

ISOKINETIC ASSESSMENT OF HIP ROTATORS IN PATIENTS WITH CHRONIC MECHANICAL LOW BACK PAIN

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Abstract:

Introduction: Chronic mechanical low back pain (CMLBP) is the most common complaint of the working-age population. In addition to human suffering, it causes a substantial economic burden due to the wide use of medical services and absence from work. Imbalance between hip internal and external rotators muscles may be a contributing factor for low back pain. **Aim of Work:** To assess the relationship between hip internal and external rotators strength in patients with chronic low back pain (CLBP). **Materials and Methods:** Patients with CLBP was referred to outpatient clinic, faculty of Physical Therapy Cairo University. Sixty patients (53 male and 7 females) suffering from CLBP their age ranged from 20-30 years with mean of age (23.76±2.39) years. We assess hip rotators (internal and external) strength by using isokinetic dynamometer concentric contraction protocol. We select two speeds to assess muscle strength (60° / sec as low speed and 180° / sec as high speed). Peak torque is the reading we select to resemble muscle strength. **Results:** in both sides paired –t test revealed that there is significant different between hip internal rotators peak torque and peak torque of hip external rotators in low speed concentric torque , also at high speed concentric torque(p<0.05) . **Conclusion:** in patient with CLBP there is imbalance between hip rotators, hip internal rotators muscles is stronger than external rotators muscles.

Keywords: Low back pain-Hip mobility-Hip muscle strength- Hip rotation

Introduction

Mechanical low back pain (MLBP) is a major cause of illness and disability, especially in people of working age. By definition, it excludes pain resulting from neoplasia, fracture or inflammatory arthropathy, or that is referred from anatomical sites outside the spine, and in most cases there is no clearly demonstrable underlying pathology (Linton 2000, Pincus et al., 2002 and Endean et al., 2011).

However, when defined by symptoms alone mechanical LBP may not be etiologically homogeneous. Although the pathogenesis is generally unclear, structural abnormalities of the spine do account for the symptom in some cases. It could be, for example, that for LBP associated with identifiable underlying spinal pathology, physical risk factors are relatively more important, while psychological risk factors have less impact (Alison et al., 2011).

This type of pain is often due to stress or strain to the back muscles; tendons, and ligaments and is usually attributed to strenuous daily activities, heavy lifting, or prolonged standing or sitting. Mechanical low back pain

is often a chronic, dull, aching pain of varying intensity that affects the lower spine and might spread to the buttocks. The pain often progressively worsens during the day because of daily physical activities such as bending, twisting, and lifting. Prolonged sitting and standing often aggravate the pain. There are no associated neurological symptoms or signs (Morki and Sinaki, 1993).

The hip joint serves as a central pivot point for the body as a whole. This large ball-and socket joint allows simultaneous, triplanar movements of the femur relative to the pelvis, as well as the trunk and pelvis relative to the femur. Lifting the foot off the ground, reaching towards the floor, or rapidly rotating the trunk and pelvis while supporting the body over one limb typically demands strong and specific activation of the hips' surrounding musculature (Neuman , 2010).

Pathology that affects the strength, control, or extensibility of the hip muscles can significantly disrupt the fluidity, comfort, and metabolic efficiency of many routine movements involving both functional and recreational activities (Neuman, 2010).

Physical therapy diagnosis related

to the hip and adjacent regions often requires a solid understanding of the actions of the surrounding muscles. This knowledge is instrumental in identifying when a specific muscle or muscle group is weak, painful, dominant, or tight (i.e., lack the extensibility to permit normal range of motion). Depending on the particular muscle, any one of these conditions can significantly affect the alignment across the lumbar spine, pelvis, and femur, ultimately affecting the alignment throughout the entire lower limb (Neuman, 2010).

Because of the anatomic proximity and interconnections of the hip joint and lumbopelvic region, a number of investigators have focused on the relationship between hip mobility and low back pain (LBP) (Fairbank et al 1984; Mellin 1988; Ellison et al., 1990; Chesworth et al., 1994; Cibulka et al., 1998; Cibulka, 1999; Grimshaw & Burden, 2000; Coplan, 2002; Vad et al., 2003; Vad et al., 2004; Wong & Lee, 2004). The interest in the hip-LBP relationship is based on the proposal that limited hip motion will be compensated by motion in the lumbopelvic region. The proposed result is (1) an increase in the frequency of lumbopelvic motion with

hip motion, (2) low magnitude loading in the lumbar region, (3) accumulation of tissue stress, and eventually (4) LBP symptoms (Van Dillen et al., 2007 and Van Dillen et al; 2008).

