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Original Article

Effects of hip exercises for chronic low-back pain patients with lumbar instability

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Abstract. [Purpose] The purpose of this study was to compare hip range of motion between a lumbar stability group and a lumbar instability group, and to evaluate the effectiveness of hip exercises for low-back pain patients with lumbar instability. [Subjects] Seventy-eight patients with chronic low-back pain were the subjects. [Methods] The patients were divided into two groups: a lumbar stability group (n=45) and a lumbar instability group (n=33). They were assessed using the Korean version of the Oswestry Disability Index (KODI) to determine the level of disability of the patients with low-back pain. A 100 mm visual analog scale (VAS) was used to assess low-back pain. [Results] The limitation of hip range of motion of the lumbar instability group was significantly greater than that of the lumbar stability group. Comparisons among four groups at three weeks and six weeks after the start of hip exercises revealed that the VAS score of each group had significantly decreased. Comparisons among four groups at three weeks and at six weeks after the start of hip exercises revealed that the KODI score of each group had significantly decreased. [Conclusion] These findings suggest that the performance of hip exercises by chronic low-back pain patients with lumbar instability is more effective than conventional therapy at reducing low-back pain and levels of disability.

Key words: Chronic low-back pain, Hip exercise, Lumbar instability

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INTRODUCTION

Many researchers have reported that lumbar postures resulting from abnormal kinematic habits are related to low-back pain[1, 2)]. Hypofunction in relation to lumbar segmental movements is divided into spasticity and instability of the lumbar segments[3, 4)]. Spinal instability is defined as an abnormal response to applied loads and is characterized by movement of spinal segments beyond their normal limits[5)] Lumbar segment hypofunction is related to low-back pain, and radiological findings have shown that lumbar instability is found in 23–69% of chronic low-back pain patients during flexion and extension movements[2, 3)]. For the evaluation of lumbar segment instability, Kasai et al.[6)] and Hicks et al.[7)] have presented the passive lumbar extension test and the prone instability (PI) test, respectively, as valid evaluation tools. In addition, lumbar segment hypofunction causes hip joint hypofunction, and lumbar segment instability leads to spasticity or weakening of the muscles surrounding the hip joint. Sahrmann[8)] advised that, because of the characteristics of the hip joint, which is anatomically adjacent to the lumbopelvic region, the hip joint's functions are closely related to low back pain. McGregor et al.[9)] reported that, to compensate for the weakening of the abdomen and the back, low-back pain patients adopt rounded-back postures with flexion of the hip, knee, and ankle joints, and that lesions in the lumbopelvic region cause the weakening and tension of the muscles surrounding the hip joint. Van Dillen et al.[10)] reported that limitation of hip range of motion of low-back pain patients was significantly different from that of healthy persons. When presenting a theory that low-back pain patients' trunk flexion causes excessive movement of the lumbar spine in the sagittal plane due to the limitation of hip joint internal rotation, McConnell[11)] reported a tendency toward internal rotation of the hip joint due to the gluteus medius muscle's hypofunction and iliotibial tract's shortening. Neumann et al.[12)] claimed that hypofunction of the gluteus medius muscle would cause lumbopelvic region instability.

A recent study investigated correlations between low-back pain intensity and the limitation of hip joint function[13)], and the assessment of the hip joint in relation to low-back pain has been perceived as playing an important role in selecting the direction of treatment. However, studies conducted in Korea have yet to clearly identify lumbar segment hypofunction related to chronic low-back pain, and no study has investigated hip joint hypofunction in relation to the pattern of hypofunction or compared changes in the intensity of low-back pain after interventions for hip joint muscles.

Therefore, the purpose of this study was to evaluate

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chronic low-back pain patients' hip joint hypofunction in relation to patterns of lumbar segment hypofunction and to examine the effects of exercises that enhance hip joint function on the decrease of low back pain and disability levels.

SUBJECTS AND METHODS

The inclusion criteria for this study was experience of low-back pain for at least three months. Participants were excluded if they had undergone an orthopedic or neurosurgical operation, if they were being treated due to other neurologic problems, if they had acute inflammation or tumors, or if they were pregnant. Among the applicants, 78 were enrolled in this study based on the selection criteria. This study was approved by D Hospital, and all the participants provided their written informed consent.

