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The Effects of Sling and Stretching Exercises on Changes in the Angle of the Cervical Spine

This study examined the effects of stretching and sling stabilizing exercises on changes in the angle of the cervical spine in military neck patients. The subjects were 20 adults diagnosed with a military neck(male:10, female:10) and they were randomly and equally assigned to a stretching exercise group and a sling stabilization exercise group. The total study period was four weeks. The intervention was applied three times per week for 60 minutes per each time. Before conducting the exercise, X-ray of each group was photographed to measure craniospinal angle(CVA) and cranial rotation angle(CRA). According to the result of comparing the two groups in changes in the cervical spine angle, there was no significant difference, and the result of comparing pre- and post-intervention was that there was significant change in CVA and CRA in the stretching group ($p<.05$) but there was no significant change in CVA and CRA in the sling stabilization exercise. Such result suggests stretching exercise is good for improving a military neck and stretching is more effective than sling in the therapeutic intervention for a military neck.

Key words: *Military neck; Sling; Stretching*

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INTRODUCTION

Due to the development of the modern society, the popularization rate of smart phones gradually increased and the time of using smart phones rapidly increased. However, using a visual display terminal(VDT) like smart phones for a long time may trigger musculoskeletal disorders such as neck, lumbar, and shoulder pain(1). Using a VDT may easily trigger damage to the upper extremities such as the neck and the shoulder because of limited task postures and repetitive upper extremity pattern, the height of working shelf, and reflection of the light increases tension of the eyes and as a result mental fatigue, damage to the upper extremity muscles and skeleton, and low back pain are brought about(2). Cervical pain is on the rise because of muscular stiffness resulting from continuously repeated work and maintaining a wrong posture habitually, damage to the cervical area in accordance with lack of exercise and increase in traffic accidents, and cervical pain in students who utilize computers frequently arising from rapid popularization of computers(3). About 70 percent of the population experience cervical pain at least once in a lifetime and about 10 to 20 percent of the population experiencing cervical pain has a problem in their cervical spine(4).

Cervical pain refers to cervical joint syndrome characterized by pain and limited range of motion of the joints in the cervical area and the surrounding tissues. Cervical pain is caused by external shock, bone diseases, and inflammation. In particular, cervical pain is triggered by inflammation in the structures such as tendons, muscles, disc of the cervical spine, and ligaments or other causes. Cervical pain is included in musculoskeletal diseases among occupational diseases and working for a long time under excessive tension continuously damages parts of the body such as the muscles, joints, and nerves. As an occupational lesion which appears with overlapping of continuous damages, the symptoms affect the joint area of the upper extremities, the head area, the cervical

area, and the shoulder area. The number of patients who visit a hospital due to such damage is considerably increasing(5). As therapeutic approaches to such military neck, a kind of cervical spine deformation bringing about such pain, mostly medication therapy, electrical stimulation therapy, hyperthermia, traction therapy, joint mobilization, and massages were applied focusing on pain adjustment. What should be the focus of pain adjustment in a military neck is to decrease overload on the muscles, joints, and soft tissues through precise postural adjustment. Accordingly, stretching and sling exercises were said to be effective in order to manage instability of the cervical spine(6).

Sling exercises have set in as another approach to exercise therapies by combining stabilization exercise concepts drawing global attention and the most recent exercise therapy theories as therapies using a sling in water started to be utilized with increase in poliomyelitis during the world war II. Therapeutic effects from sling exercise include mobilization treatment, extension, sensorimotor training, and relaxation exercise(7). Sling exercise is very safe for patients with cervical pain to perform active exercise with their weight against the gravity and because they conduct non weight bearing exercise under the condition of gravity and therefore obtain effects of exercise in water. There are very diverse methods to adjust intensity of exercise applied to cervical pain patients in a sling exercise and intensity of exercise may change according to the location of slings used when conducting sling exercise treatment, the location of joints of the human body where exercise occurs, and the boy parts of grabbing or hanging the slings. Utilizing such kinematic principles may determine exercise load appropriate for chronic cervical pain patients and may provide a therapeutic diagnosis standard to measure the degree of load where motor abnormality takes place(8).

