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Original Research Article

Comparative Study of Motor Control Exercises and Global Core Stabilization Exercises on Pain, ROM and Function in Subjects with Chronic Nonspecific Low Back Pain- A Randomized Clinical Trial

Jayanta Chakraborty[1], Pravin Kumar[2], Bibhuti Sarkar[3]

[1]Professional Trainee (PT), [2]Asst. Prof (PT), [3]Demonstrator (PT), Department of Physiotherapy, National Institute for Locomotor Disabilities (Divyangjan), Kolkata, West Bengal, India.

Corresponding Author: Jayanta Chakraborty

ABSTRACT

Background and purpose: Chronic nonspecific low back pain is one of the most common health problems. Motor control exercises and global core stabilization exercises are commonly prescribed to treat low back pain. The purpose of study was to compare the effectiveness of motor control exercises and global core stabilization exercises on pain, ROM and function in subjects with chronic nonspecific low back pain.
Study design: Randomized clinical trial.
Subjects and methods: Total of 35 subjects with chronic nonspecific low back pain were included as per inclusion & exclusion criteria through randomized method and divided into two groups A & B. 3 subjects (Group-A: 1, Group-B: 2) were dropped out due to personal reason. Group-A consist of 16 subjects with mean age 32.12±8.39 (8 males & 8 females) received motor control exercises and Group-B consist of 16 subjects received global core stabilization exercises mean age 31.81±7.67 (11 males & 5 females), thrice/week for four weeks. Outcome measurements were taken on Day 1 pre treatment and after 4 wk post treatment for pain by NPRS, ROM by Modified Schober Test (MST) and function by ODI.
Results: At the start of treatment there was no significant difference ($p>0.05$) between groups related to age, gender, NPRS, MST & ODI. There was significant ($p<0.05$) improvement in NPRS, MST & ODI in both group A & B after 4 wk of treatment but when we compared between group A & B; Group-A showed significant ($p<0.05$) improvement in NPRS, MST & ODI compared to group B.
Conclusion: The results of this study suggest that motor control exercises are more effective on pain, ROM & function when compared to global core stabilization exercises.

Key words: Nonspecific low back pain, Pressure Biofeedback Unit, Motor control exercises, Global core stabilization exercises.

INTRODUCTION

Nonspecific low back pain is tension, soreness and/or stiffness in the lower back region for which it is not possible to identify a specific cause of the pain. Several structures in the back, including the joints, discs and connective tissues, may contribute to symptoms. [1]

LBP may be classified as mechanical, non mechanical and psychogenic. Mechanical LBP may be specific or nonspecific. According to its duration, LBP may be acute (sudden onset and lasting less than six weeks), sub acute (lasting six to twelve weeks), chronic (lasting longer than twelve weeks) and recurrent. [2]

Low back pain (LBP) is experienced in 60%–80% of adults at some point in their lifetime. Andersson estimated the annual worldwide LBP incidence in adults to be 15% and the point prevalence to be 30%. [3] Some studies have demonstrated that LBP is one of the most common causes of visits to a physician and that men and women are equally affected by LBP. Generally most episodes of low back pain are not serious disease and it is self limiting. Initial aim is to distinguish the little proportion of patients with specific underlying conditions and sometime it may be life threatening disorders associated with severe nerve root pain with nonspecific mechanical low back pain. Progression of low back pain from acute to chronic episode may depend on individual factors (poor educational level, obesity, severe pain and disability), psychological (depression, distress and anxiety) and job related hazards. Trunk muscles strength, imbalance of trunk muscles, incorrect activation of erector spinae muscles have been shown to be contributory factor for nonspecific low back pain.

Two types of muscle fibres comprise the core muscles: slow-twich and fast-twich. Slow- twich fibres make up primarily the local muscle system (the deep muscle layer). These muscles are shorter in length and are suited for controlling intersegment motion and responding to changes in posture and extrinsic loads. Key local muscles include transversus abdominis, multifidus, internal oblique, deep transversospinalis, and the pelvic floor muscles. Multifidi have been found to atrophy in people with chronic low back pain. [4]

On the other hand, fast-twich fibres comprise the global muscles system (the superficial muscle layer).These muscles are long and possess large lever arms, allowing them to produce large amounts of torque and gross movements. Key global muscles are erector spinae, external oblique, rectus abdominis muscles, and quadratus lumborum (which McGill states a major Global stabilizer of the spine). [5]

