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EFFECTIVENESS OF CORE STABILIZATION EXERCISES AND MOTOR CONTROL EXERCISES IN PATIENTS WITH LOW BACK ACHE

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ABSTRACT

Background: Motor control exercises are isolated strengthening exercise for the deep spinal muscles (transverse abdominus, multifidus) whereas Core stability is achieved by global strengthening of the core muscles. There are not much studies available in the literature done or studied the short term effect of the motor control and core stabilization on subjects with low back pain. Therefore, the purpose of this study to find the comparative effect of motor control exercises versus core stabilization exercises on improvement of pain and disability in subjects with mechanical low back pain.

Method: An experimental study design, 30 subjects with non-specific mechanical low back pain were randomized into 2 groups with 15 subjects each in Group A and Group B. Subjects in Group A received Motor control exercises and subjects in Group B received Core stability exercises. Both the group received conventional exercises. The duration of intervention was given for two weeks. Outcome measurements such as pain using VAS, Functional disability using Oswestry Disability Index Questionnaire were measured before and after two weeks of intervention.

Results: Analysis using paired 't' test and wilcoxon signed rank test found that there is a statistically significant improvement ($p < 0.05$) in pain, functional disability within the groups. Comparative analysis using independent 't' test and Mann Whitney U test for comparison of difference in improvement in VAS and ODI between two groups, it was found that there was significant difference in improvement of VAS and ODI between groups. Group-A showed better improvement in VAS and ODI compared to Group B with an effect size of 1.47 and 0.99 respectively.

Conclusion: It is concluded that the Motor control exercises showed statistically significant improvement in reducing back pain and disability when compared to the Core Stabilization exercises. Thus, performing Motor Control exercises reduces pain and disability significantly compared to Core stabilization among non specific mechanical low back ache subjects.

Key words: Motor control exercises, Mechanical low back pain, Core stability exercises, pain, functional disability, visual analogue scale, Oswestry Disability Index.

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INTRODUCTION

Mechanical low back pain is described as a musculoskeletal pain which varies with physical activities and not involving root compression or serious spinal diseases. Usually, it is unilateral pain with no referral below the knee may be caused by injury to the muscles or ligaments, the facet joint, or in some cases, the sacroiliac joint.[1] Lower back pain is expected to affect up to 90% of the world's population at some point in their life. In India, approximately 35% people suffer from chronic back pain, which significantly hampers their day-to-day routine.[2, 3]

Effective management of this condition is vital not only for the relief of symptoms but perhaps more importantly for the prevention of recurrent episodes of back pain personal suffering and lost work productivity. A number of studies have demonstrated a reduction in the strength and endurance capabilities of back muscles in patients with chronic low back pain.[4] Studies on individuals with low back pain have identified impairment in the control of the deep trunk muscles (e.g. Transversus abdominis and multifidus) responsible for the stability of spine.[3]

Various methods are used to treat patients with back pain. There is evidence that conventional therapy can be effective for the relief of pain and restoration of motion in the short term, but this therapy has not met the challenge of lessening persistent and recurrent episodes of back pain. This was also our clinical experience and, in addition, general back exercises appeared to have equal limitations for the goal of controlling pain and preventing recurrent or persistent episodes of pain.[5]

Motor control exercise was developed based on the principle that individuals with low back pain lack control of the trunk muscle. The idea of using motor control learning approach to retrain the optimal control and coordination of the spine. The intervention involves- pre activation of the deep trunk muscles, with progression toward more complex static, dynamic, and functional task integrating activation of deep and global trunk muscles.[3,6]

Core strengthening has become a major trend in rehabilitation. Core strengthening is the essence, a description of the muscular control required around the lumbar spine to maintain functional stability.[6] It is a preventive regimen as a form of rehabilitation and as a performance- enhancing program for various lumbar spine and musculoskeletal injuries.[3] Principle of core stability has been accepted widely in training for the prevention of injury as well as for treatment for various musculoskeletal conditions.[7]

Motor control exercises are isolated strengthening Exercises of the deep spinal muscles (transverse abdominus, multifidus).[7] Core stability is achieved by global strengthening.[8-10] There are not much studies available in the literature done or studied the short term effect of the motor control and core stabilization on subjects with low back pain. The outcome of this study helps in planning, better treatment of low back pain which if not treated can lead to chronic problem and may have effect on social life.[3,4] Therefore, the purpose of this study to find the comparative effect of motor control exercises versus core stabilization exercises on improvement of pain and disability in subjects with mechanical low back pain. It was null hypothesized that there is no significant difference between motor control exercise and core stabilization exercise in reduction of pain and disability in patients with mechanical low back pain.

