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Comparison of Sitting with and without A Backrest during Computer Work

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Abstract. [Purpose] This study compared the differences between sitting with or without a backrest of shoulder, and trunk muscle activities during computer work. [Subjects] Fifteen healthy adults participated in this study. The participants had no history of injury to, or neurologic deficits of the neck muscles and upper extremities at the time of participation. [Methods] Surface electromyography (EMG) of the upper trapezius, serratus anterior, middle trapezius, external abdominal oblique, gluteus maximus muscles were recorded of 15 adults while they performed computer work. The recorded signals were averaged and normalized to the mean amplitude of the EMG signal obtained during submaximal reference voluntary contractions. [Results] The upper trapezius muscle activity significantly increased in sitting with a backrest. The muscle activities of the serratus anterior, middle trapezius muscle, external abdominal oblique, and gluteus maximus significantly decreased in sitting with a backrest. [Conclusion] The selection of a backrest is a very important factor for preventing work-related disorders.
Key words: Backrest, EMG, Sitting posture

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INTRODUCTION

Prolonged sitting can potentially damage the spine since it increases intradiscal pressure and compressive stress on the annulus. Thus, it is important to teach seated workers to keep a correct sitting posture while doing desk work[1)]. The ideal seated posture is one in which the lumbar spine has some degree of extension, whereas a poor posture is one in which the lumbar spine is kyphotically slumped[2)]. Proper posture is considered to be a state of musculoskeletal balance that involves minimizing the stresses and strains acting on the body[3)]. A flexed spine results in higher activity in the cervical erector spinae and upper trapezius muscles, with a posture in which the trunk is slightly inclined backward[4)]. Forward head and trunk flexion may gradually develop into a fixed postural habit when workers work at visual display terminals (VDT), and different muscle control strategies may also develop concurrently[5)]. Many studies have attempted to determine the seating postures that reduce the risk of developing musculoskeletal pain of the neck and trunk[6)]. Different chair designs have emerged which aim at allowing individuals to assume a correct sitting posture while maintaining comfort and functionality[5, 6)]. The aim of this study was to compare the differences between sitting with and without a backrest of shoulder and trunk muscles activities during computer work..

SUBJECTS AND METHODS

The subjects of this study were 15 Korean men (age: 23.7 ± 3.1 years, height: 174.3 ± 3.1 cm, body weight: 68.3 ± 5.5 kg). Subjects with limitation in range of movement of the pelvis or spine, or who had experienced orthopedic disabilities such as pain or neurologic deficits of the pelvis or spine during the previous year were excluded from the study. Prior to the start of the study, the subjects signed an informed consent document that was approved by the Human Ethics Committee of the Faculty of Health Sciences at Inje University. Electromyography (EMG) signals were preamplified by a preamplifier placed close to the electrodes and recorded on an MP150 system that amplified and sampled the EMG inputs at 1000 Hz. EMG data were analyzed using a program created by Acqknowledge software and expressed as the mean %RVC. EMGs of the upper trapezius, serratus anterior, middle trapezius, external abdominal oblique, gluteus maximus muscles were recorded. All subjects typed randomly selected computer work on a computer. The EMG data were obtained from the last 30 seconds of a 1-minute data collection period whilst the subject sat either leaning against the backrest or with no backrest. An adjustable height table and chair were used to ensure that the hips and knees were flexed by 90°. The chair was made of polypropylene materialand its adjustable height backrest could be removed. The SPSS statistical package (version 18.0, SPSS, Chicago, IL, U.S.A.) was used to analyze the significance of differences in the EMG muscle data of the muscle activities of the shoulder and trunk in between sitting with and without the backrest using the paired t-test. Values of $p<0.05$ were accepted as significant.

Table 1. Comparison of the neck, shoulder, and trunk muscle activities between sitting with and without the backrest

Muscles	mean ± SD (%MVC)	
	no backrest	backrest-leaning
UT	16.3 ± 3.7	28.6 ± 8.3*
MT	17.3 ± 4.0	9.7 ± 3.6*
SA	17.8 ± 9.8	13.2 ± 5.1*
EO	35.9 ± 9.3	20.4 ± 7.8*
GM	22.9 ± 7.2	12.8 ± 6.5*

RESULTS

The normalized EMG data of the upper trapezius, serratus anterior, external abdominal oblique, and gluteus maximus muscles significantly differed between sitting with and without the backrest ($p<0.05$). The upper trapezius, muscle significantly increased in sitting, leaning against the backrest ($p<0.05$). The muscle activities of the serratus anterior, middle trapezius muscle, external abdominal oblique, and gluteus maximus significantly decreased sitting, leaning against the backrest ($p<0.05$) (Table 1).

DISCUSSION

Many clinicians recommend a proper sitting posture to train motor patterns in order to of improve spine stability[7–9]. Vergara and Page[10] suggested that large changes in sitting posture are indicative of discomfort while small movements are necessary to alleviate pain caused by static lumbar and pelvic postures. This may indicate that seating conditions that promote movement are more comfortable. Poor muscle endurance is correlated to poor habitual sitting posture and lower muscle activity levels of the turnk[2]. Combining exercises with provision of information on the correction of poor posture is a common treatment approach for the management of neck and shoulder pain[11]. Our present study compared the differences between sitting with and without a backrest of the neck, shoulder, and trunk muscle activities during computer work. The upper trapezius, muscle significantly increased sitting, leaning against the backrest. This increase may result in increased cervical tension in the posture-stabilizing muscles as well as increased compressive forces in the articulations of the cervical spine due to forward head posture[7]. The muscle activities of the serratus anterior, middle trapezius muscle, external abdominal oblique, and gluteus maximus significantly decreased in sitting, leaning against the backrest. The erect sitting posture may result in more effective load sharing with muscle activation of the serratus anterior, middle trapezius muscle, external abdominal oblique, and gluteus maximus associated with shoulder and trunk stability[9, 12]. We consider that a backrest-leaning posture would evoke a slumped sitting posture. Slumped sitting encourages forward head position, trunk flexion and shoulder protraction. Slumped over documents and staring all day into a computer screen damages the muscles, exacerbating tension and tightness around the neck and shoulders. When spinal tissues are subject to a significant load for a sustained period, they deform and undergo remodeling changes that can become permanent[13, 14]. General office chairs with a backrest reduce compressive loading on the spine compared to an upright sitting posture without a backrest[15]. However, using a backrest with the incorrect leaning posture can produce fatigue. The backrest must be determined on the basis of the habitual characteristics of computer users when used by computer workers. Therefore, the selection of backrest is a very important factor in the prevention of work-related disorders.

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