There are diverse stretching techniques: dynamic stretching performed by patients themselves for the preventive purpose(9), stretching hold-relax and contract-relax of proprioceptive neuromuscular facilitation which applies relaxation and contraction of the muscles repetitively, and Evjenth-Hamberg stretching which mixes isometric contraction of the protagonists and antagonists and static stretching(10).

Previous research classified subjects with head forward posture into four groups a balance exercise group, a stretching exercise group, and control group and applied intervention for four weeks. The result was that the balance exercise group and stretching exercise group saw activity of maximal contraction muscles increase and the activity decrease in head forward posture(11). In another previous study, static stretching and Evjenth-Hamberg stretching were applied to head forward posture subjects with a result where their head forward posture improved(12). Lee and Kim(13) applied Schroth and sling exercise to scoliosis patients for eight weeks and obtained a result where the spinal angle significantly decreased. Seo(14) applied a sling exercise and lumbar region stabilization exercise program to middle aged women in their 40s with positive effect on spinal shape. Like this, in previous research, there was positive effect on spinal alignment through sling exercise. Kim and Eom(15) noted that 12 week lumbar stretching exercise had positive effect on correction of students with scoliosis by applying lumbar stretching for 12 weeks to elementary school students with scoliosis symptoms in their fifth and sixth grades. Clinically, middle school students diagnosed with scoliosis performed stretching for 12 weeks and their degree of rachiocampsis significantly decreased(16).

Like this, research to find an effective method through intervention on head forward posture was diversely conducted. Most research verified treatment effects only in head forward posture by comparing stretching and other interventions. Accordingly, this study applied sling stabilization exercise and stretching to the neck with those diagnosed with a military neck by an orthopedist among head forward posture patients and examined treatment effects by looking at changes in their craniospinel angle(CVA) and cranial rotation angle(CRA).

METHODS

Subjects

This study randomly and equally allocated 20 patients in their 20s medically diagnosed with a military neck to a sling stabilization exercise group and a stretching exercise group. Sufficient explanation on this study's purpose and tasks for the subjects to perform was made to the subjects and they fully understood the content. All the

subjects wrote a consent to participate in this study and took part in this experiment voluntarily. The experiment was conducted twice per week. Those who had heart or mental disease, had cognitive or visual disorder, had a lump on the spine, had spondylolisthesis of the spine, had osteoporosis or herniation of interspinal disc, and had another disease which may affect the spine and the musculoskeletal system during the experiment were excluded.

Sling

Using a sling, the subjects conducted flexion-extension and lateral bending exercise, thereby bending extending the neck and extending the lateral bending muscles.

Bending-extending exercise of the neck

In a supine position, the subject maintained the head in a neutral position and slowly stretched the head using a sling and conducted bending in a prone position. The vertical line of the sling was made to become 90 degrees against the ground and the subject was careful for the jaw and the shoulders not to be lifted. Exercise was conducted three sets, fifteen times per each set, and the subject took a rest between each set for 30 seconds

Lateral bending exercise of the neck

With the neck relaxed, the subject slowly conducted lateral bending of the head in the left and right sides. The shoulder was made not to be lifted by compensation. Exercise was conducted three sets, fifteen times per each set, and the subject took a rest between each set for 30 seconds

Stretching

The stretching method used by Park(12) was modified and used. After active contraction of the agonist, passive relaxation was repeated and lastly active contraction of the antagonist was added. Stretching was applied to the sternoclaidomatoid and trapezious upper. The intervention was conducted for four weeks, three times per week.

