Original Article

Assessment of Hip Range of Motion Limitations in Cases with Low Back Pain Based on the Classified Movement System Impairment

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Abstract

Background: The hip joint's limitation causes lumbopelvic compensatory motions, accumulating tissue stress on the lumbar spines. It is essential and valuable to evaluate hip rotation range of motion (ROM) in different low back pain (LBP) classifications to understand them and plan the best exercise program. This study aimed to compare hip rotation ROM between subjects with and without LBP classified in movement system impairment (MSI).

Materials and Methods: In this cross-sectional study, 100 subjects with LBP were classified into different MSI subgroups (mean age of 41.66 ± 7.82 years), and 100 healthy subjects (mean age of 38.96 ± 8.84 years) participated. Passive and active hip medial and lateral rotations ROM in prone and supine positions for dominant and non-dominant lower limbs were measured.

Results: Generally, in the LBP group, minimal lateral rotation as compared to controls in movement tests measuring hip rotation ROM actively and passively, in prone and sitting positions, and for dominant and non-dominant limbs ($P < 0.05$). There were no significant differences among the LBP subgroups ($P > 0.05$).

Conclusions: Due to LBP, regardless of the MSI categories, remarkably restricted hip lateral rotation ROM.

Keywords: Classification, hip joint, low back pain

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Introduction

Chronic low back pain (CLBP) is one of the most common musculoskeletal problems. Difficulties in managing this problem have made it a challenge for all professionals working on spine care.[1] Although various treatment approaches such as massage, laser therapy, and electrotherapy have been raised, exercising seems more productive, and its consequences are more permanent than other treatment methods.[2] Due to the anatomic proximity and interconnection of the hip joint and lumbopelvic region, excessive or reduced hip range of motion (ROM) can play a role in LBP development or inherent.[3] It is a fact noted that in exercise programs for LBP.

It is proposed that hip motion limitation causes lumbopelvic compensatory motions, which lead to the accumulation of tissue stress on the lumbar spine.[4-6] Hence, LBP may develop as a result; however, it may occur in turn to LBP symptoms, as well.[4]

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Moreover, it is proposed that applying classification-based treatment in CLBP leads to significant improvement. Evaluating hip rotation (ROM) in different LBP classifications may be more practical and valuable to understand them and plan the best exercise program. The Movement System Impairment (MSI) approach is a biophysically based classification system grounded on symptoms, patterns of movements, and alignments identified by a standardized clinical examination. It emphasizes the role of exercise in producing impairments and abnormalities.[7] It classifies people with LBP into subgroups, including lumbar flexion (Flex), lumbar extension (Ext), lumbar rotation (Rot), lumbar flexion-rotation (Flex-Rot), and lumbar extension-rotation (Ext-Rot) syndromes.[8]

Few studies have investigated hip ROM dysfunction in MSI subgroups.[4,9] A study evaluated hip stiffness patterns in patients with Flex-Rot or Ext-Rot syndrome. It concluded that considerable unidirectional hip motion loss in the sagittal plane is a common finding.[9] Another study found no difference in external hip rotation in lumbar Rot syndrome and lumbar Ext-Rot syndrome subgroups.[4]

Even though the hip rotation ROM in the LBP group and Rot-based MSI categories has been evaluated, there is no study on hip rotation ROM assessment in other lumbar MSI subgroups. Finding any relationship between MSI categories and hip motion loss in the transverse plane can help plan a complete and proper exercise program for CLBP. This study aimed to compare the active and passive sides of hip rotation ROM in various conditions in subjects with and without LBP who do not participate in any sports activity.

Materials and Methods

Participants

This cross-sectional study recruited 100 subjects (42 men and 58 women) with LBP and 100 subjects (52 men and 48 women) without LBP according to inclusion and exclusion criteria.

Patients with the age range of 20-55 years old and body mass index (BMI) of 22-25 kg/m^2 who had a medical history of LBP in the last three months[10] or half of the days in the previous six months.[11] It included a history of acute pain in the lumbar, hips, and knees in the recent two weeks.

Besides, age- and BMI-matched cases without any history of LBP in the recent three months[12] were recruited as the control group.

