J Int Acad Phys Ther Res 2018; 9(1): 1381—1386
ISSN 2092-8475
www.iaptr.org
https://doi.org/10.20540/JIAPTR.2018.9.1.1381

The Effects of Pelvis, Lumbar Spine and Cervical Spine Manipulation on Joint Position Sense in Healthy Adults

The purpose of this study is to investigate the effect of pelvic, Lumbar spine and Cervical spine manipulation on the joint position sense in normal adults. Thirty normal adults were divided into an experimental group of 15 subjects and a control group of 15 subjects. The experimental group was treated with pelvic, Lumbar spine and Cervical spine manipulation with massage, whereas the control group received only massage. Both groups were evaluated in terms of joint position errors (JPEs) using a digital dual clinometer before and after the experiment. The comparison of the JPEs of the experimental group and the control group before and after the experiment showed that the experimental group's cervical spine results were significantly different in the flexion, left lateral flexion, and right rotation ($p < .05$) and lumbar spine results were significantly different in the flexion and extension ($p < .05$), but the control group's results were not statistically significant in all items ($p > .05$). The pelvic, lumbar spine and cervical spine manipulation makes an effect on the joint position sense in normal adults. The findings of this study suggest that the pelvis, lumbar spine and cervical spine manipulation improve the motor ability in people with low joint position sense.

Key words: *Manipulation, Massage, Joint position sense*

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Received : 12 January 2018
Revised : 03 February 2018
Accepted : 07 February 2018

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INTRODUCTION

Pain in the neck and lumbar areas is a frequent and disabling complaint in the general population, and proprioceptive information from muscle and joint receptors is a crucial element of trunk control [1]. Joint position sense (JPS), which is the ability to perceive the locations of joints and which is an essential element of maintaining balance or kinesthetic sense, is an important function of the human body [2], JPS is a neurological input that delivers information from the body's peripheral mechanical receptors to the central nervous system. Those with functional JPS can perceive the location of each physical segment without visual assistance, and muscle spindles among the mechanical receptors of the soft tissue are known to play an important role in the function of refined position sense [3]. JPS in the spine is provided by the spinal ligaments, facet joints, and intervertebral discs [4], and more stimuli are given in the end range of joint positions [5].

Previous research has stressed that impaired JPS is a major cause of recurrent injuries, and many athletic rehabilitation programs therefore emphasize proprioception training [6]. The range of motion (ROM) of female office workers with neck pain was measured; the result showed that their mobility was decreased in all directions and that they employed altered muscle recruitment strategies [7]. According to previous restudies on lumbar JPS, there was a correlation between lumbar spinal motion and facet joint capsule strain [8]; those with back dysfunction and discogenic back dysfunction had high joint position errors (JPEs) [9], and athletes with lower back pain had a lower lumbar position sense [10].Research that examined the effects of the JPS of lumbar joint mobilization [11] and cervical joint manipulation [12] in healthy subjects reported that JPS was improved by conventional proprioceptive training [13]. Some research has also looked at the relationship between JPS and dizziness. However, most research that has examined the relationship between lower back pain and JPS involving patients with persistent neck pain or a whiplash injury has reported that JPS improved through exercises. Some research has also looked at the effects of lumbar joint mobilization or cervical joint manipulation on JPS, but there has been no research examining the effects of the concurrent application of pelvic, lumbar (L)-spine, and cervical (C)-spine manipulation on JPS. Therefore, this study intends to investigate these effects.

