J. Phys. Ther. Sci.
27: 1609–1611, 2015

Original Article

The effects of cervical joint manipulation, based on passive motion analysis, on cervical lordosis, forward head posture, and cervical ROM in university students with abnormal posture of the cervical spine

Wontae Gong, PhD, PT[1)]

[1)] *Department of Physical Therapy, Korea Nazarene University: Wolbong Ro 48, Seobuk-gu, Cheonan-si, Chungcheongnam-do 330-718, Republic of Korea*

Abstract. [Purpose] The aim of this study was to determine the effect of cervical posture manipulation, based on passive motion analysis (MBPMA) and general mobilization, on cervical lordosis, forward head posture (FHP), and cervical ROM in university students with problems in cervical posture and range of motion (ROM). [Subjects] The Subjects were 40 university students in their 20s who displayed problems in cervical posture and ROM; they were divided into an MBPMA group (n=20) and a mobilization group (n=20). [Methods] Each group underwent MBPMA or mobilization three times a week for four weeks. The effects of MBPMA and mobilization on cervical lordosis, FHP, and cervical ROM were analyzed by radiography. [Results] MBPMA was effective in increasing the cervical lordosis, cervical extension ROM (CER), and ranges of flexion and extension motion (RFEM) and in decreasing FHP. Mobilization was effective in increasing CER and decreasing FHP. [Conclusion] MBPMA can be utilized as an effective method for decreasing FHP and improving cervical lordosis and cervical ROM.
Key words: Manipulation, Motion analysis, Cervical ROM

(This article was submitted Jan. 13, 2015, and was accepted Jan. 31, 2015)

INTRODUCTION

VDT (Visual Display Terminal) syndrome refers to all complex health problems occurring in persons who use smartphones or computers for prolonged periods. A person with VDT syndrome has a misaligned posture called Forward Head Posture (FHP) in which the head sits too far forward on the trunk[1)]. Cervical extension range of motion (ROM) is adversely affected by FHP, and this has a great effect on daily living. The upper cervical spine in people with FHP experiences hyperextension, but other areas of the cervical spine show increased flexion, thereby limiting extension[2)]. Some research shows that a larger cervical extension ROM reduces the FHP and increases the endurance of the deep neck flexor[3)]. Various studies have therefore focused on how to increase cervical ROM. For example, spinal manipulative therapy[4)], the activator technique[5)], the diversified technique[6)], and sustained natural apophyseal glides (SNAGS)[7)] have been reported as effective methods for improving cervical ROM. The limitation of extension in the cervical ROM can adversely affect daily living due to headache and dizziness, and SNAGS were reported to be effective in increasing extension ROM[8)]. However, studies of the existing manual therapies for increasing cervical ROM have not analyzed passive motion in individual subjects.

The aim of the present study was therefore to use cervical joint manipulation based on passive motion analysis to determine the effects on cervical lordosis, FHP, and cervical ROM of university students with abnormal posture and range of motion (ROM).

SUBJECTS AND METHODS

This study was conducted with 200 university students attending D University in South Korea. Of them, 80 students who had a problem with their cervical posture and ROM were selected through visual inspection and underwent radiography, allowing selection of 40 subjects who complained of chronic cervical pain and whose cervical lordosis angle was less than 21°[9)], FHP was over 15 mm[10)], and extension ROM and flexion ROM were below 70° and 35°[11)] respectively. These 40 subjects were randomly grouped into two manipulation groups: a passive motion analysis (MBPMA) group as the experimental group and a general mobilization group as the control group. Patients with a history of surgical treatment of their cervical spine, rheumatoid disease, neck pain accompanying pressure fractures, and nervous system problems found in analyses of their cervical spine were

Corresponding author. Wontae Gong (E-mail: owntae@hanmail.net)

excluded. This study was approved by the university's institutional review board, and the subjects were safely protected during all of the processes of the experiment. All of the subjects understood the purpose of this study and provided written informed consent prior to participation in the study in accordance with the ethical standards of the Declaration of Helsinki. The mean age of the MBPMA group (10 males and 10 females) was 22.4±2.3 years, and their mean height and weight were 168.0±3.6 cm and 58.9±6.3 kg, respectively, while the values for the mobilization group (10 males and 10 females) were 23.1±3.1 years, 167.9±3.6 cm, and 59.1±5.9 kg, respectively. No statistically significant difference was determined between the two groups ($p>0.05$), confirming that the two groups were homogenous.

In this study, the absolute rotation angle (ARA) was chosen as the cervical lordosis measurement method used to determine changes in cervical lordosis, FHP, and anterior weight bearing (AWB)[12] to determine cervical ROM. Cervical extension ROM (CER), cervical flexion ROM (CFR), and ranges of flexion and extension motion (RFEM)[13] were imaged and measured via the lateral view of the cervical spine. The images were obtained using X-ray equipment (MDXP-40, Anyang, South Korea) by the same radiographer from a distance of 1 m. The film size was 14×14 inches.

