

Effects of lumbar stabilization exercise on functional disability and lumbar lordosis angle in patients with chronic low back pain

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Abstract. [Purpose] This study examined the effects of lumbar stabilization exercises on the functional disability and lumbar lordosis angles in patients with chronic low back pain. [Subjects] The subjects were 30 patients with chronic low back pain divided into a lumbar stabilization exercise group ($n = 15$) and a conservative treatment group ($n = 15$). [Methods] The lumbar stabilization exercise and conservative treatment groups performed an exercise program and conservative physical treatment, respectively. Both programs were performed 3 times a week for 6 weeks. The degree of functional disability was assessed by the Oswestry disability index, and lumbar lordosis angles were measured by plain radiography. [Results] The Oswestry disability index decreased significantly in the both groups; however, it was significantly lower in the lumbar stabilization exercise group. The lumbar lordosis angle increased significantly in the lumbar stabilization exercise group after treatment and was also significantly greater than that in the conservative treatment group. [Conclusion] Lumbar stabilization exercise is more effective than conservative treatment for improving functional disability and lumbar lordosis angles.

Key words: Lumbar stabilization exercise, Lumbar lordosis angle, Chronic low back pain

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INTRODUCTION

At least 80% of Koreans will experience low back pain at least once in their lifetime. It is a common condition that restricts movement and activities of daily life¹⁾. In addition, the decrease in physical activity due to industrialization has consequently increased low back pain²⁾. With long-term backache, chronic low back pain leads to pain, hypoesthesia, and decreased strength and endurance of the deep spinal muscles under the muscular system and sensory motor control, thus affecting individuals' daily living and social activities³⁾.

Despite many methods for treating chronic low back pain, approaches involving direct training of the muscles around the lumbar region rather than conservative physical treatment methods that involve pain relief have recently attracted attention⁴⁾. In particular, the importance of the relationship between lumbar stabilization and low back pain has

been empirically demonstrated; thus, lumbar stabilization exercise has been accepted as a more empiric therapeutic exercise method than any other exercise method⁴⁾. To improve spinal segment instability, lumbar stabilization exercises that strengthen the local muscle group located deep in the trunk around the lumbar vertebrae, which play an important role in providing dynamic stability for spinal segments, are useful for relieving functional disability of the spine⁵⁾. Lumbar stabilization is important for maintaining the spine and performing extremity movements⁶⁾ and is applied to adjust the imbalance between the abdominal and trunk extensor muscles. Such imbalance causes diseases in the lumbar vertebral region of the musculoskeletal system, which must be treated to prevent low back pain⁵⁾. Although many previous studies report the deep muscles provide stability, studies on the effects of controlling muscles for maintaining postures for spinal curvature and alignment are insufficient. Therefore, the present study examined the effects of lumbar stabilization exercises on functional disability and lumbar lordosis angle (LLA) in patients with chronic low back pain.

SUBJECTS AND METHODS

The present study was conducted with 30 patients (9 males and 21 females) diagnosed with chronic low back pain by orthopedists at M hospital in Daegu, Korea. The patients

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were divided into a lumbar stabilization exercise group (LSEG, $n = 15$), whose mean age, height, and weight were 48.1 ± 6.9 years, 160.8 ± 6.3 cm, and 61.9 ± 9.3 kg, respectively, and a conservative treatment group (CTG, $n = 15$), whose mean age, height, and weight were 44.0 ± 6.7 years, 163.6 ± 8.2 cm, and 60.5 ± 12.2 kg, respectively. There were no significant differences between groups with respect to baseline characteristics. Ethical approval for the study was provided by the Youngdong University Institutional Review Board. All patients read and signed informed consent forms in accordance with the ethical standards of the Declaration of Helsinki. The patients had no bone fractures, structural abnormality in joints or nerves, history of surgery, or infectious disease.

The LSEG performed a lumbar stabilization exercise program consisting of stretching as a warm-up (5 min), lumbar stabilization exercises (30 min), and stretching as a cool-down (5 min). All exercises were performed while the patient maintained basal tonus by straining the transversus abdominis muscle and pelvic diaphragm, and contracting the upper abdominal muscles with strain for 10 s followed by 5 s of rest. First, in the supine position, the patients placed both arms in contact with the sides of their trunk and bent their knees. Then, the patients raised their left and right arms in an alternating fashion above their head (5 times), raised their left and right legs in an alternating fashion from the ground (5 times), raised one arm and the opposite side leg in an alternating fashion (5 times), and raised their hip and maintained the posture (10 s). Second, the patients assumed a crawling position and repeated all motions 5 times: raising their left and right hands in an alternating fashion from the ground, raising their left and right legs in an alternating fashion from the ground, raising one leg from the ground while raising the hand on the opposite side simultaneously, moving their hip backward, and moving their hip forward. Meanwhile, the CTG was treated with a hot pack (20 min), interferential current therapy (15 min), and ultrasound (5 min) for 40 min per session. All patients underwent treatment 3 times a week for 6 weeks.

