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Preliminary Study of the Immediate Effect of Spinal Segmental Side Bending Mobilization on Improve Lumbar Range of Motion

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Abstract. [Purpose] To describe the immediate changes of mobility of intervertebral motion after lumbar side bending mobilization. [Subject and Method] Ten volunteers (10 men, aged 26–43 years) with no history of significant low back pain were recruited to participate in this study. Consenting volunteers were referred for radiographs. Three radiographs, neutral position, right side bending position prior to mobilization and right side bending position after mobilization, were taken. The L3/4 segment was chosen for mobilization. The mobilization was performed by one physical therapist. Frontal angular rotation of each lumbar spinal motion segment was measured on the pre- and post-mobilization radiographs by a blinded investigator (radiologist) using SYNAPSE software (FUJIFILM). Data were analyzed with the SPSS package, version 13.0. Within-group differences were assessed with the paired t test. [Results] Analysis of the pre- and post-mobilization radiographs showed a significant increase at the L3/4 segment from an average 5.6 to 7.1 degrees, and no significant increase at other segments, L1/2, L2/3, L4/5. [Conclusion] Our results suggest that lumbar segmental side bending mobilization targeting the L3/4 segment results in an immediate increase in the angular motion of the L3/4 segment.
Key words: Lumbar spine, Segmental range of motion, Mobilization

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INTRODUCTION

Spinal pain such as mechanical neck pain and low back pain (LBP) is a common occurrence with a life time prevalence ranging from 45% to 80%[1–4)]. One common dysfunction causing mechanical spinal pain is believed to be decreased range of motion due to tightness of the intervertebral joint capsule[5, 6)]. For the treatment of patients with decreased range of motion due to tightness of the intervertebral joint capsule, spinal manipulation and mobilization are interventions commonly utilized by a variety of professionals. Also, spinal manipulation and mobilization have been used for increasing segmental range of motion, yet very few studies have demonstrated immediate changes in the mobility of segmental motion after spinal manipulation and mobilization.

Previous studies have shown changes in active range of motion after manipulation. Pikula[7)] demonstrated increased range of motion with cervical manipulation. The range of motion measured by cervical range of motion (CROM) goniometer after movement of the entire cervical spine shows good validity and reliability[8, 9)]. Fernandez-de-las-Penas[10)] reported that cervical manipulation resulted in increased range of motion on the dysfunctional side. Segmental motion was measured with plain radiographs in their study, but they did not have a control group. Martínez-Segura et al.[11)] compared the effect on range of motion, measured with goniometer between a control group (cervical mobilization group) and a cervical manipulation group. Their results showed increased active range of motion, not segmental range of motion, in both groups.

Regarding studies using mobilization, there are a few studies that have shown the effects of mobilization. Although some studies[12, 13)] have found changes in range of motion following cervical / lumbar posterior to anterior (PA) mobilization, active range of motion, not segmental motion, was measured by CROM / inclinometer in those studies. Nevertheless, increased active range of motion measured by CROM / inclinometer dose not necessarily mean increased segmental range of motion.

Lumbar side bending mobilization is a technique for restoring side bending range of motion which focuses on a mobilizing segment using finger block as a mechanical effect[14)]. On the other hand, PA mobilization is a technique in which posterior to anterior force is applied, and it has been used with the aim of reducing pain rather than improving range of motion[15)]. Lumbar side bending mobilization has been used for a different purpose from that of PA mobilization. However, no studies have confirmed increased segmental range of motion after lumbar side bending mobili-

zation. Therefore, the effect of mobilization on the lumbar segmental range of motion is at present unclear.

The purpose of this study was to describe the immediate changes in segmental lumbar motion after lumbar segmental side bending mobilization in asymptomatic subjects. Asymptomatic subjects were chosen as a first step, because it is reported that asymptomatic people do not always have unrestricted range of motion even though they are pain free[16, 17].

SUBJECTS AND METHOD

Ten volunteers (10 men, aged 26–43 years) were recruited to participate in this study. Inclusion criteria were the following: no history of significant low back pain and no history of lumbar surgery.

This study was approved by the Ethical Committee for Clinical Research of Bizen Hospital. All subjects were informed of the radiographic procedure and the risk of radiation. All subjects provided their informed consent prior to beginning the trial.

