

Original Article

# The effect of lumbar stabilization exercises and thoracic mobilization and exercises on chronic low back pain patients

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**Abstract.** [Purpose] To investigate whether pain, balance, and stabilization of the lumbar region can be improved through thoracic mobilization in addition to lumbar stabilizing exercises. [Subjects and Methods] This study recruited 36 subjects with chronic low back pain lasting more than 12 weeks. The subjects recruited for this study participated voluntarily, and provided their signed consent to participation. [Results] Improvement in balance was largest in the lumbar stabilization exercise group, followed by the thoracic mobilization and exercise group, and the traditional physical therapy group, in decreasing order of effect. [Conclusion] In conclusion, lumbar stabilization exercises combined with thoracic mobilization had greater effects on stabilization of the lumbar region pain relief, and improvement of the function of the patients with chronic low back pain.

**Key words:** Lumbar stabilization exercises, Thoracic mobilization exercises, Chronic low back pain

*(This article was submitted Aug. 17, 2015, and was accepted Sep. 18, 2015)*

## INTRODUCTION

Low back pain is one of the most common diseases and about 70–80% of the population experience it once or more in modern society<sup>1</sup>, and its incidence, and social expenditures related to it are increasing<sup>2</sup>. There are various causes of back pain, and among them, herniation of intervertebral discs, and muscle weakness caused by muscle damage are major causes of lower back pain<sup>3</sup>.

Low back pain is caused by loss of segmental stabilization and balance ability, and limits range of motion<sup>4</sup>. Patients are designated as having chronic low back pain, when lumbar pain with non-specific causes lasts more than 12 weeks<sup>5</sup>. In recent years, mechanical causes of pain account for the greatest number of cases. After analyzing the motion of each segment of the spine of degenerated disc patients, our study group reported the most common cause of back pain is spinal instability<sup>6</sup>.

In human movement in a multi-component model, the movement of the most flexible segment generates the largest angle. Therefore, most spinal dysfunction is caused by excessive flexibility of a particular segment rather than poor flexibility<sup>7</sup>.

When conducting functional activities, the mobilization of the joints adjacent to an unstable segment is relatively increased, and decreasing the hypermobility through stabilization of the hypermobile segment can promote healing<sup>8</sup>. Thus, thoracic mobilization may help to promote stabilization of the lumbar region.

According to a recent study, instability of the lumbar spine is the most important cause of chronic low back pain<sup>9</sup>. If this instability increases, it can elicit abnormal posture reactions in static balance and result in inability to perform normal activities due to a loss of sense balance in patients with chronic low back pain. Loss of balance can also be caused by the loss of the muscular strength or neurologic imbalances.

Many studies have reported that lumbar stabilization exercises provide stabilization by strengthening the lumbar deep muscles of patients with chronic low back pain, but few studies have investigated lumbar mechanical stabilization through thoracic mobilization. Therefore, this study investigated whether pain, balance, and stabilization of the lumbar can be improved through thoracic mobilization in addition to lumbar stabilization exercises.

## SUBJECTS AND METHODS

This study recruited subjects with chronic low back pain lasting more than 12 weeks. Forty-five subjects satisfied the selection criteria, and 36 of them participated in the study. They were divided into 3 groups; a traditional physiotherapy group (TPG), a lumbar stabilization exercise group (LSEG), and a thoracic mobilization exercise group (TMEG).

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Traditional physiotherapy, lumbar stabilization exercises, or thoracic mobilization and exercise were performed three times a week for 12 weeks. The outcome measures were a visual analog scale assessment of pain, the balance index, and lumbar translation length. Selection criteria were: experience of low back pain over 12 weeks, and participants who couldn't sit long in one position, who felt pain every time they changed their position, and also frequently changed their sitting posture. The subjects chosen for this study participated voluntarily, and provided their written informed consent form in accordance with the ethical principles of the Declaration of Helsinki. All the subjects received traditional physiotherapy comprised of hot pack treatment for 20 minutes, ultrasound therapy for 5 minutes, and transcutaneous electrical nerve stimulation for 15 minutes, a total of 40 minutes.

