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Range of Active Hip Motion in Low Back Pain Patients and Apparently Healthy Controls

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ABSTRACT

Purpose: Findings from previous studies on hip mobility in individuals with low back pain (LBP) have been equivocal and focused almost exclusively on hip rotation. This study compared active range of hip motion and classified its asymmetry in male subjects with and without LBP. **Method**: The ex-post facto study involved 30 male patients with LBP and 30 age and sex-matched controls. Active ranges of motion (AROM) of both hip joints of subjects in both groups were measured with a universal goniometer and grouped into different pattern categories based on the presence or absence of a difference of 10° or more between the AROM of the two hips. The data were summarized using mean and standard deviation calculations. Further analysis was done with Chi-square test with level of significance set at $p<0.05$. **Results**: There were no significant differences between the AROM of LBP patients and controls except for hip flexion and between corresponding AROM of contralateral limbs in both groups. Patients and controls largely demonstrated symmetry in flexion, extension, abduction and adduction, but asymmetry of hip rotation was more predominant in both groups. There was however no significant differences in the proportions of patients and controls in the four hip rotation AROM patterns ($p\geq 0.344$) and the three patterns for other hip movements ($p\geq 0.372$). **Conclusion**: No statistically significant difference was found between active hip mobility of subjects with and without LBP. The majority of subjects in both groups exhibited symmetry of hip flexion, extension, abduction and adduction AROMs and more total lateral than total medial rotation AROM.

INTRODUCTION

Low back pain (LBP) is pain on the posterior aspect of the body below the twelfth rib and above the greater trochanter that may limit work, school and/or recreational activities.[1] It may be related to hip pain secondary to limitation of hip motion.[2-4] Hip pain has hence been reported to be often associated with LBP.[5] Associations between altered hip mobility and many pathologies including low back pain have also been reported by many authors.[6-10] Specifically, it has been reported that one of the predisposing factors in musculoskeletal pain syndromes of the trunk and lower extremity is perhaps limited and/or excessive range of motion of the hip joint, and that theoretically, any loss of hip rotation might place excessive mechanical stress on the lumbar spine and ultimately cause LBP.[3] The high rate of recurrence of LBP episodes has even been attributed to the altered movement patterns that may exist after the symptoms of LBP have been resolved.[1] Further, it has been opined that LBP may cause restriction of hip movement (usually manifested as greater lateral than medial rotation of the hip) perhaps due to a decrease in general physical activity during episodes of LBP.[2] It appears therefore that there is a link between LBP and hip mobility though a causal relationship has not been established.[10]

Findings from studies investigating active hip mobility in individuals with LBP have not been consistent on the link between the two entities. Fairbank et al reported that adolescents with LBP tended to have less active left hip rotation than their peers without LBP (3° difference) though there were no group differences in right rotation.[11] On the other hand, Mellin did not find any difference between men with and without LBP for both active medial and lateral hip rotations though women with LBP had less active medial hip rotation than their peers without LBP.[12]

Four hip rotation patterns have been described in individuals with LBP.[3] The patterns are pattern IA in which all possible hip rotation motions are within 10° of each other (symmetrical), pattern IB where total medial and total lateral rotations are equal but one or more differ by more than 10° (asymmetrical), pattern II in which total medial rotation is greater than lateral rotation by more than 10° and pattern III in which total lateral rotation is greater than total medial rotation by more than 10°. A greater proportion of individuals with LBP than healthy subjects have been documented to demonstrate pattern III passive movement in the hip, though the mean range of motion (ROM) measurements for the two groups were similar.[3] Individuals without LBP have also been found to have significantly greater total hip rotation ROM than matched individuals with LBP, and the LBP patients had greater lateral than medial hip rotation.[4] A study comparing lumbar spine coordination and hip joint kinematics of seated subjects with acute LBP and controls while picking an object also reported significantly reduced mobility in the symptomatic subjects.[13] More recently, individuals with LBP who participate in sports that require repetitive rotation of the trunk and hip have been documented to have significantly less total passive rotation and more asymmetry of total rotation (right versus left hip), than individuals without LBP.[8] Also, while there was no significant difference between left and right total rotation in controls, left total rotation was more limited than the right in the LBP group.[8]