A high correlation exists between hip motion and total axial rotation, thus suggesting that improving flexibility of the hips would alleviate pain and its recurrent episodes (Esola et al., 1996).

There have been a growing number of studies that suggest that asymmetry in hip rotation, where external rotation (ER) exceeds internal rotation (IR) or where IR exceeds ER are related to a number of different lower extremity musculoskeletal problems that clinicians often see (Cibulka et al., 1998).

Hip rotation asymmetry is often found in many different musculoskeletal conditions that affect the low back, hip, and knee

(Ellison et al., 1990, Chesworth et al., 1994, Tonnis and Heinecke, 1999). The results of their study lend further support to the importance of assessing hip rotation asymmetry when treating patients with low back, hip, or knee pain (Cibulka et al., 2010)

Cibulka et al (2010) have noticed that subjects with asymmetrical hip rotation usually also have hip muscle weakness, usually when more than a 15° difference in motion is found between hip internal and external rotation on a particular side.

It was documented that Isokinetic dynamometer provides an objective, reliable, and safe method with interclass correlation coefficients (ICC) of 0.99 and provides valid measurement regarding angular position, torque and velocities for testing as well as training of different groups of muscles in the upper and lower limb and trunk (Drouin et al., 2004).

Kannus, (1994) stated that peak torque has been and still is the most properly studied isokinetic strength testing parameter and its use can be recommended for research and clinical purposes.

Materials and Methods

Subjects:

The study was conducted on 60 patients (53 male and 7 female) referred from an orthopedist with the diagnosis of mechanical low back pain, their age ranged from 20-30 years with mean of age (23.76±2.39) years, mean weight (71.8±12.7) (kg), mean height

(169.65±7.49) (cm) and mean body mass index (BMI) (25.5±3.86) (kg/m²). We measured muscle torque by isokinetic dynamometer.

Subjects were included in this study if they suffer from mechanical low back pain, their age ranged from 20 to 30 years and their pain from at least three months ago. All subjects were asked to assign a consent form approved from ethical committee of faculty of physical therapy of Cairo University. This study was conducted in the lab of isokinetic of the faculty of physical therapy, Cairo University.

Patients were excluded if they had one of the following: lumbar disc prolapsed, lumbar spondylosis, spinal stenosis, spondylolisthesis, spondylolysis, ankylosing spondylitis and spinal instability, lower limb injury (surgery or leg-length discrepancy), knee or hip osteoarthritis fracture of vertebral column or history of spinal surgery kyphosis or scoliosis, rheumatoid arthritis and sacroiliac joint dysfunction.

Our patients were at working age, some of them were office worker, some were graduated students of physical therapy at training year and others were workers.

Instrumentations:**Biodex system 3 isokinetic dynamometer**

(Biodex Medical Systems, Shirley, New York, USA)

The apparatus consists of a dynamometer, a chair, and a control panel (Figure1).

The position of the dynamometer can be controlled; it can be rotated horizontally, tilted and its height can be adjusted according to the test or rehabilitation procedure as described by the manufacturer's guide. Similarly, the chair position and height can be

adjusted. The position and the tilting of the back seat can also be controlled.

The dynamometer can be controlled through the control panel or the computer software (Biodex Advantage Software). Using the panel control, the operator should set the mode (isokinetic, passive, isotonic concentric or eccentric) and the range of motion. Using the computer program, patient's data are first entered, and then the testing or rehabilitation protocol and range of motion are set. A report can be obtained, saved and printed out if desired. The main outcomes documented are: the peak torque, the average peak torque, total work, average power, and agonist/antagonist ratio.

