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Effects of Occipital Bone Stimulation by Cervical Stabilizing Exercise on Muscle Tone, Stiffness, ROM and Cervical Lordosis in Patient with Forward Head Posture: Single System Design

The purpose of this study was to investigate the effects of occipital bone stimulation by cervical stabilizing exercise on the muscle tone, stiffness, ROM, and cervical lordosis in patient with forward head posture(FHP). This study was a case study of a single patient with forward head posture. This study used a ABA' design, A and A' were the baseline phases and B was the intervention phase. The intervention was occipital bone stimulation by cervical stabilization exercise. It was administered once daily for 7 days. The therapist kept hands together, and placed the two index fingers under the subject's occipital bone. The subject performed the chin-in exercise with a maximum isometric contraction for 20 sec.The exercise was implemented by performing the movements 10 times as a set and repeating the set three times. The muscle tone was not significantly changed after intervention. However, the stiffness was decreased and lasted the effect lasted without intervention. The cervical flexion angle was increased, but the cervical extension angle was not significantly changed after the intervention. The left and right lateral flexion angles were increased and the effect lasted without any intervention. However, the left and right rotation angles were significantly changed after the intervention. Cervical lordosis increased not from 37° to 41° after the intervention. These results suggest that occipital bone stimulation by cervical stabilizing exercise had a positive effect on cervical stiffness, flexion and lateral flexion ROM, and lordosis in a patient with forward head posture.

Key words: *Forward head posture, Cervical stabilizing exercise, Stiffness, ROM, Cervical lordosis*

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INTRODUCTION

Forward head posture(FHP) is regarded as a bad posture and is commonly found in patients who experience problems with the head and neck(1). FHP is usually associated with shortening of the posterior neck extensor muscles and sternocleidomastoid muscle. Therefore, increased cervical lordosis is a common consequence of FHP(2).

When abnormal alignment of the vertebrae is continuously maintained due to inappropriate posture, the vertebrae and surrounding soft tissue might be easily exposed to a sudden impact or chronic stress, and this could lead to possible changes in the blood vessels, and spinal disease(3). Continuous FHP increases the load on the posterior cervical structures such as bone, ligaments, joint capsules, and muscles(4). FHP is a head-on-trunk misalignment, and it is described as excessive anterior positioning of the head in relation to a vertical reference line, accompanied by increased lower cervical spine lordosis(head forward, middle cervical extended, lower cervical spine flexed). This posture is associated with weakness of the deep cervical short flexor muscles(5). The deep cervical flexor muscles are small stabilizing muscles located on the anterior and anterolateral surfaces of the cervical spine deep to the sternocleidomastoid

muscle(6). Recently, the roles of the longus colli and the longus capitis, which are deep muscles, have been emphasized further in relation to the maintenance of cervical stability because increases in the strength and endurance of deep muscles can improve the ability to maintain a standing and neutral position of the neck(7). Kang suggested that people with FHP should complete deep cervical flexor training, because it would help them maintain a proper cervical posture(8).

Cervical stabilizing exercise can increase the activity of cervical deep muscles(9). Cervical stabilization exercises are effective at improving the cervical range of motion in people with FHP(10). Chung et al. suggested that the cranio-cervical flexion exercise(jaw was pulled down to make a nodding movement) was effective at enhancing the cross-sectional area of the longus colli, and the absolute rotation angle(ARA) and treating fuctional disabilities(11).

However, few studies have investigated occipital bone stimulation. Therefore, we investigated occipital bone stimulation by cervical stabilizing exercise on patient with FHP. This study was case study of a single patient with FHP. We evaluated muscle tone, stiffness, ROM and cervical lordosis.

SUBJECT AND METHODS

This study was a case study of a single patient with FHP. The subject was a 56-year-old-man who weighted of 65 kg; and was 165 cm tall. The subject agreed to participate in the study after receiving an explanation regarding the purpose and procedures of the experiment, and subject signed the an informed consent statement before participation.

This was a single-case study with the ABA' design(Fig 1), where A and A' were baseline phases and B was the intervention phase. In the present study, when no intervention was given, it was considered as the baseline phase. The baseline phase could be before or after the intervention phase. Muscle tone, stiffness and cervical ROM were measured once daily during A and B phases and on the reassessment day. The A' phase had no intervention. It was assessed on the 13th to 16th day. After the A' phase, muscle tone, stiffness and cervical ROM were measured. The total study period study was 17 days.

