A Comparison of Muscle Activity when Using Multitouch Phone for Texting among Symptomatic and Asymptomatic Young People

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1. Introduction

The rapid development of multitouch mobile phones has heralded a new era of information and communication technology, becoming the most popular handheld devices around the world. Text messaging and chatting with friends using social apps such as whatsapp, wechat, facebook are one of the most frequent form of multitouch phone activity among young people. Undoubtedly, as a pocket computer, multitouch phone has brought unprecedented convenience in many aspects, but it also gives rise to growing concern about its impact on musculoskeletal health in heavy users. To fill that gap, we investigated the differences in muscle activity between young people with and without neck-shoulder pain using multitouch phone to perform texting tasks.

2. Method

Ten healthy and 10 with neck-shoulder pain female adults, aged 18-30 from universities in Hong Kong were recruited by convenience sampling. They were allocated into Control and Case Groups respectively. All participants in Case Group had neck pain (8 with pain in both sides, 2 in right side only) and most of them had shoulder pain (n=9, 5 in both sides, 4 in right side only). Some cases had additional pain in upper back (n=5), wrist (n=6) or thumb (n=7). Participants in Case Group reported pain in the past 12 months for at least 3 months and had a mean score of 2.7±2.3 out of 10 in left side and 3.5±1.8 in right side for neck pain, 2.8±3.3 in left side and 3.7±2.5 in right side for shoulder pain on the test day. All participants were required to text on iPhone in two 10 minutes sessions with 5 minutes rest interval. The tasks are namely: 1) bilateral texting with both thumbs; 2) unilateral texting with the right thumb in a randomized balanced order. The same children's story in English was used for displaying on the iPhone screen and participants were to copy the text into the “notepad”. For the unilateral texting task, the participants were instructed to hold the phone with the dominant hand only while left hand was put on thigh. The activity of proximal muscles (cervical erector spinae “CES”, upper trapezius “UT”, lower trapezius “LT”) and distal muscles (extensor carpi radialis “ECR”, extensor digitorum “ED”, flexor digitorum superficialis “FDS” and abductor pollicis brevis “APB”) were recorded only on the dominant side by surface electromyography (sEMG) during both tasks. Participants were required to rate their discomfort of right side of neck, shoulder, upper back, elbow, wrist and thumb using numeric rating scale (0-10) before and after each task. At the end of the each task, participants were also asked to rate their overall subjective feeling using rate of perceived exertion (RPE) from 6 to 20. The independent variables were group and task. The dependent variables were (1) median muscle activity in terms of 50th% Amplitude Probability Distribution Function (APDF), (2) RPE, (3) discomfort intensity (Subtracted baseline summed score of all discomfort areas from summed score after each task), (4) accuracy and speed of texting.

3. Results

The CES and UT showed significantly higher activity in terms of 50th%APDF in the Case Group compared with Control Group in both tasks (CES: F\textsubscript{1,18}=5.59, p=0.030; UT: F\textsubscript{1,18}=8.50, p=0.009) (Fig.1). There was no statistically significant difference between tasks and no group x task interaction effect in all proximal muscles. Regarding the 50th%APDF of distal muscles, no between-group difference and group x task interaction effect were found, but strong task effects were found in all muscles (ECR: F\textsubscript{1,1}=64.47, p=0.000, ED: F\textsubscript{1,1}=16.23, p=0.001, FDS: F\textsubscript{1,1}=38.41, p=0.000, APB: F\textsubscript{1,1}=75.09, p=0.000) with significantly higher...
activities in unilateral texting compared with bilateral texting in both groups (Fig.1). Results on RPE and discomfort intensity only showed between group difference, with Case Group reporting significantly higher rate of perceived exertion (RPE) and discomfort intensity compared with Control Group in both tasks (RPE: $F_{1,18}=9.87$, $p=0.006$; Discomfort intensity: $F_{1,18}=11.31$, $p=0.004$). There were no differences in accuracy and speed of texting between Groups.

4. Discussion

Participants with neck-shoulder pain had significantly higher level of muscle activation in CES and UT muscles when texting using multitouch phone. This result is consistent with previous studies proposing an "altered motor control" associated with computer-related musculoskeletal disorders (Szeto et al. 2005). Unilateral texting put significantly more strain to forearm and thumb muscles compared to bilateral texting which may due to larger motion amplitudes of the thumb and higher force level needed when holding the phone and texting with the same hand. Based on this result, using both thumbs to text on multitouch phone is recommended in order to reduce the load on proximal and distal muscles and most likely lower the risk of developing musculoskeletal disorders. Further research is needed to delineate more precisely the association between the intensive use of multitouch devices and neck-shoulder disorders. This area of research will contribute towards the development of ergonomic guidelines for using multitouch devices.

![50th%APDF](image)

Figure 1. Mean + SD of the 50th% Amplitude Probability Distribution Function (APDF) of the surface electromyogram from the dominant side in cervical erector spinea (CES), upper trapezius (UT), lower trapezius (LT), extensor carpi radialis (ECR), extensor digitorum (ED), flexor digitorum superficialis (FDS) and, abductor pollicis brevis (APB) muscles during bilateral texting (B-TEXT) and unilateral texting (U-TEXT).

*Significant difference between groups, **significant difference between B-TEXT and U-TEXT. *$p<0.05$, **$p<0.01$, %EMG_Max: percentages of the EMG activity during 100%MVC.

References