The Effect of Carpal Tunnel Changes on Smartphone Users

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Abstract. [Purpose] The purpose of this study was to examine changes in the carpal tunnels and median nerves appearing due to frequent movements of fingers by ultrasonography in young adults who frequently use smartphones. [Subjects] The subjects of this study were 20 young male and female adults who had no limitation in the range of movement of neck, shoulder, and arm joints, musculoskeletal disorder of the arm, or neurological symptoms such as paraesthesia and agreed to participate in the study. [Methods] The subjects who agreed to participate in this study were asked to use a smartphone for 30 minutes while maintaining comfortable sitting postures on a chair. They were asked to maintain the position of their shoulders comfortably while maintaining an angle of around 90° at the elbow. Some values measured before and after the experiment using a smartphone for 30 minutes were compared. The carpal tunnel was measured using ultrasonography. [Results] There were significant differences in median nerve circumference length, area of the median nerve area, distance between the highest point of the median nerve to the lunate, and distance between the bottom point of the median nerve to the lunate between before and after the experiment (p<0.05). [Conclusion] In conclusion, the use of smartphones for too long can be considered to adversely affect the wrist, and continued use can be considered to induce muscle fatigue.

Key words: Median nerve, Smartphone user, Ultrasonography

INTRODUCTION

With the development of industries, work-related musculoskeletal disorders (WRMSD) are increasing rapidly, and as the use of video display terminals (VDT) is becoming common due to the development of computers and office automation, workers' work-related musculoskeletal disorders are also becoming a large problem1).

Among musculoskeletal disorders occurring in workers who use video display terminals, work-related musculoskeletal disorders of the neck, upper extremity, and wrist frequently occur due to increases in the use of computers1), and the prevalence rate of these disorders was shown to exceed 76%2). Elements that may cause musculoskeletal disorders due to the use of computers include physical and ergonomic elements such as the heights of desks, chairs, and screens and working postures3) and elements related to the use of devices such as computer mouses3, 4).

Since smartphones have recently come to be used more frequently than computers in daily lives, it is expected that various adverse effects of smartphones will appear. Since scheduling functions and personal information have been added to smartphones in addition to existing mobile phone functions centered on voice calls and networks using the Internet and social network systems have recently increased, it can be seen that the use of smartphones had increased greatly.

Because of the popularization of smartphones, people frequently maintain a stooped postured for a long time, and in relation to this, various diseases such as herniated cervical discs occur. Hand/foot/shoulder tingling may appear or severe pain may occur even during slight neck movements. In addition, this smartphone culture, which induces excessive use of the fingers, may overload the hand joints or muscles, and in severe cases, carpal tunnel syndromes that include hand tingling or paralysis may appear5).

Carpal tunnel syndromes are symptoms that appear because the median nerve is pressed in the region of the wrist joint6), and it is known that if pressure in the carpal tunnel increases due to tendinitis, deformation or ischemia will occur in the median nerve, resulting in nerve symptoms7).

In this respect, the purpose of this study was to examine changes in the carpal tunnels and median nerves appearing due to frequent movements of fingers by ultrasonography in young adults who frequently use smartphones.

SUBJECTS AND METHODS

This study was conducted with 20 male and female adults who had no limitation in the range of movement of neck, shoulder, and arm joints, musculoskeletal disorder of the arm, or neurological symptoms such as paraesthesia and agreed to participate in the study. Prior to the start of the study, we approval was received from Gimhae College University for its research ethics. The subjects’ mean age
was 22.3 years, mean height was 166.1 cm, and mean weight was 54.8 kg (Table 1).

First, each of the subjects who agreed to participate in this study was asked to use a smartphone for 30 minutes while maintaining comfortable sitting postures on a chair. The subject was asked to maintain his/her shoulder comfortably while maintaining an angle of around 90° at the elbow. Some values measured before and after the experiment using a smartphone for 30 minutes were compared.

