

Comparison of chronic low-back pain patients hip range of motion with lumbar instability

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Abstract. [Purpose] The purpose of this study was to compare differences in hip range of motion between a lumbar stability group and a lumbar instability group of patients with chronic low-back pain. [Subjects] Sixty-nine patients with chronic low-back pain were divided into two groups: a lumbar stability group (n=39) and a lumbar instability group (n=30). [Methods] The patients were assessed using a goniometer to evaluate the hip range of motion at pre-test. Data were analyzed using SPSS 18.0 software for Windows. The experimental data were analyzed using one-way ANOVA, repeated one-way ANOVA, and the t-test, and a significance level of 0.05. [Results] The limitation of hip range of motion of the lumbar instability group was significantly greater than that of the lumbar stability group. [Conclusion] The chronic low-back pain patients showed greater limitation of hip range of motion than healthy persons, and among them, those who had lumbar instability showed greater limitation than those with lumbar stability.

Key words: Hip range of motion, Low back pain, Lumbar instability

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INTRODUCTION

Approximately 23–69% of chronic low-back pain cases are related to lumbar segment instability¹⁾, and researchers have reported that melosalgia frequently occurs during walking, standing, and sitting by such patients²⁾. This is reported to be due to an imbalance in the motor system at the level of the spine. For example the occurrence of excessive rotation³⁾ in the lumbopelvic region during external rotation of the hip joint⁴⁾, compared to healthy persons, indicates that trunk flexion of low-back pain patients occurs excessively the sagittal plane due to limited internal rotation of the hip joint. Neumann advised that the hip joint tends to rotate internally due to hypofunction of the gluteus medius muscle and shortening of the iliotibial tract. He also stated that hypofunction of the gluteus medius muscle is a cause of instability in the lumbopelvic region⁵⁾.

Chronic low-back pain leads to pelvic hypofunction and tension in the muscles surrounding the hip joint⁶⁾. Movements in the lumbopelvic region occur abnormally early during voluntary movement of the limbs and these repeated movements can cause instability in the lumbopelvic region along with microdamage to the same region, which

may result in low-back pain⁷⁾. Although lumbar vertebrae instability has recently been diagnosed based on lateral flexion-extension of the lumbar vertebrae in radiological images, many studies using clinical measuring methods have been also reported. Abbott et al.⁸⁾ analyzed and reported the reliability of passive accessory intervertebral motion tests and passive physiological intervertebral motion tests in diagnoses of spinal displacement due to lumbar instability. Tidstrand and Horneij⁹⁾ suggested sitting subjects on a large gymnastic ball and having them perform unilateral pelvic lift tests as a tool that can be conveniently used in clinics.

Many recent studies have investigated the correlations between low-back pain and limitation of hip-joint functions³⁾, and the assessment of the hip joint in relation to low-back pain is perceived as playing an important role in selecting the direction of treatment. However, no study has been conducted in Korea on hypofunction of the hip joint in relation to chronic low-back pain or limitation of hip-joint function resulting from lumbar instability.

Therefore, the purpose of this study was to divide chronic low-back pain patients into a lumbar segment stability group and an instability group using tests described in previous studies, and to compare differences in the hip range of motion between the two groups in order to evaluate the level of lumbar instability of the patients.

SUBJECTS AND METHODS

The subjects were selected from among those who had been treated for at least three months for low-back pain. The exclusion criteria were a history of orthopedic or neurosur-

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gical operation or current treatment for other neurological problems and inability to perform the experimental tasks due to acute pain. A total of 69 study subjects selected from among the applicants were enrolled in this experiment. The means and standard deviations of the subjects' ages, heights, and weights were 56.31 ± 13.11 years, 160.87 ± 7.26 cm, and 60.36 ± 9.62 kg, respectively. This study was approved by D Hospital, and all the participants provided their written informed consent.

Single-limb stance tests were conducted to evaluate lumbar instability. Each subject stood on the left or right leg in a random order while standing with the spine in the neutral position. The subjects who could maintain a spinal upright posture for 20 seconds while maintaining the iliac crest on the level with no compensatory motion of the lower limb or upper limb on the contralateral side were regarded as exhibiting lumbar stability¹⁰. The subjects whose initial upright posture was twisted, or showed displacement of the iliac crest or compensatory motion of the lower limb or upper limb on the contralateral side were considered to exhibit lumbar instability.

For the ball test, the patients sat on a large gymnastic ball with their arms folded across the chest. Then, they lifted the soles of the feet approximately 5 cm from the ground while ensuring that the calf region did not come into contact with the ball. They were asked to maintain this posture for 20 seconds. The diameter and air pressure of the ball was adjusted to ensure the hip joint and the knee joint could be maintained at 90° flexion. In this test, subjects were considered to have lumbar stability if they maintained a spinal upright posture for 20 seconds and could maintain the iliac crest on the level with no compensatory motion of the lower limb on the contralateral side.