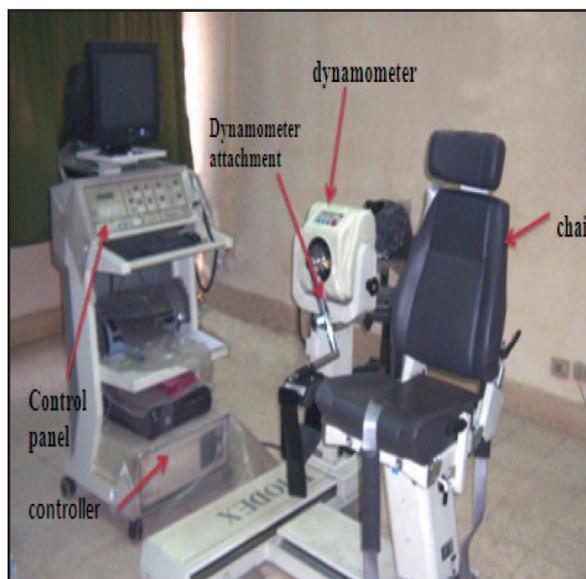


Figure (1): Biodex system 3 Isokinetic dynamometer.

Evaluation procedure

Patients had received full explanation of assessment and treatment procedures, and all procedure was performed after they signed written informed consent form.

Hip medial and lateral rotators torque assessment:

All patients were assessed bilateral hip external and internal rotators torque using an isokinetic dynamometer (Biodex Medical Systems 3). All strength testing were performed at 60°/sec (low speed) and 180°/sec (high speed). Calibration of the dynamometer was carried out before the measurements. Before testing, participants were provided with detailed instructions for the strength testing procedures. Five maximal repetitions for hip external and internal rotation were performed for each strength test

A protocol (hip external and internal rotators) for testing was set and saved on the software of the isokinetic apparatus prior to the study, unilateral isokinetic mode, contraction type(concentric/concentric), 60°/sec, 180°/sec velocities, and rest between 2sets of test (10 second) were used .

The patient's weight and height were measured and recorded. Patient's personal data were entered to the "patient" section of the software and saved.

The positions of the seat and the dynamometer were adjusted for measuring hip joint for rotators. Dynamometer orientation 0°, dynamometer tilt 0°, seat orientation 90°, and seatback tilt 85°. The attachment of the hip (of the involved side) was attached to the dynamometer (Biodex system 3 pro manual).

The patient sat on the chair of the apparatus with the hip and knee flexed to 90° (Figure 3), the axis of rotation for the dynamometer was aligned with the long axis of the femur, and the seat height and position will be adjusted for accurate alignment.

The hip attachment was adjusted to be proximal to the patient's lateral malleolus then secured by its strap. Shoulder and thigh stabilization straps were fastened (Biodex system 3 pro manual).

The dynamometer Range of Movement (ROM) was set, with 30°external rotation away (Figure 2) and 30° internal toward (Figure 3). (concentric away and concentric

toward), the anatomical position of the patient was calibrated, and the patient's limb weight was measured, neutral position was used as starting position. After two trial repetitions, the test was conducted.

The patient was verbally encouraged to maintain muscle contraction through the seated ROM, patients taking visual and auditory feedback from apparatus, and not stop the movement (if patient movement stops, resistance stops) using verbal command as push.

The patient performed 5 repetitions of concentric contraction (medial and lateral hip rotation) at velocity of 60°/s and 5 repetitions of concentric contraction at velocity of 180°/s with 10 seconds relaxation in between (Biodex system 3 pro manual). The largest number of (peak torque) readings will be documented and was used in comparison between variables. All peak torque data (Nm) was normalized to body mass index (Nm/kg/m²).



Figure (2): Hip rotation strength test for RT hip internal rotators test



Figure (3):Hip rotation strength test for RT hip external rotators test

Results

In this study, 60 patients with mechanical low back pain were participated in this study. The data in table (1) represented their mean age (23.76 ± 2.39) years, mean weight (71.8 ± 12.7) kilograms (Kg), mean height (169.65 ± 7.49) (Cm) and mean BMI (25.5 ± 3.86) (Kg/m^2).

Table (1): Physical characteristics of patients

Items	Mean	\pm SD
Age (yrs)	23.76	± 2.39
Weight (Kg)	71.8	± 12.7
Height (Cm)	169.65	± 7.49
BMI (Kg/m^2)	25.5	± 3.86

We compare between both variables (internal and external muscle peak torque) using mean values and then we use paired t-test to assess the significance of difference between variables.

