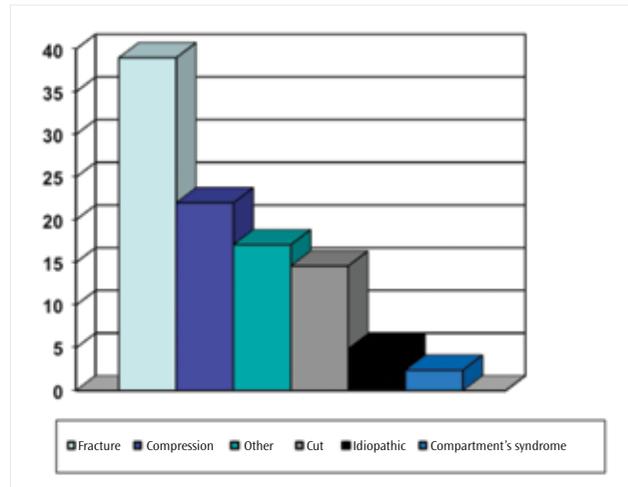


Figure 1. Causes of radial nerve damages

Table 1. Distribution of EMG diagnoses in patients

Diagnoses	Number (n)	Percentage (%)
Lesion after the triceps muscle in the spiral groove	14	34.1
Sensory and motor axonal lesion of the radial nerve	12	29.3
Axonal lesion in the posterior interosseous nerve	7	17.1
Normal	3	7.3
Axonal lesion in the superficial radial nerve	2	4.9
Cervical radiculopathy	2	4.9
Brachial plexopathy	1	2.4
EMG: Electromyography		

were referred from external centers. It was noted that in five of 10 patients who were contacted by phone, a complete recovery was recorded, while in the other five patients, no recovery was recorded. Patients exhibiting clinical recovery comprised spontaneous incidents or compression. The other patients could not be contacted by phone.

Discussion

Radial nerve lesion may develop because of different reasons on many levels. It may get damaged in the proximal segment, spiral grooves, or forearm. PIN can be damaged in the arcade of Frohse because of repetitive pronation and supination motions of the forearm (5). No pain in the compression zone, weakness, and loss of sensation in the muscles distant from extensor carpi radialis longus and brevis muscles are the main clinical features of this syndrome (5, 6). Superficial branch damage may occur less often in the thumb without any motor effect which is characterized by the loss of sensation on the dorsal surface of the hand (Cheralgi to paresteti ACE). In our study, we found only two patients had a damaged sensory branch of the radial nerve.

Orthopedic trauma is the first among the causes of radial nerve neuropathy. In a study, the radial nerve damage was identified in 12% of 237,000 patients with a humeral shaft fracture in a year, and 70% of them spontaneously healed within 8–16 weeks (7). In

the study of Garcia and Maeck (8), radial nerve lesion was identified in 12% of 227 patients with humeral fractures. In our study, we found that the radial nerve damage was caused by humeral and radius fractures, which had the highest rate (39%). Of these, 69.2% was because of falling and 54.5% was because of traffic and occupational accidents. However, in this retrospective study, majority of the affected radial nerve was in the form of preoperative radial nerve injury. PIN lesion was detected in seven (17.1%) patients. While the reason was fractures in four patients, in other cases, it was stabbing and one case was in the group of unknown reason. According to the level of damage of the radial nerve, findings may be different in the clinic. Motor and sensory fibers are affected in damages in the spiral groove at the humerus level. Weakness is apparent in the finger and wrist extension. Sensation decreased in the area, defined as fossa radialis, in the dorsal aspect of the hand's thumb, index finger, and third finger. If there is a weakness in the triceps muscle and a decreased reflex, the lesion may be in the root or plexus. If the brachioradialis and extensor carpi radialis longus muscles are affected, lesion is probably in the humeral shaft. Proximal radial nerve lesions result in mallet finger, hand, or both and limit the extension with thumb abduction (9). In our study, mallet finger and hand was observed in 87.8% of patients. PIN lesion is frequently observed in distal injuries. In a clinic, patients cannot extend their fingers at the metacarpophalangeal joint, and classically, radial deviation is observed during the extension of wrist because the extensor carpi radialis longus muscle is not affected. During EMG examination, the extensor digitorum communis and extensor indicis proprius muscles were affected. Sensory conduction studies are normal (3).

