Abstract

Objectives: This study is to find out the effect on the neck and shoulder muscle activation changes when applying the elastic and non-elastic tape in forward head posture. Methods/Statistical Analysis: After preliminary research, 30 adult males and females were recruited and agreed to participate as the subject in this study. All subjects were measured their muscle activation with forward head posture, attaching the elastic tape, non-elastic tape and not attaching the tape by using Electromyography (EMG) equipment. The muscle activation of upper trapezius and splenius capitis is analyzed by using a one-way repeated ANOVA. Findings: As a result of the measurement value comparisons, applying non-elastic tape statically decrease muscle activation than elastic tape in the forward head posture (p<.05). Improvements/Applications: The result shows that non-elastic tape is more useful for forward head posture to support.

Keywords: Elastic Tape, Electromyography, Forward Head Posture, Non-Elastic Tape

1. Introduction

Forward head posture is a state that upper cervical vertebra is stretched, lower cervical vertebra is bent and neck is forwarded at the same time. Generally, upright posture is that when looking from forehead side, spine is vertical and in sagittal plane, hip, knee and ankle are vertical along ear and shoulder line. Reversely, turtle neck syndrome (forward head posture) is that shoulder is slightly bent and neck is forwarded by watching computer monitor of which height is lower than eye level for a long time. Even though using computer under upright posture, neck is forwarded and eventually, posture is changed over time. Sustained computer work affects bending range of upper neck, in particular. In forward head posture, angle between chest upper part and spine has a significant correlation with neck pain under working posture. As a result of preceding study, it was clarified that during computer work, wrong posture was taken and due to this, neck pain was further deepened. As external bending torque applied to cervical vertebra is increased, forward head posture provides serious burden to neck extensor and connective tissue around neck. Over time, excessive load is applied to spinal tissue as well and this load causes permanent spinal deformation. In addition, forward head posture also affects reduction of proprioception. In proved that as exercise method of forward head posture, stretching and strengthening exercise program being progressed in exercise class for 32 weeks were effective. In clarified that functional recovery program and forward head posture correction exercise affected function of nerve root positively. In Morningstar et al. proved that immediate effect was represented at the time of spinal massage and forward head load. In reported that stretching, strengthening and sense training were effective for correction. Taping is a conservative skill being used by therapists for increasing stability of support level during exercise or facilitating or suppressing function of joint or muscle and as taping type, elastic tape and non-elastic tape are available. As elastic tape, kinesio-tape developed by KaseKenzo has been known to be most popular. Non-elastic tape provides a function of

*Author for correspondence
mainly increasing dynamic stability and reducing pain so that body could be used functionally. Besides, it is effective for improving exercise range, strength and function. According to preceding study, it was reported that conservative therapeutic method using taping was effective for forward head posture positively. However, a research on an effect of non-elastic taping on forward head posture was not satisfactory. Therefore, in this study, at the time of computer typing work under forward head posture, an effect of application of elastic, non-elastic tape on muscle activity of trapezius muscle and splenius capitis was explored.

