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The effect of an ergonomic computer device on muscle activity of the upper trapezius muscle during typing

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Abstract

Objective: Investigate whether an ergonomic computer device, characterised by an inclined working area and keyboard localisation close to the screen (the Up-Line), decreases the muscle activity of the upper trapezius muscle.

Methods: In a crossover design 19 healthy subjects and 19 patients with Whiplash Associated Disorder (WAD) typed during 10 min at the Up-Line and at a standard workstation with 15 min of rest in between. During typing surface EMG was measured of the trapezius muscle. The subjects were asked to rate sitting comfort and complaints.

Results: Although most subjects subjectively preferred the Up-Line, on average no significant differences were found in muscle activity between the two workstations for both patients and healthy subjects. Individually in 5 healthy subjects (25%) and in 6 patients (31%) muscle activity was lower when working at the Up-Line.

Conclusion: Although some subjects subjectively prefer the Up-Line in sitting comfort, on average the Up-Line did not decrease the muscle activity, both in healthy subjects as in patients with WAD.

Keywords: Electromyography; Ergonomic device; Occupational rehabilitation

1. Introduction

In the last decade the number of subjects with work related musculoskeletal disorder (WMSD) increased dramatically. In The Netherlands over 2 million workers are at risk for WMSD and in 500,000 of them this is due to computer work (Huppes and Schreibers, 1999). Several anatomical sites are mentioned to be at risk for musculoskeletal discomfort during computer work especially neck shoulder region (Waersted et al., 1991; Schüldt et al., 1987; Hagberg and Kvarnstrom, 1984) and arm (Hales et al., 1994). The musculoskeletal discomfort is hypothesised to be a result of a chronic imbalance between the functional capacity of the worker and the functional workload. This imbalance can be reduced by increasing the functional capacity of the worker and/or by decreasing the functional workload (Goeken, 1998, Mathiassen and Winkel 1996, Bergqvist et al., 1995a, b).

Different kinds of computer workstation and computer devices like forearm support and ergonomic mice have been developed in the last decade to try to reduce workload (Cook and Kothiyal, 1998; Harvey and Peper, 1997; Bergqvist et al., 1995a, b; Vasseljen and Westgaard, 1995; Fernström et al., 1994; Takala and Viikari-Juntura, 1991).

In occupational rehabilitation, a successful return to work of chronic pain patients is hampered as these patients often have a lowered functional capacity. A category of chronic pain patients is patients with Whiplash Associated Disorder (WAD). These patients complain about chronic pain in the neck and as a consequence they are not able to perform computer work during prolonged period of time. An ergonomic computer workplace adaptation might be able to reduce the functional workload and might due to this have a positive influence on a successful return to work.

Such an ergonomic computer workplace adaptation has been developed to assist in a more successful return to work of patients with a WAD. Characteristics of this adaptation, called the Up-Line, are an inclined working area and the keyboard located close to the screen

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Fig. 1. The Up-Line: characteristics of the Up-Line are the inclined work area and the position of the keyboard close to the screen.

(Fig. 1). These features enable total forearm support, wrist in neutral position and require only slight flexion of the neck to focus on the keyboard. The first subjective experiences were positive. Patients continued their work over a longer period and they indicated having fewer complaints when working at the Up-Line compared to a standard workstation (according the guidelines of the Dutch Ministry of Labour, 1999).

In this study it is hypothesised that due to the total forearm support and the keyboard position the Up-Line will cause a decreased muscle activity of the neck. To investigate this, the muscle activation level of the trapezius muscle during typing at the Up-Line is compared to typing at a standard workstation. Beside EMG measurements, the subjective interpretation, using Visual Analogue Scale, concerning sitting comfort and work performance and work posture are measured. Two groups of subjects have been included in this study, healthy subjects and patients with WAD.

2. Methods

2.1. Subjects

Nineteen healthy persons and 19 patients with WAD have been included in this study. General inclusion criteria were: age between 20 and 50 yr, no history of inflammatory disease, no use of muscle relaxants and a body mass index less then 30. Specific inclusion criteria for healthy subjects were absence of history of neck pain and for patients with WAD no history of musculoskeletal disorders before neck pain started due to WAD. Only patients with WAD type 2 or type 3, according to the Quebec Task Force for WAD (Spitzer et al., 1995) were included.

2.2. Protocol

2.2.1. Design

Using a crossover design, every subject typed 10 min at the standard workstation and at the Up-Line with 15 min rest in between. Half of the subjects started typing at the Up-Line and the other half started at the standard workstation. The text to be typed was designed in such a way that it required an equal amount of keystrokes from the left and right side of the keyboard.

2.2.2. Computer workstations

Before starting, the subject had permission to change the height of the chair and the table to achieve 90° angles in hips and knees and to position the screen with the eye level 10 cm below the upper border of the screen.

2.2.2.1. The standard workstation. The position of the document was fixed on the left side of the screen and the keyboard had a fixed position on the table.

2.2.2.2. The Up-Line. The position of the document was fixed on the left side of the screen. The keyboard had a fixed position close to the screen. The inclined working area of the Up-Line had a fixed position of 18° with the tabletop (Fig. 1).

2.2.3. Measurements

2.2.3.1. Muscle activity. During typing surface EMG (sEMG) was recorded for the left and right trapezius muscle. Bipolar surface electrodes were placed bilaterally above the descending part of the trapezius muscle 2 cm lateral of the middle of the line between the acromion and the processus of the 7th cervical spine in the direction of the muscle fibres according to international guidelines with a 2.5 cm interelectrode distance with an electrode size of 1 cm in diameter (Mathiassen et al., 1995; Hermens et al., 2000). A reference electrode was placed around the right ankle.

The sEMG signal was low-pass filtered at 3–400 Hz filter, sampled at 1000 Hz and AD converted (12 bit). To facilitate comparison between individuals, EMG was normalised using a submaximal isometric reference test. In sitting position the subject was asked to hold both arms in a position of 90° abduction for 15 s. This reference test was repeated 4 times with 1 min rest in between two tests and was performed before the experiment (Mathiassen et al., 1995).

2.2.3.2. Sitting comfort. Immediately after the typing task the subject was asked to mark a Visual Analogue Scale (VAS), representing how comfortable he/she sat during 10 min typing. The VAS is a 10 cm vertical line, with sitting uncomfortable at the bottom of the scale (zero) and sitting as comfortable as possible on the top of the scale (10).