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Knee Joint Reposition Accuracy among Chronic Low Back Pain Patients and Healthy Subjects

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Abstract: The purpose of this study was to investigate the knee joint repositioning accuracy as a measure of knee joint proprioception in patients with chronic low back pain (CLBP) and healthy subjects. methods: Thirty subjects of both sexes participated in this study,15 subjects with chronic low back pain and 15 normal subjects, aged between 20–40 years old. Active knee joint repositioning accuracy as a measure of knee joint proprioception was tested for both groups by Biodex multijoint system, pro Isokinetic dynamometer. Results: There was a significant difference between the two groups in knee joint repositioning accuracy as the knee joint repositioning error increased in patients with chronic low back pain. Conclusion: Knee joint repositioning accuracy decreased in patients with (CLBP) as compared to healthy subjects. These results suggest that chronic low back pain has a negative impact on the knee joint proprioception.

Key words: Chronic Low Back Pain · Knee Proprioception

INTRODUCTION:

The most widespread public health problem suffered by the industrialized world currently is low back pain (LBP). It affects a huge part of the population and composes a heavy load on national health and welfare systems in terms of diagnostics, treatment, absenteeism and early retirement. Added to that, the sudden withdrawal of active people from their daily activities leading to psychosocial effects on them [1, 2].

Approximately about 80% of people could suffer from pain on the back even if it is for one time in their life. The incidence of developing acute low back pain condition is between 15% and 30% of the population, especially in adulthood. So, the manifestation of this condition is high. The increase in mechanical LBP in children, teenagers and young adults are shown in epidemiological studies. Estimation about the cumulative prevalence in this population is built up to 30% [3, 4].

Patients with LBP show greater muscle imbalance than subjects without LBP, especially in the deep lumbar muscles [5, 6], which lead to incorrect posture and movement in an effort to avoid pain, resulting in abnormal muscle and ligament function that can limit the active range of motion (AROM) [7].

Many authors proved that the LBP patients have sensory-motor deficits [8]. The segmental spinal stability is affected by these deficits and lastly lead to articular damage and following chronic pain [9].

Proprioception is the central nervous system (CNS) neural aggregated impulses getting from particular axonal endings named mechanoreceptors [10]. Information about limb position, force, awareness and heaviness is provided by peripheral afferents inputs from muscle spindles, joint receptors, cutaneous receptors and Golgi tendon organs (GTO) and this refers to a proprioceptive mechanism. Timing and velocity error produced by a sudden disturbance of resistance during multipoint motion can be corrected by proprioceptive information [11].

The proprioceptive system is responsible for the body coordination and stability and is a major component of function and performance in the functional activity [12,13]. The proper function of the proprioceptive system is essential for injury free athletics, especially with complex motor activities [14]. One of the risk factors

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associated with falls in elderly subjects was poor proprioception [15]. Therefore, any activity that further disturbs proprioceptive acuity would increase the risk of falls.

The correlation between CLBP and knee joint reposition accuracy as a measure of knee proprioception hasn't been clearly established. If this effect can be reliably established, rehabilitation protocols could be altered to include proprioceptive training of the knee joints in cases of CLBP.

Aim of the Study: The aim of the study was to investigate the knee joint repositioning accuracy as a measure of knee joint proprioception in chronic low back pain (CLBP) patients and healthy subjects.

MATERIAL AND METHODS

Thirty subjects of both sexes aged from 20 to 40 years old participated in this study and they were divided into two equal groups, group A included 15 normal subjects and group B included 15 subjects with CLBP diagnosed by orthopedists and neurologists. All patients had a continuous duration of complaining of pain more than 3 months. Exclusion criteria: Any disease in the knee joints, history of surgical approach in the knee and lower back, back and knee deformities, smokers and diabetic patients, athletic subjects and positive straight leg raising test (pain and numbness).

Instrumentation: -Biodex multijoint system, pro Isokinetic dynamometer (Biodex Medical INC., Shirley, New York, USA), was used to measure the reposition accuracy of the knee joint.

