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The Effects of Gong's Mobilization on the Cervical Range of Motion and the Resting and Concentration States of the Brain of College Students

HyunJu Oh, PhD, PT[1)], Jinyeol Jeon, PhD[2)], Yeonju Kim, PhD, PT[3)]

[1)] *Department of Rehabilitayion Science Graduate School, Daegu University*
[2)] *Department of Sports Science, Daegu Catholic Uiversity: 330, Gumrak-1-ri, Kyoungsan-si, Kyoungbuk, 702-966 Republic of Korea.*
TEL: +82 53-850-3729, FAX: +82 53-850-3729, E-mail: jjy67@hanmail.net
[3)] *Department of Physical Therapy, Graduate school of Daegu University*

Abstract. [Purpose] This study examined the effects of Gong's mobilization on the cervical lordosis, forward head posture (FHP), cervical range of motion (ROM), and the resting and concentration states of the brain. [Subjects] Forty college students who had problems with cervical posture and ROM were divided into a Gong's mobilization group (n=20) (an experimental group) and a control group (n=20). [Methods] We performed Gong's mobilization on the experimental group three times per week for four weeks and looked at the effects of Gong's mobilization on cervical lordosis, FHP, and cervical ROM. We also examined the effects of Gong's mobilization on the brain's activation levels by analyzing brain waves during the brain's resting and concentrating states using neuro-feedback equipment. [Results] Gong's mobilization increased cervical lordosis, cervical extension ROM (CER), and the ranges of flexion and extension motion (RFEM). It also decreased FHP and enhanced the brain's resting state, rest-α, low rest-β, and high rest-β waves; and during concentration, it increased high β waves. [Conclusion] Gong's mobilization improved FHP and increased the ROM of the cervical spinal area. These improvements in dynamic parts are effective at enhancing the brain's resting state, which indicates that Gong's mobilization may affect the maximization of the brain's steady state and attention and concentration.
Key words: Gong's mobilization, Concentration, Forward head posture

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INTRODUCTION

Forward head posture (FHP) caused by improper posture results in dynamic stress on the neck by the head[1)]. Patients who have such problems with the cervical spinal area are likely to experience reduced flexion and extension ROM[2, 3)] as well as poor craniocervical posture. Therefore, it is necessary to evaluate the craniocervical posture and ROM in the cervical area of such patients[4)]. In the anatomical structure, the cervical spinal area and the brain are closely related in their positions. Bad FHP can degrade proprioception and obstruct coordination between the nerves and the muscles, which can lead to psychological problems[5)]. Human thoughts and behaviors are regulated by the brain and its functions depend on the activities of many cranial nerves. These activities can be measured by electroencephalography (EEG)[6)]. The brain produces waves of different frequencies, which can be used to analyze human behaviors and the functional conditions of the brain. Recently, EEG has been used to enhance cognitive functions such as attention, concentration, response time, behavior modification, precision, tension alleviation, and determination[7)].

This study will examined the effects of Gong' mobilization on the improvement of FHP and cervical ROM to verify whether improving problems of the cervical spinal area is an effective way of enhancing the brain's resting state and concentration. The results of this study should provide a basic method for examining patients with dynamic stress on the cervical area as well as to evaluate students' learning capabilities.

SUBJECTS AND METHODS

We conducted a visual appraisal of 230 students who attended G College in Korea, out of whom 70 students who were suspected of having problems with cervical posture and ROM were selected. We performed radiography on these 70 students. Among them, 40 students whose cervical lordosis angle, FHP, and extension ROM, and flexion ROM were 21 degrees or lower[8)], 15 mm or longer[9)], 70 degrees or lower, and 35 degrees or lower, respectively, were chosen. They were randomly allocated to a Gong's mobilization group, the experimental group, and a control group each with 20 members. The average age, height, and weight of the Gong's mobilization group (10 males and 10 females) were 21.85 ± 2.70 years, 166.75 ± 9.99 cm, and 58.90 ± 13.17 kg, respectively. The average age, height, and weight of the control group were 20.95 ± 1.60 years, 167.10 ± 8.09 cm, and 57.60 ± 10.27 kg, respectively. The two groups did not demonstrate statistically significant differences in the above data (p>0.05), therefore, the two groups were considered homogeneous.

