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Original Article

Comparison of the Forward Head Angle and the Lumbar Flexion and Rotation Angles of Computer Workers Using Routine and Individually Fixed Computer Workstations

Won-gyu Yoo[1)]

[1)] *Department of Physical Therapy, College of Biomedical Science and Engineering, Inje University: 607 Obangdong, Gimhae, Gyeongsangnam-do 621-749, Republic of Korea*

Abstract. [Purpose] This study compared the forward head angle and the lumbar flexion and rotation angles of computer workers using routine and fixed computer workstations. [Subjects] Ten male workers voluntarily consented to participate in the study. [Methods] A 3-D motion analysis system was used to measure the angles of the forward head and lumbar flexion. All subjects performed computer work for 30 minutes using both types of workstation. [Results] When working at the fixed workstation, the forward head angle was less than that observed when the routine workstation was used. At the fixed workstation, the lumbar flexion and rotation angles were less than that at the routine workstation. [Conclusion] The computer workstation individually fixed for standard posture may have prevented poor sitting posture.
Key words: Computer workstation, Forward head angle, Sitting posture

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INTRODUCTION

A flexed spine due to poor sitting posture, such as slump sitting posture, results in higher activity in the upper trapezius and erector spinae muscles, in a posture in which the trunk is slightly inclined backward[1)]. Panjabi theorized that spinal instability in the form of laxity around the neutral position of a spinal segment developed because of a significant decrease in the capacity of the stabilizing system that maintains the spine in a neutral position[1)]. The stabilizing system consists of three interacting subsystems. Habitually shortened muscle length, which becomes evident when an individual muscle does not travel through a complete range of motion on a daily basis, may cause adaptive changes in muscle length, in turn triggering habitual forward head and slumped sitting postures[2, 3)]. Use of poorly designed computer workstations may rapidly lead to the development of such postures[3–5)]. Therefore, I developed a computer workstation that minimizes such effects. The purpose of the present study was not to solve or elucidate the mechanisms of musculoskeletal disorders. Rather, this study determined whether a computer workstation individually fixed for standard posture beneficially influences sitting posture. This study compared the forward head angle and the lumbar flexion and rotation angles of computer workers using routine computer workstations and computer workstations individually fixed for standard posture.

SUBJECTS AND METHODS

Ten males computer workers voluntarily consented to participate in this study. None had any history of disease or any problem with walking. Their average age, height, and weight were 31.3 ± 4.3 years, 176.2 ± 3.0 cm, and 70.5 ± 6.3 kg, respectively. Each subject provided his informed consent before participating in the study. This study was approved by the Inje University Faculty of Health Sciences Human Ethics Committee. A 3-D motion analysis system, CMS-HS (Zebris Medizintechnik, Isny, Germany), was used with a sampling rate of 30 Hz to measure the angles of the forward head and lumbar flexion during 30 minutes of computer work. Single markers for forward head angle were placed on the right tragus of the ear and the 7th cervical spinous process (C7) by the same investigator. The forward head angle was defined as the angle between the line from the tragus to the C7 line and the vertical axis at C7. The lumbar flexion and rotation angles were measured using two triple-marker sets. Triple markers were attached to the lumbar region and the pelvis at L1–2 and S1–2, respectively. Lumbar flexion and lateral bending and rotation were calculated relative to movements of the pelvis. The routine computer workstation featured a 23-inch monitor, a keyboard and a mouse on a table, and a swivel chair with five wheels. To allow analysis of lumbar motion, the armrest and backrest were removed. Both the table and chair were adjustable

Corresponding author. Won-gyu Yoo (E-mail: won7y@inje.ac.kr)

in terms of height and were initially set to ensure that elbows, hips, and knees were flexed at 90°. The keyboard and mouse were positioned frontally, 30 cm from the trunk, the monitor was reclined by 20°, and the top of the display was set at eye level (I term these conditions "the standard sitting posture"). The computer workstation individually fixed for standard posture used the same hardware, but all products were fixed to encourage the standard sitting posture for each subject. The keyboard was fixed using wedges, and the range of mouse motion was limited (also using wedges). The chair was fixed to the table and floor. All wheels and the swivel apparatus were fixed on the chair. All subjects performed selected computer work for 30 minutes using each type of workstation. The test order was random, and the interval between tests was 30 min. The computer work was performed using the Hansoft program. SPSS version 12.0 (SPSS, Chicago, IL) was used to assess differences in forward head and lumbar flexion angles. The paired t-test was used to explore the significance of differences in measures obtained using the two workstations. Significance was accepted for values of $p < 0.05$.