Procedures: After explanation of the study objective and procedures, an informed consent was obtained from all volunteers about agreement of study participation. Proprioception accuracy was assessed for the dominant knee by the Biodex Multijoint system, pro isokinetic dynamometer (Biodex Medical Inc., Shirley, NY) through active repositioning test by examining the ability of subjects to reproduce actively an angle at which the joint had been placed before in non-weight-bearing position.

Measurement Procedure

- Each subject was asked to sit on the chair of the Biodex system with the knee of the tested leg aligned with the axis of the dynamometer and positioned in 90° flexion (starting position), the subject was stabilized in the test position by straps around the trunk, pelvis and thigh and was blindfolded to eliminate visual input during testing, the tibial pad was secured to the shank 3 cm superior to the lateral malleolus [16]. Type of test was chosen (active repositioning test with speed 30°/s) with three repetitions of the test. Initially the anatomical reference angle was set at 45° then the subject leg was returned to the starting position [16].
- For standardization, the tested limb was allowed to move to target angle (45°) actively, then was held for 10 seconds as a teaching process for the subject so the subject could memorize the position and then the limb was allowed to return to the starting position. Then the subject was asked to move his limb to the target angle (45°) actively, when the subject felt that he/she reached the target angle actively he/she would stop the apparatus using the Hold/Release button. Subjects were not permitted to correct the angle [16, 17].
- Three trials were done and the mean angular difference of the 3 trials, between the target angle position and the subject perceived end range position (absolute error) was recorded in degrees as the deficit in repositioning accuracy and was used in the statistical analysis.

Statistical Analysis: Data statistical analysis was done using the statistical package for social sciences (SPSS) version 20. Data was presented as mean and standard deviation. Unpaired t- test was used to analyze the data between study and control groups. The p-value was $p<0.05$.

RESULTS

General Characteristics of the Subjects: The results showed no significant differences between the two groups for age, weight, height and body mass index (BMI) as shown in table (1).

Knee Joint Repositioning Error: The results revealed that there was a significant difference between knee joint repositioning errors for the control and study groups as the mean value of the control group (A) was (2.88±1.28) and for the study group(B) was (5.6±2.72) where the t-value was (3.50) and P-value was (0.002) as shown in table (2).

Table 1: Physical characteristics of subjects in each group.

	A		B		Comparison		
Items	Mean	±SD	Mean	±SD	t-value	P-value	S
Age (years)	27.2	±6.94	29	±8.44	0.638	0.529	NS
Weight (Kg)	69.13	19.7	67.4	13.6	0.28	0.782	NS
Height (cm)	165.3	12.13	162	10	0.8	0.429	NS
BMI (Kg/m2)	25.26	4.26	25.56	4.29	0.188	0.852	NS

SD: standard deviation, P: probability, S: significance, NS: non-significant.

Table 2: Differences in knee joint repositioning errors between the two groups.

	Knee joint repositioning error	
Unpaired t test	Control group (A)	Study group (B)
Mean	2.88	5.6
±SD	±1.28	±2.72
Mean difference	2.726	
DF	28	
t-value	3.501	
P-value	0.002	
S	S	

Sig: significance NS: Non significant P: probability

DISCUSSION

This study was conducted to investigate the knee joint repositioning accuracy as a measure of knee joint proprioception in CLBP patients and healthy subjects.

In this study active repositioning test was used to measure the proprioceptive accuracy of the knee joint by Biodex multijoint system, pro isokinetic dynamometer. Lephart et al., concluded that assessment by active joint reposition stimulates muscle and joint mechanoreceptors and is a more functional assessment of afferent pathways and were proved to be a valid and reliable test for proprioception [14].

The results of this study showed that there was a significant difference between knee joint repositioning errors for the control and study groups where P-value was (0.002).

The decrease in the knee proprioceptive accuracy in CLBP patients as compared to normal subjects as reported in this study has many explanations.