The intervention was occipital bone stimulation by cervical stabilizing exercise. It was administered once daily for 7 days (the intervention phase). The cervical stabilizing exercise was a modified version of Chung et al.(11). The subject was instructed to take a supine position, and bent hip and knee joint to avoid lumbar lordosis. The subject performed the chin-in exercise with a maximum isometric contraction for 20 sec. To occipital bone stimulation, the therapist kept hands together, and placed the two index fingers under the subject's occipital bone. The exercise was implemented by performing the movements 10 times as a set and repeating the set three times with a rest period of two minutes after each set. This contraction was monitored by the examiner using palpation. There was a 1 min stretching period before and after the exercise. The intervention was conducted once daily for a total 7 days.

The subject was assessed with respect to muscle tone, stiffness, ROM, and cervical lordosis. Muscle tone and stiffness were measured with Myoton2 PRO (MyotonAS,Tallinn,Estonia) over the area located at a 2 cm distance from the left side of the C4 spinous process. To measure the stiffness, the device was positioned vertically on the skin marker in a relaxed condition in the prone position. Stiffness was measured twice. Mean values were used. Values for cervical ROM such as flexion, extension, lateral flexion, and rotation were measured using Goniometer (EZ Read Jamar Goniometer, America). All movements were performed and measured while the subject was seated on a static chair.

Cervical lordosis was measured with an X-ray before starting the treatment and after completing the treatment. Cervical lordosis was measured in this order after lining the horizontal surfaces of C1 and C7 and drawing a vertical line on the horizontal line.

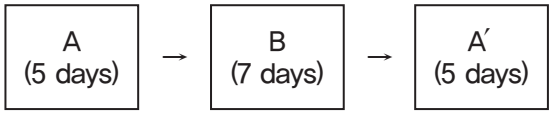

Fig. 1. Experimental flow chart.
A=baseline 1(no intervention),
B=treatment phase(intervention and assessment)
A'=baseline 2(no intervention)

RESULTS

This study investigated whether occipital bone stimulation by cervical stabilizing exercise could cause structural and functional changes in the cervical spine of a patient with FHP. The measurements of muscle tone, stiffness and cevical ROM are summarized in 〈Table 1〉.

The muscle tone was not significantly changed after the intervention. However, the stiffness was decreased and lasted the effect lasted without any intervention. Values for cervical ROM such as flexion, extension, lateral flexion, and rotation were measured. The cervical flexion angle was increased, but the cervical extension angle was not significantly changed after the intervention. The left and right lateral flexion angles were increased and the effect lasted without any intervention. However, the left and right rotation angles were not significantly changed after the intervention.

〈Fig. 2〉 shows cervical lordosis on a X-ray. Cervical lordosis increased from 37° to 41° after the intervention.

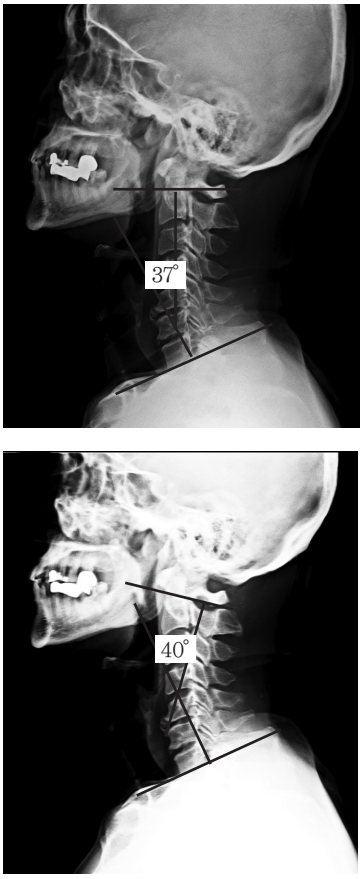

Fig. 2. Cervical lordosis on a x-ray (superior: pre, inferior: post)