RESULTS

When working at the fixed workstation, the forward head angle (18.0 ± 8.5 degrees) was less than that observed when the routine workstation was used (34.4 ± 11.9 degrees). At the fixed workstation, the lumbar flexion angle (16.3 ± 5.7 degrees) was less than that observed at the routine workstation (29.6 ± 10.6 degrees). At the fixed workstation, the lumbar rotation angle (10.2 ± 4.9 degrees) was less than that observed at the routine workstation (19.1 ± 9.7 degrees).

DISCUSSION

When working at the fixed workstation, the forward head angle was less than that observed when the routine workstation was used. At the fixed workstation, the lumbar flexion and rotation angles were less than that at the routine workstation. My hypothesis was that use of a routine workstation might create a habitual leaning posture unless the keyboard, mouse, and chair were used properly. Indeed, the subjects changed the positions of all three components. The sitting posture was changed within approximately 10 min to a position that allowed comfortable working. Szeto et al.[6] attributed changes in muscle patterns principally to personal habitual postures rather than postures dictated by workstations. Yoo and Kim[7] also reported that a comfortable seat may induce much more pelvic posterior tilting than a hard or unstable seat, which may in turn decrease lumbar lordosis. Also, development of forward head posture may reflect compensation for the posterior movement of the center of gravity. Most computer users are well acquainted with the requirements for maintenance of a good or standard posture. However, they commonly fail to maintain such postures, because they involuntarily change good posture to a more relaxed posture to concentrate on computer work. Poor postural patterns eventually create neck and back pain[3]. Although it could not be affirmed that the effect of computer workstations individually fixed for standard posture is better than ergonomic chair designs and interventions, it has a positive effect which has not been investigated in previous studies. The ultimate goal of this study was not spine straightening, since this can lead to other musculoskeletal disorders. Instead, we determined whether workstations individually fixed for standard posture could be used to prevent excessive trunk flexion and rotation. The fixed computer workstation may have prevented poor sitting posture. Also, the fixed computer workstation could be used for education of a good sitting posture for computer workers unfamiliar with the standard sitting posture.

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REFERENCES

1) Panjabi MM: The stabilizing system of the spine. Part I. Function, dysfunction, adaptation, and enhancement. J Spinal Disord, 1992, 5: 383–389. [Medline] [CrossRef]
2) O'Sullivan PB, Mitchell T, Bulich P, et al.: The relationship between posture and back muscle endurance in industrial workers with flexion-related low back pain. Man Ther, 2006, 11: 264–271. [Medline] [CrossRef]
3) Reeves KB, Stanfield J, Hughes L: Assessment of video display workstation set up on risk factors associated with the development of low back and neck discomfort. Int J Ind Ergon, 2005, 35: 593–604. [CrossRef]
4) Torén A: Muscle activity and range of motion during active trunk rotation in a sitting posture. Appl Ergon, 2001, 32: 583–591. [Medline] [CrossRef]
5) Davis KG, Marras WS: The effects of motion on trunk biomechanics. Clin Biomech (Bristol, Avon), 2000, 15: 703–717. [Medline] [CrossRef]
6) Szeto GP, Straker LM, O'Sullivan PB: A comparison of symptomatic and asymptomatic office workers performing monotonous keyboard work–2: neck and shoulder kinematics. Man Ther, 2005, 10: 281–291. [Medline] [CrossRef]
7) Yoo WG, Kim MH: Effect of different seat support characteristics on the neck and trunk muscles and forward head posture of visual display terminal workers. Work, 2010, 36: 3–8. [Medline]