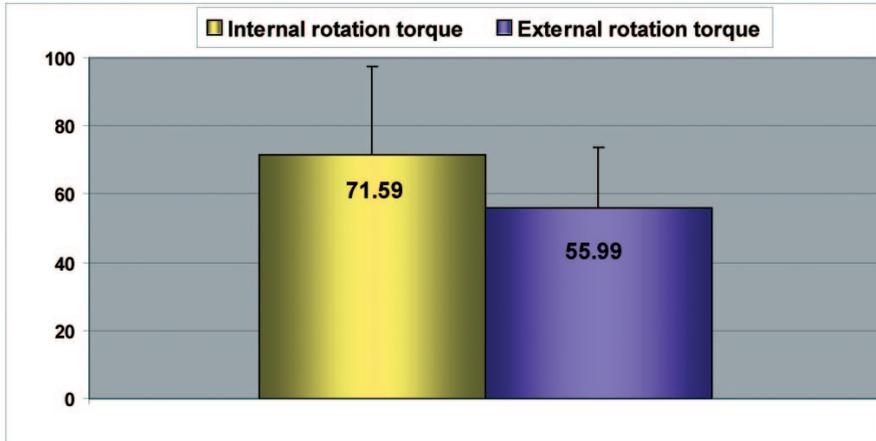
Right hip internal and external torque at low speed:

Figure (4): Mean and \pm SD of right hip internal and external rotation torque at low speed.

There was a significant difference in the paired t-test between right hip internal rotation torque at low speed and right hip external rotation torque at low speed (Fig.4) as the mean value of right hip internal rotation torque at low speed (71.59 ± 26.01) was higher than right hip external rotation torque at low speed was (55.99 ± 17.71) where the t-value was (7.11) and P-value was (0.0001).

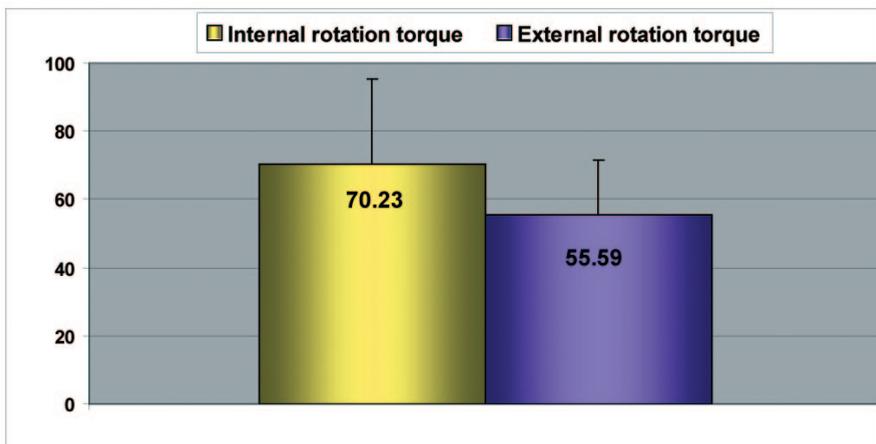
Left hip internal and external torque at low speed:

Figure (5): Mean and \pm SD of left hip internal and external rotation torque at low speed

There was a significant difference in the paired t-test between left hip internal rotation torque at low speed and left hip external rotation torque at low speed (Fig.5) as the mean value of left hip internal rotation torque at low speed (70.23 ± 25.13) was higher than left hip external rotation torque at low speed (55.59 ± 16.22) where the t-value was (7.0) and P-value was (0.0001).

Right hip internal and external torque at high speed:

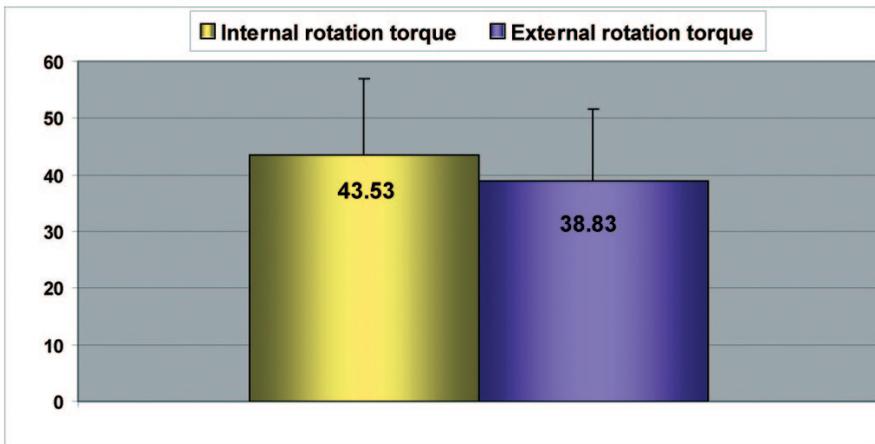


Figure (6): Mean and \pm SD of right hip internal and external rotation torque at high speed.