O'Sullivan et al., found that LBP patients have weakness of the deep muscles of the back than patients without LBP and also they have reduced proprioception function which lead to lack of position sense. So this weakness of the muscles and reduced proprioception function may affect the mechanics of the low back area including the lumbosacral region and sacroiliac joints which lead to variations in sensory information from proprioceptors and mechanoreceptors of muscles and joints in the lumbar spine and sacroiliac joint capsule [18]. Hart et al., reported that motor neuron excitability changes of the lower extremity may be due to a variation in the sacroiliac joint capsule sensory information. Also excitability of quadriceps motor neurons may be affected by variations in sensory information from the proprioceptors and mechanoreceptors of the muscles and joints in the lumbar spine [19].

Low back pain individuals have demonstrated neuromuscular control alteration and lumbopelvic region stabilizing muscles delayed activation, particularly the multifidus and transverse abdominus muscles and increased the fatigue rate during the exercise of the lumbar paraspinal muscles [18-21].

Low back pain leads to muscle function localized changes which are suggested to develop a further reorganization of the movement pattern of the whole lower extremity [22]. The kinetic chain motor patterns of the whole lower extremity have been shown to be affected by alteration of muscle function in one region [21, 23]. Particular to LBP, impairment of distal muscles appears as gluteal muscle weakness [24] and quadriceps muscles weakness and inhibition [21, 23, 25].

Increased fatigability of the muscles of back extensor is common in chronic low back trouble (CLBT) patients and that increased lumbar fatigue also may be a risk factor for the future LBP [26].

Chronic low back pain persons commonly show unbalanced or weakness of muscles of the trunk and tend to have a faster fatigue rate during continuous extension exercise of the lumbar area. This muscular insufficiency may affect muscles of the lower extremity adaptations to maintain stability and preserve normal function during fatiguing exercises. Recently, persons with normal knees show more quadriceps inhibition (QI) after lumbar extension fatiguing exercise which may indicate quadriceps adaptation in response to fatigue of the lumbar paraspinal muscles [27].

Zazulak *et al*., concluded that core proprioception impairment as determined by active trunk proprioceptive repositioning accuracy, predicted a knee injury risk in female athletes, where the core of the body includes thoracolumbar spine and pelvis passive structures and the active contributions of the muscles of the trunk [28].

Difficulty keeping proper positioning and stability of the trunk due to increased fatigue may affect lower limb joints during activities and may be a predictor of a risk of injury of the lower extremity in poor core and trunk stability persons [29].

Another explanation which may account for the alteration in knee proprioceptive ability in patients with LBP may be due to that most of the muscles around the knee joint attached or originate from the lumbopelvic region. So, they are affected by the mechanical changes of this region due to LBP and impaired core proprioception.

The findings of this study were in line with the findings of a research work done by Pline et al., who investigated the effect of lumbar extensor fatigue and circumferential ankle pressure on the sense of the ankle joint motion and they concluded that muscle fatigue of the lumbar extensors decreased ankle joint motion sense (JMS) [30].

The results were supported by the work done by Brumagne and colleagues who examined the position sense during a lumbar repositioning task in control and LBP subjects and they concluded that LBP subjects showed a significantly lower repositioning accuracy than that of healthy subjects [31, 32].

The repositioning accuracy in LBP and healthy subjects was compared by Gill and Callaghan in two different tasks: (1) repositioning of the trunk in flexion, (2) repositioning of the lumber in a four-point kneeling position and they found that patients with CLBP showed increased absolute errors for the two tasks [33].

On the other hand the correlations between the LBP injuries history and the lumbar spine proprioception were studied by Parkhurst and Burnett and they reported that no significant correlation between injuries of low back and repositioning errors was found [34].

Also Newcomer et al., in one of their studies to compare between healthy and LBP subjects in repositioning accuracy, they observed no differences in repositioning accuracy of the trunk between them [35].

This variation in results may be due to the difference in protocols used in every study. Actually, variables such as repositioning amplitudes, starting positions, intervals between trials and learning of the task varied between experiments leading to many hypotheses for explanation of the observed results.

CONCLUSION

The results of the present study showed that the knee joint repositioning accuracy decreased in patients with CLBP as compared to healthy subjects. These results suggest that CLBP has a negative impact on the knee joint proprioception.

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