METHODOLOGY

A comparative experimental study design with two groups- Group A: Motor control exercise and Group B: Core stabilization exercise. As this study involved human subjects the Ethical Clearance was obtained from the Ethical Committee of The Oxford college of Physiotherapy, Bangalore as per the ethical guidelines of Bio-medical research on human subjects. Subjects included who were diagnosed with non specific mechanical low back pain aged 30-45 years, both male and female, with minimum to moderate disability (up to 40%) on Oswestry Disability Questionnaire, with VAS of below 5cm score, Subjects who are willing to participate in the study. Subjects were excluded with any previous or current experience in core strengthening, Subjects who are on regular fitness program, Past history of fractures (spine, rib) or injury, Past history of abdominal surgery, Any other systemic illness, Spinal or disc pathologies. Subjects were recruited from The Oxford Physiotherapy OPD, and The Apollo clinic, JP Nagar, Bangalore. The study was conducted at The Oxford Physiotherapy OPD, Bangalore. Subjects who meet inclusion criteria were recruited by Simple random sampling method using lottery method, randomly allocated subjects into two groups. Subjects were unaware of their group allocation and to ensure that the criteria were fulfilled. Total 30 Subjects (n=30) who meet inclusion criteria, 15 in each group, were informed about the study and a written informed consent was taken. The duration of intervention in the study was 2 weeks.

PROCEDURE OF INTERVENTION FOR GROUP A:

Subjects in this group received motor control exercises[6,7] with conventional exercises under supervision.

STAGE-I -FIRST WEEK: 8 reps

Involves exercises aimed at retraining multifidus and transverse abdominus, these exercises were supplemented with exercises for the pelvic floor muscles, breathing control and control of spinal posture.

1. Isolation of Transversus Abdominis and training:

Step 1: Subject in supine with neutral position of the spine (gentle anterior curve in the lumbar spine). Assistant was given to the patient to press their lumbar back to the ground thus making a posterior tilt at the pelvis. Instruction was given to patient to place their hands on ASIS and lift the scapula till the inferior angle, simultaneously breathe in and out while contracting Transversus abdominis. Move with each breath- exert with exhalation, breathe in to rest or hold.

Step 2: Strengthen the co activated core- Once the patient has learnt to isolate the Transverse abdominis, isolation and activation was supervised to perform in many different positions- i.e. sitting, standing, and bending over. Later the exercises were slowly progressed to the following exercises: a. In side lying- the patient keeps their ankles together and lift their top knee, then the ankle, then extend leg, then flex the leg, return the ankle and finally the knee; b. Supine with knees and hips flexed- instruct the patient to lift the right foot off the floor and then the left foot off the floor. Alternate leg extensions making sure a proper strategy for core stabilization. Exert with exhalation, breathe in to rest or hold.

2. Isolation of Multifidus and training:

Patient in Side-lying with spine in neutral posture. Hips are flexed. Therapist palpates the multifidus to isolate (find the spinous process and then fall off into the gutter just sideways from the bone). If multifidus deficit it feels like a hole or soft spot compare to the opposite side. Instructions: Step 1: Patient was instructed to imagine guy wire running from the inner part of the thighs, up into the groin, through the pelvis, to the finger palpating the multifidus. Ask patient to breathe in and on the breath out contract the multifidus with the image or connect the leg firmly along the guy wire (think about drawing the thigh into the pelvis). The patient was instructed to think about suspending, or lifting, the vertebra slightly off the one below (like lifting the lid of a tea pot). No actual movement of the hip, pelvis or spine should occur. The contraction of the multifidus should feel like slow, firm 'swelling' under the therapist finger much like air filling up a ballon therapist should not feel a rapid contraction. Hold the contraction without becoming rigid, and continue to breathe. Involves the increase in complexity of the exercise by progressing through a range of functional tasks and exercises targeting coordination of trunk and limb movement and maintenance of trunk stability.[6, 7, 8]

