



Original Article

Relationship between position sense and reposition errors according to the degree of upper crossed syndrome

SEO-YEUNG GU, MS, PT¹⁾, GAK HWANGBO, PhD, PT¹⁾, JEON-HYEONG LEE, PhD, PT^{2)*}

¹⁾ Department of Physical Therapy, College of Rehabilitation Science, Daegu University, Republic of Korea

²⁾ Department of Physical Therapy, Daegu Health College: 15 Yeongsong-ro, Buk-gu, Daegu 41453, Republic of Korea

Abstract. [Purpose] The purpose of this study was to compare reposition errors in subjects with upper crossed syndrome to examine the effects of upper crossed syndrome on position senses. [Subjects and Methods] A sample population of 60 subjects was randomly divided into three groups of 20: a normal group, a mild group, a moderate group. A cervical range of motion device was attached to the head of each subject using straps and the reposition errors of cervical flexion, extension, right lateral flexion, left lateral flexion, right rotation and left rotation were measured. [Results] The normal group showed smaller reposition errors than the mild group and the mild group showed smaller reposition errors than the moderate group but none of the differences among the three groups was significant. [Conclusion] Reposition errors increased in the order of the normal, mild, moderate group but the differences were not significant. In addition, the degree of the subjects' postural misalignment was higher in the moderate than in the mild group. These results demonstrate that cervical spine position sense declines as postural misalignment becomes more severe.

Key words: Upper crossed syndrome, Position sense, Reposition error

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INTRODUCTION

Office workers or students who spend long periods in front of a computer or at a desk begin to adopt a forward head posture, with the head forward of the spinal center line, when maintaining a normal spinal posture becomes difficult while sitting for work¹⁾. A forward head posture causes mechanical stress on the neck. Due to the muscle imbalances resulting from the stress, some muscles are inhibited and weakened and other muscles tend to lose tensility²⁾. This muscle imbalance leads to a vicious cycle that includes bent shoulders, shoulder rises, and abnormal postures of the shoulder blades. The vicious cycle also leads to weakening of the muscles below the neck, such as the rhomboid muscles, the anterior serratus muscle, and the lower trapezius muscle, and hardening of the antagonist muscles, such as the greater pectoral muscle, the upper trapezius muscle, and the musculus levator scapulae, due to stiffness. Janda defined this phenomenon as upper crossed syndrome (UCS)³⁾.

Proprioceptive senses are the senses used to control the positions and motions of the trunk and parts of the body in space⁴⁾. Proprioceptive senses related to the spatial recognition of the head require not only information from the vestibular organs and visual information, but also proprioceptive sense information from the cervical spine⁵⁾. Proprioceptive senses perform two important roles in the neck: they provide information on posture and motion of the cervical spine to the central nervous system, and they provide cervical reflexes for stability and protection of the cervical spine⁶⁾. Pathology, injuries, muscle fatigue, and aging have been reported as causes of damage to cervical spine positional senses, and recent studies have reported

*Corresponding author. Jeon-Hyeong Lee (E-mail: coordi18@naver.com)

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that position sense declines in patients with damage to the cervical spine or who complain of pain^{7, 8}).

Therefore, the present study aimed to compare the reposition errors of subjects with upper crossed syndrome to examine the effects of upper crossed syndrome on position sense.

SUBJECTS AND METHODS

In the present study, lateral photos were taken of 200 undergraduate students of D University. In total, 60 subjects (39 females, 21 males) were selected, based on the photos and they were divided into three groups (normal, mild, moderate) of 20 subjects per group based on the classification criteria of the experiment. None of the subjects had any musculoskeletal system disease, pain, or neurologic symptoms, and all the subjects voluntarily agreed to participate in this study after receiving sufficient explanation about the study method and purpose. This study was approved by the Institutional Review Daegu University. The subjects' mean age was 22.3 ± 0.33 years, their mean heights were 166.20 ± 1.43 cm in the case of the normal group, 167.30 ± 1.28 cm in the case of the mild group and 167.40 ± 1.73 cm in the case of the moderate group and their mean weights were 59.05 ± 1.73 kg in the case of the normal group, 62.70 ± 2.24 kg in the case of the mild group and 59.60 ± 2.31 kg in the case of the moderate group.

All the subjects who participated in the experiments were instructed to sit on a chair with a backrest, to position their ankle, knee, and hip joint at 90° and to face forward.

Photos were taken using smartphones to classify the degrees of the upper crossed syndrome, and the photos were analyzed using Dartfish software (DFKOREA, Korea). The distances between the lateral center line of the shoulder and the lateral center line of the ear were measured, and those with the lateral center line of the shoulder positioned less than 1 cm forward from the lateral center line of the ear were classified as the normal group, those with the lateral center line of the shoulder positioned 1–2.5 cm forward from the lateral center line of the ear were classified as the mild upper crossed syndrome group, and those with the lateral center line of the shoulder positioned 2.5–5 cm forward from the lateral center line of the ear were classified as the moderate upper crossed syndrome group⁹.

