



Design of an electronic instrumentation for measuring repetitive hand movements during computer use to help prevent work related upper extremity disorder

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ABSTRACT

Repetitive movements for computer users can result in complaints caused by extreme hand posture, finger movements, and force when using the computer, which is known as Work Related Upper Extremity Disorder (WRUED). This study is about the construction of electronic instrumentation for monitoring and quantifying these movements and forces, using sensors to register wrist posture and fingertip force with software developed to collect and process the data. Tests evaluated the performance of the instrumentation with seventeen subjects participating in this study. The maximum extension observed for the first test was 41°, however after training the subject decreased this value to 33°. Six subjects had a wrist extension of between 15° and 41° for the first test; five reduced their wrist extension (between 3° and 33°) during the second test ($p = 0.08$) while one subject increased instead of decreased it. No subject performed fingertip force greater than 0.77N during the first test; this was reduced to 0.57N during the second test ($p = 0.04$). The average typing frequency in the group decreased from 3.2Hz to 2.5Hz during the second test ($p = 0.01$). Results confirm that this solution may potentially contribute to hand movement reeducation, thereby reducing the risk of WRUED for computer users.

Relevance to industry: Knowledge of repetitive movements during computer use and associated WRUED is essential for prevention. This electronic instrumentation aids the correction of hand movements, which reduces the risk of injury due to inappropriate posture, extreme range of movement, or force during computer use.

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1. Introduction

Different occupations cause musculoskeletal disorders (Corry et al., 2000) and one of these occupations is frequent computer use. Consequently, with increasing computer use, Work Related Upper Extremity Disorder (WRUED) is becoming common. This complaint, among other factors, is associated with repetitive movement and inappropriate positions that cause injuries to tendons, muscles, and joints. This includes long duration of computer use (Douwes et al., 2007). Generally, computer users do not have any guidance to assist them with correct hand positions, movements, and the force exerted by their fingers.

Computers users who keep their wrist extended by more than 20° are at risk of developing carpal tunnel syndrome (CTS) (Liu

et al., 2003). CTS is defined as an acute or chronic compressive lesion of the median nerve in the wrist (Turhanoglu and Beyazova, 2003).

According to Barbe and Barr (2006), musculotendinous injuries, which result from performing repetitive and/or forceful tasks, are due to repeated overstretch, compression, friction, and overexertion. Sometimes the keyswitch design and finger posture makes it worse (Jindrich et al., 2004).

WRUED causes hand and arm pain. Individuals with severe impairment of hand motor control or severe hand pain may not be able to perform required tasks Zong-Ming and Harkness (2004). In this case, normally they must use some orthoses (Ferrigno et al., 2009).

Repetitiveness has been identified as a major risk factor for Work-related upper-extremity musculoskeletal disorder (You and Kwon, 2005; Jones and Kumar, 2007). Corry et al. (2000) defined repetition as the joint changing direction by 5° in a study about wrist movements.

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