Sternocleidomatoid

The subjects lay in a supine position on a therapeutic bed and let the head and neck outside of the bed, and placed the shoulders on the edge of the bed. The subject's shoulder and chest were fixed with a belt and the experimenter stood near the head of the bed. The postures of the head and the neck were made for the patient to feel tension on the shortened muscles easily. So that both ears of the subject were in the palms of the therapist, the therapist held the head with the hands and the experimenter held the mastoid process of the subject with the fingers. In this posture, the experimenter rotated the head of the subject totally in the right side and pulled it while laterally bending it in the left side. At this time, the subject was directed to say "stop" at the point where slight pulling feeling was felt before feeling pain and this point was considered as the posture for initial stretching. In the posture of initiating stretching, the subject gave force with a feeling of pressing the right hand and induced isometric contraction using balanced force with a similar amount of force in the opposite directions.

Isometric contraction was conducted for six seconds and while contracting, intensity was heightened slowly from one to six so as to prevent Valsalva maneuver which may occur during isometric exercise. While the subject relaxed for two to three seconds, the experimenter moved passively in a direction where more stretching occurred. The experimenter should move to the point of being stopped by the muscles and maintained the point for 15 to 16 seconds. Lastly, for the strengthening of the antagonist, the experimenter directed the subject to look at the right side and had the subject move onto the direction of extending the head. The experimenter strengthened the antagonist of the subject by resisting against such motion. The motions were applied for six seconds and a resting time for 10 seconds was given so that the subject maintained the posture of force being gone. The above motions were conducted four times and stretching was applied for a total of 160 seconds.

Upper Trapezius

The subject lay in a supine position and had the head and the neck outside of the bed. The shoulders and the chest were fixed with a belt. The experimenter stood at the head of the bed and held the subject's back of the head with the right hand and supported the subject's head with the wrist and the arm. The experimenter held the jaw of the subject with the left hand while conducting pulling, and maintaining pulling, the experimenter rotated in the right direction and laterally bent the cervical spine of the subject in the left direction. The experimenter moved his body together with the head of the subject. Then isometric

contraction was induced and maintained for six seconds and for the strengthening of the antagonist, the location of holding the hand was maintained and the experimenter pulled the jaw of the subject to the right side. Then the experimenter had the subject look at the direction of stretching and move toward the direction of stretching the head. By resisting such motion, the antagonist of the subject was strengthened. Isometric contraction duration, relaxation method, and total stretching application time were applied in the same way as that of the sternocleidomastoid muscle.

Before and after sling and stretching, CVA and CRA were measured. In a subject with forward head posture on x-ray, CVA and CRA refer to a small angle and a large angle and when CVA and CRA are measured, the subject stood comfortably and maintained natural head posture, and relaxed both arms and placed them beside the trunk. For angle measurement after photographing x-ray, a straight line was drawn on the seventh cervical spine, the tragus of the ears, and the lateral canthus of the eyes to measure CVA and CRA.

Data Analysis

For analysis of data in this study, statistical analysis program SPSS 18.0 was used. In order to verify normality of the data, K-S test was used and in order to analyze differences in changes in the cervical spine angle an independent t-test was carried out. Statistical analysis level α was at .05.

RESULTS

This study randomly and equally allocated 20 patients in their 20s medically diagnosed with a military neck to a sling stabilization exercise group and a stretching exercise group. Table 1 shows general characteristics of the subjects.

Table 1. General Characteristics of the Subjects

Characteristics	Stretching(n=10)	Sling Ex(n=10)
weight (kg)	66.59±14.15	63.72±6.61
height (cm)	170.44±10.67	168.19±8.11
age (years)	21.10±1.52	21.20±2.09

Changes in the cervical spine in each group shows changes in the cervical spine angle in each group(Table 2). According to the result of examining changes in the CVA and CRA in each group, both groups saw the values increase after the experiment but such change was not statistically significant($p>.05$). According to the result of examining changes in CVA and CRA after the exercise in each group, there was no significant change in the sling stabilization exercise group ($p>.05$) but there was statistically significant change in both the CVA and CRA in the stretching group ($p<.05$).