In order to examine changes in cervical lordosis, FHP, and cervical ROM, we photographed and measured the absolute rotation angle (ARA) of cervical lordosis, anterior weight bearing (AWB)[10] for FHP, and the lateral view of the cervical spine for cervical extension ROM (CER), cervical flexion ROM (CFR), and ranges of flexion and extension motion (RFEM)[11]. For radiography, the subjects stood and held a position as comfortable and natural as possible, while closing their eyes and relaxing their neck, shoulder, and above-elbow muscles as much as possible level with the root of their nose and external occipital protuberance horizontally in line with each other. The same radiographic technician radiographed the subjects with the same X-ray equipment (MDXP-40, medien, Korea) from a distance of 1 m using 14×14 inch film. The experimental group received Gong's mobilization three times per week for 4 weeks for 20 minutes each time. Gong's mobilization is intended to induce a normal cervical extension by passively making the patient's cervical posture neutral prior to mobilization. Apophyseal joint gliding and end range passive physiological movement are made concurrent in Gong's mobilization[12]. This technique first neutralizes the patient's cervical position, then begins mobilization using gravity and acceleration by restricting the movement of articular surfaces other than fixed articular surface as much as possible level when inducing mobilization of fixed facet joints using the three-point pressure system. The control group did not receive any intervention during the experimental period. The brain's resting state and concentration were measured using a neuro-feedback system (Braintech Corp., Korea), which uses a headband with a sensor that can measure brain waves which is placed on the subject's prefrontal lobe area. The subject's interest is aroused using a computerized gaming program. The subject wears the headband on the frontal area because brain waves can be adequately measured from this position and it is easier to attach electrodes to the forehead than other parts of the head. In particular, the prefrontal lobe controls crucial cognitive functions, thinking operations, and creativity, as well as brain functions related to learning behaviors[13]. Measurements were taken after the subjects had established a comfortable position wearing the head band with the FPz area on the center of their foreheads with appropriate force. Once this was achieved, the ground electrode was connected to the left earlobe. In order to examine the differences in brain waves between resting and concentration, each state was measured for two minutes during the resting state and the concentration state while the subjects completed a spoon folding task.

The goal of the spoon folding task was to fold the spoon when an appropriate type of wave was released for each mode. The subject gained higher scores for folding more spoons. The results were statistically analyzed using SPSS 12.0 KO (SPSS, Chicago, IL, USA). After the subjects' general characteristics were determined, the paired t-test was used to compare changes in cervical posture, cervical ROM, resting, and concentration in each group between pre- and post-intervention. The differences between the two groups were tested using the independent t-test. The statistical significance level, α, chosen as 0.05.

Table 1. Comparison of cervical ROM, resting and concentration states of the brain in each group (unit: ARA, CER, CFR, RFEM- degree, AWB-mm)

Group	Category	Pre (Mean ± SD)	Post (Mean ± SD)
Gong's	ARA	11.9 ± 10.4	15.3 ± 9.3
	AWB*	23.0 ± 11.0	14.8 ± 8.3
	CER*	53.9 ± 9.7	63.9 ± 12.5
	CFR	20.9 ± 6.7	22.3 ± 10.2
	RFEM*	74.8 ± 10.3	16.8 ± 3.8
	R*	61.6 ± 18.9	73.7 ± 13.1
	R-alpha*	9.4 ± 8.2	13.4 ± 3.0
	R-beta low*	3.7 ± 3.3	7.8 ± 6.7
	R-beta high*	1.6 ± 2.2	3.5 ± 3.1
	C	54.4 ± 21.8	55.6 ± 19.5
	C-alpha	11.9 ± 8.7	17.3 ± 11.5
	C-beta low	5.3 ± 6.0	8.4 ± 5.8
	C-beta high*	2.2 ± 2.4	4.5 ± 3.5
Control	ARA	14.4 ± 9.3	14.7 ± 9.3
	AWB	20.2 ± 11.3	19.7 ± 10.1
	CER	51.6 ± 7.1	52.2 ± 6.8
	CFR	19.0 ± 9.2	18.8 ± 8.4
	RFEM	70.6 ± 10.8	71.4 ± 10.1
	R	43.1 ± 21.6	44.4 ± 22.2
	R-alpha	18.2 ± 10.0	17.3 ± 8.9
	R-beta low	7.8 ± 4.8	8.8 ± 4.7
	R-beta high	3.3 ± 2.1	4.6 ± 3.1
	C	30.4 ± 14.7	37.3 ± 10.2
	C-alpha	21.7 ± 10.1	16.1 ± 7.1
	C-beta low	10.8 ± 5.9	11.4 ± 6.9
	C-beta high	4.4 ± 2.8	5.7 ± 4.1

*p<0.05; Gong's: Gong's mobilization group; ARA: absolute rotation angle; AWB: anterior weight bearing; CER: cervical extension ROM; CFR: cervical flexion ROM; RFEM: ranges of flexion and extension motion; R: resting; C: concentration.

