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EVALUATION OF STATIC AND DYNAMIC BALANCE IN SINGLE AND DUAL TASK CONDITIONS AMONG PATIENTS WITH CHRONIC NON-SPECIFIC LOW BACK PAIN - AN OBSERVATIONAL STUDY

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ABSTRACT
Aim and objective: The aim of the study was to assess the static and dynamic balance in single and dual task conditions among patients with chronic nonspecific low back pain. And also to evaluate the static and dynamic balance in single and dual task among healthy individuals.
Methods: An observational study was conducted on chronic non-specific low back pain patients among age group 25-50 years. Subjects were selected according to inclusion & exclusion criteria.
Results: One leg standing duration in single & dual task was significantly reduced in chronic non-specific low back pain patients (Group B) compared with Healthy Individuals (Group A). Anterior, Posteromedial and Posterolateral Cumulative reach distances in single and dual task are significantly reduced in (Group B) compared with (Group A).
Conclusion: Both static and dynamic balance were impaired in chronic nonspecific low back pain group (group B)
Keywords: chronic nonspecific low back pain, one leg stance test**,** y balance test, balance, postural control.

INTRODUCTION

Low back pain is a global problem and estimated that it has been the main cause of living with disability in 86 to 188 countries based on the Global Burden of Disease Study 2013. [1] Approximately 70% to 85% of people have experienced low back pain with recurrent symptoms at least once during their life and 4% to 33% of patients suffer consistently from chronic pain .[2] Nonspecific low back pain is defined as low back pain not attributable to a recognizable, known specific pathology (eg. Infection, tumour, osteoporosis, fracture, structural deformity, inflammatory disorder, radicular syndrome or cauda equina syndrome). Some researchers categorise low back pain on the basis of various combinations of timeframe, site, symptoms, duration, frequency, severity and exclusions). The published work usually distinguishes Acute, Subacute, and Chronic categories and stages of low back pain on the basis of duration of the episode. The respective cutoffs are typically less than 6 weeks for acute, 6-12 weeks for subacute, and more than 12 weeks for chronic low back pain. Muscles of lower back which has main functions during maintenance of posture are the Erector spinae, Multifidus, and Paraspinal muscles.

Balance is an important term describing the dynamics of body posture to prevent falling. [3] Static balance is the body's ability to maintain body balance in a still position and for a prolonged period of time. For e.g. standing. Dynamic balance is the body's ability to maintain balance when moving, such as walking, running, getting up from a sitting position and agility movements .[4] It has been proposed that balance impairments in LBP patients may correlate with deficits in the musculoskeletal and neural systems, such as compromised lumbar proprioception and delayed muscle response, which finally decrease lumbar stabilization.[5] According to Kibler et al. core stability and strength are the important components to maximize efficient balance and function in upper and lower extremity movements. So in subjects with chronic low back pain there results paraspinal and other trunk muscle weakness.[6] It leads to reduced postural stability, balance and neuromuscular control in subjects with CLBP.[6] Musculoskeletal and neural deficits such as impaired lumbar proprioception and delayed trunk muscle response can result in poor postural control in chronic low back pain. A review of literature indicates that improvement of postural control using rehabilitation training could alleviate pain in musculoskeletal conditions or disorders. Balance is an ability to maintain a posture through the interaction between the musculoskeletal system and the nervous system and to maintain a state of equilibrium while keeping the centre of gravity (COG) within the base of support (Nichols,1996)[8]. So, the ability to maintain balance is the most basic and indispensable element of daily

life and purposeful human activity (Cohen et al,1993) and is integral to the many tasks that require the adjustment of body posture and balance with regard to space[9].

Studies suggest that individuals with low back pain (LBP) have abnormalities in motor control of deep trunk muscles, characterized by delayed neuromuscular recruitment and changes in the lumbosacral proprioception[10,11]. Taken into consideration these abnormalities may predispose to instability and also decreased postural control observed in some experimental conditions[12].Pain seems to influence motor response in individuals with LBP, delaying and reducing the amplitude of oscillation of the centre of pressure (COP) on an unstable surfaces [13],as well as increasing oscillation of the COP in the sagittal and coronal planes [14,15,16]when they stand on one foot[17] .
The one leg stance test (also referred to as timed single limb stance, unipedal balance test and one -leg standing balance) is a simple test for measuring static aspects of balance that can be used in a variety of settings and requires minimal equipment or training [18]. The one leg stance test is a valid measure [19]considered to assess postural steadiness in a static position by a temporal measurement [20]. The y-balance test (YBT) derived from the star excursion balance test (SEBT) has been reported to be valid and reliable measure of dynamic balance[21,22,23,24]. Also the results of the YBT have been reported to be related to lower extremity impairments and to be predictors of injury [25,26].