The MBPMA group had a 10-min manipulation session three times a week for four weeks. The characteristics of the manipulation received by the experimental group were aimed at increasing flexion, extension, and side bending ROM by checking the cervical facet joint ROM via passive motion analysis. In the passive motion analysis group, subjects lay down on the table in the supine position, and the 7th cervical vertebra (C7) was placed on the table while the other segments above C7 were placed off the table. A therapist held the occipital region of the subject in one hand and the C6 spinous processes (SP) in the other hand using the radial side of the 2nd metacarpophalangeal (MCP) joint, and pushed the occipital region down slowly to check the mobility of the C5 and C6 joints. This method was used to check the extension ROM of each joint in the cervical spine by holding the C5, C4, and C2 SPs. For joints whose extension ROM mobility was decreased, extension ROM of right facet joint was accurately inspected by the therapist by holding the occipital region in one hand after right (Rt.) rotation of the head and neck of the subject by about 15° and holding the right articular pillar in the centrum below the joints. The same method was also used to check left (Lt.) facet mobility. After inspection, manipulation was applied by accurately locating the joints whose extension ROM was restricted. For example, manipulation was applied while performing extension with Rt. side bending at Rt. C4–5 to close only Rt. C4–5 of the subject as much as possible in order to increase ROM in the Rt. C4–5 facet. Here, the movement of joints other than Rt. C4–5 were avoided as much as possible. In order to increase flexion ROM, flexion with Rt. side bending of the subject, in the same supine position, was induced to occur at the C5–6 joints to check the open ROM in the Lt. C5–6 facets, and manipulation was applied by checking mobility while preventing movement of the other surrounding joints.

This method allowed inspection of the ROM of many left and right joints in the cervical spine to be performed and manipulation to be applied. In order to increase side bending ROM, flexion with Rt. side bending of the subject, in the same supine position, was induced to occur at the C5–6 joints to check the open ROM in the Lt. C5–6 facets, and manipulation was applied by checking mobility while preventing movement of other surrounding joints. Using this method, ROM of many left and right joints in the cervical spine was inspected and manipulation was applied. The control group received 15-min cervical mobilization sessions three times a week for four weeks.

Table 1. Comparison of ARA, AWB, CER, CFR, and RFEM in the each groups (mean±SD) (unit: ARA, CER, CFR and RFEM, degree; AWB, mm)

Category	Group	Before	After
ARA	MBPMA*	12.9±6.8	18.1±7.01
	Mobilization	13.1±8.7	15.7±8.1
AWB	MBPMA*	22.5±10.4	14.1±6.4
	Mobilization*	22.0±10.3	17.3±9.6
CER	MBPMA*	51.9±8.8	65.4±6.3
	Mobilization*	52.9±10.3	58.7±10.9
CFR	MBPMA	20.0±5.8	24.6±8.6
	Mobilization	19.5±7.9	20.5±7.2
RFEM	MBPMA*	71.9±8.6	90.1±11.2
	Mobilization	72.5±14.3	79.2±13.2

*$p<0.05$, MBPMA: manipulation based on passive motion analysis; ARA: absolute rotation angle; AWB: anterior weight bearing; CER:cervical extension ROM; CFR: cervical flexion ROM; RFEM: ranges of flexion and extension motion

The experimental results were statistically analyzed using SPSS 12.0 KO (SPSS, Chicago, IL, USA). After the general characteristics of the subjects were determined, paired t-tests were used to compare the changes in ARA, AWB, CER, CFR, and RFEM between before and after the experiment in each group. The differences between the 2 groups were tested using independent t-tests. The statistical significance level, α, was set at 0.05.

RESULTS

The ARA, AWB, CER, and RFEM were higher in the MBPMA group after the experiment, while the AWB and CER were higher in the mobilization group after the experiment ($p<0.05$) (Table 1).

No statistically significant differences were found between the MBPMA and mobilization groups before the experiment ($p>0.05$). By contrast, the CER and RFEM were significantly higher in the MBPMA group than in the mobilization group after the experiment, and the overall changes before and after the experiment were also larger in the MBPMA group than in the mobilization group ($p<0.05$) (Table 2).

DISCUSSION

Previous studies on combined traction with cervical manipulation in patients with severe FHP and decreased

Table 2. Comparison of ARA, AWB, CER, CFR, and RFEM between the MBPMA group and mobilization group (mean±SD) (unit: ARA, CER, CFR, and RFEM, degree; AWB, mm)

	Category	MBPMA G	Mobilization G
Before	ARA	12.9±6.8	13.1±8.7
	AWB	22.5±10.4	22.0±10.3
	CER	51.9±8.8	52.9±10.3
	CFR	20.0±5.8	19.5±7.9
	RFEM	71.9±8.6	72.5±14.3
After	ARA	18.1±7.0	15.7±8.1
	AWB	14.1±6.4	17.3±9.6
	CER*	65.4±6.3	58.7±10.9
	CFR	24.6±8.6	20.5±7.2
	RFEM*	90.1±11.2	79.2±13.2
Change between before and after the experiment	ARA	5.2±8.4	2.6±11.9
	AWB	8.4±8.2	4.7±6.9
	CER*	13.5±11.5	5.8±11.2
	CFR	4.6±11.0	0.9±9.2
	RFEM*	18.1±15.0	6.7±17.3