The lumbar stabilization exercise group, additionally performed exercise for stabilizing the multifidus muscles, and transversus abdominis, after receiving traditional physiotherapy. The lumbar stabilization exercise program consisted of three exercises. Each exercise was repeated 12 times for 1 set, and 5 sets, with a break of 3 minutes between sets, were performed in one therapy session. The 3 exercises were: a semi-situp, holding the legs in a cross-legged position lying face downwards, and lying on the side keeping one leg raised.

The thoracic mobilization and exercise group additionally performed two exercise programs and received passive thoracic soft tissue mobilization to increase the thoracic mobility after traditional physiotherapy. The thoracic mobility exercise program consisted of 2 exercises. Each exercise was repeated 12 times for 1 set, and a total of 5 sets, with a break of three minutes between sets, were performed in one therapy session.

Thoracic soft tissue mobilization was carried out for 5 minutes after performance of the thoracic soft tissue exercises. These involved moving the upper body, only putting a pillow on the thoracic area, moving the thoracic area, and mobilization with the upper body and lower body crossed. Pain levels were assessed using a visual analog scale (VAS). In this study, balance was assessed as the best score of 3 trials in a standing posture on a balance measuring instrument (MICROSWING 5.0, HAIDER BIOSWING, Germany) connected to a computer using Posturomed software.

The lumbar translation length test is an objective test of lumbar instability. If any segment of the functional spine is in an unstable state during measurement of the translation of

the functional spine under a physical force, it translates more than stable segment in the physical forces at that time. In case sagittal plane displacement was transferred more than at least 3 mm in any one segment the curve or expansion when conducting the X-ray inspection, we called it an instability of the lumbar when more than 9% of adjacent vertebral body diameter was transferred<sup>10</sup>.

The translation length of the unstable segments was measured in the same way before and after the intervention to test the translation distance of the segments of the patients with chronic low back pain. To measure the distance, a line was drawn on the upper surface of the lower vertebrae of the segment to be measured in the sagittal plane of the X-ray, together with a vertical line. Then, the lower surface of the upper vertebrae and the end part of end plate of the upper surface of the lower vertebrae were connected to this line vertically, and the distance between the two lines was measured.

All data obtained in this study were processed using SPSS for 20.0 Windows. After the intervention, the differences in lumbar stability, balance, and pain between the groups were examined using the paired t test. The statistical significance level,  $\alpha$ , used was 0.05.

## RESULTS

The general characteristics of the subject are shown in Table 1.

The lumbar stability values as measured on X-rays are shown in Table 2. The thoracic mobilization and exercise group and the lumbar stabilization exercise group showed significant improvements in the lumbar stabilization test.

The balance index scores are shown in Table 2. Balance improvement was largest in the lumbar stabilization exercise group, followed by the thoracic mobilization and exercise group, and traditional physical therapy, in decreasing order of effect. VAS scores of pain are also shown in Table 2. Pain showed improvements in all of the groups.

**Table 1.** The general characteristics of the subjects

Variables	TPG (N=12)	LSEG (N=12)	TMEG (N=12)
LBP duration (years)	3.3±1.1	2.8±2.2	2.9±1.3
Gender: Male (%)	11 (91.7)	10 (83.3)	8 (66.7)
Age (years)	45.4±6.4	43.0±6.3	43.0±5.4

**Table 2.** Comparison of lumbar stabilization, balance index, pain among the three groups

Group	Lumbar stabilization (N=12) Unit (mm)		Balance index (N=12) Unit (score)		Pain (N=12) Unit (score)	
	pre	post	Pre	post	pre	post
LSEG	3.7±0.6	1.2±0.5*	179.7±62.3	597.5±40.4*	6.9±0.6	3.1±0.3*
TMEG	3.7±0.7	1.54±0.5*	167.9±47.6	450.6±50.5*	7.1±0.6	3.0±0.4*
TPG	3.5±0.4	3.29±0.4	179.5±41.0	261.9±41.1	7.1±0.5	3.2±0.2*

\*p<0.05, paired t-test

LSEG: lumbar stabilization exercise group, TMEG: thoracic mobilization exercise group, TPG: traditional physiotherapy group

## DISCUSSION

Today, most people experience back pain caused by lumbar damage at least once in their lifetimes. It lasts from 2 months to 3 months, and it has a probability recurrence<sup>11</sup>.

