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BIOMECHANICS AND PERFORMANCE WHEN USING A STANDARD AND A VERTICAL COMPUTER MOUSE

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INTRODUCTION

Using computer is a common task. Computers are increasingly common in the workplace and at home. Computer mouse devices are often used for interfacing with softwares, websites and programs. The biomechanics involved in standard computer mouse use has been implicated in increased risk of developing musculoskeletal disorders. The objective of this study was to compare the biomechanics and performance while using a standard and a vertical computer mouse.

METHODS

Sixteen (6 males, 10 females) healthy volunteers, aged 26±3 years and with a body mass index of 24±3 kg/m^2 participated in the study. All participants were physical therapy students with similar schedules and computer use requirements. The subjects completed computer mouse tasks with a standard and a vertical computer mouse after an adaptation period of 16h over two weeks. The electrical activity of the extensor carpi ulnaris, extensor digitorum communis, pronator teres, flexor digitorium superficialis and upper trapezius muscles was measured using surface electromyography (sEMG), and wrist flexion-extension, radial-ulnar deviation and prono-supination were measured using electrogoniometers (elgons) (Figure 1). Performance was measured using the Fitts' Law test, and user satisfaction was evaluated using a questionnaire including 5-point scales (5 = best).

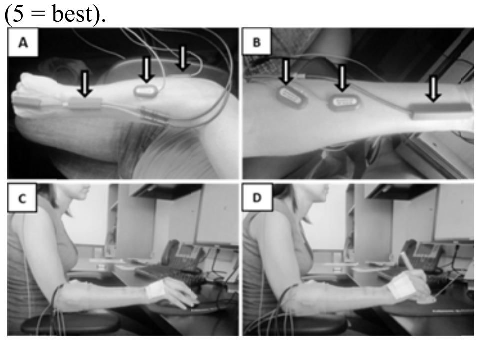

Figure 1. Data collection setting and sensor placement. (A) View from above showing from left to right the wrist elgon placed on the posterior aspect of the joint, and the sEMG electrodes placed on the skin over the muscle bellies of the extensor digitorum communis and extensor carpi ulnaris. (B) View from above showing from left to right the sEMG electrodes placed on the skin over

the muscle bellies of the pronator teres, flexor digitorium superficialis and the torsiometer placed on the anterior aspect of the on the forearm. (C) Data collection using a standard, and (D) using a vertical computer mouse.

RESULTS

There was less pronation (mean difference ≠-14º, p<0.001), ulnar deviation (≠-12º, p 0.016), extensor carpi (≠-3%, p 0.006) and extensor digitorum (≠-4%, p<0.001) muscle activity, but more wrist extension (≠13º, p<0.007) when using the vertical mouse.
User satisfaction was good (68±14%); however, performance was worse with the vertical mouse (≠-0.65 bits/s, p<0.001).

DISCUSSION

Increased wrist extension was also found in a study comparing a trackball mouse with a standard mouse [1]. Despite the increased extension, there was less wrist extensor muscle activity. This can be explained by the fact that when the forearm is in a more neutral pronation-supination position, gravity effects are minimized to accomplish extension. Gravity effects were removed when using the vertical computer mouse by repositioning the forearm in a more neutral position. Other computer mouse designs also reduced forearm muscle activity, but to a lower extent [2,3]. Decreased forearm muscle activity is an important outcome because myofascial pain syndrome of forearm extensors is one of the most common upper extremity disorders associated with occupational keyboard/mouse use [4].

A previous study of the effects of using slanted computer mouse designs found that as the slanted angles increased, ulnar/radial deviation decreased, wrist flexion/extension increased, and sEMG levels of the extensor carpi ulnaris, pronator teres and upper trapezius muscles decreased [5]. We had similar findings, but the upper trapezius muscle tended to be more active when using the vertical than the standard computer mouse. This might have happened because the subjects did not rest their forearms on the table when using the new mouse. Thus, further training is required because when the forearm is supported there is only modest activation of shoulder muscles [6]. Also, the decreased performance possibly occurred due to insufficient adaptation time, and may have contributed to increased UT muscle activity Further instructions and an instruction guide on how to use the vertical mouse are necessary.

CONCLUSION

Using the **v**ertical mouse decreased the exposure to biomechanical risk factors for musculoskeletal disorders, resulting in less wrist pronation and lower wrist extensor muscle activity. Additional training and familiarization time may be required to improve user performance with the vertical mouse.

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