Investigation of Two Possible Compression Sites of the Deep Branch of the Radial Nerve and Nerve Supply of the Extensor Carpi Radialis Brevis Muscle

Yalcin KIRICI and M. Kemal IRMAK*

Departments of Anatomy and *Histology-Embryology, Faculty of Medicine, Gulhane Military Medical Academy, Ankara, Turkey

Abstract

The posterior interosseous nerve arises from the deep branch of the radial nerve, and compression by adjacent structures results in posterior interosseous nerve syndrome. Sixty upper limbs from 30 Turkish subjects (18 males and 12 females) were dissected to reveal the course of the posterior interosseous nerve and to examine possible compression sites at the proximal and distal edges of the supinator muscle, and the exit of the nerve from the extensor carpi radialis brevis muscle. Posterior interosseous nerve syndrome is most probably caused by the tendinous part of the supinator muscle at the proximal edge.

Key words: posterior interosseous nerve syndrome, compression, course

Introduction

The posterior interosseous nerve is a deep branch of radial nerve which innervates the extensor carpi radialis brevis and the supinator muscles.20) Posterior interosseous nerve syndrome is an entrapment neuropathy of the posterior interosseous nerve within the forearm extensor muscles.7,10,17,20) Nerve branches to the extensor carpi radialis brevis muscle and the supinator muscle may arise from the main trunk of the radial nerve or from the proximal part of the posterior interosseous nerve, but almost invariably originate above the arcade of Frohse.

The posterior interosseous nerve is vulnerable to both traumatic1-10) and nontraumatic mechanical damage.8) The arcade of Frohse is the most common structure that causes compression of the posterior interosseous nerve, especially if the arcade is fibrous. Iatrogenic compression may also develop after surgical procedures involving the proximal radial region.10) Patients with posterior interosseous nerve syndrome present with weakness in finger extension and thumb extension and abduction.4,7,20) Posterio
the anatomical distances and their measurement points as described previously.14)

The proximal arcade of the superficial layer of the supinator muscle (arcade of Frohse) and the distal border of the supinator muscle were studied as structures that may cause compression of the posterior interosseous nerve. The arcade of Frohse was observed under a stereomicroscope (Stemi 2000; Carl Zeiss, Jena, Germany) and classified as tendinous if the medial and lateral halves of the arch were fibrous in texture and white in color, or membranous if the medial half of the arcade was muscular or translucent. The distal edge of the supinator muscle at the exit of the posterior interosseous nerve was similarly classified. In addition, the exit of the nerve which supplies the extensor carpi radialis brevis muscle was also studied.

All statistical analyses were performed with the SPSS 10.0 package (SPSS for Windows; SPSS Inc., Chicago, Ill., U.S.A.). All values are given as mean ± standard deviation. Differences between the left and right arms were examined with the paired sample t test, and continuous variables with the chi-square or Fisher exact tests. Since the data were distributed normally, the Pearson coefficients of correlation were calculated to investigate the relationships between two variables. P values less than or equal to 0.05 were evaluated as statistically significant.

**Results**

Measurements of the five distances are given in Table 1. Only the L1 distance was significantly different between the right and left arms (p < 0.05). The other measurements showed no significant differences. There was a positive correlation between the distances L1 and L5 in the left arm (r = 0.642, p = 0.001), and a positive correlation between L1 and L2 and negative correlation between L1 and L3 in the right arm. There was no significant correlation between proximal and distal structure types on either side.

The posterior interosseous nerve passed through the radial tunnel anterior to the humeroradial joint and then coursed beneath the arcade of Frohse, which is the proximal edge of the superficial layer of the supinator muscle. The proximal edge of the supinator muscle had a well-developed tendinous arch in 40 of the specimens (67%) and was membranous in the remaining 20 specimens (33%). The distal edge of the supinator muscle had a thick

![Fig. 1 Schematic illustration of the anatomical measurements.](image)

**Table 1 Measurements of the anatomical distances**

<table>
<thead>
<tr>
<th></th>
<th>L1</th>
<th>L2</th>
<th>L3</th>
<th>L4</th>
<th>L5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right</td>
<td>8.48 ± 1.05*</td>
<td>3.48 ± 1.08</td>
<td>1.98 ± 0.58</td>
<td>6.12 ± 1.06</td>
<td>22.42 ± 1.52</td>
</tr>
<tr>
<td>Left</td>
<td>9.20 ± 1.70*</td>
<td>3.23 ± 1.10</td>
<td>2.07 ± 0.42</td>
<td>6.28 ± 1.05</td>
<td>22.11 ± 1.78</td>
</tr>
</tbody>
</table>

Values are mean ± standard deviation. *p = 0.012.

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Table 2  Number of tendinous or membranous edge of the supinator muscle

<table>
<thead>
<tr>
<th></th>
<th>Right side</th>
<th></th>
<th>Left side</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Proximal edge</td>
<td>Distal edge</td>
<td>Proximal edge</td>
<td>Distal edge</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Tendinous</td>
<td>12</td>
<td>8</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Membranous</td>
<td>6</td>
<td>4</td>
<td>13</td>
<td>12</td>
</tr>
</tbody>
</table>

*p < 0.018.

Fig. 2 Photograph showing the muscles and nerves of the lateral aspect of the arm. a: posterior antebrachial cutaneous nerve, d: brachioradialis muscle, M: biceps brachii muscle, N: brachialis muscle, p: posterior brachial cutaneous nerve, R: radial nerve, T: lateral head of the triceps brachii muscle.