SUBJECTS AND METHODS

Subjects

The subjects who participated in this study were 30 students at N university in Korea. They were equally divided into an experimental group (five males and ten females) and a control group (five males and ten females). The age, height, and weight of the experimental group were 22.7 ± 1.4 (mean ± SD) years, 164.8 ± 6.6 cm, and 60.2 ± 9.4 kg, respectively, and the age, height, and weight of the control group were 21.7 ± 1.4 years, 165.1 ± 7.3 cm, and 66.9 ± 10.5 kg, respectively. There were no statistically significant differences in the general characteristics of the two groups. All the subjects were adults who were 20 years or older, and any subjects who had a history of surgery, who had received hospital treatment, or who had cervical or lumbar herniation of an intervertebral disc were excluded from this study. This study was approved by Korea Nazarene University's institutional review board, and the subjects were protected throughout the experiment. All the subjects understood the purpose of this study and provided written informed consent prior to their participation in the study in accordance with the ethical standards of the Declaration of Helsinki.

Intervention

The experimental group received pelvic, L-spine, and C-spine manipulation and massage for 30 minutes each session with three sessions per week for four weeks. The control group received only massage. For the pelvis, a high-velocity, low-amplitude technique in a prone position was employed according to Gonstead's theory, and when the impact was applied, the therapist overlapped both hands and placed them on the posterior superior iliac spine or the ischial tuberosity and applied shock three times using the therapist's weight, gravity, and acceleration [14,15]. For lumbar mobilization, the mobilization of all five joints on the left and right sides of the lumbar vertebrae was performed using Gong's mobilization technique [11]. For cervical joint manipulation, the rotational correction was performed by contacting the rear areas of the posterior articular pillar of the segment intended for declination with the therapist's thumb, giving declination force on the horizontal plane against the Y-axis, and then applying short and fast thrust in the end range. For the correction of the lateral flexion, the therapist's index finger contacted the lateral area of the segment intended for correction, triggered lateral flexion to the coronal plane against the Z-axis, and applied short and fast thrusts in the end range. An increase in extension ROM was induced by Gong's mobilization [16]. The activity of the experimental group is restricted to the maximum extent. The massage was applied to the sternocleidomastoid, upper trapezius, levator scapulae, posterior cervical, erector spine, quadratus lumborum, latissimus dorsi, and gluteal muscles. Compression, stripping and cross fiber friction were used as massage techniques.

Measurement

JPS was evaluated using JPEs. In other words, more JPEs indicated a lower JPS ability. JPEs were measured using digital dual clinometers (Dualer IQ, JTECH Medical, USA). After the subjects were trained twice to find precise locations of the Fle 35°, Ext 35°, LLF 30°, RLF 30°, LR 45°, and RR 45° in a neutral position with passive movement under the direction of the tester, they were directed to find the location of each of the six directions with active movement alone without guidance by the tester. Then, the differences were recorded. JPEs were measured three times before and after the experiment, and the average value was used for analysis. Cervical JPEs were measured only from the Fle, Ext, LLF, RLF, LR, and RR, and lumbar JPEs were measured only from the Fle, Ext, LLF, and RLF [11,12].

Data Analysis

The experimental results were statistically analyzed using SPSS 18.0 KO (SPSS, Chicago, IL, USA). After the general characteristics of the subjects were determined, paired t-tests were used to compare the changes in the Fle, Exe, LLF, RLF, LR and RR for the pre-test and post-test in each group. The differences between the two groups were tested using independent t-tests. The statistical significance level, α, was set at .05.

RESULTS

The comparison of the JPEs in each group

The comparison of the JPEs of the experimental group and the control group before and after the experiment showed that the experimental group's cervical spine results were significantly different in the Fle, LLF, and RR but that the control group's results were not statistically significant in all items (p 〉 .05) 〈Table 1〉. The experimental group's lumbar spine results were significantly different in the Fle and Exe (p 〈 .05), but the control group's results were not statistically significant in all items (p 〉 .05) 〈Table 2〉.