A left lumbar side bending mobilization at L3/4 was performed by one physical therapist who had more than 10 years experience of the use of the technique. The mobilization was performed as follows.The subjects were positioned prone with their lumbar spine in a neutral position and a pillow under their abdomen. To identify the L3 spinous process, one physical therapist marked the potential spinous processes of L3 and L4 with a clip before a radiograph was taken. If the radiograph showed that the clip was at the correct level, L3 and L4, the mobilization was performed. The left thumb of the therapist standing on left side of the patient's body applied pressure from the left to the right of the L3 spinous process indicated by the top clip. The reason why the therapist blocked the L3 spinous process from the left to the right was to focus the force between L3 and L4, in other words, to minimize the force going above L3. The therapist's right hand held the subject's medial distal thigh, then left lumbar side bending was introduced through left hip abduction until resistance was felt by the right hand. There are two types of mobilization force applied in this technique, stretch and progressive oscillation. In progressive oscillation, it is difficult to control each oscillation; thus, we chose stretch, as it is easier to control the force. The duration of stretch at the end of the range of motion was chosen as three seconds as is normally used in clinical practice. This procedure was repeated three times.

A TOSHIBA, KXO-50G was used for the radiological examinations. The radiological setting was 320 mA of radiation exposure. A medium kilovoltage (average 75kV) was used. The tube was centered on L3. The focal film distance for each exposure was 100 cm.

After identifying the spinous processes of L3 and L4 and marking with a clip, described as above, subjects were passively moved to the left side bending position for the entire lumbar spine until the therapist felt the L1/2 segment move under his left hand placed on the interspace between the spinous process of L1 and L2. In this position posterior-anterior radiograph was taken (Fig. 1). Then, L3/4 mobilization was performed by one physical therapist. After the mobilization was repeated three times with three seconds stretch each time, the therapist moved the subject to the left side bending position again, and the post-mobilization radiograph was taken.

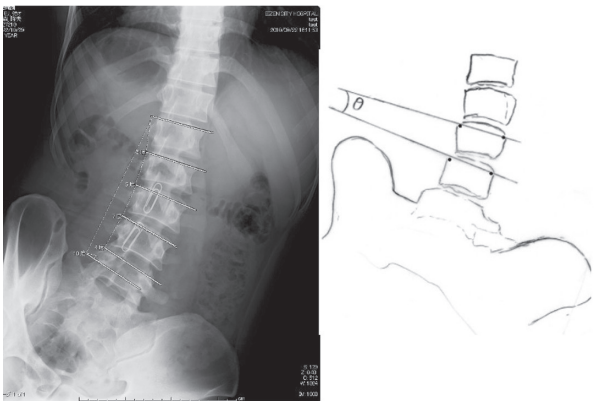

Fig. 1. Radiological assessment of segmental frontal angular rotation (side bending motion) of the lumbar spine. The angle between two vertebrae is given by the angle between the lines across the top corners. θ; Segmental frontal angular rotation.

The segmental frontal angular rotation of each lumbar spinal motion was measured by an investigator (radiologist) using SYNAPSE software (FUJIFILM) on the pre-mobilization and post-mobilization radiograph. The angle resulting from the intersection of the 2 lines drawn across two consecutive vertebrae tops was considered the degree of segmental side bending motion (Fig. 1).

Data were analyzed with the SPSS package, version 13.0 (SPSS Inc., Tokyo, Japan). Intra-rater reliability for radiologic measurement was assessed using the intraclass correlation coefficient (ICC). ICC was high ($ICC_{(1,2)}$ of 0.94, 95% CI 0.81, 0.99). The paired t-test was used to analyze differences in segmental rotation between pre-mobilization and post-mobilization.

RESULTS

The values for segmental side bending motion with standard deviation are presented in Table 1. The difference in between pre-mobilization and post-mobilization radiographs demonstrated a significant improvement in L3/4 segment motion where side bending mobilization was performed ($p < 0.001$) (Table 1). No significant differences in segmental motion were found at the segments L1/2 ($p > 0.05$), L2/3 ($p > 0.05$) or L4/5 ($p > 0.05$).