The 78 selected subjects were divided into a lumbar stability group (n=45) and a lumbar instability group (n=33) based on questionnaire and lumbar instability test results. Among the 45 subjects in the lumbar stability group, 25 were randomly assigned to a hip-joint exercise subgroup (Experimental Group I), and 20 were randomly assigned to Control Group I. Among the 33 subjects in the lumbar instability group, 22 were randomly assigned to a hip-joint exercise group (Experimental Group II), and 11 were assigned to Control Group II. An evaluation before the intervention determined the low-back pain intensity, low-back pain related disability indexes, and the hip range of motion of the patients. Experimental Group I group and Experimental Group II performed hip-joint exercises along with lumbar stabilization exercises. Control Group I and Control Group II only performed lumbar stabilization exercises. The intervention was conducted for a total of six weeks and low-back pain intensity and low-back pain related disability indexes were repeatedly evaluated at three weeks and six weeks after the start of the intervention. During the experimental period, two participants in Experimental Group I, four in Control Group I, one in Experimental Group II, and two in Control Group II dropped out due to time constraints. Therefore, only the data of the 69 subjects who completed the experiment was analyzed.

Lumbar instability was evaluated as at least one positive finding in three tests: passive accessory inter-vertebral motion (PAIVM), passive lumbar extension (PLE), and PI. The VAS was used to examine the intensity of low-back pain of the subjects, and the KODI questionnaire was used to examine the level of functional disability due to low-back pain of the study subjects.

For the lumbar stabilization exercises, the study subjects performed four closed-chain exercises that are effective for lumbar stabilization. The exercises were selected from the sling exercises for lumbar stabilization presented by Unsgaard-Tondel et al[14]. The subjects maintained 10 seconds of contraction in of each exercise, before returning to the initial position and resting for three seconds. They repeated each exercise four times per set for four sets, with 30 second rest periods between each set. As subjects' ability to perform the exercises improved, the region of suspension was moved distally to increase the load.

To increase hip range of motion, Experimental Group I and Experimental Group II actively performed open-chain hip joint exercises using slings, and each exercise was performed for five minutes. There is a functional relation between the hip and lumbar spine in the lumbopelvic region. The subjects performed the exercises for a total of 20 minutes, three times a week.

Experimental Group I and Experimental Group II also performed active resistance exercises for the hip joint using elastic bands (Theraband, USA). The band colors were selected based on subjects' ability. For hip joint flexion, extension, abduction, and adduction, the subjects were instructed to fix the band on the ankle in the standing position, the starting position and to perform active exercises throughout the entire range of motion for each task. For internal rotation and external rotation, the subjects were instructed to fix the band on the ankle in an upright sitting position on a fixed chair, the start position, and to perform active exercises throughout the entire range of motion for each task. When their abilities to perform the exercises had improved, the subjects were instructed to sit on a Swiss ball for the starting position. The lengths of the bands were set so that 75% of the maximum resistance exercise could be maintained. Each task was repeated ten times at 75% of maximal muscle strength. Each of the six exercises was repeated 10 times. The subjects were instructed to perform three sets of exercises per motor unit and to take a rest for one minute between each set. The study subjects performed the exercises three times per week and the intervention was conducted for six weeks.

One-way ANOVA was conducted to examine whether there were differences in low-back pain intensity and low-back pain related disability indexes among the four groups. One-way repeated ANOVA was also conducted to examine differences in the degree of changes between the measurement time points among the four groups. The Bonferroni test was conducted as post-hoc tests. The measured data were statistically processed using SPSS WIN ver. 18.0 and a significance level of α=0.05.

RESULTS

The general characteristics of the 69 subjects who completed the intervention are shown in Table 1. There were no significant differences in the mean ages, heights, weights, and body mass indexes the four groups ($p>0.05$). The low back pain intensities of the four groups were compared with each other at different times (Table 2). In the evaluation at three weeks and six weeks after the beginning of the intervention, each of the four groups showed significant decreases in low-back pain intensity ($p<0.01$). According to the results of the post hoc test, each of the four groups showed significant differences in low-back pain intensity between before the intervention and at three and six weeks after the beginning of the intervention ($p<0.01$). The low-back pain related disability indexes of the four groups were compared at different times (Table 3). All of the four groups showed significant differences in the low-back pain related disability indexes three weeks and six weeks after the beginning of the intervention ($p<0.01$). According to the results of the post hoc tests, each of the four groups showed significant differences in terms of low-back pain related disability in-