The carpal tunnel was measured using ultrasonography (ESAOTE Europe B.V., Maastricht, Netherlands), and 7–10 MHz high-frequency linear probes were used to see carpal tunnel structures. The median nerve was measured while having the subject maintain his/her wrist in a neutral position, since measured values may differ depending on probe positions. For internal consistency, the same measurer conducted the measurement, and proximal carpal tunnel regions were measured. To observe the inside of the carpal tunnel, the tester quantitatively measured changes in structures other than the median nerve in horizontal scanning and measured the structures’ horizontal diameters before and after the experiment (Fig 1).

SPSS (SPSS 19.0 for Windows, SPSS Inc., Chicago, IL USA) was used to analyze the collected data. We performed the paired t-test to compare measured items before and after smartphone use. Statistical significance was accepted at values of p<0.05.

**RESULTS**

Table 2 shows the results of comparison of carpal tunnel structures before and after the use of smartphones to illustrate differences.

The median nerve circumference was shortened from 1.39 ± 0.08 cm before the experiment to 1.12 ± 0.08 cm after the experiment, and the difference was statistically significant (p<0.05).

The area of the median nerve area decreased from 10.78 ± 0.95 mm² before the experiment to 8.12 ± 1.40 mm² after the experiment, and the difference was statistically significant (p<0.05).

The distance between the highest point of the median nerve to the lunate increased from 8.06 ± 0.32 mm before the experiment to 9.09 ± 0.46 mm after the experiment, and the difference was statistically significant (p<0.05).

The distance between the bottom point of the median nerve to the lunate increased from 5.76 ± 0.45 mm before the experiment to 6.79 ± 0.55 mm after the experiment, and the difference was statistically significant (p<0.05).

**DISCUSSION**

Recently, the use of video display terminals is an increasing trend due to the use of smartphones and the development of computers, and this can be said to induce musculoskeletal disorders. Among elements that may cause musculoskeletal disorders when smartphones are used, the height of the chair, users’ postures, and screen sizes, as well as age, personality, and sex, are considered to be able to affect users’ bodies.

The purpose of this study was to examine changes in the carpal tunnel in the wrist through which the median nerve passes by ultrasonography after use of smartphones. It could be seen that the circumference and area of the median nerve decreased after the use of smartphones. Based on this, it can be considered that the space in the carpal tunnel decreased, and as a result, soft tissues pressed the median nerve.

In addition, both the distance between the top of the median nerve to the lunate and the distance between the base of the median nerve to the lunate increased. Based on this, it was considered that soft tissues in the spaces between the these points such as muscles and ligaments were thickened because of the use of smartphones and thus the length of the carpal tunnel space increased from the top the median nerve.

**Table 1.** General characteristics of the subjects

<table>
<thead>
<tr>
<th>Variable</th>
<th>Young adults (n=20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>22.3 ± 0.8</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>166.1 ± 6.6</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>54.8 ± 8.0</td>
</tr>
</tbody>
</table>

**Table 2.** Comparison of carpal tunnel conditions between before and after tapping

<table>
<thead>
<tr>
<th></th>
<th>Tapping Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circumference (cm)</td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>1.39 ± 0.08</td>
</tr>
<tr>
<td>After</td>
<td>1.12 ± 0.08</td>
</tr>
<tr>
<td>Area (mm²)</td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>10.78 ± 0.95</td>
</tr>
<tr>
<td>After</td>
<td>8.12 ± 1.40</td>
</tr>
<tr>
<td>TH (mm)</td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>8.06 ± 0.32</td>
</tr>
<tr>
<td>After</td>
<td>9.09 ± 0.46</td>
</tr>
<tr>
<td>BH (mm)</td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>5.76 ± 0.45</td>
</tr>
<tr>
<td>After</td>
<td>6.79 ± 0.55</td>
</tr>
</tbody>
</table>

(n=20) Circumference: median nerve circumference; Area: median nerve area; TH: top of the median nerve to the lunate high; BH: Base of the median nerve to lunate high. *p<0.05
to the lunate and base of the median nerve to the lunate.

Given the aforementioned results, repetitive use of the hand, postures, and mechanical stress can be considered to cause carpal tunnel syndromes based on the theory of cumulative trauma disorder models. Therefore, the use of smartphones for too long can be considered to adversely affect the wrist\(^9\). In addition, continued use can be considered to induce muscle fatigue.

ACKNOWLEDGMENT

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REFERENCES