A cervical range of motion (C-ROM Basic, Performance Attainment Associates, USA) device was used to measure joint position senses in the neck region. The C-ROM device was attached to the head of each subject using straps, and the subject was instructed to wear an eye patch to block visual information to place the head in the neutral position, and to freely move in various directions to relieve tension. When joint position senses were measured, external effects that might confuse the subject's proprioceptive information or cause sensory fatigue, such as noises and skin irritation, were blocked. For the measurement, the C-ROM device was put on the head of the subject, and the shoulders of the subject were fixed by the experimenter so that the movements would not be affected by other parts of the trunk. The experiment was conducted by instructing the subject to move the head to make a neck angle of 30° , which is 60% of the normal range of motion (ROM) of the neck¹⁰. The subject was instructed to maintain the angle of 30° for three seconds in order to recognize the angle, return to the neutral position and to make the angle of 30° again two times repeatedly without assistance, while taking a rest for three seconds between measurements. Flexion was measured first followed by extension, right lateral flexion, left lateral flexion, right rotation, and left rotation.

To compare reposition errors among the three groups, differences from 30° as a reference value, which is 60% of the full ROM, were measured as absolute values and compared using one-way ANOVA and the least significant difference (LSD) was used for post-hoc comparisons. The PASW statistics ver. 12.0 program was used for all statistical analyses with a significance level of $\alpha = 0.05$.

RESULTS

The subjects showed gradually bigger reposition errors in the order of the normal, the mild and the moderate group but none of the differences between the three groups was significant ($p > 0.05$) (Table 1).

Table 1. The comparison of repositioning errors in cervical movement

Motion	Normal	Mild	Moderate
Flexion($^\circ$)	3.10 ± 0.18	3.43 ± 0.32	3.93 ± 0.66
Extension($^\circ$)	3.58 ± 0.18	4.30 ± 0.50	4.60 ± 0.55
Right Bending($^\circ$)	2.05 ± 0.17	2.35 ± 0.34	2.85 ± 0.36
Left Bending($^\circ$)	3.00 ± 0.15	3.30 ± 0.30	3.88 ± 0.46
Right Rotation($^\circ$)	5.00 ± 0.27	5.35 ± 0.20	5.85 ± 0.66
Left Rotation($^\circ$)	5.28 ± 0.26	5.45 ± 0.22	5.65 ± 0.44

Mean \pm standard error

Normal: normal group, Mild: mild group, Moderate: moderate group

DISCUSSION

Subjects with upper crossed syndrome generally sit or stand with stooped postures, compared to other subjects. In a study of biomechanical changes in the trunk among sitting postures, Caneiro et al. reported that larger degrees of flexion of the dorsal spine and the lumbar spine appeared in stooped postures than in upright postures¹¹⁾, and the reason was that forward postures with the chin positioned forward appear in stooped postures, putting the upper cervical spine into extension and the lower cervical spine into flexion¹²⁾. In a study that examined the effects of different sitting postures on neck proprioceptive senses, Jung et al. reported that position senses were poorer in stooped postures than in normal postures¹³⁾ and Lee found that subjects with severe forward head postures and larger reposition errors had poorer neck position senses¹⁴⁾. The results of the present study show that the mild group had smaller reposition errors than the moderate group but the differences were not significant; also, the degree of the subjects' postural misalignment was higher in the moderate group than in the mild group. Therefore, cervical spine position sense declined as postural misalignment became more severe. In a study of the relationship between the habit of laterally bending the neck and position senses, Kim reported that position senses declined in those who had incorrect postures¹⁵⁾, and Bolton stated that as the longus colli muscle, a deep neck muscle, acts as a neck posture-maintaining muscle, proper neck postures are maintained thanks to the information delivered from the muscle spindles located in the longus colli¹⁶⁾. Kirsch and Garza noted that in chronic neck pain patients, appropriate location information could not be provided due to the atrophy of the longus colli muscle¹⁷⁾. Therefore, from these results it can be inferred that if such inappropriate postures are continuously maintained, the position senses of the cervical spine can decline further.

Jung et al. reported that the position of the head is recognized through appropriate proprioceptive senses, and information for maintaining proper postures needs to be continuously provided¹³⁾. Therefore, in relation to the postures of the cervical spine, habits to develop correct posture are considered necessary to prevent the occurrence of damage or pain due to decline in position sense.

Studies of the diverse causes of declines in neck position sense involving subjects from many age groups are considered necessary.

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