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Research Article

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Relationship between Hip Medial Rotation Range of Motion and Weight Distribution in Patients with Low Back Pain

Sang-Kyu Kim, PT, MSc, Won-Bok Kim, MD, PhD[1], Young-Uk Ryu, PT, PhD[2†]

Realpodi Foot Center
[1]Department of Physical Therapy, Daegu University
[2]Department of Physical Therapy, Catholic University of Daegu

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| Abstract |

PURPOSE: This study intended to verify whether there was actual correlation between weight-bearing asymmetry and a limitation in hip joint rotation range in patients with low back pain.

METHODS: Thirty five low back pain patients voluntarily participated this study. For each participant, hip joint medial rotation symmetry rate and the weight-bearing symmetry rate were calculated. The correlation between the two variables was investigated.

RESULTS: A decrease in the left hip joint medial rotation range of motion (ROM) was observed more often than a reduction in the right hip joint medial rotation ROM. However, similar number between right and left side was observed in ground reaction force more weighted. The coefficient between the passive hip joint medial rotation symmetry rate and the weight loading symmetry ratio was -0.19 ($p < 0.05$).

CONCLUSION: The present study demonstrated a weak correlation between the hip joint medial rotation ROM and the weight distribution of both feet. Such result suggests that careful evaluation by separating each element is needed in treating patients with low back pain. Future research should take into account asymmetric alignment and abnormal movement in different joints of the body as well as asymmetry in the bilateral hip joint rotation and the unilateral weight supporting posture.

Key Words: Low back pain, Hip medial rotation, Weight distribution

Ⅰ. Introduction

About 90% of adults undergo low back pain once per lifetime, and 50% experience its recurrence. Five to 10% of low back pain progresses into a chronic condition (Andersson, 1999; Klenerman et al., 1995; Von Korff, 1994). Low back pain is a common disease that anybody may experience. However, it occurs due to diverse causes, and it triggers various functional problems.

In order to heighten the understanding of low back pain, many researchers have paid attention to the mobility of

†Corresponding Author : ryu3091@cu.ac.kr

the hip joint and weight distribution on both lower limbs. First, much research has shown that decreased medial rotation of the hip joint was related to low back pain (Chesworth et al., 1994; Vad et al., 2003; Vad et al., 2004; Murray et al., 2009; Cibulka et al., 1998; Ellison et al., 1990). In those who suffered from low back pain, the range of active medial rotation of the hip joint was smaller than in those who did not(Chesworth et al., 1994), In those with low back pain, medial rotation was smaller than lateral rotation of the hip joint(Cibulka et al., 1998; Ellison et al., 1990). In particular, among those who enjoyed sports related to rotation, such as golf or tennis, those with low back pain experienced a deficit in the medial rotation range of the hip joint of the leading leg, but those without low back pain did not undergo a deficit in medial rotation range(Vad et al., 2003; Vad et al., 2004; Linda et al., 2008; Murray et al., 2009).

Childs et al.(2003) noted that patients with chronic low back pain had a greater asymmetry in weight distribution between the left side and the right side. In addition, they observed that the degree of asymmetry in weight distribution was in proportion to the degree of the pain. Kim et al.(2009) showed that the degree of weight support asymmetry tilting toward the affected side changed in proportion to a decrease in low back pain by pelvic manipulation.

As examined above, the limited hip joint rotation range and the asymmetric weight-bearing on both feet are related to low back pain. Such research results imply that asymmetry in the medial rotation of the hip joint in patients with low back pain may trigger a weight-bearing asymmetry of the feet. Nonetheless, whether a weight-bearing asymmetry in the feet and a limitation in the rotational range of the hip joint are associated has not been proven. Accordingly, this study intended to verify whether there was actual correlation between weight-bearing asymmetry and a limitation in hip joint rotation range in patients with low back pain.

Ⅱ. Methods

1. Study Subjects and Period

The subjects of this study were 35 low back pain patients who visited G Hospital in Daegu and whose age ranged from 30 to 50, whose Oswestery disability index was 50% or lower, and whose pain index score was six points or lower. The number of males was 17, and the number of females was 18. The subjects' average age was 41.63±6.59 years old. Those who had received treatment, who had a systemic disease (such as cancer), who had a rheumatic disease, or who had an abnormality of the neurological system were excluded from the experiment. An explanation of the whole procedure of the experiment was made, and voluntary consent to participate was obtained prior to the experiment.