Table 1. Comparison of cervical spine position errors in each group (unit: degree)

Group	Category	Pre-test	Post-test	t-value	p
Experimental group	Fle	4.53±2.66	1.60±1.12	4.11	.00*
	Exe	3.66±3.39	2.06±1.70	1.65	.12
	LLF	2.60±1.95	1.06±1.09	3.15	.00*
	RLF	3.13±2.06	2.00±1.36	1.93	.07
	LR	4.26±3.91	1.86±1.12	2.11	.05
	RR	4.20±4.16	1.60±1.45	2.69	.01*
Control group	Fle	3.46±2.99	3.26±2.01	.21	.83
	Exe	3.60±1.95	3.53±2.61	.08	.93
	LLF	2.46±2.09	2.73±1.48	-.38	.70
	RLF	3.00±1.81	3.33±2.19	-.40	.69
	LR	3.93±2.15	4.20±2.42	-.29	.77
	RR	3.60±2.06	3.40±1.68	.33	.74

* p〈.05, Mean±SD, Fle: flexion, Exe: extension, LLF: left lateral flexion, RLF: right lateral flexion, LR: left rotation, RR: right rotation

Table 2. Comparison of lervical spine position errors in each group

Group	Category	Pre-test	Post-test	t-value	p
Experimental group	Fle	2.46±1.55	1.06±0.70	3.72	.00*
	Exe	2.13±1.59	.86±0.91	2.57	.02*
	LLF	1.46±1.12	1.33±0.81	.38	.70
	RLF	1.80±1.47	1.33±0.97	1.28	.22
Control group	Fle	2.33±1.54	2.86±2.29	-.75	.46
	Exe	1.93±1.09	2.26±1.75	-.58	.56
	LLF	1.60±1.50	1.40±0.91	.48	.63
	RLF	1.40±1.29	1.60±1.12	-.44	.66

* p〈.05, Mean±SD.
Fle: flexion, Exe: extension, LLF: left lateral flexion, RLF: right lateral flexion, LR: left rotation, RR: right rotation

The comparison of the JPEs between experimental group and control group

The comparison of the difference of pre test and post test of the cervical spine JPEs results did show a statistically significant difference between the two groups in the Fle, LLF, and RR ($p < .05$)〈Table 3〉. The lumbar spine JPEs results did show a statistically significant difference between the two groups in the Fle and Exe ($p < .05$) 〈Table 4〉.

Table 3. . Comparison of cervical spine position errors between experimental group and control group (unit: degree)

Category		Experimental group	Control group	p
difference of pre test and post test	Fle*	2.93±2.76	0.20±3.62	.02*
	Exe	1.60±3.73	0.06±3.21	.23
	LLF*	1.53±1.88	−0.26±2.65	.04*
	RLF	1.13±2.26	−0.33±3.17	.15
	LR	2.40±4.38	−0.26±3.47	.07
	RR*	2.60±3.73	0.20±2.30	.04*

* $p<.05$, Mean±SD.
Fle: flexion, Exe: extension, LLF: left lateral flexion, RLF: right lateral flexion, LR: left rotation, RR: right rotation

Table 4. .Comparison of lumbar spine position error between experimental group and control group (unit: degree)

Category		Experimental group	Control group	p
difference of pre test and post test	Fle*	1.40±1.45	−0.53±2.74	.02
	Exe*	1.26±1.90	−0.33±2.19	.04
	LLF	0.13±1.35	0.20±1.61	.90
	RLF	0.46±1.40	−0.20±1.74	.25

* $p<.05$, Mean±SD.
Fle: flexion, Exe: extension, LLF: left lateral flexion, RLF: right lateral flexion

DISCUSSION

The facet joints serve mechanical and mechanosensory functions in the spine. In addition, when a lumbar spinal motion occurs, the intervertebral angle and lumbar facet joint capsule strain increase simultaneously. The capsule of the facet joint involves not only joint stability through movement but also pain and proprioception [8]. Since the increased ROM of the capsule of the facet joint has led to improvement in proprioception functions, thereby enhancing JPS, this study examined the effects of the concurrent application of pelvic, L−spine, and C−spine manipulation on healthy adults' JPS.

