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Research Article

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The Effect of Neck Assistive Device Considering Mckenzie Type Subjects with Forward Head Posture

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| Abstract |

PURPOSE: The aim of this study was to determine the effect of device considering Mckenzie type for the subjects with forward head posture (FHP).

METHODS: The subjects were 35 patients with FHP (mean age was 23.7 ± 2.8 years; mean height; 172.1 ± 11.7, mean weight; 65.8 ± 13.9, mean NDI(Neck Disability Index; 3.7 ±3.2, mean FHP; 6.7 ± 2.2). We measured the posture with the Body style S-8.0(LU Commerce, South Korea) to evaluate the FHP. We collected the surface EMG(Myosystem 1400, Noraxon, USA) data to quantify changes in normalized activation levels of muscles in SternoCleidoMastoid muscle(SCM), Scalenus Anterior(SA), Trapezius upper fiber(TU) and Splenius Cervicis(SC), during the subjects were instructed to glide their head into a "chin-in" position for a retraction without and with device.

RESULTS: The condition with device significantly decreased the %RVC of SA(90.84±40.54), SCM(74.98±43.65) and TU(67.60±47.83) compared to the condition without device(SA;100.39±56.32, SCM;119.03±109.26, Trapezius;80.55±39.27). But the %RVC of capitis(65.87±47.83) with device was increased(70.82±52.78). There was significant difference in the %RVC between SCM and Trapezius muscle in two conditions.

CONCLUSION: New device for FHP reduces the EMG activities of the TU, SCM and SA muscle. We have to develop the function of feedback to facilitate the motion in the future.

Key Words: Forward head posture, Mckenzie, Eelctromyography

Ⅰ. Introduction

Habitual postures of the head and neck vary considerably among the general population. Specially, Forward Head Posture (FHP) is one of the common types of habitual head posture (Edmondston et al, 2007).

FHP can cause by keeping an abnormal posture for a long time (Lee et al, 2014) like prolonged sitting by looking at computer monitor (Kim, 2013). The repeated FHP can aggravate a neck pain (Falla et al, 2007). Therefore, FHP

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should be treated to prevent the neck pain for the individuals.

The individuals with postural neck pain may have a different perception of 'good' posture (Edmondston et al, 2007). So, the different perceptions of individuals have to be corrected.

Kjellman and Oberg(2002) reported that Significant improvement in Distress and Risk Assessment Method scores was shown in the McKenzie exercise in patients with neck pain. In contrast, Clare et al(2004) stated that the data about benefit of McKenzie exercise is insufficient for neck pain patients. Despite the disagreement of results, the Mckenzie method is common for patients with mechanical problem of neck as correction method for abnormal posture(Shin et al, 2014). Therefore, some researchers have developed the device based on McKenzie method for neck posture(Lee et al, 2014).

Those who work in limited environment don't have enough time and space to do exercise. Therefore, they need the device that can be learnt and carried easily and then they will be able to do exercise in limited environment like their work place.

But, the device that is portable is rare to find. Therefore, it might be helpful if the device is portable and can be evaluated by individuals, it will develop the muscle power for the worker with FHP. Therefore, we design the device based on Mckenzie type for FHP and investigate the effect of the device.

Ⅱ. Method

1) Subject

From December 2014 to March 2015, 35 subjects were recruited in the study. Human subjects' approval was obtained from the Eulji University (Grant number EU 14-61) and this study adhered to the ethical principles of the Declaration of Helsinki. Inclusion criteria were: FHP above 2.5 cm; NDI above 3 score; no history of concussion or mild neck injury in 12 months; no other past neurological disorder or fracture. On the basis of the research of Kim(2013), Excel program was used to determine that a sample size of 35 participants in group were needed to achieve as followed formule : $N= \frac{(z_\alpha + z_\beta)^2 \sigma_m^2}{2(\mu_t - \mu_c - \delta)^2}$;Standard Deviation 30%; $\sigma = 0.3$; Mean Difference $\varepsilon = 8.4$: $\varepsilon = \mu_t - \mu_c$; limitation of comparative study $\delta = 0.25$(25%). Considering the drop-out rate, 35 people were included in this study.