Currently, passive treatments for patients with low back pain are losing favor, and exercise treatments, active treatments which are effective at promoting a normal life, improving capacity, and preventing recurrence, are being used for the rehabilitation of patients with chronic low back pain<sup>12</sup>.

It has often reported that lumbar stabilization exercise, which has been extensively studied among the treatment programs including the exercise, is an effective treatment method<sup>13</sup>. We conducted the standing on one leg check targeting the patients with low back pain, and the result is reported that they were not good at maintaining a balance compared to normal people because the muscles ability was bad. It has also been reported that patients with chronic low back pain have poorer one-leg standing ability on an unstable surface than healthy people, and there was a difference in their weight distributions in two-legged standing between the presence and absence of sight. Musculoskeletal disorders such as low back pain are said to limit the ability to maintain balance<sup>14</sup>.

Chronic low back pain patients need to maintain the posture of the trunk, and generate lumbar stability by contracting muscles such as the transversus abdominis and multifidus which are responsible for the stability of the lumbar region. Therefore, lumbar stabilization exercises involving the multifidus and transversus abdominis result in improvements in postural balance in patients with chronic low back pain<sup>15</sup>.

Only a few studies have investigated other treatment programs for lumbar instability. Recently, a method of treatment that can relieve pain and improve functional limitations has been introduced for back pain. This method reduces the stress caused by excessive movement of segments displaying lumbar instability through mobilization of the segments which have restricted motion<sup>16</sup>.

The present study shows that lumbar stabilization exercise was most effective for lumbar stabilization, followed by thoracic mobilization exercise, and traditional physiotherapy, in decreasing order of effect. In other words, lumbar stabilization exercises and thoracic mobilization exercises improved lumbar stability.

Considering this result, it seems to be closely related between abnormal movements of lumbar segments and lumbar stabilization exercises, and a reduction in the abnormal movements of segments that have lumbar segmental instability was achieved by performance of lumbar stabilization exercises or thoracic mobilization exercises, resulting in improvement of low back pain. After the intervention, the balance index scores showed significant improvements in all three groups.

This study demonstrated that lumbar stabilization exercises and thoracic mobilization exercise improved the balance of patients with chronic low back pain, and chronic low back pain caused lumbar injury is closely related to the balance of the trunk. Pain assessed by the visual analogue scale showed significant reductions between before and

after the intervention on all of the group, and there was no statistically significant difference among the groups after the intervention.

According to the results traditional physiotherapy didn't reduce the abnormal movements of the unstable segments or weakened deep muscles of the patients with chronic low back pain caused by lumbar instability. Therefore, there was a reduction in pain and an improvement in balance, but there was the possibility of recurrence of low back pain because of the lack of correction of lumbar instability. Lumbar stabilization exercises improved lumbar stability by adjusting the abnormal movements of lumbar region by strengthening the multifidus and transversus abdominis, which are lumbar deep muscles.

This result is consistent with the significant reduction in pain and functional improvement after the intervention of lumbar stabilization exercises which were conducted to strengthen the multifidus and transversus abdominis, which are lumbar deep muscles<sup>17</sup>. The intervention to improve the thoracic mobilization of the thoracic mobilization exercise group increased thoracic mobility, improved lumbar stability by decreasing the abnormal excessive motion of the unstable lumbar segments, and improved the physical disability by reducing pain and improving balance.

In conclusion, existing studies have mostly investigated lumbar stabilization exercises known as treatment for lumbar instability in patient with chronic low back pain. In this study, an indirect treatment method for the treatment of unstable segments in patients with chronic low back pain was investigated. Lumbar stability improved and the stress caused by excessive movements of the relatively unstable lumbar segments was reduced by increasing the mobilization of thoracic segments which showed restricted movements. Therefore, it is our opinion that the clinical treatment of lumbar stabilization exercises combined with thoracic mobilization has a greater effect on the stability of the lumbar region, relieving pain, and improving the function of patients with chronic low back pain.

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