Associations have also been reported between LBP and other hip motions other than rotation.[2, 14, 15] For instance, 33% of patients with LBP were reported to have hip flexion less than 43°.[14] Hip flexion, extension and internal rotation have also been reported to have statistically significant negative correlations with LBP in male patients with chronic LBP.[2] Similarly, decreases in hip flexion and extension have been found to correlate positively to the degree of LBP in 54-63 year-old men.[15]

The pelvis and lower limbs form the basis of the spine; consequently, movements and postures of the lower extremity can affect postures and movements of the spine.[2] An assessment of hip movement patterns may also help differentiate between male individuals with or without a history of LBP, and rehabilitation could then be directed at improving the faulty movement patterns.[1] Findings from studies comparing hip mobility in individuals with and without LBP have been equivocal probably because of differences in methodology- type of ROM assessed (active versus passive), type of LBP (acute, chronic, recurrent etc), duration of the back pain, the clinical diagnosis, instrument used to asses hip mobility, etc. Hip mobility among Nigerians with low back pain has not been reported. We also observed that previous studies on hip mobility in patients with LBP have been restricted largely to hip rotation in heterogeneous groups of male and female subjects. The objectives of this study were hence:

1. Comparing active hip ROM of Nigerian male LBP pain patients and age-matched controls.
2. Grouping the active hip ROM of both groups into discernible movement patterns.
3. Comparing the distribution of male low back pain patients and apparently healthy age-matched controls within the movement patterns.

The statistical hypothesis was that there would be no significant difference between the distribution of patients and controls in the different hip movement patterns.

MATERIALS AND METHODS

This is an ex-post facto study**.** Subjects for the study were thirty male patients with mechanical low back pain who were aged 20-70 years and were already receiving or freshly referred for physiotherapy treatment at the University College Hospital or Ring Road State Hospital, Ibadan, Nigeria, and thirty apparently healthy age-matched males who were members of staff of the University College Hospital, Ibadan, Nigeria that volunteered to participate in the study. Subjects were sampled sequentially and matched by age (±2years) since age is a critical factor in joint mobility even in the absence of an apparent joint pathology.[16,17] We considered a sample size of 30 adequate for each group in our study since power calculation in a related study indicated that a sample size of 20 LBP patients and 20 aged-matched healthy subjects was adequate.[4] The sample size in our study was also dictated by the number of patients that received treatment in the two clinics that participated in the study within the data collection period of 4 months. Subjects met the following inclusion criteria:

1. Patients' LBP must be of mechanical origin as ascertained through physical examination and history by one of the researchers (a physiotherapist). We defined mechanical LBP as pain affected by activities, postures and movement of the spine.

2. The patients must have no history of fracture involving the hips, back, and pelvis or any disease that may affect mobility at the hips, back or pelvis.
3. Apparently healthy subjects must have no recent history (within the previous six months) of pain in the low back or hips.

We excluded LBP patients whose pain was non-mechanical in origin (i.e. visceral, psychogenic and neurologic) from this study.

Procedure
Approval for the study was sought and obtained from the joint Institutional Review Committee (IRC) of the University of Ibadan/University College Hospital, Ibadan, Nigeria. Permission of relevant authorities, informed consent, and age of the subjects were sought and obtained. Weight and height of all subjects were measured using standardized instruments and procedures.[18] A long arm universal goniometer was used to measure active ranges of flexion, extension, abduction, adduction, and internal and external rotation of the subjects' hips in degrees to the nearest whole number. The universal goniometer has been accepted as a valid instrument for the measurement of joint range of motion; its intra-rater reliability (r) for the measurement of hip abduction has been reported as 0.75.[19] It has also been observed to give excellent validity and reliability in measurements of hip joint range of motion.[3]

One tester (OAF) carried out all the measurements because previous studies have suggested that variation among goniometric measurements taken by one tester is less than that among measurements taken by several testers and that intratester reliability is higher than intertester reliability.[19, 20] The patients with LBP did not receive any treatment before ROM measurements, as this might affect their range of motion**.** The ranges of all motion on the subjects' left and right hips were measured using standardized procedure (positioning, stabilization and goniometer placement).[19] Hip rotations were measured with the subjects prone while other hip motions were measured with the subjects supine. All subjects wore non-restricting clothing during measurements. Movements were performed actively and terminated when subjects felt tightness. Measurements were taken once. We measured active ROM because of available evidence that passive ROM is more difficult to measure reliably than active ROM.[22] All AROM measurements were taken once (one trial) because one measurement per measurement session has been reported to be as reliable as an average of repeated measurements in one session.[19]