Step 2: Strengthen the co activated core: Once patient can isolate the multifidus, and Transversus abdominis can practice this isolation in many different position, sitting, standing, bending over etc. Once patient can turn the muscle on easily patient progress to following exercise each progression below begins with a good core contraction (which include pelvic floor) and this connection should be held throughout the movement. Remember to move with control breathing pattern – exert while exhalation, breathe into rest or hold. Patient position: Side lying- While maintaining connection to multifidus, keep ankles together, lift top knee, then ankle, then extend leg then flex leg return ankle and finally knee.

STAGE-II: SECOND WEEK:- Motor Control Exercise -15reps with 5-10 sec hold

Step 3: Incorporate into other activities

The final step is to remember to use the core during regular life activities.

Isolation of Pelvic Floor: Patient lies on the back or side or sit with the spine in a neutral posture. Ask the patient to firmly palpate their abdomen. The patient was instructed to think about their muscles around urethra / vagina or the muscles that draw testicles up and then gently and slowly lifting the urethra, vagina or testicles up and forward into their abdomen. Also muscles around the anus and think about closing them (same movements was instructed to do after completing a bowel movement).

PROCEDURE OF INTERVENTION FOR GROUP B:

Subjects in this group received core stability exercises [8-10] with Conventional Exercises.

STAGE-I: FIRST WEEK:- 8 reps

1. Transversus Abdominus (Ta) Activation : Patient in supine and places his/her fingers 2 cm in and down from the ASIS. Asked the patient to draw in their pelvic floor. Also draw the belly buttom in and hold muscle contraction for 10 seconds.

2. Transversus Abdominus Marching: Patient lies supine and draws the pelvis floor and belly button in. Ask the patient to maintain the muscle contraction and lift one leg up, hold and then return to starting position. Alternate legs.
3. Pelvic Tilt: Patient in supine lying. Ask the patient to slowly tilt the pelvis into anterior and posterior.
4. Segmental Bridge: Patient in supine lying with both feet at hip distance apart. Ask the subject/ patient to tilt the pelvis (assist the patient) and slowly lift the pelvis off the mat. Ask the patient to move one vertebra at a time.

STAGE-II: SECOND WEEK: 15reps with 5-10 sec hold

5. Fall Out: Patient in supine lying, with both the feet and knee together. Instruct the patient to draw in the pelvic floor and also the belly button. Now ask/ assist the patient to slowly shift the knees 3 cms to the side while keeping the body still. Return to the middle and repeat on the other side.
6. Modified Crunch: Patient lying on their back with the hands by their ears. Instruction: lift up the head and shoulder off the mat.
7. Cat Stretch: Starting position: 4 point kneeling position maintain the neutral spine posture. Instruction: make a hump at the spine.
8. Back Extension: Patient in prone lying with the hands in line with the ears. Instruction: ask the patient to lift their head and shoulders off the mat (remember to lift one vertebra at a time.

EXERCISE FOR BACK EXTENSION[11,12,13]

Cool down exercise 5 - 10 minutes: At the end of each day exercise program, subjects were asked to do cool down exercises, which followed by stretching exercises. Again before starting the training for next session, the subjects were asked for any discomfort.

At the end of 2 weeks of motor control exercise and core stabilization exercise program, post test scores were measured for both the groups using same measurement tools.

Exercise were performed under the direct supervision of the Physiotherapist for Both the Groups.

Exercise Protocol[11,12]

Treatment Duration: 60 minutes.

It includes 5 - 10 Minutes of warm up and 5 - 10 Minute of cool down exercise Session & 30 - 40 minutes of Exercise Training with 2 minutes of Rest time between the sets. Treatment duration may vary between the subjects in Group A and Group B and based on subject performance.

Total duration: 2 Weeks

No. of Sessions: 5 Sessions per week and 1 session per day. 1st week: 8 reps 2nd week: 15reps with 5-10 sec hold

Common Warm up Exercises protocol for both the Groups 5 - 10 mins:[14] which consisted of spot jogging, followed by some free exercises, diaphragmatic breathing exercise and light stretches held for 15 seconds. Based on assessment (may vary with subjects), like hamstring, Hip flexors and low back muscles.