*$p<0.05$. G: group

cervical lordosis reported an increase in cervical lordosis and a decrease in FHP[12]. Nordemar performed manipulation and transcutaneous nerve stimulation on 30 patients with acute neck pain wearing a cervical colla and showed that the manipulation group had rapid symptom reduction and improved range of motion[14]. Howe et al. divided 51 patients into 2 groups: one group underwent manipulation and the other used medication. The manipulated group had immediate improvement in ROM and more relief from pain following treatment[15]. Gong applied Gong's Mobilization and SNAGS to university students in their 20s with problems in cervical posture and ROM and reported that Gong's Mobilization was effective in increasing cervical lordosis, CER, and RFEM[16].

The present study also showed that both groups had statistically significant decreases in FHP and increases in cervical extension ROM. The MBPMA group also had significant increases in cervical lordosis and RFEM. However, neither group showed any increase in cervical flexion ROM. No significant differences were found between the MBPMA group and mobilization group before the experiment, but CER and RFEM were significantly higher in the MBPMA group than in the mobilization group after the experiment, and and the overall changes before and after the experiment were also statistically larger. These results indicated that MBPMA treatment, which included passive motion analysis, was more effective than mobilization. The mobility of the cervical right and left facet joints of the subjects in the MBPMA group was inspected in the supine position, and the joints that had restriction in ROM were accurately located; manipulation was then applied while movement in the surrounding joints was prevented. Future studies should examine the immediate effects of MBPMA, as well as focus on the application of MBPMA to lateral flexion and rotations.

ACKNOWLEDGEMENTS

This research was supported by Korea Nazarene University Research Grants in 2015.

REFERENCES

1) Hickey ER, Rondeau MJ, Corrent JR, et al.: Reliability of the cervical range of motion device and plumb line techniques in measuring resting head posture. J Manual Manip Ther, 2000, 8: 10–17. [CrossRef]
2) Neumann DA: Kinesiology of the Musculoskeletal System: Foundations for Physical Rehabilitation. Singapore: Elsevier press, 2004, pp 345–386.
3) Gong WT, Kim CS, Lee YM: Correlations between cervical lordosis, forward head posture, cervical ROM and the strength and endurance of the deep neck flexor muscles in college students. J Phys Ther Sci, 2012, 24: 275–277. [CrossRef]
4) Haldeman S: Spinal manipulative therapy in sports medicine. Clin Sports Med, 1986, 5: 277–293. [Medline]
5) Osterbauer PJ, Derickson KL, Peles JD, et al.: Three-dimensional head kinematics and clinical outcome of patients with neck injury treated with spinal manipulative therapy: a pilot study. J Manipulative Physiol Ther, 1992, 15: 501–511. [Medline]
6) Reggars JW, Pollard HP: Analysis of zygapophyseal joint cracking during chiropractic manipulation. J Manipulative Physiol Ther, 1995, 18: 65–71. [Medline]
7) Mulligan BR: Manual Therapy NAGS SNAGS MWMS etc. 5th ed. Plane View. New Zealand: services Ltd, 2003.
8) Reid SA, Rivett DA, Katekar MG, et al.: Sustained natural apophyseal glides (SNAGs) are an effective treatment for cervicogenic dizziness. Man Ther, 2008, 13: 357–366. [Medline] [CrossRef]
9) Owens E, Hoiris K: Cervical curvature assessment using digitized radiographic analysis. Chiropr Res J, 1990, 4: 47–62.
10) Harrison DD, Janik TJ, Troyanovich SJ, et al.: Comparisons of lordotic cervical spine curvatures to a theoretical ideal model of the static sagittal cervical spine. Spine, 1996, 21: 667–675. [Medline] [CrossRef]
11) Neumann DA: Kinesiology of the Musculoskeletal system. St. Lous: Mosby, 2002.
12) Harrison DE, Harrison DD, Betz JJ, et al.: Increasing the cervical lordosis with chiropractic biophysics seated combined extension-compression and transverse load cervical traction with cervical manipulation: nonrandomized clinical control trial. J Manipulative Physiol Ther, 2003, 26: 139–151. [Medline] [CrossRef]
13) Shiraishi T: Skip laminectomy—a new treatment for cervical spondylotic myelopathy, preserving bilateral muscular attachments to the spinous processes: a preliminary report. Spine J, 2002, 2: 108–115. [Medline] [CrossRef]
14) Nordemar R, Thomer C: Treatment of acute cervical pain-a comparative study.
15) Howe DH, Newcombe RG, Wade MT: Manipulation of the cervical spine—a pilot study. J R Coll Gen Pract, 1983, 33: 574–579. [Medline]
16) Gong WT, Hwang Bo G, Lee YM: The effects of Gong's Mobilization on cervical lordosis, forward head posture, and cervical ROM in abnormal posture of the cervical spine of college students. J Phys Ther Sci, 2011, 23: 531–534. [CrossRef]