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Comparison of the Hamstring Muscle Activity and Flexion-Relaxation Ratio between Asymptomatic Persons and Computer Work-related Low Back Pain Sufferers

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Abstract. [Purpose] The purpose of this study was to compare the hamstring muscle (HAM) activities and flexion-relaxation ratios of an asymptomatic group and a computer work-related low back pain (LBP) group. [Subjects] For this study, we recruited 10 asymptomatic computer workers and 10 computer workers with work-related LBP. [Methods] We measured the RMS activity of each phase (flexion, full-flexion, and re-extension phase) of trunk flexion and calculated the flexion-relaxation (FR) ratio of the muscle activities of the flexion and full-flexion phases. [Results] In the computer work-related LBP group, the HAM muscle activity increased during the full-flexion phase compared to the asymptomatic group, and the FR ration was also significantly higher. [Conclusion] We thought that prolonged sitting of computer workers might cause the change in their HAM muscle activity pattern.
Key words: Computer work-related LBP, Flexion-Relaxation ratio, Hamstring

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INTRODUCTION

Recently, the relationship between low back pain (LBP) and prolonged maintenance of the same posture has been established[1)]. LBP is increasing in computer workers who sit for most of the day[1, 2)]. Staying seated for a long time causes special concerns for the spine, the circulation, and the muscle and joints[2)]. Phillips et al.[3)] stated that the sitting position of occupational posture is a potent risk factor for LBP. The flexion-relaxation (FR) response is initiated by a reflex control which allows to deactivate and the passive components of the spine to provide[4)]. It is reported that this response appears in the lumbar region in more than 90% of healthy people without LBP[4, 5)]. People with LBP show altered trunk muscle activation patterns with higher amplitude and longer duration in the low back muscles[5)]. Recently, it was suggested that an activation pattern similar to FR is shown by the hamstring (HAM) muscles[6)]. So, we compared the hamstring muscle activities and flexion-relaxation ratios of an asymptomatic group and a computer work-related LBP group in the flexion, full-flexion, and re-extension phases of trunk flexion.

SUBJECTS AND METHODS

The study subjects were 10 asymptomatic computer workers, aged 20–29 years (26.6±3.8 years, mean±SD), whose average height and weight were 175.2±5.7 cm and 68.5±6.2 kg, respectively, and 10 computer workers with work-related LBP, aged 20–29 years (25.0±2.7 years, mean±SD), whose average height and weight were 176.1±4.7 cm and 64.0±5.2 kg, respectively. Each subject worked in a seated posture for long periods every day, and verbally reported that prolonged sitting seemed to provoke or to exacerbate lower back pain (LBP). All subjects completed the Korea Oswestry Disability Index and performed the clinical measures and the trunk forward flexion and return tasks in the same order. The muscle activities were measured using a NORAXON Telemyo 2400T (NORAXON Inc., Scottsdale, AZ, USA). The sEMG system was synchronized with a 3D motion capture system. The electrodes were attached to the right hamstring (HAM) muscle, at the lateral aspect from the midway point between the gluteal fold and the back of the knee. The EMG parameters that were compared between the study groups were RMS activity of each phase (flexion, full-flexion, and re-extension phase) of trunk flexion and the flexion-relaxation (FR) ratio of muscle activity, which was calculated as the ratio of the flexion phase and full-flexion phase. The EMG data selected for analysis were the RMS of the muscle activity for the median 1 second during the flexion phase (a), the full-flexion phase (b), and the re-extension phase. The formula for calculating the FR ratio was as follows: the value obtained in (b) divided by the value obtained in (a), multiplied by 100. The SPSS statistical package (version 14.0; SPSS, Chi-

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cago, IL, USA) was used to analyze significant differences in EMG parameters during the trunk forward flexion and return. Statistically significant differences between the two groups were tested using the independent t-test, with statistical significance accepted for values of $p<0.05$.

RESULTS

The activity measurements in the HAM muscle, during the flexion phase, were 24.4±13.0 μV in the asymptomatic group and 25.7±10.0 μV in the computer work-related LBP group ($p>0.05$). During the full-flexion phase, these values were 12.4±9.8 μV in the asymptomatic group and 24.0±12.5 μV in the computer work-related LBP group, and this difference was statistically significant ($p<0.05$). During the re-extension phase, the values were 37.0±17.4 μV in the asymptomatic group and 39.8±13.9 μV in the computer work-related LBP group, but this difference was not statistically significant ($p>0.05$). The FR ratios of the HAM muscle were significantly higher in the computer work-related LBP group (106.6±52.0) than in the asymptomatic group (55.6±23.1) ($p<0.05$).

DISCUSSION

The EMG RMS of the HAM muscle during the full-flexion phase was significantly higher in the computer work-related LBP group than in the asymptomatic group. The FR ratio of the HAM muscle was significantly increased in the computer work-related LBP group when compared to the asymptomatic group. Previous investigations have demonstrated that hip extensor exercises enhance lumbopelvic stabilization during trunk motion or lower-extremity movement[7, 8]. The lumbopelvic stabilizing role of the HAM muscle is important, because of its anatomical proximity and interconnections through its attachment to the sacrotuberous ligament[8]. The proximal biceps femoris tendon of the HAM muscle originates from the sacrotuberous ligament by way of the ischial tuberosity. During flexion, the ischial tuberosity experiences inferior torsion as a result of increased tension on the biceps femoris muscle, which causes increased tension in the sacrotuberous ligament[9]. Increased tension can stimulate the mechanoreceptor and neural systems, which, in turn, eccentrically activate the hip extensors[2, 9]. Flexion of the trunk allows pelvic anterior rotation in combination with lumbar flexion. Eccentric contraction of the hip extensors or HAM muscles occurs during pelvic anterior rotation in the sagittal plane. The HAM muscles of the computer work-related LBP group may have been eccentrically hyper-activated during the full-flexion period, as a result of increased muscle tension. Sitting for long periods produces a high load on the spine of computer workers, causing LBP, and this may lead to either muscle shortening or muscle weakness, or hyper- or hypo-mobility of joints[10]. These changes are also associated with a slumped sitting posture, because a slumped posture can produce pelvic posterior tilting while sitting.

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