2. Measurement Tool and Procedure

First, the subjects' medial rotation range of motion (ROM) of the hip joint was measured. As shown by the results of studies by Vad et al.(2003, 2004) and Linda et al.(2008), the whole hip joint rotation range (including medial and lateral rotations) of the lower limb whose hip joint medial rotation range is more restricted is more limited. Therefore, this study measured only the medial rotation ROM. A prone position is known as the most reliable testing position in which to measure the ROM of hip joint rotation, so the subjects took a prone position on a therapeutic bed, placing the hip joint in a neutral position(Cibulka et al., 1998, Ellison et al., 1990). The subjects then flexed the knees at 90° and stabilized the pelvis with a belt(Fig 1).

The arms were placed directly down the side, and the head was rotated in a comfortable direction. The lower limb not being tested was slightly abducted(Ellison et al., 1990).

The passive hip joint ROM was measured with an Baseline® AcuAngle Inclinometer(Fabrication Enterprises Inc, Irvington, NY, USA) (Fig 1B). The ROM was

determined to be a tilt angle at the point where the hip joint was not able to be rotated any more. Measurement was taken three times for each of the left and right lower limbs.

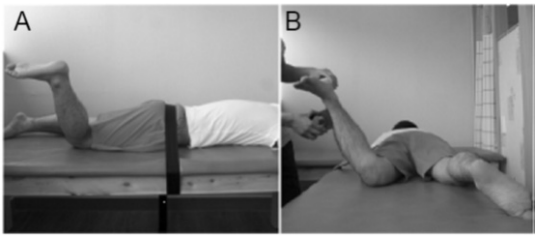

Fig 1. measurement posture of the hip joint medial rotation ROM

After the measurement of the hip joint medial rotation ROM was taken, the weight distribution of both lower extremities was measured. The subjects located each of their feet on two force plates (AMTI, Newton, MA, USA) and maintained a static standing position. The force plates had been preheated for just over 45 minutes in order to remove electrical drift and were then used for the experiment. A mark was made on the plates in order for all the subjects to step onto the same parts and stand so that the locations of the feet did not affect the size and speed of postural sway; the width between the two feet was set at 20 cm. The subjects looked straight ahead in an upright standing position. Data was collected for 30 seconds. The first 10 seconds were excluded from data analysis as a period of postural adaptation. Thereafter, the weight loaded on both lower limbs was calculated using the average value of ground reaction force applied for 20 seconds to the two feet. The analogue data generated from the force plates was converted into digital data using an analogue/digital converter and was stored in the hard drive of the computer and used for analysis. The sampling frequency rate of the force plates was set at 200 Hz.

3. Data Analysis

In order to test the hypothesis of this study, the hip joint medial rotation ROM symmetry rate and the weight-bearing symmetry rate were calculated, and the correlation between the two variables was investigated. The hip joint medial rotation ROM symmetry rate is derived by dividing the left hip joint medial rotation ROM by the right hip joint medial rotation ROM. When the symmetry rate is 1, the left and right medial rotation ranges of motion are completely symmetric; when the rate is < 1, the right hip joint medial rotation ROM is larger than the left hip joint medial rotation ROM; and when the rate is > 1, the left hip joint medial rotation ROM is larger than the right hip joint medial rotation ROM.

The weight loading symmetry ratio measures the degree of weight symmetrically loaded on the feet. Ground reaction forces applied to both feet were measured, and then the average weight-bearing rate of both feet was calculated. For statistical processing, the average of measured values taken three times was used. The weight loading symmetry ratio is the value obtained by dividing the left foot weight loading value by the right foot weight loading value. When the symmetric rate is one, the subject stands with the left and right sides in complete symmetry, when the rate is smaller than one, the weight loading on the right side is larger, and when the rate is larger than one, the weight loading on the left side is larger.

4. Statistical Processing

For statistical analysis of this study, SPSS version 18.0 was used. Pearson's coefficient was used in order to evaluate the correlation between the symmetry ratio of hip joint rotation range and the weight loading symmetry ratio. The significance level to verify statistical significance was set at $\alpha = 0.05$.

Ⅲ. Results

Table 1 shows the general characteristics of the subjects. In the passive hip joint medial rotation range, a decrease in the left hip joint medial rotation range was observed more often than a reduction in the right hip joint medial rotation range (Table 2). However, similar number between right and left side was observed in more weighted ground reaction force (Table 2). The coefficient between the passive hip joint medial rotation range symmetry rate and the weight loading symmetry ratio was -0.19 ($p < 0.05$), with weak correlation.

