Comparison of the Symmetry of Right and Left Lateral Cervical Flexion and Rotation and the Cervical FRR in Young Computer Workers

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Abstract. [Purpose] This study compared the symmetry of right and left lateral cervical flexion and rotation, and the cervical flexion-relaxation ratio (FRR) in young computer workers in Korea. [Subjects and Methods] Twenty computer workers (14 males and 6 females) participated in this study. We measured their right and left lateral cervical flexion, rotation, and FRR. [Results] Right and left lateral flexion and right and left rotation showed no significant differences between the sides. The left cervical FRR was significantly lower than the right cervical FRR. [Conclusion] The cervical FRR, expressed as a numerical value, is a more sensitive marker for measuring neuromuscular changes associated with mild asymmetry than CROM.

Key words: Cervical range of motion, Flexion-relaxation ratio, Muscle imbalance

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INTRODUCTION

Measuring the active cervical range of motion (ROM) has frequently been used to discriminate between painful and asymptomatic individuals, and assessments of ROM, have been reported to be two of the best estimators of cervical disability¹⁾. Reduced active movement within the cervical region may disturb functional activities, and causes a lack of corrective and protective reactions and loss of mobility in the neck area, which are associated with changes in the passive structures of the cervical spine^{1, 2)}. A recent study proposed that patients with neck pain had a significantly lower cervical flexion-relaxation ratio (FRR), which could be a useful marker of the modulation of neuromuscular activity in patients with neck pain³⁾. The cervical FRR can be used to evaluate the effects of treatment by quantifying neck disability/damage and neck disorders^{3, 4)}. Ning et al.⁵⁾ investigated the asymmetry of lumbar FR during symmetrical performance of sagittal movements. Furthermore, Olson et al.⁶⁾ found symmetrical bilateral muscle activation in low back muscles. To our knowledge, there is no previous report of asymmetry of cervical FR. Thus, in this study, we compared the symmetry of right and left lateral cervical flexion, rotation, and the FRR in young computer workers in Korea.

SUBJECTS AND METHODS

The subjects were 20 computer workers (14 males, 6 females). Their average age, weight, and height were 23.8 ± 3.7 (mean $\pm$ SD) years, 63.4 ± 12.1 kg, and 169.7 ± 7.7 cm, respectively. The subjects used computers for 5.0 ± 1.5 h/day (mean $\pm$ SD) as full-time student workers in a university office. All subjects were right-hand dominant, and they had been free of any neck or back pain for a minimum of 1 year prior to the study; they also had no upper-limb or cervical spine pathology, or rheumatological or neurological conditions. This study was approved by the Inje University Faculty of Health Sciences Human Ethics Committee. Each subject provided written informed consent before participation in this study. Right and left lateral cervical flexion and rotation were measured using a Cervical Range of Motion instrument (CROM; Performance Attainment Associates, St. Paul, MN, USA). The instrument attached to the subject's head, and contains two gravity goniometers and one compass goniometer. The frontal-plane gravity goniometers measure lateral flexion, while the compass goniometer measures rotation. The tester measured the right and left lateral flexion and rotation using the CROM. After measuring the cervical active ROM, electromyographic data were recorded to analyze the right and left FR ratio. Surface electrodes were placed on both sides of the cervical erector spinae (CES) muscles, 2 cm lateral to the C4 spinous process. To measure the FR ratio, subjects were asked to perform a standardized cervical flexion-extension movement in three phases: (1) flexion phase, complete cervical flexion for 3 s, (2) relaxation phase, static period in complete cervical flexion held for 3 s, and (3) re-extension phase, extension to return to the initial position for 3 s. The FR ratio was calculated by dividing the maximal muscle activation during the re-extension

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phase by the activation during the relaxation phase. Both measured values of the active cervical ROMs and the mean FR ratios of the three trials of each test were calculated for statistical analysis. The independent t-test was used for comparisons between right and left cervical lateral flexion, rotation, and cervical FRR of computer workers. P values < 0.05 were considered to indicate statistical significance.

RESULTS

The right and left lateral flexion ($42.4 \pm 8.0^\circ$ and $47.2 \pm 9.2^\circ$), right and left rotation ($69.3 \pm 8.7^\circ$ and $70.4 \pm 9.1^\circ$) showed no significant differences between the sides. The left cervical FRR (1.9 ± 1.1) was significantly lower than the right cervical FRR (2.3 ± 1.3) ($p < 0.05$).