Fig. 3 Photograph showing the muscles and nerves of the lateral aspect of the anterior cubital region. e: superficial branch of the radial nerve, G: extensor carpi radialis brevis muscle, H: brachioradialis muscle, mt: biceps brachii muscle tendo, pl: posterior interosseous nerve, Q: bicipital aponeurosis, rs: nerve supply extensor carpi radialis brevis muscle, S: supinator muscle.

tendinous edge in 10 (17%), and a membranous texture in 50 (83%) of the extremities.

We did not observe any significant difference in tendinous or membranous edges between males and females in the right arm (Table 2). However, 11 of the female cadavers (91.7%) had tendinous edges in the left arm whereas only one (8.3%) had a membranous edge. This sex difference at the proximal edge of the muscle was significant (p < 0.018). The other parameters showed no significant differences.

Fourteen extensor carpi radialis brevis muscles (47%) were supplied by the posterior interosseous nerve, and 16 (53%) by the radial nerve in the right arm. Eighteen extensor carpi radialis brevis muscles (60%) were supplied by the posterior interosseous nerve, and 12 (40%) by the radial nerve in the left arm. Photographs of the posterior interosseous nerve and radial nerve, and related muscles are shown in Figs. 2 and 3.

Discussion

A previous study found the extensor carpi radialis brevis muscle is innervated by the superficial radial nerve in 43% of arms, the radial nerve in 55%, and the posterior interosseous nerve in 2%.14) Classical anatomy textbooks report that this muscle is innervated mostly by the posterior interosseous nerve. Our study suggests that the posterior interosseous nerve is responsible in 47% of arms and the radial nerve in 53%. The L2, L3, L4, and L5 distances measured at the both sides were nearly equal in all 30 cadavers. The L1 distance was significantly different, possibly because the extensor carpi radialis brevis muscle can be innervated by various nerves. We thought that if the nerve which supplies the extensor carpi radialis brevis muscle is derived from

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the posterior interosseous nerve, and compression occurs, this nerve will also be entrapped together with the posterior interosseous nerve. However, we could not observe any relationship between the fibrous texture of the arcade of Frohse, and the innervation type of the extensor carpi radialis brevis muscle.

Four structures may compress the posterior interosseous nerve. The nerve is commonly compressed at its entrance into the supinator muscle, but also at its exit from the supinator muscle. The most common site of compression in the forearm is the arcade of Frohse. Fibrous texture of the arcade of Frohse may cause posterior interosseous nerve syndrome if the supinator muscle shows hypertrophy with intensive usage of the muscle. However, the present study could not show a causative relationship between the nature of the arcade of Frohse and posterior interosseous nerve syndrome.

The arcade was tendinous in 57% of cases and membranous in 43%. The distal edge of the supinator muscle was tendinous in 65% of cases and membranous in 35%. Both the proximal and distal edges of the supinator muscle are potential sites of compression of the posterior interosseous nerve. Both radial tunnel syndrome and posterior interosseous nerve compression syndrome are caused by compression of the posterior interosseous nerve. Posterior interosseous nerve syndrome occurs in less than 10% of cases. Entrapment of the posterior interosseous nerve is caused by the tendinous margin of the extensor carpi radialis brevis muscle, or by a fibrous band at the distal edge of the body of the supinator muscle. There are numerous reports suggesting that the fibrous texture of the arcade of Frohse is an etiologic factor leading to posterior interosseous nerve syndrome. Hypertrophic muscles of this kind may cause entrapment of the nerve.

Fibrous change in the arcade of Frohse of the supinator muscle may cause posterior interosseous nerve syndrome if other factors such as enlargement of the muscle are also present. Another explanation of the lower ratio of posterior interosseous nerve syndrome in population groups, despite the higher ratio of fibrous arcade of Frohse, is that symptoms related to posterior interosseous nerve syndrome may be attributed to underlying factors other than posterior interosseous nerve syndrome. Tendinous arcade of Frohse is an important factor in the development of the posterior interosseous nerve syndrome. Four cases were the result of paralysis of the posterior interosseous nerve, caused by compression of the nerve between the arcade of Frohse and the two heads of the supinator muscle.

References

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Address reprint requests to: Y. Kirici, M.D., GATA Anatomi AD, 06018 Etilik, Ankara, Turkey.
e-mail: ykirici@gata.edu.tr

Commentary on this paper appears on the next page.
Commentary

This manuscript has all of us carefully reevaluate the distal aspects of the radial nerve as it traverses into the forearm. When the nerve goes past the sensor carpi radialis brevis, the classic anatomy books say that muscle is enervated by the posterior interosseous nerve. But in the review in 30 cadaver dissections that muscle is enervated by the radial nerve more than half the time. The extensor carpi radialis brevis can actually be enervated by both aspects of the nerve. When there is compression in this area, while the fibrous texture of the arcade of Frohse may be important. It appears that the nerve’s entrance into the supinator muscle may indeed be more important.

However, if there are fibrous changes in the arcade of Frohse the spinator muscle, especially associated with enlargement of that muscle, then the symptoms are related to the interosseous nerve compression will be apparent. In the article, there is some discussion on the etiology of “tennis elbow.” The interosseous nerve could be part of this. More commonly, this is extensor tendinitis, coming further up the arm away from the radial nerve. These people are to be congratulated on their extensive section.

Thomas B. Duck, M.D., F.A.C.S.
Department of Neurosurgery
Johns Hopkins University
Annapolis, Maryland, U.S.A.