In a study related vertebral joint mobilization, Gong et al. mentioned that cervical joint mobilization could increase cervical ROM and muscle endurance [17] and Lee et al. mentioned that lumbar joint mobilization could increase lumbar ROM and decrease lumbar back pain [18]. In a study related to cervical JPS, Treleaven et al. measured the JPEs of 102 subjects with dizziness and unsteadiness following a whiplash injury and 44 healthy adults and reported that the JPS of those with dizziness and unsteadiness following a whiplash injury decreased more significantly than that of healthy subjects [19]. This study also reported that cervical mechanoreceptor dysfunction may be the cause of dizziness in patients with a whiplash injury. Jull et al. applied six weeks of conventional proprioceptive training and craniocervical flexion training to 64 female subjects with a history of either idiopathic (n = 39) or traumatic (n = 25) chronic neck pain and measured the JPEs of the subjects' cervical extension and rotation. Although both groups' JPE decreased, the proprioceptive training group saw their JPE decrease more than the craniocervical flexion training group [13]. Gong applied cervical joint manipulation and massage to 15 subjects in an experimental group and only massage to 15 subjects in a control group [12]. The results of this experiment showed that cervical joint manipulation reduced JPEs and improved JPS.

In a study related to lumbar joint mobilization, Konstantinou et al. applied joint mobilization to 26 lower back pain patients and reported that the group that received joint mobilization experienced a significant increase in lumbar extension ROM [20]. Simon et al. applied vibration to the paraspinal muscles of 23 young patients with lower back pain and 21 control subjects, measured their lumbosacral position sense, and reported that repositioning accuracy was significantly lower in the patient group than in healthy individuals [21]. This research is similar to the present study, which concentrated on stimulation of the joint capsule mechanoreceptors, because it involved the stimulation of the mechanoreceptors of the deep muscles. Gong applied lumbar joint mobilization and massage to 15 subjects in an experimental group and only massage to 15 subjects in a control group and reported that lumbar joint mobilization reduced JPEs and improved JPS [11].

The results of the examination of the effects of the concurrent application of pelvic, L-spine, and C-spine manipulation on health adults' JPS showed that the cervical spine manipulation had statistically significant effects on the Fle, LLF, and RR ($p < .05$) and that the lumbar spine manipulation had statistically significant effects on the Fle and Exe ($p < .05$). Such results are similar to those of previous studies, which concluded that that joint manipulation enhanced JPS. The mobility of each segment, which was triggered by joint manipulation, likely activated the proprioceptors of the joint capsules and deep muscles, which improved JPS but Massage did not affects the JPS because it did not increase the mobility of the joint. Thus, pelvic, L-spine, and C-spine manipulation should be applied to those with decreased JPS capabilities that resulted from reduced ROM or from vertebral dysfunction with decreased motor activity.

CONCLUSION

To examine the effects of the pelvic, lumbar spine, and cervical spine manipulations on the joint position sense of normal adults, subjects were classified into the experimental group and the control group of 15 members each. The experimental group received L-spine and C-spine manipulation with massage, and the control group received only massage. The joint position errors were measured before and after experiment with a digital dual clinometer. As a result, the experimental group showed statistical significances in the differences of joint position error between flexion, extension, left lateral flexion, right lateral flexion, left rotation, right rotation in the neck, flexion, extension, left lateral flexion, right lateral flexion in the lumbar. However, no statistical significances were found in the control group. This result is similar to a previous study which reported that joint manipulation improved the joint position sense. The joint manipulation generated mobility in each segment and activated the proprioceptors of the joint capsules and deep muscles, thus improving the joint position sense. Therefore, pelvic, L-spine and C-spine manipulations could be used to clinically treat the motor ability of people with low joint position sense due to reduced joint range of motion. or patients with vertebral dysfunction.

ACKNOWLEDGEMENTS

This research was supported by the Korea Nazarene University Research Grants in 2018.