The Oswestry disability index (ODI) was used to assess functional disability. Ten questions were scored from 0 to 5 according to the patient's ability to perform various functions; higher scores indicate more severe disability. The scores for the individual items were summed and divided by 45 points (maximum), and converted into a percentage.

The LLA was measured by plain radiography (R-630-150, Dongkwang, Korea) of the lumbar region and magnifying the images 3 times by using a picture archiving and communication system (PACS; Infinitt, Korea). Lumbar lordosis was assessed by measuring the angle formed between a line parallel to the top (i.e., body endplate) of the first lumbar vertebral body and a line parallel to the top of the bottom vertebral body where kyphosis to the sacral vertebrae begins (Fig. 1).

Paired and independent t-tests were performed for intra- and intergroup comparisons, respectively, of functional disability and LLA. SPSS version 12.0 Windows was used for statistical analysis, and the level of significance set a $p < 0.05$.



Fig 1. Measurement of lumbar lordosis angle

Table 1. ODI and LLA

	Group	Pre	Post
ODI (%)	CTG**	30.4 ± 11.7	26.2 ± 11.9
	LSEG**	30.1 ± 12.4	$18.4 \pm 8.3^\dagger$
LLA (°)	CTG	32.3 ± 3.5	32.2 ± 3.4
	LSEG**	32.1 ± 3.3	$35.6 \pm 4.4^\dagger$

ODI: Oswestry disability index, LLA: lumbar lordosis angle, CTG: conservative treatment group, LSEG: lumbar stabilization exercise group. $^\dagger p < 0.05$, independent t-test, ** $p < 0.01$ paired t-test

RESULTS

The ODI decreased significantly in both groups after the intervention ($p < 0.05$). However, it was significantly lower in the LSEG after the intervention ($p < 0.05$). The LLA increased significantly in the LSEG after treatment ($p < 0.05$) and was also significantly greater than that in the CTG after treatment ($p < 0.05$) (Table 1).

DISCUSSION

Most adults experience low back pain at least once in their lifetime. Many researchers have tried to establish the causes of low back pain and develop effective treatments⁷⁾. Accordingly, the present study examined the effects of lumbar stabilization exercises on the functional disability and LLAs of patients with low back pain.

Sung⁸⁾ applied stabilization exercises to patients for 4 weeks, which significantly decreased the ODI. Furthermore, Niemistö et al.⁹⁾ report that the ODI was significantly lower in 204 patients who performed trunk stabilization exercises for 3–12 months than controls. Moreover, Hicks et al.¹⁰⁾ report that the ODI decreased significantly after 8 weeks of lumbar stabilization exercises. Concordantly, in the present study, the ODI decreased significantly after lumbar stabilization exercises. This recovery of functionality is similar to the results of a study conducted by Sekendiz et al.¹¹⁾, who report lumbar stabilization exercises help mobilize motor units coordinated by the large-unit muscle system and local

muscle systems such as the musculus transversus abdominis, diaphragm, and lumbar multifidus muscles; furthermore, such exercises helped restore the function of the stabilizers that contribute to the postural control of the trunk and deep abdominal muscles, increasing the range of joint motion.

Magora¹²⁾ reports that changes in the spinal curvature of patients with low back pain are a reliable indicator of severe low back pain. In contrast, Day et al.¹³⁾ and During et al.¹⁴⁾ report that spinal curvature is unassociated with low back pain. Jackson and McManus¹⁵⁾ report that the mean LLAs in healthy adults and low back pain patients were 60.9° and 56.3°, respectively. Furthermore, Kim¹⁶⁾ applied trunk stabilization exercises and found that lumbar lordosis was significantly lower after treatment than that in the control group. Hwang¹⁷⁾ studied the effects of a gymnastics program aiming to relieve low back pain and reports the LLA increased significantly in the gymnasts after exercise. Choi¹⁸⁾ reports the LLA increased significantly after an 8-week core program for middle-aged women. Yoo¹⁹⁾ reports that low back pain decreased, limited lumbar range of motion was relieved, and pelvic tilt angle recovered after individual strengthening exercises were implemented in patients with excessive lordosis. In the present study, lumbar lordosis increased to a significantly greater extent in the LSEG than the CTG after treatment. Because the LLA approached the average angle among healthy people after stabilization exercise and it can be assumed that lumbar stabilization exercises aid the recovery of LLAs among healthy people after treatment, the results indicate measuring the LLA is helpful for diagnosing patients with low back pain and assessing them after treatment. The present study has some limitations. First, the number of subjects was small. Furthermore, because they were selected from among patients who visited a single hospital over 6 weeks, their daily lives could not be completely controlled. Finally, long-term observation could not be conducted because of the short treatment period. Therefore, future long-term studies with more subjects are necessary to confirm the results.

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