Although obvious findings were not detected in the first 2 weeks, it contributes in determining the severity of trauma, an early stage surgery planning, or preoperative injury. It is indicated that EMG can be performed prior to surgery in patients with ongoing complaints for 6–8 weeks in general. However, in practice, early and late phase follow-up EMG is important. The average time until EMG examination in our study was 68.41 days. Considering the etiological causes, this situation makes us think that EMG is more commonly demanded in cases where healing is limited and time consuming. In addition, since nerve damage associated with compression shows recovery in days, either EMG is not demanded or the patients do not come due to spontaneous recovery until that time.

Conservative approaches are the first-line of treatment. If there is no open wound, hand splints and physical therapy are the required methods before an operation. In our study, PTR was administered or spontaneous recovery was observed in most patients.

Achieving limited results with respect to follow-up and prognosis of the patients was among the limitations of our study. Clinical

improvement was recorded in five of 10 patients who were contacted by phone.

Conclusion

The diversity of etiological causes leading to radial nerve lesions is remarkable. Greater frequency in male patients may be associated with the fact that factors, such as trauma and occupational accidents, are observed more in this sex. Electrophysiological studies can provide valuable contributions in the diagnosis and follow-up of radial nerve neuropathy.

Ethics Committee Approval: Ethics committee approval was not received due to the retrospective nature of this study.

Informed Consent: Written informed consent was not received due to the retrospective nature of this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - U.E.; Design - B.E.D.; Supervision - U.E.; Funding - B.E.D., F.N.T.; Materials - B.E.D.; Data Collection and/or Processing - B.E.D.; Analysis and/or Interpretation - H.T.A.; Literature Review - Ö.O., O.K.; Writer - B.E.D., U.E.; Critical Review - U.E.; Other - E.A.D., F.N.T.

Acknowledgements: Thanks to the all authors for contributions in order to prepare this study.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

References

1. Gültekin Y. Yüzeysel radyal sinir sensoriyel iletiminin normal verileri ve tanı değeri. *Gülhane Tıp Dergisi* 2003; 45: 321-5.
2. Güdemez E. Üst ekstremitelerde görülen periferik sinir kompresyon nöropatileri. *Türk Aile Hekimleri Dergisi* 2007; 11: 5-12.
3. Doğan YP, Eser F, Bodur H, Atan Ç. Posterior interosseöz sinir sendromu: Olgu sunumu. *FTR Bil Der.* 2007; 3: 110-3.
4. Verhaar J, Spaans F. Radial tunnel syndrome. An investigation of compression neuropathy as a possible cause. *J Bone Joint Surg Am.* 1991; 73: 539-44.
5. Suematsu N, Hirayama T. Posterior interosseous nerve palsy. *J Hand Surg.* 1998; 23: 104-6. [\[CrossRef\]](#)
6. Sponsellar PD, Engber WD. Double-entrapment radial tunnel syndrome. *J Hand Surg* 1983; 8: 420-3. [\[CrossRef\]](#)
7. Samardzic M, Grujicic. Radial nerve lesions associated with fractures of the humeral shaft. *Injury* 1990; 21: 20. [\[CrossRef\]](#)
8. Garcia AJ, Maeck BH. Radial nerve injuries in fractures of shafts of the humerus. *AM J Surg* 1999; 625: 1960.
9. Lowe JB, Sen SK. Current approach to radial nerve paralysis. *Plastic and Reconstructive Surgery* 2002; 110: 1099-112. [\[CrossRef\]](#)