Subjects with the following problems were excluded from the study: leg or thigh pain,[13] positive straight leg raise (SLR) test or severe neurological symptoms,[14] history of tumor, infection, or fracture in lumbar spines, hips, and knees,[4,15] previous spinal, hip or knee surgery,[4,16] rheumatoid arthritis, ankylosing spondylitis, marked kyphosis or scoliosis,[4,15] pain or neural deficit limited hip ROM measurement,[10] professional sports activities,[15] and lower-extremity impairment (e.g., leg length discrepancy),[4] any history of acute pain in the lumbar, hips and knees in the recent two weeks[10] and pregnancy.[4]

The Ethics Committee of Isfahan University of Medical Sciences approved the study protocol under opinion number IR.MUI.REC.1395.3.520. The study protocol met the Helsinki declaration criteria; therefore, I explained it to the study participants and requested them to sign the written form of participation.

Sampling method

The participants were recruited from patients referred to the outpatient physiotherapy clinic of Isfahan University of Medical Sciences, through convenience, with a non-randomized sampling method.

Data collection

There were two components of tests that were completed in one session by the primary investigator. The tests included MSI assessment in the LBP group and hip rotation ROM measurements in both LBP and control groups.

MSI assessment

Subjects in the LBP group were examined according to the MSI classification.[8,10] The examination tests are shown in Table 1 and include the movements and positions. For each activity, monitored symptoms, the pattern of signs, and body alignments. Based on the subject's history and examination results, all the issues were classified into one of the three MSI categories [Table 1].

Hip rotation measurements

Hip rotation ROM was measured using a baseline digital inclinometer. Subjects were requested to wear non-restrictive clothing and performed a standardized 5-minute warm-up on a static exercise bike.[17,18] Measurements took place in the prone and sitting positions non-randomly. In the horizontal position and lying on a treatment table, the pelvis was stabilized using a belt at the level of the posterior inferior iliac spine.[18] The measured hip was placed in 0° of abduction and flexed the knee to 90°. Another hip was identified in 30° of kidnapping. The inclinometer was positioned 10 cm distal to the tibial tuberosity.[18,19] After zeroing the inclinometer to a fixed vertical reference, passively moved the leg to achieve medial and lateral rotation to the point of the first resistance feeling.

In contrast, no pelvic rotation has occurred.[10,17] For active measurement, subjects were instructed to reach the end available ROM.

For the sitting position, the issue sat on a firm chair in an upright position and a belt fixed thigh. The subjects were instructed not to lift their pelvis and bend backward. The measured hip was placed in 0° of abduction and adduction and flexed the knee to 90°. The inclinometer's position and testing procedure were like the prone position test. It obtained Measurements for both dominant and non-dominant sides. It took three measurements for each class and side, and the mean was recorded.[18]

Statistical analysis

All Statistical analyses were performed using the Statistical Package for Social Sciences (SPSS) version 20 (SPSS

Inc., Chicago, IL, USA) software. An analysis of covariance (ANCOVA) was used to compare the average values of the hip rotation ROM between groups, and age, weight, and height were used as the covariates. Also, the differences among the subgroups of LBP were compared using analysis of variance (ANOVA) with a Bonferroni adjustment and set the significance level at 0.05.

Results

One hundred subjects with LBP and 100 healthy subjects with a mean age of 40.31 ± 8.33 years and mean weight of 73.44 ± 13.15 kg, and evaluated mean height of 169.05 ± 9.59 cm in this study. It found no significant differences in age, weight, or size between the two groups ($P > 0.05$). The comparison of demographic information is illustrated in Table 2.

All of the subjects were classified based on MSI classification. There were 37 subjects in Flex-based, 55 subjects in Ext-based, and eight subjects in the Rot-based syndrome subgroup.

To determine the inter-rater reliability, a pilot study of 10 subjects was performed in which repeated each measurement three times within a week interval. The intra-tester reliability measures (Interclass correlation) for all the studied variables were excellent.