The transversus abdominis has received attention for its stabilizing effects. It has fibers that horizontally (except for the most inferior fibers, which run parallel to the internal oblique muscle), creating a belt around the abdomen. “Abdominal draw in” of the abdomen creates isolated activation of the transversus abdominis. The transversus abdominis and multifidus have been shown to contract 30 ms before movement of the shoulder and 110 ms before movement of the leg in healthy people, theoretically to stabilize the lumbar spine. [6, 7]

Motor control exercises are isolated exercises of the deep spinal muscles (transverse abdominis, multifidus) where as Core stability is achieved by global strengthening. There are not many studies available in the literature which has compared the effect of motor control and global core stabilization on subjects with chronic nonspecific low back pain. The outcome of this study helps in planning, better exercise protocol for treating LBP. So this study was done to compare the effect of motor control exercises and global core stabilization exercises on pain, ROM and function in subjects with chronic nonspecific LBP.

METHODOLOGY

The study was conducted between March 2018 to February 2019 at NILD, Kolkata. Ethical approval from the Institutional Ethical Committee (IEC) for this study was taken. 45 subjects (Age between 20-45 years for both genders) with chronic low back, pain intensity of 3-8 on Numeric Pain Rating Scale (NPRS) and duration of at least 3 months were approached with the proposal of the study.

Subjects were excluded if they had Spinal pathologies like fractures, tumor and deformities, nerve root compromise (spondylolisthesis, spinal stenosis, disc herniation or any radiating pain below the knee), spinal surgery, neurological disorder (CVA, Parkinson disease etc), Acute infection or acute systemic disorder, metabolic or vascular diseases, pregnancy, and non-cooperative or psychiatric subjects. In this study total subjects (n=10) were excluded due to not meeting the inclusion criteria (n=6) and unable to attend for the procedure (n=4).

Informed consent was taken from all subjects who agreed to participate and demographic data, baseline pain intensity after activity on NPRS scale, [8] lumbar flexion and extension range of motion measured by Modified Schober test (MST) [9] and function by ODI score [10] was taken at pre intervention. Randomization of the subject was done using a convenient sampling and the Subjects (n=35) were allocated in Group-A (n=17, Motor Control Exercises), and Group-B (n=18, Global Core Stabilization Exercises). A hand out consisting of exercise diagram and dosage was given to each subject of both groups to maintain adherence to the exercise program.

Total three subjects were dropped out from both groups within two weeks of intervention due to health related issues (n=1) from Group A and personal reasons (n=2) from Group B. Post intervention data was collected after four weeks of treatment and on the final day of intervention at 4th week.