Most of the literature review suggest of postural stability among sports professional and elderly population. But no study focuses on population with low back pain due to prolong working or sitting hours. Hence, the need of the study was to assess static and dynamic balance in subjects with chronic non-specific low back pain. Also to increase awareness of fall risks and progressing disability among them, prediction of injury, advice about proper ergonomics and design proper assistive devices for the same.

METHODOLOGY

An observational study was done at Dr. Ulhas Patil College of Physiotherapy, Jalgaon. The study duration was 6 months. Sample size of the study was 32 calculated by (G -power software) and then equally divided into 2 groups. Group A (n=16) Group B (n=16) and subjects were included according to inclusion and exclusion criteria. Inclusion criteria was -Age 25-50 years, both males and females, NPRS score 3-5 out of 10 for (Group B), non-specific chronic low back pain from at least 3 months for (Group B) and normal BMI. Exclusion criteria was history of spinal surgery for at least 3 months, lower extremity musculoskeletal dysfunctions, vestibular dysfunctions, trunk or spinal deformity, presence of nerve root compression resulting with neurologic symptoms & spinal pathologic conditions and auditory deficits.

PROCEDURE

Static balance was assessed by OLS in Single and Dual task. To evaluate one leg stance (OLS) for Single task &dual task the patients were instructed to stand on one leg with eyes open. One leg stance duration was measured on the leg by using stopwatch.

Single task in OLS
Fig 1- One leg standing on (RT) Leg single- task.

Dual task in OLS
Fig 2- One leg standing on (RT) leg dual -task.

Y-balance test which measures muscular strength, flexibility, and the proprioceptive sense of the lower limbs in three directions-AT (anterior), PM (posteromedial) and PL (posterolateral) with left leg supporting the body and the right leg stretched. For Right leg, the distance from the centre footrest to the tip of the stretched leg was measured in cm units. An attempt was regarded as a failure and measured again if the supporting foot (left) was removed from the ground, if the body was supported with the stretched foot (Lt) in order to keep balance or if the patient did not return to starting position. All the tests were carried out in 2 conditions: Single task (performance of the test alone), Dual manual task (performance of the test while carrying a cup of water with the surface of water 3 cm from the edge). The whole procedure was demonstrated to the individuals. The individuals with shoe off, stood on one leg (Lt) at the marked tape, with both hands on the hips. While maintaining single leg stance, the subject was asked to reach with the free leg (Rt)in the Anterior, Posteromedial and Posterolateral directions. The distance from the centre of footrest to the tip of stretched leg(rt) was measured by measuring tape in cm units. The testing order was reaching in the anterior direction, then posteromedial followed by posterolateral direction. The leg length was measured from ASIS to medial malleolus with measuring tape in cm units to normalize leg length in analysis of y balance test. 3 practice trials were done for each direction and the maximum value was taken for final analysis. For interpretation of Y balance test the sum of all maximum reach distances taken in 3 directions divided by the leg length and then multiplied by 100, which gives the final composite value in percent.

SINGLE TASK IN Y BALANCE TEST

Fig.3- Y balance test posteromedial direction in single task

DUAL TASK IN Y BALANCE TEST

Fig. 4 - Y balance test posteromedial direction in dual task

STATISTICAL ANALYSIS

The data and measurements of subjects was entered in MS Excel before it was statistically analysed. Means and standard deviations were calculated for all the needed variables. Statistical analysis was carried out using GraphPad InStat version 3.05. The statistical analysis was done using unpaired t-test. The unpaired t-test was used for between group statistical analysis to compare healthy group and CNLBP patient's group. Normality test -Statistical significance was set at $p > 0.10$.

RESULTS

Total 32 individuals were taken in the study. Divided into 2 groups- Healthy group A (n=16) & CNLBP group B (n=16). Mean age of the individuals in group A was (36.50 + 8.9) & for group B was (44.94 + 7.0) Mean values were taken for both tests (OLS) & (YBT) in both single and dual tasks and then compared within group A & B.

1.Baseline data for distribution of age and BMI in healthy participants (Group-A) and CNLBP participants (Group-B)

Table-1

Variables	Mean ± Std. Deviation	
	GROUP A	GROUP B
Age	36.50 ± 8.89	44.94 ± 05
BMI	22.58 ± 2.024	23.82 ± 1.20

Comment- Table 1 depicts the mean age of the participants. There were 16 participants in the group between age group 25-50 yrs. The mean age was 36.50 for the Group A [Healthy]. The mean age was 44.09 for the Group B [CNLBP] patients.
Table 1. depicts the mean BMI for groups. Mean BMI for group A (HEALTHY) was 22.58 and for group B (CNLBP) was 23.82.