The results showed that in the majority of the movements, significantly restricted lateral hip rotation in the active and passive, prone and sitting positions, and dominant and non-dominant lower limb, among patients with LBP as compared to the control group (MPrPaN: $P = 0.011$; LPrAD: $P = 0.002$: LPrAN: $P = 0.005$; LPrPaD: $P = 0.006$; LPrPaN: $P = 0.001$; LSAD: $P = 0.037$; LSAN: $P = 0.025$ and LSPaN: $P = 0.008$) [Table 3]; although passive medial rotation in the prone position of non-dominant limb (MPrPaN) and passive lateral rotation in sitting position of non-dominant limb (LSPaD) movements were not consistent with the overall results.

The outcomes also demonstrated that except for passive lateral rotation in the prone position in non-dominant limb (LPrPaN) movement, there were no differences in other hip rotation movements among the MSI subgroups (P value > 0.05) [Table 4].

Table 1: Movement system impairment findings in different position tests

Position tests	Flexion-based	Extension-based	Rotation-based
Standing	Standing preferred to sitting Forward bending increases pain	Back against wall decreases pain Forward bending decreases pain Return from forward bending increases pain	Paraspinal asymmetry Side bending and rotation increases pain and asymmetric motion
Sitting	Exaggerated lordosis decreases pain Slumped sitting increases pain Terminal knee extension increases pain	Slumped sitting decreases pain Flat back decreases pain Exaggerated lordosis increases pain Feet unsupported increases pain	Knee extension causes lumbopelvic rotation
Supine	Legs straight decreases pain Less ROM for active hip flexion with knee flexion Passive knees to chest increases pain	Legs straight increases pain Thomas test increases pain Active straight leg raised increases pain Full shoulder flexion increases pain Active knee and hip flexion increases pain	Supine lying increases pain, relative to starting position Hip or knee flexion causes pelvic rotation Early lumbopelvic rotation with hip abduction/lateral rotation
Prone	Prone lying decreases pain Early posterior tilt with prone knee bend	Prone knee bend increases pain Active hip extension increases pain Prone lying increases pain	Prone knee bend causes asymmetrical pelvic rotation Early lumbopelvic rotation with hip rotation motion
Quadruped	Rocking backward increases pain Flexion from neutral increases pain	Rocking backward decreases pain Rocking forward increases pain	Asymmetry in the lumbar spine region in neutral Arm lift in neutral causes spine rotation Rocking increases pain and spine rotation

Discussion

Our findings in the current study determined a remarkable restriction in lateral hip rotation in subjects with LBP compared to healthy subjects. Numerous studies have shown a correlation between LBP and restricted hip rotation ROM, but the results are controversial.[11,20-22] Vad *et al*.[23] reported limitations in different directions, including flexion and abduction. Also, external rotation through the FABER test can be due to hip external rotation restriction. However, some studies have demonstrated considerable limitations not only in lateral rotation but in other directions, as well.[24]

Table 2: Demographic information of the subjects

Variables	LBP	Control	P
Gender (male/female)[b]	52 (52)/48 (48)	44 (44)/56 (56)	
Age (year),[a]	41.66 (7.82)	38.96 (8.84)	0.075
Weight (kg),[a]	74.70 (13.36)	72.19 (12.95)	0.180
Height (cm),[a]	168.54 (10.11)	169.56 (9.07)	0.459
BMI (kg/m^2)[a]			

[a]Values are presented as mean (SD). [b]Value are presented as number (%). LBP=low back pain, kg=kilograms, cm=centimeters, BMI=body mass index, m=meters

Table 3: Comparison of different rotations of hip joint in the LBP and control groups

Movements	LBP	Control	*P*
MPrAD	26.54	28.37	0.361
MPrAN	23.68	23.24	0.391
MPrPaD	28.17	28.72	0.789
MPrPaN	25.85	23.54	0.011
MSAD	25.95	27.11	0.330
MSAN	24.011	23.98	0.588
MSPaD	28.14	28.73	0.346
MSPaN	27.49	26.82	0.311
LPrAD	31.40	34.82	0.002
LPrAN	34.34	38.23	0.005
LPrPaD	31.42	34.86	0.006
LPrPaN	36.28	41.71	0.001
LSAD	23.91	25.35	0.037
LSAN	23.60	25.38	0.025
LSPaD	29.25	29.77	0.556
LSPaN	28.34	30.35	0.008