In the passive accessory intervertebra motion (PAIVM) test, the tester touched and pressed the spinous process of the lumbar vertebral body of each patient perpendicularly with the tester's hand while the patient was in a prone position. Patient were judged to have lumbar instability if excessive movements of the vertebral body were felt or if the vertebral body moved in an abnormal way. This test is considered highly valid with high specificity (81–89%) and low sensitivity (29–46%)⁹.

In the passive lumbar extension (PLE) test, with the patients in a prone position, the tester gently pulled both of the patient's lower limbs to a height of 30 cm from the surface of the bed while keeping the patient's knees extended¹¹. Hypermobility of the lumbar region is induced by the passive lumbar extension performed in this test, which will cause pain in the low back of patients with lumbar instability. Patients were considered to have lumbar instability if pain, accompanied by a very heavy feeling, occurred in the lower lumbar region. This test's positive likelihood ratio is high at 8.84.

In the prone instability (PI) test, the tester pressed the lumbar spinous processes of the patients when they were in the prone position with the hip joint placed at the corner of a board. The patients were considered to have lumbar instability if pain was felt while the lumbar spinous process was pressed and the pain disappeared when the hip joint was extended with both knee joints in an extended position. The

reliability of this test is $r=0.89^{12}$. In the five test described above, 0 points were awarded for lumbar instability as defined by each test and 1 point was awarded for lumbar stability, and when appropriate scores were awarded for both the left and right sides. The score of each subject was summed possible range of 0–7 points, and the average score of all subjects was calculated. Those with scores higher than the average were assigned to a lumbar stability group, and those with scores lower than the average were assigned to a lumbar instability group.

Each patient's hip range of motion was evaluated using a goniometer. Both sides were measured in a random order. The measurements were repeated three times and the average value was calculated. The measurement reliability of the goniometer for hip range of motion is reported to be very high with Cronbach α values of at least 0.90⁶.

The experimental data were analyzed using one-way ANOVA, repeated one-way ANOVA, and the t-test. The data were statistically processed using SPSS WIN ver. 18.0 and a significance level of $\alpha=0.05$

RESULTS

The inter-rater reliabilities of the five lumbar instability tests ranged from 0.87–0.96 for the single-limb stance test, 0.72–0.84 for the ball test, 0.62–0.82 for the PLE test, 0.78–0.92 for the PAIVM test, and 0.83–0.99 for the PI test. The inter-rater reliability for division determination of lumbar instability across the five tests ranged from 0.74–0.89. The average and standard deviation of the scores of the subjects in the five tests were 3.6 and 0.38, respectively. The subjects with scores equal to or lower than 3, were assigned to the lumbar instability group ($n=30$) and those with scores higher than 4 points were assigned to the lumbar stability group ($n=39$). In this study, the inter-rater reliability of the goniometer for the measurement of hip range of motion was a Cronbach α value of 0.83. The hip ranges of motion of the lumbar stability group and the lumbar instability group were compared. The lumbar instability group showed significantly greater limitation of the hip range of motion than the lumbar stability group ($p<0.01$) (Table 1). The differences between the lumbar stability group and the lumbar instability group were larger for hip-joint flexion and internal rotation than other hip-joint motions.

DISCUSSION

The inter-rater reliabilities of each of the five tests used in this study to evaluate lumbar instability analyzed, and they were found to be similar to those of previous studies. The inter-rater reliability was also found to be high. The ratios of lumbar instability were reported as ranging from 23 to 69% in a study of radiological images¹³. The ratio of the present study falls within that range.

In this study, the inter-rater reliability for the measurement of the hip range of motion by goniometer was a Cronbach α value of 0.83. Compared to the hip range of motion of healthy Koreans reported by a previous study⁶, the hip range of motion of the chronic low-back pain patients in this study was significantly different. This is consistent with Van

Table 1. Comparison of the levels of the hip range of motion between the lumbar stability group and the lumbar instability group

		Lumbar stability group	Lumbar instability group
Flexion	Left	4.36±5.64	11.17±7.84**
	Right	3.08±5.33	8.83±6.65**
Extension	Left	4.49±4.26	8.83±4.68**
	Right	4.87±3.89	8.50±4.39**
Abduction	Left	1.15±3.71	5.00±6.43**
	Right	1.03±3.07	3.00±4.47*
Adduction	Left	4.74±4.72	10.50±6.35**
	Right	4.87±5.44	9.53±5.32**
External rotation	Left	1.67±3.31	6.50±5.28**
	Right	2.05±4.25	6.50±6.45**
Internal rotation	Left	9.23±6.74	20.83±8.00**
	Right	8.97±7.08	19.17±5.46**

^aMean (degree) ± SD.

Significant difference between lumbar stability group and lumbar instability group of * $p < 0.05$, ** $p < 0.01$.

Dillen et al.¹⁴, who reported that the range of joint motion in hip-joint extension by subjects with low-back pain was significantly different from that of healthy persons.