Table 2. Changes in the cervical spine in each group

Variable	Group	Pre-test	Pre-test	P
CVA	Sling Ex.	73.18±6.97	69.16±5.49	.55
	Stretching	71.33±6.28	65.33±5.22†	
CRA	Sling Ex.	153.07±11.2	148.73±15.92	.74
	Stretching	150.66±11.21	142.70±10.53†	

$p<.05$, CVA: Craniospinel angle; CRA: Cranial rotation angle

DISCUSSION

Cervical pain refers to cervical joint syndrome characterized by pain and limited range of motion of the joints in the cervical area and the surrounding tissues. Cervical pain is caused by external shock, bone diseases, and inflammation. In particular, cervical pain is triggered by inflammation in the structures such as tendons, muscles, disk of the cervical spine, and ligaments or other causes. Cervical pain is included in musculoskeletal diseases among occupational diseases and working for a long time under excessive tension continuously damages parts of the body such as the muscles, joints, and nerves. As an occupational lesion which appears with overlapping of continuous damages, the symptoms affect the joint area of the upper extremities, the head area, the cervical area, and the shoulder area. The number of patients who visit a hospital due to such damage is considerably increasing(5). A military neck refers to the condition of the head having moved forward and excessive flexion in the lower cervical spine characteristically appears(17). When such posture is maintained for a long time, musculoskeletal disorder like upper cross syndrome

appears and such disorder decreases lordosis of the cervical spine with progression of kyphosis of adjacent upper thoracic spine(18). Such changes trigger elevation and protraction of the shoulders and unbalanced alignment conditions of the spine such as excessive head forward posture and kyphosis of the thoracic spine. This study applied sling and stretching to the neck of patients diagnosed with a military neck, thereby examining their effects on the angle of the cervical spine.

According to the result of changes in CVA and CRV in each group, the stretching group's CVA and CRA significantly decreased from 71.33±6.28 to 65.33±5.22 and from 150.66±11.21 to 142.70±10.53, respectively. Yang et al.(19) applied cervical flexion-extension, stretching, and cervical stabilization exercise through sling exercise to those with head forward posture for four weeks and measured their pressure pain, CRA, and CVA. There was no significant change in their pressure pain but there was significant change in CRA and CVA through RULA. Kim et al.(20) divided 25 subjects in to a sling exercise group and a control group and conducted an experiment for four weeks. They measured CVA, CRA, muscle activity, and cervical spine arrangement and observed that CVA and CRA differed between the two groups. Unlike such previous research, in the present study CRA and CVA statistically significantly changed in the stretching group.

In the present study, the reason why CVA and CRA significantly changed in the stretching group is that cervical spinal alignment was improved by stretching the muscles, which effectively improved their military neck. The stretching group extended the shortened muscles to the normal range through stretching, improving joint range of motion of the neck restricted by shortened muscles and changing the neck located forward into a normal posture. In the sling group, there was no significant unlike previous research. This is considered as difference in measurement tools and exercise conducting process. In other words, in the previous research, RULA program was used after digital camera photographing while in the present study observation was made with X-ray. In performing exercise in the present study, intervention in the sling stabilization exercise group was less than that in the stretching group, without proper utilization of weakened muscles of the patients, and there was no significant change in the sling stabilization exercise group. Nonetheless, in that CRA and CVA decreased in the sling group, the intervention positively affected the sling group. It is considered that conducting exercise without influence by the gravity by moving joint range of motion of the neck led to utilization of weakened muscles and balance of unbalanced muscles, changing abnormal form of the neck into a normal form.

This study was conducted for four weeks which was short to examine long-term effect and the number of subjects was small at 20. Therefore, future research should study more number of diverse age groups for a longer term.