2. Materials and Methods

A questionnaire was performed by targeting 30 healthy adults (males, females) who are attending S university located at A-san City while usually using portable computer. All the subjects participated in the study voluntarily consented to test participation after they were fully informed of objective and method of study before starting the test. Selection condition of subjects is as follows: 1. A person who does not have physical balance damage by operation of nervous system or musculoskeletal system in the past and visual, auditory deficit. 2. A person who voluntarily participated in the test and prepared informed consent form. 3. A person who was not exposed to physical fatigue by physical labor or exercise before the test. 4. A person who had an experience of having used Korean word processor, Korean computer exercise program. And condition of exception is as follows: 1. A person who was diagnosed as having musculoskeletal disease relevant to upper extremities and around neck for the recent past 6 months. 2. A person who complains pain at the time specific motion. 3. A person who is unable to maintain one specific posture for 10 minutes. 4. A person who has dizziness or other disorder when using electronic device. General characteristics of subjects are as follows Table 1. This study was performed under the approval of IRB, Sun Moon University (SM-201508-020-1). While using portable mobile phone, activity of trapezius muscle and splenius capitis was investigated by using sEMGOQUS100 (Zero WIRE EMG, Italy, 2009) (Figure 1). EMG analogue signals being collected from 4 channels were sent to MP150 system and after it being converted to digital signals, its signal was analyzed and data was processed by using computer sEMG software myoresearch 1.06.44 software. Sampling rate was set as 1000 Hz and noise was minimized by using bandwidth of 20-500 Hz that is measurement frequency band filter of Bagnoli EMG system and collected signals were processed by Root Mean Square (RMS) (Figure 2). For this study, integrated type desk-chair of the university was used and slight height adjustment was allowed so that subjects could feel comfort within the range of maintaining knee joint position of 90° bending and typing work was made to be performed under the condition that lower arm of subjects was paralleled with floor bottom. As portable computer, LG U 46 model (screen size: 14") was used and subjects were requested to perform typing exercise for 2 minutes. Under the condition of holding 1 kg dumbbell in both hands, subjects were directed to have back of their hand upward by spreading both hands and they were advised to stand with eyes looking straight (Figure 3). Relevant posture was maintained for 15 seconds and during posture maintaining, upper trapezius muscle and splenius capitis were repeatedly measured for 4 times each by using EMG signal. From 4 times repeated measurement value, just each middle 5 seconds was used. After cutting elastic, non-elastic tape at the length of approx. 15 cm, it was divided into two strands to horizontal direction after leaving end tip of one side (approx. 5 cm). Two-stranded taping was attached to upper trapezius muscle based on C7 starting from just under the hairline. At this time, taping was applied under head-up condition. After taping attachment, adhesion was activated by rubbing it (Figure 4), (Figure 5). Subjects performed typing under the condition of maintaining forward head position. For ensuring their posture unification, they were advised to maintain the condition of naturally spreading both legs with placing their sole on floor after having their hip and knee joints to be bent by 90° by using goniometer while sitting on integrated desk-chair. Waist was made to touch back support in parallel and their eyes were made to look straight. As forward head posture, distance from manubrium to end tip of jaw were made to be maintained under the condition of jaw being stuck out up to 9 cm by using horizontal level and goniometer. In order to maintain this distance, by attaching tape from jaw to manubrium diagonally, parallel was maintained and the researcher kept supervising during test period (Figure 6). Distance (9 cm) from jaw to manubrium that is forward head posture standard was designated as mean value of the range in which typing work could be performed under
the condition that subjects did not feel inconvenience through pre-simulation. Under each condition, subjects were advised to perform typing for 2 minutes. In this study, EMG data being measured for 2 minutes under computer typing posture was processed by RMS. Mean value was obtained by using value for 1 minute excluding 30 seconds of starting point and other 30 seconds of ending point. Such value was standardized by using %RVC. In this study, for statistic processing of data, measured value of all the items was estimated as mean value and SD by using Window SPSS Version 22.0 that is a commercial statistics program. Before, after application of taping, as a result of using Shapiro wilk in order to test normality for mean comparison of muscle activity for upper trapezius muscle and splenius capitis, such normality was satisfied. For comparison between elastic taping application and non-elastic taping application, One-way repeated ANOVA was performed and for post hoc test, Bonferroni was used. Statistical significant level (p) was set at below 0.05. In this study, EMG data being measured for 2 minutes under computer typing posture was processed by RMS; Mean value was obtained by using value for 1 minute excluding 30 seconds of starting point and other 30 seconds of ending point. Such value was standardized by using %RVC. In this study, for statistic processing of data, measured value of all the items was estimated as mean value and SD by using Window SPSS Version 22.0 that is a commercial statistics program. Before, after application of taping, as a result of using Shapiro wilk in order to test normality for mean comparison of muscle activity for upper trapezius muscle and splenius capitis, such normality was satisfied. For comparison between elastic taping application and non-elastic taping application, One-way repeated ANOVA was performed and for muscle activity of right/left upper trapezius muscle, right/left splenius capitis depending on with/without application of elastic/non-elastic taping under retraction head posture of normal adult was compared.

### Table 1. General characteristics of subjects (n = 30)

| Subjects | Data |
|----------|------|
| Sex      | Male (n = 7/23.33%) Female (n = 23/76.67%) |
| Age (year) | 19.70±2.07* |
| Hight (cm) | 165.86±7.71 |
| Weight (kg) | 62.40±12.57 |

*mean±standard deviation (SD)
The Comparisons of Tape of Different Type Applied on Forward Head Posture Positions

Figure 5. Non-elastic tape.

Figure 6. Measure posture.

3. Result

In application of elastic taping and non-elastic taping, statistically significant difference was represented among the subjects (p<.05). In addition, as a result of post hoc test, significant difference was represented between not application of taping and application of elastic taping, application of taping and not application of taping and application of non-elastic taping, application of taping and application of non-elastic taping (p<.05) in Table 2 (Figure 7).

4. Discussion

If using image display terminal under constant posture for a long time, high muscular tension and pain may be induced. In\textsuperscript{16} said that abnormal posture induces bending of neck and head and increases muscular activity of cervical erector spinae and upper trapezius muscle\textsuperscript{16}. In addition, use of image display terminal makes posture slightly bent by inducing bending of neck and shoulder and its use for a long time increases muscular activity of cervical erector spinae and upper trapezius muscle and induces muscular fatigue. High muscular fatigue of neck and shoulder creates frequent pain of surrounding tissue and if pain is occurred persistently, it becomes chronic disease and ROM of neck is reduced\textsuperscript{17}. Park could realize that posture correction exercise may affect neck and shoulder of subjects having turtle neck syndrome\textsuperscript{3}. In\textsuperscript{18} reported that as a result of research on fatigue level of neck and shoulder depending on mobile phone using posture and break time, it may affect subjective fatigue level of neck and shoulder and muscular activity of splenius capitis\textsuperscript{18}. In\textsuperscript{18} showed that forward head posture at the time of computer typing work more increases muscular activity of upper trapezius muscle and splenius capitis than neutral head posture and burden of neck and shoulder is increased\textsuperscript{18}. In view of previous study, it could be realized that forward head posture affects neck and shoulder. Based on this result, we