RESULTS

The pre-intervention values of the ARA, AWB, CER, CFR, RFEM, and the resting and concentration states of the brain in the experimental group and the control group were compared with their post-intervention values using the paired t-test. In the Gong's mobilization group, the pre-intervention values of AWB, CER, RFEM, R wave, R-alpha wave, low R-beta waves, and high R-beta waves were significantly different from their post-intervention values, while C waves, C-alpha waves, and low C-beta waves showed no significant differences. None of the items in the control group showed statistically significant differences (p>0.05) (Table 1). The independent samples t-test showed the different values before and after the intervention in the experimental group and the control group were significantly different for ARA, AWB, CER, RFEM, R waves, R-alpha waves, C-alpha

Table 2. Comparison of changes in cervical ROM, resting and concentration states of the brain between groups (mean ± SD)

Category	Gong's (Post-pre)	Control (Post-pre)
ARA*	3.4 ± 7.8	0.4 ± 0.9
AWB*	−8.2 ± 8.4	−0.6 ± 2.4
CER*	10.0 ± 10.5	0.6 ± 1.8
CFR	1.5 ± 9.8	0.8 ± 2.3
RFEM*	11.4 ± 15.0	0.8 ± 2.2
R*	14.1 ± 25.4	1.3 ± 13.6
R-alpha*	8.8 ± 15.1	−0.9 ± 13.4
R-beta low	4.1 ± 7.4	1.1 ± 7.7
R-beta high	1.9 ± 3.5	1.3 ± 3.8
C	1.2 ± 23.7	6.9 ± 16.8
C-alpha*	5.4 ± 14.3	−5.6 ± 12.5
C-beta low*	2.5 ± 9.6	−2.0 ± 6.5
C-beta high	2.3 ± 3.9	1.4 ± 3.6

*$p<0.05$

waves, and low C-beta waves ($p<0.05$) (Table 2).

DISCUSSION

In terms of neurophysiology, an alpha wave is a basic wave that reflects the steady state of the brain and it is affected little by artifacts. For this reason, it is traditionally used to evaluate the brain's left and right hemisphere functions with regard to human behaviors[14–16]. Furthermore, human mental processes are most efficient when they produce an alpha wave[17]—the emergence of an alpha wave during meditation indicates that the brain is in a steady state, therefore it is used as a measure of emotional stability[18]. Moreover, alpha wave training has been found to enhance abstract thinking, consciousness, senses, and self-adjustment[19]. As for rhythmic activities in the cranial nerves, beta waves, or fast waves, are prevalent when humans pay attention to and concentrate on outside information. These nerves consume a lot of energy. When this state is continuous, the brain becomes confused and anxious. When an excessive amount of information is delivered to the cerebral cortex, its information-processing and decision-making capabilities are overwhelmed and maintaining attention and concentration becomes difficult[20]. Therefore, it is necessary to maintain the alpha or theta waves that are prevalently produced when the brain is resting and is in a steady state[21]. Attention and concentration are most effectively achieved when the transition from alpha waves to beta waves is easy and the brain can return to a state of alpha waves in order to prepare for beta waves[22].

According to the results of previous studies, Gong's mobilization is effective at improving forward head posture and cervical range of motion (ROM), and at increasing alpha waves during rest, low beta waves during rest, and high beta waves. In this study, Gong's mobilization resulted in increased high beta waves during concentration, but no significant differences in alpha and low beta waves during concentration and during rest were observed. This means that Gong's mobilization does not have a direct effect on the changes in alpha and low beta waves during concentration, but has an indirect influence on the increase in alpha waves during rest, a condition that facilitates effective achievement of attention and concentration. Accordingly, this study showed that Gong's mobilization is effective at improving forward head posture and cervical ROM and that improvement in dynamic problems in the neck is effective at enhancing the steady state of the brain during attention and concentration.

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