Subjects were subsequently grouped into four AROM patterns for hip rotation (Table 1 a) and three AROM patterns each for hip flexion, extension, adduction and abduction (Table 1b) in line with Barbee-Ellison et al[3]:

Table 1a: Description of hip rotation AROM patterns

Pattern IA (symmetrical) : TM=TL (RL=LL, RM=LM or differed by less than 10°
Pattern IB (asymmetrical): TM=TL though one or more of LM, LL,RM, and RL differed by more than 10°
Pattern II : TM greater than TL
Pattern III : TL greater than TM

RL= right lateral AROM, LL= left lateral AROM, RM= right medial AROM, LM= left medial AROM,
TM (RM+LM) = total medial AROM, TL (RL+LL) = total lateral AROM
AROM= active range of motion

Table 1b: Description of AROM patterns for hip flexion, extension, adduction, and abduction

Pattern I : RE=LE, RF=LF, RAD= LAD, RAB=LAB
Pattern II: RE>LE, RF>LF, RAD> LAD, RAB> LAB
Pattern III: LE>RE, LF> RF, LAD> RAD, LAB> RAB

RE= right extension AROM, LE= left extension AROM, RF= right flexion,
LF=left flexion, RAD=right adduction AROM, LAD=left adduction AROM,
RAB= right abduction AROM, LAB= left abduction AROM

The AROMs were operationally defined as equal if there was a difference of 10° or less between the measurements on both hips and unequal if the difference was greater than 10° because differences of less than 10° may simply be due to measurement error as suggested by Barbee-Ellison et al.[3]

Data Analysis
Independent t-tests were used to compare the AROM of LBP and control subjects while paired t-tests were used to compare the AROM of right and left hips in subjects in both groups. Percentages were used to describe the proportion of subjects in each

movement pattern category. A 2 X 3 chi-square test (for hip flexion, extension, abduction and adduction individually) and a 2 X 4 chi-square test (for hip rotation motions) were used to determine whether or not the distributions of subjects within movement pattern categories were significantly different between LBP subjects and controls. The statistical significance was set at $p < 0.05$.

RESULTS

There were no significant differences between the physical characteristics (age, weight, height, and body mass index) of the two groups (Table 2).

Table 2: Characteristics of participants*

	LBP Group	Control Group	Mean difference	95% CI	p
Age (yrs)	47.10 ± 12.82	47.67± 10.46	-0.57	-6.61 to 5.48	0.852
Height (m)	1.69 ± 0.06	1.69 ± 0.06	0.00	-0.03 to 0.04	0.776
Weight (kg)	68.87 ± 11.62	68.10 ± 11.25	0.57	-5.34 to 6.46	0.848
BMI (kg/m²)	23.96 ± 3.64	23.97 ± 3.87	-0.00	-1.94 to 1.94	0.999

*Data are presented as mean ± standard deviation.
LBP = Low back pain, CI = Confidence interval, BMI = Body mass index

The AROM of hip motions for subjects in both groups is presented in Table 3.

Table 3: Hip AROM in LBP and control groups*

Hip motion	LBP group	Control group	Mean difference	95% CI	p
Right flexion	108.37 ± 5.68	111.23 ± 6.61	-2.90	-6.09 to 0.29	-0.074
Left flexion	107.73 ± 5.90	112.57 ± 8.10	-4.83	-8.49 to 1.17	0.011**
Right extension	14.37 ± 5.49	15.07 ± 5.50	-0.70	-3.54 t0 2.14	0.624
Left extension	15.07 ± 5.13	15.80 ± 6.12	-0.73	-3.65 to 2.19	0.617
Right abduction	28.87 ± 6.79	29.57 ± 7.11	-0.70	-4.29 to 2.89	0.698
Left abduction	29.20 ± 6.76	29.07 ± 8.42	0.13	-3.81 to 4.08	0.946
Right adduction	18.73 ± 5.17	18.50 ± 5.16	0.23	-2.44 to 2.90	0.862
Left adduction	17,23 ± 4.26	18.33 ± 4.87	-1.00	-3.46 to 1.26	0.356
Right medial rotation	30.30 ± 6.77	28.83 ± 6.92	1.47	-2.07 to 5.01	0.410
Left medial rotation	30.30 ± 6.34	29.87 ± 7.26	0.43	-3.09 to 3.96	0.806
Right lateral rotation	37.90 ± 9.21	36.57 ± 6.90	1.33	-2.87 to 5.54	0.528
Left lateral rotation	39.40 ± 9.62	37.30 ± 9.34	2.10	-2.80 to 6.99	0.394
Total medial rotation	60.60 ± 11.95	58.70 ± 12.95	1.90	-.54 to 8.34	0.557
Total lateral rotation	77.30 ± 17.81	77.87 ± 15.01	3.43	-5.08 to 11.95	0.423
Total right rotation	68.20 ± 13.28	65.40 ± 10.29	0.37	-3.34 to 8.94	0.365
Total left rotation	69.70 ± 12.40	67.17 ± 12.64	0.44	-3.94 to 9.00	0.436