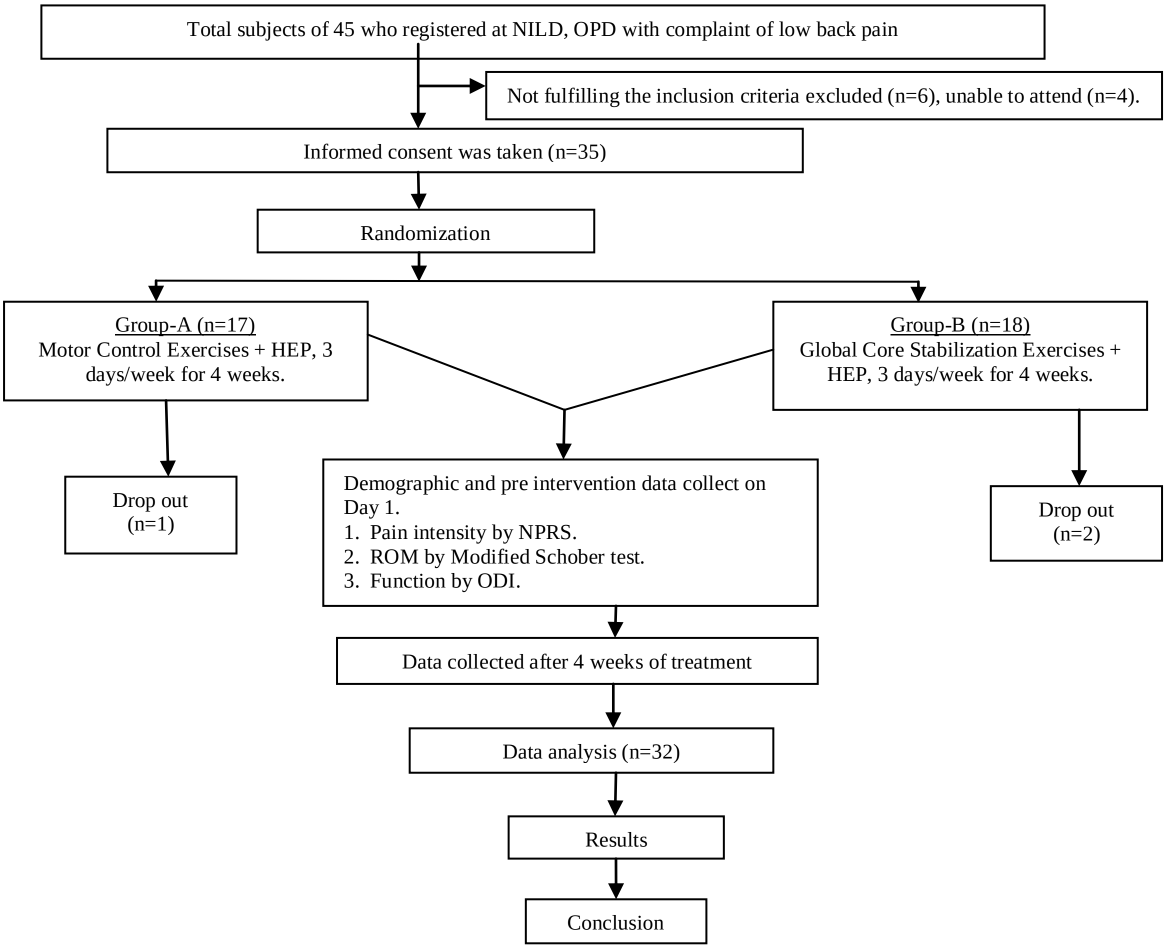

Fig 1: Consort flow diagram

Interventions:

Both A and B group prior to start of exercise program warm-up and simple stretching received for iliopsoas, hamstrings and back muscles. Subjects instructed for same protocol of home exercise program (HEP). Group-A received motor control exercise program with low load activation of the local stabilizing muscles was initially administered, isometrically and in minimally loading positions. Subjects were explained that the muscle encircles the trunk when activated, the waistline draws inward (Abdominal drawing in maneuver). Subject was instructed to "take a relaxed breath in and out", hold the breath out and then draw in subject lower abdomen without moving the spine. [11] Independent contraction of transversus abdominis is achievable through the abdominal drawing in maneuver (ADIM), however learning and teaching an accurate ADIM can be time consuming and difficult. The pressure biofeedback unit (PBU) used for clinical evaluation of the abdominals, but it can also provide feedback to subjects who are receiving the motor control training. In the supine position, the PBU is placed below the lumbar lordosis and air is infused into the bulb to create a pressure of 40 mmHg, pressure increases of 0-2 mmHg also resulted in significantly decreases in the IO+EO (internal obliques and external obliques) contraction. In the prone position, the PBU is placed between the navel and the ASIS and air is infused into the bulb to create a pressure of 70 mm Hg. A decrease of 4 mmHg in pressure in performance of the active drawing in maneuver is believed to indicate a successful result of the exercise, whereas a 4-10 mmHg pressure decrease indicates independent contraction of Transverse Abdominis. [12]

Motor control exercises are following the sequence breathing exercise in hook lying position, abdominal draw in supine with pressure biofeedback, abdominal draw in prone with pressure biofeedback, quadruped position and abdominal draw in, sitting position and abdominal draw in, after two weeks progressively introducing abdominal draw in with hip abduction and abdominal draw in with heel slide with pressure biofeedback unit. All exercises are done10 repetitions 10 second hold and 2 minutes rest given after every exercise.

Group-B received Global core stabilization exercises according to Core stability exercise principles (Venu Akuhota et al.). [13] Abdominal bracing technique should be initiated; all exercises advance if able to perform 30 repetitions with 8 second hold. The exercises following the sequences abdominal bracing with heel slides, abdominal bracing with bridging, quadruped arm lifts with bracing, quadruped leg lifts with bracing, quadruped alternate arm and leg lifts, side plunk with knees flexed and progression with knees extended after two weeks, trunk curl and progression with Swiss ball after two weeks.

DATA ANALYSIS

The data were recorded in the data collection form as shown in the master chart and tabulated for statistical analysis. All data was analysed using SPSS version 23 software. Chi square test was used to check male: female homogeneity. "Paired sample t test" was used to analyze within groups comparison for variables NPRS, MST and ODI. "Independent sample t test" was used to analyze between groups comparison for variables NPRS, MST and ODI. The p value was set at <0.05.