2) Measurement

We measured the posture with the Body style S-8.0(South Korea, LU Commerce) and used the Body Style analyzer (system software) to evaluate the FHP. The subjects were told to stand on the posture pad and took pictures of lateral view of the subjects. Data of photography was transferred to the Body Style analyzer (South Korea, LU Commerce)(Fig 1). We analyzed the FHP. After analyzing the data, we recruited the subjects who have FHP above 2.5cm.

We used the surface EMG and collected EMG data to quantify changes in normalized activation levels of muscles as the effect of using the device. Raw EMG voltages were amplified, passed through a bandpass filter (20 to 500 Hz), and the sample frequency was 1024Hz (Myosystem 1400, Noraxon, USA). Software (Myosystem 1400, Noraxon, USA) was used to digitally rectify the data. The maximum values those obtained from the RVC effort for each subject were used to normalize (% RVIC) data collected from the test with device and without device to facilitate the comparison of data between muscles and among subjects. RVC was measured while the subjects retracted their heads. We measured SternoCleidoMastoid muscle(SCM), Scalenus Anterior(SA), Trapezius upper fiber(TU), Splenius Cervicis (SC). The placement of surface EMG on the muscles of neck were marked on the skin using published suggestions

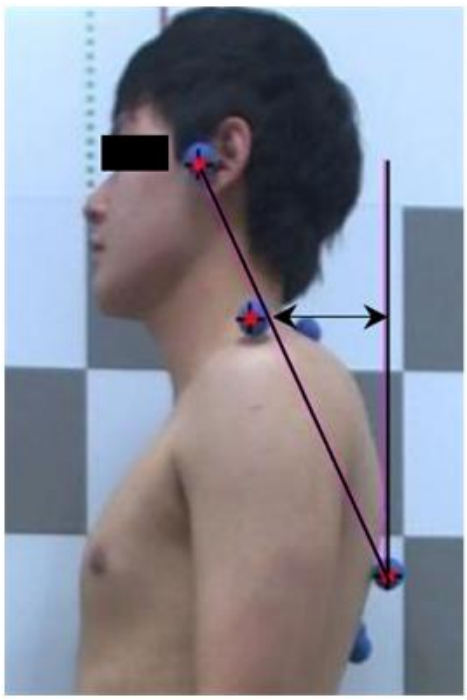

Fig. 1. Measurement of FHP

Fig. 2. Neck assistive device

(Falla et al, 2002; Sommerich et al., 2000; O'leary et al, 2012). After location were marked, the skin was first shaved and then firmly rubbed and washed with alcohol and then the electrodes (Ag/AgCl : SEED, Korea ;conductive area: 15 X15mm) put on the skin, fastened using double adhesive tape. A ground electrode was placed over the C7.

With a subject in the seated position, data were collected while each subject was instructed to glide their head into a "chin-in" position for a retraction trial without and with device (Fig 2). The subject was instructed to hold this position for 5 seconds. The subject then returned to starting position for 5 seconds to rest. These motions were repeated three times for each trial, and we used the mean value of three trails.

3) Data Analysis

We performed the paired t test to compare differences with and without device in subjects. Statistical analysis was performed using SPSS 18.0 and significance was accepted for values of $p<0.05$.

Ⅲ. Results

The demographic characteristics of the participants (n = 35) were as follows: mean age was 23.7 ± 2.8 years; mean height; 172.1 ± 11.7cm, mean weight; 65.8 ± 13.9kg, mean NDI(Neck Disability Index); 3.7 ±3.2score, mean FHP; 6.7 ± 2.2cm.

The condition with device significantly decreased the %RVC of SA(90.84±40.54), SCM(74.98±43.65) and TU(67.60±47.83) comparing with the condition without device(SA;100.39±56.32, SCM;119.03±109.26, TU;80.55 ±39.27). But the %RVC of SC(65.87±47.83) was increased in the condition with device(70.82±52.78). There were significant difference in the %RVC of SCM and TU between two conditions ($p < 0.05$)(Table 1).