Table 2. Mean relative muscle activation (%RVC) during forward head posture according kind of taping. unit: %RVC

|                     | Pre-taping | Elastic taping | Non-elastic taping | F     |
|---------------------|------------|----------------|--------------------|-------|
| Rt. upper trapezius | 107.51±42.75 | 96.54±40.12    | 85.61±38.40        | 70.02 |
| Lt. upper trapezius | 107.95±55.76 | 88.78±31.18    | 73.95±29.30        | 19.70 |
| Rt. Splenius capitis| 163.34±60.61 | 134.13±63.49   | 101.34±30.91       | 33.86 |
| Lt. Splenius capitis| 130.54±53.74 | 111.43±46.75   | 87.27±42.57        | 13.01 |

\(p < .05\) All values are mean ±Standard deviation

Figure 7. Comparison of %RVC during elastic and non-elastic taping.
measured upper trapezius muscle and splenius capitis that are known to be affected by forward head posture and by applying elastic taping and non-elastic taping under retraction head posture, researched on muscular activity. As its result, when applying taping than before taping application, muscular activity was decreased and when applying non-elastic taping than applying elastic taping, muscular activity was represented to be more decreased in upper trapezius muscle. At the same time, in case of muscular activity of splenius capitis, when applying taping than before applying taping, muscular activity was decreased in the same way as upper trapezius muscle and in non-elastic taping than elastic taping, muscular activity was more significantly represented. In\textsuperscript{21} said that at the time of applying taping to front shoulder impingement syndrome, alignment of scapula is corrected and as low load is applied to impingement inducing structure, excessive tension could be moderated\textsuperscript{21}. In\textsuperscript{22} said that taping suppressing upper trapezius muscle has a possibility of being able to restore normal pattern of muscular activity\textsuperscript{22}. Marik reported that in case of applying elastic taping to patient with shoulder impingement syndrome, it could facilitate ROM and activity of lower trapezius muscle and enable motion of patient with hemiplegia without pain\textsuperscript{22}. When applying taping intervention than not applying it, a functional effect was represented. In\textsuperscript{23} said that pain occurrence is suppressed as kinesio taping inactivates myofascial trigger point of shoulder deltoid and shoulder function could be improved by muscular normalization and pain relieving effect\textsuperscript{23}. In\textsuperscript{24} said that when applying the elastic tape to young adults with rounded shoulders due to the increased length of the teres minor reduces the rounded shoulders status\textsuperscript{24}. In\textsuperscript{25} that at the time of computer work after application of elastic taping under forward head posture, muscular activity of upper trapezius muscle was increased\textsuperscript{25}. Elastic taping suppresses forward head posture by enhancing function of cervical erector spinae and makes such posture to be returned to normal head posture\textsuperscript{25}. In this study also like preceding study, muscular activity was decreased in elastic tape. Previous study that non-elastic taping was more effective for stabilizing foot of patient with chronic ankle instability at central position than elastic taping\textsuperscript{26,27}. It could be seen from this result that non-elastic taping is more effective for stabilizing physical structure than elastic taping. In this study also like preceding study, it could be realized that at the time of applying elastic taping and non-elastic taping, significant reduction was represented in upper trapezius muscle and splenius capitis and reduction of muscular activity provided significant mechanical effect in suppressing forward head posture and was helpful not only for aligning normal posture but also for enhancing function and reducing pain of neck and shoulder. It is considered that muscular activity was reduced as non-elastic tape reduced instability of cervical vertebra by straightening its structure support. This effect is considered to be more effective in non-elastic taping than in elastic taping. Limitation of this study is that taping effect in neutral head posture and forward head posture was not sufficiently verified. In addition, measurement time before, after taping was short and number of subjects was hard to be generalized. There are several methods as taping method of neck and shoulder but just one method was applied and so, in the future study, a research considering suggested data by using other taping method and increasing number of subjects is required to be performed.

5. Conclusion

In this study, at the time of application of elastic and non-elastic tape, muscular activity of neck and shoulder under forward head posture was compared. As a result of this study, at the time of application of non-elastic taping rather than elastic taping, reduction of muscular activity was more significantly represented in upper trapezius muscle and splenius capitis. Therefore, application of non-elastic taping is considered to be more effective intervention method than elastic taping.

6. References

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The Comparisons of Tape of Different Types Applied on Forward Head Posture Positions

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