RESULTS

There were total 32 subjects (19 males and 13 females) with Chronic Nonspecific Low back pain were randomly distributed into two groups, Group–A consisted of 16 subjects (08 males and 08 female) with mean age of 32.12±8.39 and Group-B consisted of 16 subjects (11 males and 05 females) with mean age of 31.81±7.67. Both the groups were homogeneous at baseline as there was no significant ($p>0.05$) difference between groups related to age, weight, height and BMI and dependent variable NPRS, MST & ODI (Table-01).

Within group analysis both Group-A and Group-B showed significant ($p<0.05$) improvement in pain, ROM and function after 12 sessions of treatment. "Paired sample t test" was used to analyze within groups comparison for variables NPRS, MST and ODI (Table-02 and Table-03).

TABLE-01: DEMOGRAPHIC DATA AND DEPENDENT VARIABLES IN BOTH GROUPS BEFORE STARTING THE TREATMENT

	Group A (n=16)	Group B (n=16)	Independent t test		Results
			t-values	p-values	
AGE (Mean, SD)	32.12 ± 8.39	31.81 ± 7.67	0.110	0.913	Non significant.
WEIGHT (Mean, SD)	62.12±11.39	65.62± 10.14	-918	0.366	Non significant
HEIGHT (Mean, SD)	163.44±10.77	163.86±9.778	-114	0.910	Non significant
BMI (Mean, SD)	23.13±2.859	24.65±3.600	-1.316	0.198	Non significant
NPRS (Mean, SD)	6.500 ± 0.966	6.312±0.743	0.535	0.913	Non significant.
MST FLEXION (Mean, SD)	3.406±0.757	4.031± 0.694	-2.433	0.135	Non Significant
MST EXTENSION (Mean, SD)	1.219±0.446	1.468±0.498	-114	0.146	Non Significant
ODI (Mean, SD)	49.813±11.297	47.625±6.781	-1.316	0.512	Non Significant

TABLE-02: WITHIN GROUP-A PRE & POST TREATMENT COMPARISONS

Variables	Pre Treatment Mean ± SD	Post Treatment Mean ± SD	t- Value	p-Value
NPRS	6.500±0.96	1.375±0.88	18.845	0.000
MST FLEXION	3.406±0.757	5.750±0.408	-12.952	0.000
MST EXTENSION	1.219±0.446	2.138±0.340	-6.721	0.000
ODI	49.813±11.297	7.563±8.469	10.543	0.000

TABLE-03: WITHIN GROUP-B PRE & POST TREATMENT COMPARISONS

Variables	Pre Treatment Mean ± SD	Post Treatment Mean ± SD	t- Value	p-Value
NPRS	6.312±0.704	3.250±1.437	9.141	0.000
MST FLEXION	4.031±0.694	5.062±0.573	-6.398	0.000
MST EXTENSION	1.468±0.498	1.843±0.436	-3.873	0.002
ODI	47.625±6.781	24.937±9.490	10.543	0.000

On Comparison between two groups, Group-A showed statistical significant ($p<0.05$) improvement in NPRS, MST and ODI after 12 sessions of treatment when compared to Group-B (Table-04).

TABLE-04: COMPARISONS BETWEEN GROUP-A AND GROUP-B SUBJECTS AFTER TREATMENT

Variables	Group A Mean±SD	Groop-B Mean±SD	t- Value	p- Value
NPRS POST	1.375± 0.885	3.250 ± 1.437	-4.443	0.000
MST FLEXION POST	5.750±0.408	5.062±0.573	3.905	0.000
MST EXTENSION POST	2.138±0.340	1.843±0.436	2.123	0.042
ODI POST	7.563 ±8.469	24.937 ±9.490	-5.464	0.000

DISCUSSION

In case of chronic LBP deep/local stabilizing muscles of lower back region, multifidus, transverse abdominis and pelvic floor become dysfunctional; Howard A Knudsen stated that no other treatment approach targeted these specific deep stabilizing muscles. So the function and dysfunction of these local muscles is important to treat low back pain. [14] The local stabilizers are very important to give the segmental stability by their anatomical position. Among the abdominal muscles, the transversus abdominis is of particular interest as a spinal stabilizer because of its anatomical characteristics, on the other hand multifidus is one of the smallest most powerful muscle that gives stability to the spine, muscle consist of a number of fleshy and tendinous fasciculi, which fill up the groove on either side of the spinous processes of the vertebrae, from the sacrum to the axis and provide segmental stability. [15] So, if these in particular become dysfunctional low back pain is achieved.