Table 1. The comparison of %RVC of muscles between two conditions

Muscle(%RVC)	Without device	With device	t
SA	100.39±56.32	90.84±40.54	1.20
SCM	119.03±109.26	74.98±43.65	3.02*
TU	80.55±39.27	67.60±47.83	2.18*
SC	65.87±47.83	70.82±52.78	-1.15

* P<0.05

※ SternoCleidoMastoid muscle(SCM), Scalenus Anterior(SA), Trapezius upper fiber(TU), Splenius Cervicis(SC).

Ⅳ. Discussion

Neck symptoms are frequently reported by computer users. More than 50% of the computer users appealed symptoms in neck. The total yearly costs of neck symptoms have recently increased (Bernard et al, 2006). One of the main symptoms related with neck is FHP because workers demonstrate trends of increased head tilt and neck flexion posture while they are working in their workplace environment(Yoo, 2013). Therefore, it may be very benefit to develop the device that can reeducate the abnormal posture in FHP. So, we developed the device and verified to the effect.

McKenzie method is most common to decrease the neck pain. Kim et al (2013) developed the assistive device for neck retraction based on Mckenzie method and suggested that assistive device helped the efficacy of neck retraction exercise. His device was effective for decreasing the activity of SCM. Other researchers(Shin et al, 2014; Kim, 2013) developed the device based on Mckenzie method too eventhough Kjellman and Oberg(2002) insisted that the Mckenzie method could not provide a definite evidence of treatment efficacy in patients with neck pain. Therefore, device based on Mckenzie method could help the improvement for neck pain. So, we hypothesized the device considering Mckenzie method could help FHP and, developed the new device.

FHP induce to increased lordosis of the lower cervical spine as well as thoracic kyphosis and the limitation of cervical ROM, specifically general cervical rotation and flexion(Quek et al, 2013), and the muscle activity of SCM and TU is high, and the muscle activity of SC semispinalis is weak and long. And also, upper cervical was extended and lower cervical was flexed (Neuman 2010). Mckenzie exercise like neck retraction with chin in position will make flexed upper cervical and extended lower cervical for FHP.

FHP leads to lengthening and weakening of the anterior cervical muscles as well as shortening of the posterior cervical muscles. When a muscle is shortened or lengthened compared to its resting position, its ability to generate force is reduced. Lee et al.(2015) found the activity of muscle when, the subject's retraction of his neck was lower than the protraction.

As I mentioned earlier, Mckenzie exercise that makes head retracted position will help to decrease the muscle activity of SCM, upper trapezius and others associated with neck in the subject with FHP. We hypothesized if new device can facilitate the retraction of neck, it will help to decrease the abnormal muscle activity and will improve the abnormal neck posture like FHP. So, we designed the function feedback for retraction motion and researched the activity of those muscles when the subject with FHP used the new device while they retracting their muscle.

We found out that our device can help decrease the muscle activities of SA, SCM and TU comparing the condition without device. And there were significant difference in SCM, TU between conditions.

But, standard deviation of muscle activity of SCM was

large. It might be that the muscle strength of SCM was various among the subject or SCM acted as compensation movement when the flexor of subject was weak. But we did not control it before we started the examination. So, it has to confirm the characteristic of muscle power among the subjects in the future.

The main limitation of this study was the small sample size available for analysis, owing to the number of subjects who withdrew. The main reason for low withdrawal rates of FHP subjects is that we selected the subjects only with FHP but no other problem in healthy young people.

Ⅴ. Conclusion

New device based on Mckenzie exercise for FHP reduces the EMG activities of the TU, SCM and SA muscle. These results suggest that reduced activities result from the changes in ability to generate force and the corrected posture due to retraction movement. We have to develop the function of feedback to facilitate the motion in the future.

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