*****Data are presented as mean ± standard deviation. ** Significant difference between groups at $p < 0.05$
LBP= Low back pain, CI= Confidence interval

There were no significant differences between the AROM of controls and individuals with LBP for all hip motions except left hip flexion where the control group had significantly greater AROM ($p = 0.011$). In the left hip, the control subjects demonstrated more motion in flexion, extension, and adduction but the LBP subjects had greater abduction, medial rotation and lateral rotation. In the right hip, the control subjects had more motion in flexion, extension, and abduction. The LBP subjects had greater total medial rotation, total left rotation and total right rotation while control subjects had greater total lateral rotation. The right and left hip ROM of participants are compared in Table 4.

Table 4: Comparison of left and right hip ROM in LBP and control groups*

	LBP group					Control group				
Hip movement	**Left**	**Right**	**Mean diff.**	**95% CI**	**p**	**Left**	**Right**	**Mean diff.**	**95% CI**	**p**
Flexion	107.73 ± 5.90	107.33 ± 5.63	0.60	1.15 to 2.35	0.488	112.56 ± 8.10	111.23 ± 6.61	-1.33	-4.01 to 1.34	0.316
Extension	15.07 ± 5-13	14.37 ± 5.49	-0.70	-2.46 to 1.06	0.423	15.80 ± 6.12	15.07 ± 5.50	-0.73	-2.52 to 1.05	0.408
Abduction	29.20 ± 6.76	28.27 ± 6.79	-0.33	-2.48 to 1.81	0.753	29.07 ± 8.42	29.57 ± 7.11	0.50	-1.48 to 2.48	0.609
Adduction	17.23 ± 4.26	18.73 ± 5.17	1.50	-0.78 to 3.78	0.185	18.33 ± 4.87	18.50 ± 5.16	0.17	1.85 to 2.18	0.867
Medial rotation	30.30 ± 6.34	30.30 ± 6.77	0.00	-2.02 to 2.02	1.000	29.87 ± 7.26	28.83 ± 6.92	-1.03	-3.20 to 1.13	0.337
Lateral rotation	39.40 ± 9.62	37.90 ± 9.21	-1.50	-3.78 to 0.78	0.190	37.30 ± 9.34	36.57 ± 6.90	-0.73	-3.22 to 1.75	0.551
Total rotation	69.70 ± 12.40	68.20 ± 13.38	-1.50	-4.55 to 1.55	0.323	67.17 ± 12.64	65.40 ± 10.29	-1.77	-5.91 to 2.37	0.390

*Data are presented as mean ± standard deviation.
LBP= Low back pain, AROM= active range of motion, CI= confidence interval, diff. = difference

In both LBP and control subjects, there was no significant difference between the ranges of right and left hips for all the ROMs. The AROM of the left hip was greater than that of the right hip except for hip flexion and adduction in both LBP and control subjects. Also, in each group, the range of lateral rotation was greater than that of medial rotation, total lateral rotation greater than total medial rotation and total left rotation greater than total right rotation. The distribution of patients and controls in the three movement patterns for the AROMs of hip flexion, extension, abduction and adduction is presented in Table 5.