The significant improvement in motor control exercise group compared to core stabilization. The exact biological basis for the efficacy of motor control exercises in patients with nonspecific low back pain is still unclear. [16] But if subjects can be taught to control their trunk muscles while performing functional activities, then this may explain the improvements seen in activity, activity limitation and global impression of recovery. There is some evidence that this training can change trunk muscle behavior during functional tasks. A range of mechanisms have been proposed to explain the effect of motor control training on pain. These mechanisms include reduced load and improved quality of movement, as a result of improved coordination of trunk muscles. Such changes in control may mediated by plastic changes at the motor cortex or elsewhere in the motor system. [17,18] Core stabilization exercises have beneficial effect both the groups by reducing pain and disability of patients with low back pain as the segmental muscles worked out. [19]

The result of this study indicates that all the subjects have better improvement in pain perception both in Group-A and Group-B. But in comparison between the two groups, motor control exercises (Group-A) showed statistically significant improvement on pain intensity which was measured by NPRS.

Pain can cause changes in motor control; this was several key implications for re-education of motor control in subjects with chronic nonspecific low back pain. 'Fear' or anticipation of pain and (re)injury may be one of the factors which cause development of motor control changes. The demand for accurate motor control is likely to be increased in people with low back pain because of microtrauma to the passive elements of the spine. If passive support is reduced, this must be compensated by changes in motor control. Therefore, motor control must be adapted to compensate for this reduction in stability of control. The important issue is that numerous changes occur in the nervous system, including plastic changes in the spinal cord and higher centre, as well as changes in the periphery. Motor control education makes a patient responsible for their own recovery; this may lead to positive outcomes in terms of changing the patient's locus of control, which is an important aspect of cognitive behavioral approaches.

Between the groups, there was statistically significant improvement for Group-A on lumber flexion and extension measured by MST compared to Group-B. The local/deep and superficial/global abdominal muscles are commonly affected in an opposite manner by the presence of pain. Hypothetically, this may result in reduced efficiency of fine-tuning of intervertebral control. As mentioned above, the global muscles are inefficient for controlling intervertebral motion and can only do so at the 'cost' of increased spinal loading and co-activation. This follows the hypothesis of Cholewicki et al (1999), who suggested that excessive activity in superficial muscles might be a measurable compensation for poor passive or active segmental support. [20, 21] So, re-education of the local/deep muscles restores the normal fine tuning of intervertebral motion which facilitated to increase ROM.

In this study on comparison between groups Group-A subjects showed significant decrease in functional disability as rated on ODI questionnaire. Pain is the main factor that leads to disability in subjects with chronic nonspecific low back pain. Rationale behind improvement in disability might be due to ease in pain that leads to less suffering in daily activities i.e. sitting, standing, lifting heavy weight. As the subject's pain decreased it leads to an improvement in ODI scores. In the feedback- mediated control, the neural control system initiates a response of the trunk muscles to afferent input from an unpredicted perturbation (Massion, 1992). [22] Changes in a variety of reflex responses have been identified in musculo-skeletal pain syndromes (Leinonen et al 2001). [23] Recent studies have also identified changes in the activity of transversus abdominis. Changes in muscle thickness, fascicle pennation angle and fascicle length can be measured with ultrasound imaging and are related to muscle activity (Herbert and Gandevia 1995). [24] When healthy individuals performed gentle isometric leg efforts, automatic recruitment of transversus abdominis could be detected. Motor control exercises improve the strength of transversus abdominis which are ultimately given the stability of lumbo-pelvic region and improving the function also. Injury to the joints and structures has devastating effects on muscles surrounding the joints. The effects are rapid, localized, potent and long lasting. The muscles surrounding and intimately linked to the joints are the most affected in subjects with chronic nonspecific subjects and functional disability increases. Motor control interventions are the isolated exercises which protect the joints in conditions of joint injury and deloading, improving the strength and prevent the atrophy of local/deep muscles. Thus, overall improves the desired function.

CONCLUSION

The Motor Control Exercises showed statistically significant improvement in pain, ROM and function when compared to Global Core Stabilization Exercises in subjects with chronic nonspecific low back pain.

Limitations and Suggestion

This single centre study was conducted with a small sample size, without any follow up period. A long follow up may be included to find out long efficacy. Future multicentre studies may be conducted with real time ultrasound imaging of local muscles, to examine diagnose and treat, EMG biofeedback can be used for quantifying muscle activity.

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