M=medial rotation, L=lateral rotation, Pr=prone, S=sitting, Pa=passive, A=active, D=Dominant, N=non-dominant

Table 4: Comparison of different rotations of hip joint in MSI subgroups of LBP

Movements	*P*		
	Flex vs Ext-based	Ext vs Rot-based	Flex vs Rot-based
MPrAD	0.791	0.088	0.372
MPrAN	0.210	0.080	0.751
MPrPaD	0.315	0.098	0.917
MPrPaN	0.219	0.173	0.740
MSAD	0.797	0.163	0.251
MSAN	0.266	0.210	0.616
MSPaD	0.879	0.246	0.186
MSPaN	0.328	0.241	0.869
LPrAD	0.583	0.650	0.336
LPrAN	0.792	0.535	0.361
LPrPaD	0.822	0.607	0.888
LPrPaN	0.174	0.834	0.041
LSAD	0.734	0.115	0.497
LSAN	0.821	0.331	0.473
LSPaD	0.836	0.389	0.715
LSPaN	0.270	0.679	0.068

Ext=extension, Flex=flexion, Rot=rotation, M=medial rotation, L=lateral rotation, Pr=prone, S=sitting, Pa=passive, A=active, D=Dominant, N=non-dominant

In general, we found no significant differences between the cases and control groups in the assessment of internal rotation ROM. These outcomes were inconsistent with some of the studies in the literature, which assessed athletic populations. For instance, Vad *et al*.[23] evaluated tennis players, and in another study, the golfers were considered.[25] Both studies observed significant limitations in the passive bilateral hip internal rotation. These findings were confirmed by the studies performed on amateur golfers[17] and judo players[15] in both active and passive internal rotation examinations.

It should note that we evaluated subjects without sports activities while those who participated in sports activities performed the specific movements in a wide ROM. It is the probable reason for controversies in the other studies. Therefore, our outcomes can be generalized to people with LBP who do not exercise regularly.

We also measured hip rotation ROM in subjects with classified LBP in the current study. Subgrouping increases sample homogeneity, which can better explain the relationship between hip function and LBP. Besides, performed the assessments actively and passively in flexed and extended hip positions (prone and sitting positions), involving different shortened and elongated muscles and other tissues, but found no difference. It is hypothesized that hip rotation ROM differs in different subgroups, but practically, there was no significant difference in these categories. Due to the overlapping in the subjects assigned to 3 assessed categories in this study. The subjects were also divided into five primary subgroups; however, they found no differences again.

In contrast to our findings, Van Dillen and colleagues showed different hip and lumbopelvic rotation motion timing in the Rot and Ext-Rot subgroups. It may have occurred due to the assessment of athletes and emphasis on muscle timing; however. The mention might have found these movement patterns because of symptoms irrelevant to LBP.[4]

Other investigations have revealed that greater lumbopelvic rotation during lateral hip rotation[26,27] can lead to the deterioration of symptoms. It may cause avoidance of lateral hip rotation in cases with LBP.

Another theory about the etiology of LBP targets the shortness of the iliotibial band, tensor fasciae late, and piriformis muscle in flex-Rot, Ext-Rot, and Rot subgroups. It is probably another causative reason leading to limited hip external rotation.[27]

The pain level was not rated, which can be a limiting factor to voluntary muscle contractions. To generalize the outcomes limited the number of subjects in some subgroups. Moreover, using an objective method to measure ROM may be more valid.

In summary, we found significant restriction in lateral hip rotation in cases presenting LBP. Besides, we found no significant differences in hip ROM among the LBP patients according to MSI subgroups.

Conclusion

Due to LBP, regardless of the MSI categories, was remarkably restricted hip lateral rotation ROM. There were no significant differences among the LBP subgroups. Future studies need to investigate hip rotation ROM in different classifications to recognize the fundamental role of the hip joint in LBP.

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Conflicts of interest

There are no conflicts of interest.

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