REFERENCES

1. Greene HS, Cholewicki J, Galloway MT, et al. A history of low back injury is a risk factor for recurrent back injuries in varsity athletes. Am J Sports Med. 2001; 29(6): 795-800.
2. Treleaven J, Jull G, LowChoy N. The relationship of cervical joint position error to balance and eye movement disturbances in persistent whiplash. Man Ther. 2006; 11(2): 99-106.
3. Hewitt BA, Refshauge KM, Kilbreath SL. Kinesthesia at the knee: the effect of osteoarthritis and band age application. Arthritis Rheum. 2002; 47(5): 479-83.
4. Sjolander P, Johansson H, Djupsjobacka M. Spinal and supraspinal effects of activity in ligament afferents. J Electromyogr Kinesiol. 2002; 12(3): 167-76.
5. Gandevia SC, McCloskey DI, Burke D. Kinaesthetic signals and muscle contraction. Trends Neurosci. 1992; 15(2): 62-5.
6. Laskowski ER, Newcomer-Aney K, Smith JJ. Refining rehabilitation with proprioception training: expediting return to play. Phys Sportsmed. 1997; 25(10): 89-104.
7. Johnston V, Jull G, Souvlis T, et al. Neck movement

ㄴ and muscle activity characteristics in female office workers with neck pain. Spine. 2008; 33(5): 555–63.
8. Lanuzzi A, Pickar JG, Khalsa PS. Relationships between joint motion and facet joint capsule strain during cat and human lumbar spinal motions. J Manipulative Physiol Ther. 2011;34(7):420-31.
9. Georgy EE. Lumbar Repositioning Accuracy as a Measure of Proprioception in Patients with Back Dysfunction and Healthy Controls. Asian Spine Journal. 2011; 5(4): 201~7.
10. Silfies SP, Cholewicki J, Reeves NP. Lumbar position sense and the risk of low back injuries in college athletes: a prospective cohort study. BMC Musculoskeletal Disorders. 2007; 8: 129, doi:10.1186/1471–2474–8–129.
11. Gong WT. The Influence of lumbar joint mobi–lization on joint position sense in normal adults. J Phys Ther Sci. 2014; 26(12): 1985-7.
12. Gong WT. Effects of Cervical Joint Manipulation on Joint Position Sense of Normal Adults. J Phys Ther Sci. 2013; 25(6): 721-3.
13. Jull G, Falla D, Treleaven J, et al. Retraining cervical joint position sense: The effect of two exercise regimes. J Ortho Res. 2007; 25(3): 404–12.
14. Gong WT, Ro HL, Park GD, et al. The influence of pelvic adjustment on functional leg length inequality and foot pressure. J Phys Ther Sci. 2011; 23(1): 17–9.
15. Gong WT. The influence of pelvic adjustment on vertical jump height in female university students with functional leg length inequality. J Phys Ther Sci. 2015; 27(1): 251–3.
16. Gong WT, HwangBo 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(3): 531–4.
17. Gong WT, Lee SY, Lee YM. The Effects of Cervical ROM and Muscle Endurance on Cervical Joint Mobilization of Normal Adults. J korean soc phys med. 2010; 5(1): 7–13.
18. Lee YH, Kwon WA, Kim HS, at al. Effects of joint mobilization on the range of motion and pain of patient with chronic low back pain. J korean soc phys med. 2007; 2(2): 113–24.
19. Treleaven J, Jull G, Sterling M. Dizziness and unsteadiness following whiplash injury: charac–teristic features and relationship with cervical joint position error. J Rehabil Med. 2003; 35(1): 36-43.
20. Konstantinou K, Foster N, Rushton A, et al. Flexion Mobilizations with Movement Techniques: the Immediate Effects on Range of Movement and Pain in Subjects with Low Back Pain. J Manipulative Phys Ther. 2007; 3(3): 178–85.
21. Simon B, Paul C, Roeland L, et al. The Role of Paraspinal Muscle Spindles in Lumbosacral Position Sense in Individuals With and Without Low Back Pain. Spine. 2000; 25(8): 989–94.