Table 1. General characteristics of subjects

	Mean	SD
Age (yrs)	41.63	6.59
Height (cm)	164.12	3.65
Weight (Kg)	61.64	4.41
ODI score (%)	38.04	1.05
VAS score	4.01	1.31

Table 2. Number of more observed case in hip medial rotation range and ground reaction force (Fz) between left and right side, and its mean value and symmetry ratio

	N	Left	Right	Ratio
Hip med. rot. (deg)	35	37.17(14.22)	40.63(13.89)	0.94(0.32)
Lt > Rt	9	45.89(14.21)	36.00(15.24)	1.33(0.26)
Lt < Rt	26	34.15(13.18)	42.23(13.32)	0.80(0.22)
Fz (N)	35	30.85(6.77)	30.03(6.44)	1.04(0.16)
Lt > Rt	19	31.53(6.17)	27.35(4.39)	1.15(0.12)
Lt < Rt	16	30.14(7.48)	32.87(7.16)	0.91(0.06)

Ⅳ. Discussion

With low back pain patients as subjects, this study examined whether there was a correlation between the distribution of weight applied to both feet and the bilateral hip joint medial rotation range. The results showed that they were not correlated. As mentioned in the introduction, in general, weight distribution and hip joint medial rotation range are asymmetric in patients with low back pain. So why did the two factors influencing low back pain not have any correlation in this study?

This study result signifies that the weight distribution of the study participants did not result from low back pain. A standing position is the most basic static balance posture and in general reflects an individual's habitual position. Certainly, as described earlier, patients with low back pain tended to have asymmetry in their body weight distribution while they maintained a standing position, but their degree of low back pain was moderate, at 4 (standard deviation = 1.31). In other words, they had ordinary low back pain rather than severe low back pain. Therefore, the subjects did not distribute their weight resulting from low back pain while maintaining a standing posture, but they distributed their weight in their habitual standing posture. As a result, there may be no correlation between weight distribution and the medial rotation range of the hip joint. It will be an important task to look at the degree of low back pain and the range of medial rotation of the hip joint in future research.

Second, the dominant foot of all the subjects was the right foot, and their left hip joint medial rotation range tended to be more restricted than their right hip joint medial rotation range. This shows that rather than low back pain bringing about asymmetry in the hip joint medial rotation range, the dominantly used foot had more influence on this rotation range. According to Linda et al.(2008), 98% of the subjects had the right hand as their dominant hand, and exercise which required rotation had more motions demanding weight movement to the left leg; therefore, limitation of the left hip joint rotation may contribute more to low back pain than right hip joint rotation. Accordingly, the hip joint medial rotation ranges in this study show

the possibility that the dominantly used foot had more effect on low back pain. Future research that examines the degree of the hip joint rotation range according to whether the dominant foot is the left or the right will be interesting.

In this study, the lumbopelvic area was fixed while measuring the hip joint rotation range, and therefore, it was not known whether lumbopelvic rotation occurred. In addition, it was verifiable whether, when the lumbopelvis was not fixed, it moved together with the hip joint rotation or whether lumbopelvic rotation took place when the rotation reached the end range. According to Van Dillen et al.(2001)'s study of compensatory movements of the lumbopelvis, among the 169 patients tested with low back pain, the highest number of subjects (50%) had lumbar extension rotation syndrome, followed by lumbar extension syndrome. Such a movement pattern, accompanied by rotation and extension from the lumbar spine to the affected side, is also considered to have a correlation with weight distribution asymmetry. It seems that in the present study, asymmetry in the hip joint rotation range did not correlate with weight distribution asymmetry, because there was a combined effect of the muscular imbalance around the hip joint which triggers asymmetry of rotational range and the movement accompanied by compensatory rotation and extension of the lumbopelvic region, all of which caused weight distribution asymmetry. Future research that studies the correlation between variables considering such complex factors and weight distribution asymmetry will be intriguing.

Ⅴ. Conclusion

According to the study results, there was a weak correlation between the bilateral hip joint medial rotation ROM and the weight distribution of both feet. Such results mean that careful evaluation by separating each element is needed in treating patients with low back pain. This will also be an important matter to consider in physical examinations and evaluations of lumbar pain as well as in preventive and treatment strategies. There are many factors that affect lumbar pain, and therefore, future research should take into account asymmetric alignment and abnormal movement in different joints of the body as well as asymmetry in the bilateral hip joint rotation range and the unilateral weight supporting posture.

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