Table 5: Distribution of subjects within the movement patterns for hip flexion, extension, adduction, and abduction

Hip movement	Pattern I	Pattern II	Pattern III	Total	X^2	p-value
Flexion						
LBP group **Control group**	24 (80.0%) 27 (90.0%)	3 (10.0%) 1 (3.3%)	3 (10.0%) 2 (6.7%)	30 (100.0%) 30 (100.0%)	1.37	0.502
Extension						
LBP group **Control group**	27 (90.0%) 27 (90.0%)	1 (3.3%) 2 (6.7%)	2 (6.7%) 1 (3.3%)	30 (100.0%) 30 (100.0%)	0.667	0.612
Abduction						
LBP group **Control group**	25 (83.3%) 27 (90.0%)	3 (10.0%) 2 (6.7%)	2 (6.7%) 1 (3.3%)	30 (100.0%) 30 (100.0%)	0.610	0.737
Adduction						
LBP group **Control group**	24 (80.0%) 27 (90.0%)	4 (13.3%) 1 (3.3%)	2 (6.7%) 2 (6.7%)	30 (100.0%) 30 (100.0%)	1.976	0.372

Pattern I of hip flexion, extension, abduction and adduction was the most common in both low back patients and controls while the prevalence of patterns II and III was almost equal in both groups. However, there were no statistically significant differences (p=0.372) between the proportions of patients and controls within the hip movement patterns. The distribution of patients and controls within the four movement patterns for hip rotation are presented in Table 6.

Table 6: Distribution of subjects in the four hip rotation movement patterns

	Pattern IA	Pattern IB	Pattern II	Pattern III	Total	X^2	p-value
LBP group	3 (10.0%)	1 (3.3%)	2 (6.7%)	24 (80.0%)	30		
Control group	8 (26.7%)	1 (3.3%)	3 (10.0)%	18 (60.0%)	30	3.33	0.344
Total	11 (100.0%)	2 (6.7%)	5 (8.3%)	42 (70.0%)	60		

Pattern III was the most common hip rotation AROM pattern, while pattern 1B that was observed in only 3.3% of both groups was the least common hip rotation movement pattern presentation. However, 80% of the patients with low back pain compared to 60% of control subjects had pattern III. Also, 26.7% of the controls compared to 10% of the patients had pattern 1A presentation. There was however no significant difference (p=0.34) in the distribution of patients and controls in the four hip asymmetry patterns.

DISCUSSION

There were no statistically significant differences between the physical characteristics (age, weight, height and body mass index) of the patients with low back pain and control subjects, thus implying that both groups were fairly matched in their physical characteristics and that we have largely controlled for the documented influence of such variables on joint mobility. The lack of significant difference between the physical characteristics of the two groups, though they were only matched by age, may be a reflection of similarity in stature of Nigerians that belong to the same generation.

The ranges of active hip motion that we obtained for the apparently healthy subjects in our study were markedly lower than the average values reported by the American Academy of Orthopedic Surgeons (AAOS) and other sources.[16,17,23,24,25] Indeed, the 15^o, 15^o and 18^o obtained as the mean ranges of hip extension, hip abduction and hip adduction respectively among the control subjects in our study were about half of the values reported by AAOS.[23] This may suggest that the Nigerians studied were less flexible than the population reported by the AAOS perhaps due to differences between the races and/or age and gender of the populations as such factors have been known to affect range of joint motion and joint flexibility.[26-28] This observation however needs to be taken with caution in view of our study's sample size. The purpose of the study was also not to establish normative values for the Nigerian population.

We observed no significant differences between all hip AROMs except flexion in individuals with and without LBP in our study. Our finding with regard to hip rotation agrees with that of Mellin that reported no difference between men with and without LBP for active medial and lateral hip rotations.[12] Barbee-Ellison et al also reported no difference in passive range of hip rotation motion between people with and without LBP.[3] Our finding is however contrary to the report of Chestworth et al that individuals with LBP have significantly less active medial, lateral and total hip rotation than individuals without LBP.[4] We also observed that both LBP subjects and controls had greater lateral than medial rotation of the hip as observed in previous studies.[3,8] As in previous studies, we did not find any significant difference between left and right hip AROMs for both LBP and control groups.[2,11]

The majority of the LBP patients and control subjects exhibited pattern I movement category (AROM of both hips did not differ by more than 10^o) for hip flexion, extension, and abduction/adduction 10^o and hence demonstrated symmetry of these movements. We also did not observe any significant difference in the distribution of LBP patients and controls among the movement patterns. The literature did not reveal any previous study that compared LBP patients and controls on the basis of hip AROM imbalances except rotation. Significant negative correlations, however, have been reported between all AROMs of the hip (except lateral rotation) and LBP in men.[2] Decreases in hip flexion and extension have also been reported to positively correlate with the degree of low back pain in 54-to 63-year-old men.[15] However, in consonance with the findings of Porter and Wilkinson, we observed that the patients with LBP had significantly lower mean range of hip flexion than the controls.[14]