Table 1. General characteristics of the study subjects

	Lumbar stability group		Lumbar instability group	
	EG I (n=23)†	CG I (n=16)‡	CG II (n=21)†	EG II (n=9)‡
Age (year)	54.9±10.6[a]	50.0±11.4	59.38±17.3	61.0±13.2
Height (cm)	161.0±7.1	161.9±7.7	161.0±8.3	159.7±6.0
Weight (kg)	61.9±9.8	60.9±9.8	59.2±10.0	59.4±8.9
BMI (%)	23.8±2.8	23.2±2.8	22.8±2.9	23.3±2.6

[a] Mean ± SD
†Lumbar stabilization exercise+ hip joint exercise; ‡Lumbar stabilization exercise.
EG: Experimental group; CG: Control group; BMI: body mass index

Table 2. Comparison of the intensities of low back pain of the four groups at different times

	Period	Lumbar stability group		Lumbar instability group	
		EG I (n=23)†**	CG I (n=16)‡**	CG II (n=21)†**	EG II (n=9)‡**
Pain (VAS)	Before intervention	55.7±8.9[a]	55.3±10.7	61.0±10.0	58.9±8.6
	3 weeks later*	46.1±6.9	47.5±10.8	39.1±10.7	53.89±9.6
	6 weeks later*	39.6±7.5	45.6±10.3	27.6±9.8	43.3±12.0

[a] Mean ± SD
†Lumbar stabilization exercise+ hip joint exercise; ‡Lumbar stabilization exercise.
*Significant difference between the lumbar stability group and the lumbar instability group ($p<0.05$)
** Within-group significant difference ($p<0.01$)
VAS: visual analog scale; EG: Experimental group; CG: Control group; LBP: low back pain

Table 3. Comparison of low back pain related disability indexes of the four groups among the different time points

	Period	Lumbar stability group		Lumbar instability group	
		EG I (n=23)†**	CG I (n=16)‡**	CG II (n=21)†**	EG II (n=9)‡**
Disability (ODI)	Before intervention	23.8±10.5[a]	25.6±12.3	30.6±18.8	25.9±15.8
	3 weeks later	20.2±9.1	23.2±11.3	22.7±14.5	22.7±13.1
	6 weeks later	17.5±8.1	21.7±10.7	18.3±11.1	19.8±12.1

[a] Mean ± SD
†Lumbar stabilization exercise+ hip joint exercise; ‡Lumbar stabilization exercise.
** Within-group significant difference ($p<0.01$)
ODI: Oswestry disability index; EG: Experimental group; CG: Control group; LBP: low back pain

dexes before the intervention and at three and six weeks after the beginning of the intervention ($p<0.01$).

DISCUSSION

The proportion of subjects with lumbar instability, 42.32%, in the present study is similar to the ratios of lumbar instability (23–69%) reported by previous studies which used radiological images to assess chronic low-back pain patients' flexion-extension. In the present study, the evaluation of the subjects' hip range of motion before the intervention revealed that it was less than that of healthy Koreans reported by a previous study[15]. Although Melin[16] reported that limitation of the hip range of motion would increase along with the low-back pain, and that significant limitation of hip-joint flexion, extension, and internal rotation, as well as decreases in the flexibility of the hamstring muscle were observed in males, and in the present study, the levels of limitation were found to be significantly high in hip-joint extension and internal rotation. In addition in the comparison of the two groups, the lumbar instability group showed higher levels of limitation than the lumbar stability group ($p<0.01$), which indicates that higher levels of lumbar instability are related to higher levels of limitation of hip range of motion.

Nadler et al.[17] reported that low-back pain patients showed imbalances in their hip-joint muscles and that the strength of the hip-joint extensor muscles was increased by lumbar strengthening exercises. Limke et al.[18] implemented resistance exercises in spinal rehabilitation exercises for patients with chronic low-back pain and melosalgia, and reported decreases in low-back pain intensity and disability levels.