Outcome measures

Pre treatment scores were taken from the subjects, which included assessment of pain using visual analog scale (VAS), and the Oswestry disability index for functional disability. After completion of treatment period of 2 weeks, post treatment scores were taken to find out the difference between the pre and post treatment scores.

VAS: Pain was measured with the visual analog scale where subjects were asked to indicate on the scale, the severity of pain from the range of 0 (zero) no pain to 10(ten) most severe pain was measured.[15]

Oswestry Disability Index: The Oswestry disability index is based on ten questions, basically related to pain intensity, personal care, lifting, walking, sitting, standing ,sleeping, social life, traveling and employment/homemaking each followed by six alternatives . Each question is scored from 0–5, and the sum of the scores is then expressed as a percentage.[16] The Oswestry index seems to be capable of detecting a patient's functional disability in different spinal disorders. Oswestry Disability Index demonstrates good reliability in test–retest performance clinically at initial evaluation and up to 6 weeks following interventions. Questionnaires have similar responsiveness rates of 0·76–0·78 but two studies report a responsiveness rate of 0·94 for the Oswestry.[17]

Statistical Methods

Descriptive statistical analysis was carried out in the present study. Out Come measurements analyzed are presented as mean ± SD. Significance is assessed at 5 % level of significance with p value was set at 0.05 less than this is considered as statistically significant difference. Paired 't' test as a parametric and Wilcoxon signed rank test as a non-parametric test have been used to analysis the variables pre-intervention to post-intervention with calculation of percentage of change. Independent 't' test as a parametric and Mann Whitney U test as a non-parametric test have been used to compare the means of variables between

two groups with calculation of percentage of difference between the means. The Statistical software namely SPSS 16.0, Stata 8.0, MedCalc 9.0.1 and Systat 11.0 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

RESULTS

The study was completed with total 30 subjects (Table-1). In Group A there were 15 subjects with mean age 37 years and there were 10 males and 5 females were included in the study. In Group B there were 15 subjects with mean age 37.07 years and there were 9 males 6 females were included in the study. There is no significant difference in mean ages between the groups.

The comparison of pre and post scores of VAS within two groups (Table-2 and Graph-). It shows, in both the groups there was significant improvement between pre and post mean scores. In Group A (Motor control Exercise) when compared for pre and post mean score there was significant improvement from 3.8 ± 0.83 to 2.73 ± 0.85 with p value < 0.01* and Group B there was significant improvement from 3.73 ± 1.06 to 3.2 ± 1.06 with p value < 0.01*

The comparison of pre and post scores of ODI within two groups (Table-3 and Graph-2). In both the groups there was significant improvement between pre and post mean scores. In Group A when compared for pre and post mean scores there was significant improvement from 18.8 ± 6.56 to 16.53 ± 4.76 with $p < 0.01$* and in Group B there was significant improvement from 25.87 ± 7.64 to 24.8 ± 7.64 with $p < 0.01$* after 2 weeks of intervention.

The comparison of difference in improvement in VAS and ODI between two groups (Table-4 and Graph-3), it was found that there was significant difference in improvement of VAS and ODI between groups. Group-A showed better improvement in VAS and ODI compared to Group B with an effect size of 1.47 and 0.99 respectively.

Table 1: Basic Characteristics of the subjects studied

Basic Characteristics of the subjects studied		Group A		Group B		Between the groups Significance
Total number of subjects studied (n)		15		15		--
Age in years (Mean ± SD)		37±2.76 (35-45)		37.07±3.51 (42-30)		P < 0.05
Gender	Males	n = 10	66.7%	n = 9	60.0%	p = 0.705 (NS)
	Females	n = 5	33.3%	n = 6	40.0%	

Table 2: Comparison of Pre and post scores of VAS within groups

VAS	Group A	Group B
Pre-Intervention Mean ± SD (Min-Max)	3.8±0.83 (2-5)	3.73±1.06 (2-5)
Post-Intervention Mean ± SD (Min-Max)	2.73±0.85 (2-4)	3.2±1.06 (2-4)
P value	0.01*	0.01*
Z score	2.14	1.80
Effect size	1.27	0.5