There was a significant difference in the paired t-test between right hip internal rotation torque at high speed and right hip external rotation torque at high speed (Fig.6) as the mean value of right hip internal rotation torque at high speed (43.53 ± 13.49) was higher than right hip external rotation torque at high speed (38.83 ± 12.96) where the t-value was (3.53) and P-value was (0.001).

Left hip internal and external torque at high speed:

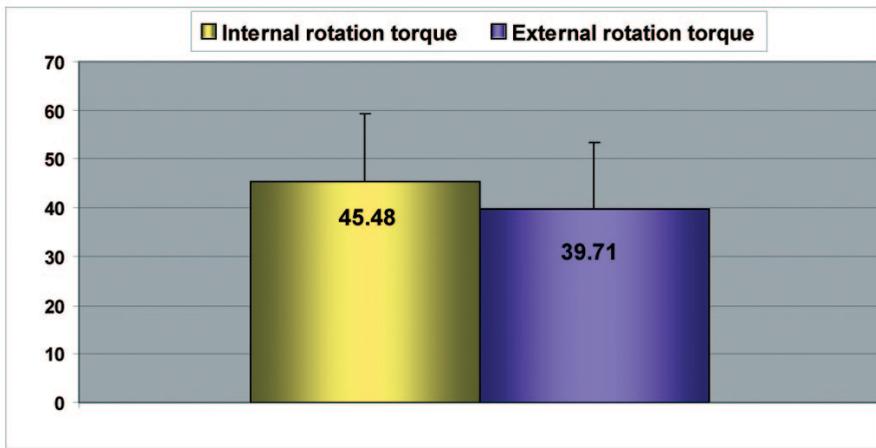


Fig.(7): Mean and \pm SD of left hip internal and external rotation torque at high speed,

There was a significant difference in the paired t-test between left hip internal rotation torque at high speed and left hip external rotation torque at high speed (Fig.7) as the mean value of left hip internal rotation torque at high speed (45.48 ± 13.73) was higher than left hip external rotation torque at high speed (39.71 ± 13.88) where the t-value was (3.6) and P-value was (0.001).

Discussion

In the isokinetic lab room in the faculty of Physical Therapy of Cairo University, we assessed both hip internal and external rotators peak torque/BMI using an isokinetic dynamometer (Biodex Medical Systems 3). All strength testing were performed at $60^\circ/\text{sec}$ and $180^\circ/\text{sec}$.

Since the majority of hip external rotation muscles lie posterior to the joint, hip flexion likely places these

muscles at more efficient lengths and it produces more efficient Isokinetic torque. Thus we choose seating position to assess hip rotators power.

We chose $60^\circ/\text{s}$ because a muscle produces greater concentric force at slower Isokinetic testing velocities. Therefore, the testing velocity of $60^\circ/\text{s}$ is a good representation of both the concentric and eccentric force-producing capabilities.

We also use 180°/s speed to assess muscle torque in different conditions which simulate high speed activities that persons do it normally (Running, sports activities).

The results of this study revealed that in patients with chronic mechanical low back pain (CMLBP) strength of hip internal rotation (peak torque assessed by isokinetic dynamometer) is higher than strength of hip external rotation .To our knowledge measuring strength of hip rotators muscles using isokinetic dynamometer in patients with CMLBP has not been done up till now.

These results agreed with the results obtained by Cibulka 2010 who detected that there is asymmetry in hip rotators strength in patients with LBP. It may be due to asymmetry in hip rotation Range Of Motion (ROM) in those patients cause disturbance in muscle performance affecting length tension relationship.

These results were opposite with results obtained by Cibulka and Watkins 2005,who investigate a case of patella-femoral pain syndrome (PFPS) and found hip internal rotation at affected limb was weaker than hip external rotation. This may be due the different clinical presentation as our people

suffering from CMLBP and their case suffer from PFPS .

Conclusion

The findings of this study revealed that hip internal rotators muscles are stronger than hip external rotators. Based on this study, we recommend adding a strengthening program exercise for hip external rotators in patients with CMLBP to regain the balance between hip rotators as this may add a complete resolution of the problem which is very difficult to resolve completely. So, clinicians should take care of hip rotators in treating patients with mechanical low back pain.

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