DISCUSSION

Lumbar side bending mobilization has been used for the purpose of increasing the segmental range of motion of hypomobile segments. However, little information about this technique has been reported. The current study may be the first to provide preliminary radiological evidence of increased segmental motion following lumbar side bending

Table 1. Segmental side bending angles in each segment before and after mobilization

Level	Pre-mobilization Post mobilization	Means (degree)	Standard deviations (degree)	95% confidence intervals Lower band (degree)	 Upper band (degree)
L1/L2	Pre-mobilization	3.5	1.1	2.7	4.3
	Post-mobilization	3.9	0.9	3.3	4.5
L2/L3	Pre-mobilization	5.3	1.6	4.2	6.4
	Post-mobilization	5.4	1.2	4.6	6.2
L3/L4	Pre-mobilization	5.6	0.8	5.0	6.2
	Post-mobilization	7.1*	0.9	6.8	7.7
L4/L5	Pre-mobilization	5.8	2.2	4.3	7.3
	Post-mobilization	5.3	2.4	3.6	7.0

* p value < 0.001 compared with pre mobilization. NOTE. Each value represents the means and SD, 95% CI.

mobilization.

Chiradejnant et al.[15] found changes in range of motion following posterior to anterior (PA) lumbar mobilization. Kanlayanaphotporn et al.[13] also reported significant increases in cervical range of motion after PA cervical mobilization. The increased active range of motion found in these studies[13, 18] was measured with CROM and an inclinometer. Lee's et al.[18] demonstrated that PA mobilization resulted in motion at neighboring segments in addition to the target segment. Therefore, it is possible that movement the entire spine (cervical, lumbar) influences the range of motion improvement. Kulig et al.[19] also demonstrated that PA mobilization produced extension of the lumbar spine. The above results support the idea that PA mobilization results in movement of the entire spine. These results of PA mobilization suggest that improved range of motion as measured by CROM and an inclinometer may be due to increase of motion of the entire spine in osteokinematic motion.

In the present study, we demonstrated that lumbar side bending mobilization targeting the L3/4 segment resulted in immediate increase of segmental angular motion. It has been suggested that intervertebral joint dysfunctions, characterized by a reduction of mobility of spinal segment, result in joint degeneration and instability adjacent to hypomobile segments, resulting in pain. If spinal mobilization or manipulation is performed at specific segments, it should affect the hypomobile joint and lead to an increased range of motion and relieve stress at adjacent level. Therefore, a technique for treating specific lumbar spinal levels by mobilization/manipulation is desirable. The results of the present study indicate that the technique we used can be used for improvement of range of motion at a specific level (segmental level).

Chiradejnant et al.[15] reported that PA mobilization at a random level as well as PA mobilization at the most symptomatic level reduced pain. Kanlayanaphotporn et al.[13] demonstrated that there was no apparent difference in the active range of motion between a preferred mobilization group and a random mobilization group. Although the result of these studies might suggest identifying a specific level and site for mobilization is less important, they used PA mobilization, the validity of which is controversial in segmental mobilization[18]. The results of present study suggest that segmental mobilization results in increased a range of motion at the target segment. This indicates that the specific level (site) chosen for mobilization is important. One possible explanation for our results, which support the importance of choosing segment or site in contrast to previous studies,[18] is the method of mobilization. The lumbar side bending mobilization we used in this study is considered specific and focuses on mobilizing a segment using finger block as a mechanical effect. However, PA mobilization, which was used in previous studies, is non-specific, causing motion at not only the target segment but also at neighboring segments. In addition, PA mobilization has been used with the aim of reducing pain rather than improving range of motion[15]. This difference in technique may have led to the conclusion that identifying a specific site for mobilization is less important in PA mobilization.

The subjects in the current study were asymptomatic volunteers. Although they were asymptomatic, it dose not necessarily mean that they had an unrestricted range of motion[16, 17]. We think that including asymptomatic volunteers gave the validity to the findings in terms of clinical efficacy. However, including subjects with current complaints of low back pain have given more the study greater credibility.

Our preliminary study has several limitations. First, this study had a small sample size (n=10) and included only men due to concerns over radiation effects, and these criteria may have affected the uniformity or homogeneity. Second, we did not have a control group. We can't confirm the effects of mobilization on the segmental range of motion without a control group, although our pre-post data of the segmental range of motion in other lumbar segments, on which mobilization was not performed, did not show any statistically significant changes. Third, this study only concentrated on the immediate effects of mobilization. Future study should assess not only the immediate effects but also the long-term effects with a larger sample and a control group.

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