CONCLUSION

This study applied sling and stretching to 20 subjects in their 20s three times per week, 60 minutes per each time, for four weeks. The result of applying sling and stretching to a military neck was that there was no difference between the sling group and the stretching group in CVA and CRA. However, in the stretching group, there was significant difference between the pre-test and post-test results in CVA and CRA. This suggests that stretching positively affects improvement in a military neck and will be helpful as a therapeutic intervention for a military neck in future clinical application.

REFERENCES

1. Kim YG, Kang MH, Kim JW, Jang JH, Oh JS. Influence of the duration of smart phone usage on flexion angles of the cervical and lumbar spine and on reposition error in the cervical spine. Phys Ther Kor, 2013; 20(1): 10-11.
2. Kim JJ, Lee KJ. Fatigue subjective symptoms and risk factors in bank workers with VDT. J Prev Med Public Health, 2005; 38(1): 45-52.
3. Kim JH, Song SW. A study on work related stress factor of private bodyguard and security. Korea Sports Research, 2006; 17(5): 395-404.
4. Hur JG. Effects of neck stabilization exercise to the patients with chronic neck pain. Korea Sports Research, 2006; 17(1): 121-133.
5. Gak HB. Analysis of the change of the neck pressure pain threshold in long term computer users. J Korea Contents Assoc, 2008; 8(6): 151-158.

6. Kim YM, Kim HB. Management for cervical instability. J Kor Acad Ortho Manu Ther 2005; 11(1): 74-91.
7. Kim SY, Kwon JH. Lumbar stabilization exercises using the sling system. J Kor Acad Ortho Manu Ther 2001; 7(2): 23-39.
8. Citle Kirkesola. Sling Exercise Therapy(S-E-T) : A total concept for exercise and active treatment of musculoskeletal disorders. J Kor Acad Ortho Manu Ther 2001; 7(1): 87-106.
9. James W, David AK, Kathleen SE, Edward RL. The effect of static stretching of the calf muscle-tendon unit on active ankle dorsiflexion range of motion. J Ortho Sport Phys Ther 2003; 33(7): 408-417.
10. Lee HH. The effects of Evjenth-Hamberg stretching on range of motion of knee joint and isometric, isokinetic muscle strength. Yonsei University 2003.
11. Lee DH. The effects of Balance Exercise and Stretching Exercise on Forward Head Posture. Daegu University, 2011.rg stretching and static stretching on improvement of forward head posture. Yongin University 2013.
12. Lee JH, Kim SY. Comparative effectiveness of schroth therapeutic exercise versus sling therapeutic exercise in flexibility, balance, spine angle and chest expansion in patient with scoliosis. J Kor Soc Phys Med 2014; 9(1): 11-23.
13. Seo DH. The effects of sling exercise and lumbar stabilization exercise for 8 weeks on vertebra posture lumbar muscular strength and static balance in middle-aged women. Namseoul University 2013.
14. Bo Young Kim, Woo Seop Eom. The Effect of Lumbar Stretching on the Degree of Scoliosis and Flexibility in Elementary School Students. Korean journal of elementary education 2012; 23(4): 1-10.
15. Rhim YT, Kang SY, Kim JW. Effect of a three-month stretching program on flexibility and cervature in middle School girl studunts with mild scoliosis. J Kor Soc Study Phys Edu 2004; 9(1): 186-194.
16. Moore MK. Upper crossed syndrome and its relationship to cervicogenic headache. J Manipulative Physiol Ther 2004; 27(6): 414-420.
17. 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(4): 281-291.
18. Yang HS, Kim YH, Myung HS, Park HK. The effects of sling exercise on muscle tension and pain of forward head posture. J KSSPT 2007; 3(1): 63-70.
19. Kim EJ, Kim JW, Park BR. Effects of sling exercise program on muscle activity and cervical spine curvature of forward head posture. J Kor Content Assoc 2011; 11(11): 213-220.