DISCUSSION

The relationships between asymmetry in cervical motion and muscles are important information regarding neck pain^{7, 8)}. Here, our results show that right and left lateral flexion, and right and left rotation were not significantly different between the two sides. However, the left cervical FRR (1.9) was significantly lower than the right cervical FRR (2.3). Pialasse et al.⁹⁾ determined the presence or absence of an FRP response in the cervical region using a cut-off for the FR ratio of 2.5. The cervical FRR is much lower in patients with neck pain than in those without. It can also be a reliable indicator of altered neuromuscular control in patients with neck pain³⁾. The subjects participating in the present study were all right-handed, which influenced the asymmetry of the right and left FR ratio. The dominant hand is used to operate the mouse and keyboard. Consequently, the dominant shoulder experiences much motion during computer work, whereas the non-dominant side maintains a prolonged static posture. Thus, the prolonged static posture of the left CES would lead to more rapid accumulation of stress in the CES muscle than on the right side. The cervical FRR, expressed as a numerical value, is a more sensitive marker for measuring neuromuscular changes associated with mild asymmetry than CROM. Muscle imbalance or asymmetry caused by side-to-side differences are particularly important, because they may result in increased or decreased range of

motion on one side during movement, asymmetry of postural alignment, and the generation of unexpected asymmetrical movements^{7, 8)}. Korea has one of the highest rates of internet and computer use globally, greater than 80%¹⁰⁾. This study was conducted to prepare for the possibility that generations of young computer-using Koreans may develop chronic neck pain. The results of this study should be clinically helpful in the assessment of neck pain in young computer workers in Korea.

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REFERENCES

- 1) Johnston V, Jull G, Souvlis T, et al.: Neck movement and muscle activity characteristics in female office workers with neck pain. *Spine*, 2008, 33: 555–563. [[Medline](#)] [[CrossRef](#)]
- 2) Szeto GP, Straker LM, O'Sullivan PB: A comparison of symptomatic and asymptomatic office workers performing monotonous keyboard work—1: neck and shoulder muscle recruitment patterns. *Man Ther*, 2005, 10: 270–280. [[Medline](#)] [[CrossRef](#)]
- 3) Murphy BA, Marshall PW, Taylor HH: The cervical flexion-relaxation ratio: reproducibility and comparison between chronic neck pain patients and controls. *Spine*, 2010, 35: 2103–2108. [[Medline](#)] [[CrossRef](#)]
- 4) Lee MR, Yoo WG, An DH, et al.: The effect of backpack loads on FRR (Flexion-relaxation Ratio) in the cervical spine. *J Phys Ther Sci*, 2011, 23: 599–601. [[CrossRef](#)]
- 5) Ning X, Haddad O, Jin S, et al.: Influence of asymmetry on the flexion relaxation response of the low back musculature. *Clin Biomech (Bristol, Avon)*, 2011, 26: 35–39. [[Medline](#)] [[CrossRef](#)]
- 6) Olson M, Solomonow M, Li L: Flexion-relaxation response to gravity. *J Biomech*, 2006, 39: 2545–2554. [[Medline](#)] [[CrossRef](#)]
- 7) Cibulka MT, Strube MJ, Meier D, et al.: Symmetrical and asymmetrical hip rotation and its relationship to hip rotator muscle strength. *Clin Biomech (Bristol, Avon)*, 2010, 25: 56–62. [[Medline](#)] [[CrossRef](#)]
- 8) Page P, Frank CC, Lardner R: Assessment and Treatment of Muscle Imbalance: The Janda Approach. *Human Kinetics*, 2010.
- 9) Pialasse JP, Dubois JD, Choquette MH, et al.: Kinematic and electromyographic parameters of the cervical flexion-relaxation phenomenon: the effect of trunk positioning. *Ann Phys Rehabil Med*, 2009, 52: 49–58. [[Medline](#)] [[CrossRef](#)]
- 10) A survey of the real state of Internet use: National approved statistics number 12005. Korea Broadcasting and Communication Commission & Korea Internet and Security Agency, 2010.