Pattern III of hip rotation was the most common and pattern IB was the least common among the LBP patients in agreement with the findings of Barbee-Ellison et al.[3] However, while Barbee-Ellison et al reported that pattern II was the most common among the healthy subjects studied by them, we observed that pattern III was also the most common among the control subjects in our study. Specifically, we observed that 80% and 60% of the LBP patients and controls respectively had pattern II as opposed to 48% for LBP patients and 27% for controls reported by Barbee-Ellison et al.[3] It has been suggested that pattern III asymmetry of hip rotation in LBP patients is perhaps due to muscular imbalances between the hip rotator muscles, especially the Piriformis muscle which when shortened might cause excessive lateral rotation and restricted internal rotation of the hip.[8] It is however not clear why majority of non-LBP subjects in our study also demonstrated this hip movement pattern.

We observed that patients with LBP and control subjects demonstrated at least one hip rotation asymmetry pattern category, and that there were no significant differences in the distribution of subjects within the movement pattern categories. This suggests that there was no pattern category that was characteristic of patients with low back pain and thus no symmetry or asymmetry of hip rotation pattern can be linked to the presence of the low back pain syndrome. This contradicts the report of a significant difference between the distribution of LBP patients and controls in the hip rotation ROM patterns, thus suggesting that a hip AROM pattern was characteristic of patients with LBP in the study by Barbee-Ellison et al.[3] The discrepancy between the finding from our study and that of Barbee-Ellison et al in this instance could be a reflection of inherent differences between the populations studied as racial differences in flexibility have been established. While our study involved only male subjects, both male and female subjects participated in the study by Barbee-Ellison et al and this could have affected the AROM values reported by them. We also assessed active ROM as opposed to passive ROM assessed in the study by Barbee-Ellison et al and it is plausible that LBP affects active and passive mobility of the hip differently. It is also possible that some of the LBP patients who had received physiotherapy treatment before our study might have regained some hip mobility such that their hip mobility may not be too different from that of the controls at the time of our study.

Limitations

Our study has some limitations. First, we used a full-circle goniometer in place of a more sophisticated three-dimensional camera now available for motion analysis and which would have resulted in more accurate ROM measurements. However, the strength of goniometry used in our study is the easy transferability of our finding to the clinical setting. Secondly, since some of the LBP patients have received some physiotherapy treatments before being involved in our study, their AROM could have improved at the time of measurement and hence affect the internal validity of our findings. Thirdly, we appreciate that the non-blinding of the individual who assessed participants' hip AROM to the participants' groups is a limitation of our study that could have affected its internal validity. Finally, our study did not consider the clinical diagnoses of our LBP patients and the duration of the LBP which are factors that may determine the extent to which hip mobility is affected by LBP.

Implication for Future Studies

Our study was restricted to only male subjects to ensure homogeneity in the sample studied, but this would have limited the application of our findings among female LBP patients. There is therefore a need for future studies that would investigate hip mobility in female LBP patients and/or compare hip mobility in male and female LBP patients. Future studies also need to investigate the influence of such factors as the clinical diagnosis and duration of the LBP on hip mobility. The study equally needs to be replicated in individuals with chronic and/or recurrent LBP as well as patients with sacroiliac joint dysfunction either existing alone or co-existing with LBP.

Clinical Implication

We did not observe any significant difference in the distribution of LBP patients and control subjects among the hip movement patterns and hence accepted our null hypothesis. It is therefore plausible that LBP may not significantly affect hip mobility in male Nigerian LBP patients. Our finding has also contributed to the equivocal findings concerning hip mobility and LBP, thus suggesting the need for further studies. However, since asymmetry of hip rotation was more frequent in the patient group and our study is limited in scope by our LBP patients' selection, clinicians managing LBP patients may still need to pay attention to the possible coexistence of reduced hip mobility which may compromise the outcome of their intervention.

CONCLUSIONS

There were no significant differences between the active ROM of the LBP patients and controls except for left hip flexion. The majority of participants in both groups had symmetry of hip flexion, extension, abduction and adduction, and pattern II asymmetry of hip rotation. There were however no significant differences in the proportions of LBP patients and controls in the different asymmetry patterns.

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