Mellin¹⁵ reported that the limitation of the hip range of motion would increase with increasing intensity of low-back pain, and that hip-joint flexion, extension, and internal rotation, decreases in the flexibility of the hamstring muscle of males, and hip-joint flexion and extension in females were significantly affected by low-back pain. However, in the present study, the level of limitation appeared not to be influenced by intensity, and the levels of limitation were shown to be high in hip-joint extension and internal rotation. The limitation of hip-joint extension is attributable to the retroversion of the pelvis, due to the weakening and shortening of the psoas muscle. High levels of limitation in hip-joint internal rotation is thought to be caused by retroversion of the pelvis, which is related to the shortening of the muscles in hip-joint external rotation resting from habitual sitting on the floor, a feature of Korean daily life. The lumbar instability group showed higher levels of limitation than the lumbar stability group ($p < 0.01$), which indicates that the level of lumbar instability is related to the level of limitation of hip range of motion. This would be explained by the lack of a stabilizing function in the lumbar region, pelvic region, and hip joint, due to the weakening or tension of the hip-joint muscles caused by hypofunctioning of lumbar segments in chronic low-back pain patients.

Given these results, if limited hip-joint functions could

be improved, the functions of the hip-joint muscles that contribute to the stabilization of the lumbopelvic region would recover, which would help with the recovery of lumbar stability. This would be helpful for reducing the intensity of low-back pain. In addition, chronic low-back pain patients showed greater limitation in hip range of motion than healthy persons, and those who had lumbar instability showed higher levels of limitation than those with lumbar stability. Therefore, the evaluation of the hip joint and therapeutic interventions should be considered major elements of treatments for chronic low-back pain patients with lumbar instability, and further research should be conducted on this topic.

REFERENCES

- 1) Siebenga J, Leferink VJ, Segers MJ, et al.: A prospective cohort study comparing the VAS spine score and Roland-Morris disability questionnaire in patients with a type A traumatic thoracolumbar spinal fracture. *Eur Spine J*, 2008, 17: 1096–1100. [[Medline](#)] [[CrossRef](#)]
- 2) Kishi S, Morikita I: Range of motion of hip joints of male university kendo practitioners with lower back pain. *J Phys Ther Sci*, 2009, 21: 253–256. [[CrossRef](#)]
- 3) Cho MS; Lee YM.: Correlations among sacral angle lumbar lordosis lumbar rom, static and dinamic lumbar stability in college students. *J Phys Ther Sci*, 2011, 23: 793–795. [[CrossRef](#)]
- 4) Sahrman S: Diagnosis and treatment of movement impairment syndromes. Elsevier Health Sciences, 2002.
- 5) Neumann D: Kinesiology of the musculoskeletal system: Foundations of physical rehabilitation. Mosby, 2002.
- 6) Nussbaumer S, Leunig M, Glatthorn JF, et al.: Validity and test-retest reliability of manual goniometers for measuring passive hip range of motion in femoroacetabular impingement patients. *BMC Musculoskelet Disord*, 2010, 11: 194. [[Medline](#)] [[CrossRef](#)]
- 7) McGregor AH, McCarthy ID, Doré CJ, et al.: Quantitative assessment of the motion of the lumbar spine in the low back pain population and the effect of different spinal pathologies of this motion. *Eur Spine J*, 1997, 6: 308–315. [[Medline](#)] [[CrossRef](#)]
- 8) Adams MA: Biomechanics of back pain. *Acupunct Med*, 2004, 22: 178–188. [[Medline](#)] [[CrossRef](#)]
- 9) Abbott JH, McCane B, Herbison P, et al.: Lumbar segmental instability: a criterion-related validity study of manual therapy assessment. *BMC Musculoskelet Disord*, 2005, 6: 56. [[Medline](#)] [[CrossRef](#)]
- 10) Tidstrand J, Horneij E: Inter-rater reliability of three standardized functional tests in patients with low back pain. *BMC Musculoskelet Disord*, 2009, 10: 58. [[Medline](#)] [[CrossRef](#)]
- 11) Kasai Y, Morishita K, Kawakita E, et al.: A new evaluation method for lumbar spinal instability: passive lumbar extension test. *Phys Ther*, 2006, 86: 1661–1667. [[Medline](#)] [[CrossRef](#)]
- 12) Hicks GE, Fritz JM, Delitto A, et al.: Interrater reliability of clinical examination measures for identification of lumbar segmental instability. *Arch Phys Med Rehabil*, 2003, 84: 1858–1864. [[Medline](#)] [[CrossRef](#)]
- 13) Murata M, Morio Y, Kuranobu K: Lumbar disc degeneration and segmental instability: a comparison of magnetic resonance images and plain radiographs of patients with low back pain. *Arch Orthop Trauma Surg*, 1994, 113: 297–301. [[Medline](#)] [[CrossRef](#)]
- 14) Van Dillen LR, Sahrman SA, Norton BJ, et al.: Effect of active limb movements on symptoms in patients with low back pain. *J Orthop Sports Phys Ther*, 2001, 31: 402–413, discussion 414–418. [[Medline](#)] [[CrossRef](#)]
- 15) Mellin G: Correlations of hip mobility with degree of back pain and lumbar spinal mobility in chronic low-back pain patients. *Spine*, 1988, 13: 668–670. [[Medline](#)] [[CrossRef](#)]