2.Baseline data for gender distribution of healthy participants (Group-A) and CNLBP (Group- B)
The frequency of gender distribution for male was 1 and females were 15 and percentage for male was 6.3% and females were 97.8% same for both the groups i.e group A and group B.

3.Intergroup comparison of mean and std. deviation of One leg stand (single task) and (dual task) test

Table-2

	Groups	Mean ± SD	T-value	p-value	Significance
Single task	Group A	44.06± 5.497	6.206	0.0001	Extremely significant
	Group B	8.875 ±1.390			
Dual task	Group A	40.18 ± 37.98	3.557	0.0013	Very significant
	Group B	6.125 ± 4.911			

Table-2 depicts group comparison of mean of OLS duration in single task. Analysis using unpaired t- test shows that comparison of group A and group B was statistically extremely significant with p value of 0.0001. It shows OLS duration was significantly reduced in group B [CNLBP] than group A [Healthy] also, Table 3 depicts group comparison of mean of OLS duration in dual manual task. Analysis using unpaired t-test shows comparison of group A and group B was statistically very significant with p-value of 0.0013. It shows OLS duration in dual task was significantly reduced in group B [CNLBP] than group A [Healthy].

4.Intergroup comparison of mean and std. deviation of Y balance (single task) and (dual task) test

Table 3

	Groups	Mean ± SD	T-value	p-value	Significance
Single task	Group A	83.25 ± 8.55	9.017	0.0001	Extremely significant
	Group B	57.43 ± 7.61			
Dual task	Group A	81.87± 10.74	7.57	0.0001	Extremely significant
	Group B	54.25 ± 9.62			

Table-3 depicts group comparison of mean of YBT distance in single task. Analysis using unpaired t- test shows that comparison of group A and group B was statistically extremely significant with p value of 0.0001. It shows YBT single task distance was significantly reduced in group B [CNLBP] than group A[Healthy] also, Table-4 depicts group comparison of mean of YBT distance in dual task. Analysis using unpaired t- test shows that comparison of group A and group B was statistically extremely significant with p value of 0.0001. It shows YBT dual task distance was significantly reduced in group B [CNLBP] than group A [Healthy].

DISCUSSION

The main aim of this study was to assess static and dynamic balance among patients with CNLBP & then compare with healthy individuals also to identify whether a balance problem exists in back pain patients in order to understand lower back disorder mechanisms.[30]

The differences between the 2 groups with and without NCLBP may be related to trunk muscle fatigue, weakness, loss of mobility, sensory motor deficits which consequently affects on balance. It can be as a result of base of support as the inter-malleolar distance was kept constant (15 cm) for both the groups, showing that CNLBP subjects found difficulty in maintaining stability within the base of support.[6] Also musculoskeletal strength is crucial for the first 5 seconds of the single leg stance test.[34]

One leg standing was difficult for the back pain patients as there seems increased body sway. Y balance test which measures the dynamic balance shows that the patients with CNLBP could not stretch the leg to reach the maximum distance due to pain, fear of fall & decreased confidence level in balancing. Dual manual task adds difficulty to their level of balancing and reaching the leg to maximum limit hence decreasing the reach distance showing significant decrease in balance.

YBT can make a better evaluation of the movements of subjects because it can check the stretched distance, determine success or failure by checking whether the foot used for balancing is removed from the ground .[22] The findings of the current study shows that SLST could be incorporated as part of a screening protocol to identify women at increased risk in their 40's and 50's who could experience falls without effective active management.[36]

In summary chronic non-specific low back pain disorders can be associated with neuromusculoskeletal alterations and decreased neurophysiological function, which in turn can lead to problems such as trunk fatigue, weakness, loss of mobility, sensory motor deficits and consequently affects the balance.[31]

CONCLUSION

One leg standing duration in single & dual task was significantly reduced in CNLBP (Group B) compared with Healthy Individuals (Group A) hence static balance was impaired in CNLBP group. Anterior, Posteromedial and Posterolateral Cumulative reach distances in single and dual task were significantly reduced in (Group B) compared with (Group A) hence dynamic balance was impaired in CNLBP.

CLINICAL IMPLICATION

Balance tests in LBP patients should be done in clinical practice to assess them and then interventions like increasing core muscle strength, improving postural control & balance re-training can be done.

LIMITATIONS

Inaccurate measurements may be introduced by visual error of the inspector, fatigue or practise effect on patients.

FUTURE SCOPE

Based on the balance evaluation by YBT along with Functional movement screen (FMS) "Move 2 perform Algorithm software" (a computer application), patients then categorized according to risk level (Normal, Slight increased risk, moderate increased risk and substantially increased risk).

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