Table 1. Muscle tone, stiffness, ROM and cervical lordosis

	Baseline					Intervention							AI
Day	1	2	3	4	5	6	7	8	9	10	11	12	17
Tone (Hz)	18.2	18.7	16.5	17.8	16.6	16.7	16.7	16.7	15.7	15.4	15.5	16.1	16.8
Stiffness(N/m)	275.5	285.5	283.0	276.5	280.5	283.2	276.0	265.0	276.0	269.5	256.0	258.5	264.5*
Flex (°)	38	39	40	40	40	42	44	46	48	52	52	51	52*
Ext (°)	30	32	31	30	30	31	32	33	34	34	33	33	34
Llf (°)	23	27	28	30	30	32	24	35	37	36	38	40	37*
Rlf (°)	32	33	30	32	32	35	37	40	40	41	42	43	45*
Lrot (°)	31	33	32	33	33	35	33	34	34	32	32	32	30
Rrot (°)	52	48	49	50	50	51	51	52	53	52	52	53	52
CL(°)	37											41	

AI:after intervention (5 days)
Flex:flexion; Ext:extension; Llf:left lateral flexion; Rlf:right lateral flexion
Lrot:left rotation; Rrot:right rotation; CL: Cervical lordosis

DISCUSSION

The head, neck, and shoulder related structures are biomechanically interconnected in a complex way, and individual segments can exert normal motor skills only when appropriate positions of the joints are maintained(7). Approximately 60% of the neck pain patients are reported to have FHP(4). A sustained forward flexion posture of the spine has been associated with increased cervical compressive loading and a creep response in the connective tissue(12). Also, this posture is associated with weakness of the deep cervical short flexor muscles(5). Cervical stabilizing exercise can increase the activity of cervical deep muscles(9).

Therefore, the purpose of this study was to identify the effects of occipital bone stimulation by cervical stabilization exercises in a patient with FHP. This study was a case study of a single patient with FHP. The subject of this study was a 56-year-old man. Age-related changes in posture commonly include a forward head, rounded shoulders, increased thoracic kyphosis, and reduced lumbar lordosis. These changes are generally attributed to gradual changes in the structure and mechanics of connective tissues which result in a loss of elasticity and inability to effectively counteract the gravitational torque that pulls the body into a forward bent position(13).

In the present study, the muscle tone was not significantly changed after the intervention. However, the stiffness was decreased and the effect lasted without any intervention. The mechnical properties are typically expressed as stiffness, which is related to the amount, type, temperature and organization of structures such as muscle, elastin, proteoglycans and water(14). Stiffness has been related to pain, reduced voluntary movement, and abnormal spinal joint stiffness(15). In the present study, muscle stiffness was decreased after intervention and the intervention effect was maintained for five days without any further intervention. These results suggest that occipital bone stimulation by cervical stabilizing exercise is an effective rehabilitation method for reducing stiffness in FHP patient.

Cervical ROM is regarded as the standard test by which a patient with a disorder such as FHP is assessed, because it enables investigators to focus on the factors of pain and functional movement(10). In the present study, cervical ROM were measured flexion, extension, lateral flexion, and rotation. The cervical flexion angle was increased, but cervical extension angle was not big changed after intervention. And left and right lateral flexion angles were increased and lasted effect without intervention. The left and right rotation angles were not big changed after intervention. Therefore, occipital bone stimulation by cervical stabilizing exercise is considered to have positive effect on flexion, and lateral flexion. However, cervical extension, and rotation did not show a positive influence. It can be considered that cervical stabilizing exercise affected the muscles of flexion and lateral flexion than extension muscles. Falla et al. reported that cervical stabilizing exercise can increase the activity of cervical deep flexor muscles(9). Kang reported that deep cervical flexor training is a useful method for maintaining neck mobility and muscular endurance in people with FHP(8). Therefore, the intervention method applied in the present study increased the muscle activity of the neck flexion and lateral flexion, thus positively affecting cervical ROM.

In the present study, the cervical lordosis angle was increased from 31° to 41°. Cervical posture must be considered for postural assessment, specifically because adjacent postural compensations are expected in other segments considering that muscle chains are interconnected(16). FHP, in which the head is positioned forward is a posture that commonly appears in cervical problem patients as a way of decreasig the curve spine(17). These results suggest that occipital bone stimulation by cervical stabilizing exercise had a positive effect on cervical stiffness, flexion and lateral flexion ROM, and lordosis in a patient with FHP.

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