Previous studies have shown that lumbar stabilization exercises performed by chronic low-back pain patients are effective at reducing low-back pain intensity and low-back pain related disability indexes, and this study also found significant decreases in low-back pain intensity and disability

indexes ($p<0.01$) in each of the four subgroups, confirming that lumbar stabilization exercises are helpful for the treatment of low-back pain. In the comparison of average differences in the decreases in low-back pain among the measurement time points between the experimental subgroups for which hip joint exercises were added as an intervention, and the control subgroups, the experimental subgroups showed significantly larger decreases than the control subgroups ($p<0.01$). The lumbar instability experimental group, that had higher levels of limitation of the hip range of motion, showed larger decreases than the lumbar stability group ($p<0.01$).

The control groups allowed comparison of the effects of lumbar stabilization exercises. The lumbar instability group showed larger decreases in low-back pain intensity after lumbar stabilization exercises than the lumbar stability group.

When the hip range of motion was evaluated six weeks after the beginning of the intervention, each of the four groups showed increases in the range of motion, with the experimental subgroup of the lumbar instability group showing the largest increase. The differences in the range of motion among the four subgroups were not statistically significant.

In conclusion chronic low-back pain patients have limitations in the range of motion of their hips compared to healthy persons, and the patients with lumbar instability showed greater limitation than the patients with lumbar stability ($p<0.01$). When patients with lumbar instability and high levels of limitations of the hip range of motion, performed hip joint exercises including lumbar stabilization exercises, their low-back pain and disability indexes significantly decreased compared to the lumbar stability exercise and the control subgroups ($p<0.01$). In conclusion, the evaluation and therapeutic intervention for the hip joint should be considered a major element for chronic low-back pain patients with lumbar instability; therefore, further research should be conducted.

REFERENCES

1) Kasai R: Current trends in exersie management for chronic lowback pain: comparison between strengthening exercise and spinal segmental stabilization exercise. J Phys Ther Sci, 2006, 18: 97–105. [CrossRef]
2) Park SD: Reliability of ultrasound imaging of the transverses deep abdominal internal oblique and external oblique muscle of patients with low back pain performing the drawing-in maneuver. J Phys Ther Sci, 2013, 25: 845–847. [Medline] [CrossRef]
3) Kirkaldy-Willis WH, Farfan HF: Instability of the lumbar spine. Clin Orthop Relat Res, 1982, (165): 110–123. [Medline]
4) Mayer TG, Robinson R, Pegues P, et al.: Lumbar segmental rigidity: can its identification with facet injections and stretching exercises be useful? Arch Phys Med Rehabil, 2000, 81: 1143–1150. [Medline] [CrossRef]
5) American Academy of Othopedic Surgeon: A glossary on spinal terminology. Chicago, 1985.
6) 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]
7) 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]
8) Sahrmann SA: Diagnosis and Treatment on Movement Impairment Syndromes. St Louis: Mosby, 2002.
9) 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]
10) Van Dillen LR, Sahrmann 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]
11) McConnell J: Recalcitrant chronic low back and leg pain—a new theory and different approach to management. Man Ther, 2002, 7: 183–192. [Medline] [CrossRef]
12) Neumann DA: Kinesiology of the Musculoskeletal System: Foundations for Physical Rehabilitation. St Louis: Mosby, 2002.
13) Scholtes SA, Gombatto SP, Van Dillen LR: Differences in lumbopelvic motion between people with and people without low back pain during two lower limb movement tests. Clin Biomech (Bristol, Avon), 2009, 24: 7–12. [Medline] [CrossRef]
14) Unsgaard-Tøndel M, Fladmark AM, Salvesen Ø, et al.: Motor control exercises, sling exercises, and general exercises for patients with chronic low back pain: a randomized controlled trial with 1-year follow-up. Phys Ther, 2010, 90: 1426–1440. [Medline] [CrossRef]
15) Roach KE, Miles TP: Normal hip and knee active range of motion: the relationship to age. Phys Ther, 1991, 71: 656–665. [Medline]
16) 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]
17) Nadler SF, Malanga GA, Bartoli LA, et al.: Hip muscle imbalance and low back pain in athletes: influence of core strengthening. Med Sci Sports Exerc, 2002, 34: 9–16. [Medline] [CrossRef]
18) Limke JC, Rainville J, Peña E, et al.: Randomized trial comparing the effects of one set vs two sets of resistance exercises for outpatients with chronic low back pain and leg pain. Eur J Phys Rehabil Med, 2008, 44: 399–405. [Medline]