*Statistically Significant difference $p < 0.05$; NS- Not significant

Graph 1: Comparison of pre and post scores of VAS within two groups

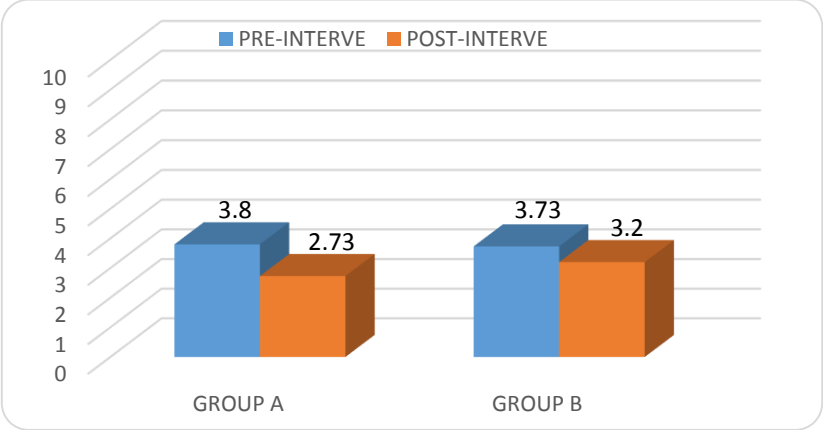


Table 3: Comparison of pre and post scores of ODI Index within two groups

ODI	Group A	Group B
Pre-Intervention Mean ± SD (Min-Max)	18.8±6.56 (6-32)	25.87±7.64 (14-40)
Post-Intervention Mean ± SD (Min-Max)	16.53±4.76 (8-26)	24.8±7.64 (14-38)
P value	< 0.01*	< 0.01*
Z score	2.32	2.32
Effect size	1.3	0.9

*Statistically Significant difference p < 0.05; NS- Not significant

Graph - 2: Comparison of pre and post scores of ODI Index within two groups

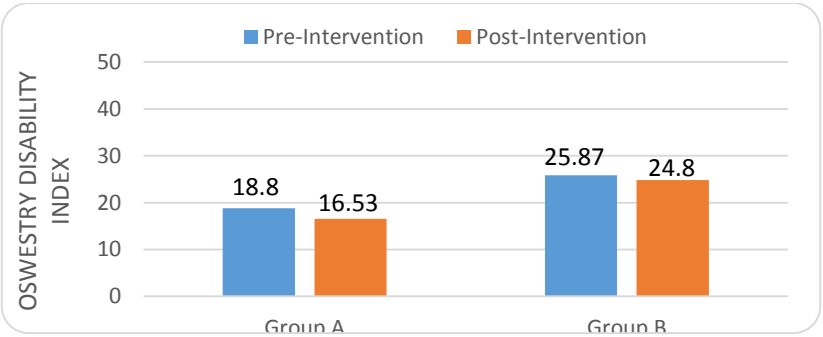
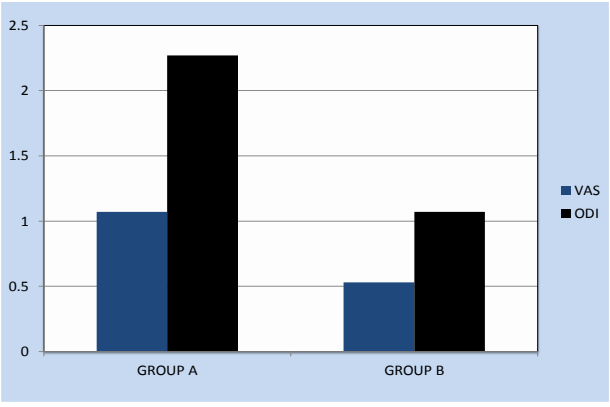


Table 4: Comparison of difference in improvement of VAS and ODI between groups

Study parameters	Group A(Mean)	Group B (Mean)	p value	Effect size
VAS	1.07 ± 0.02	0.53 ± 0.52	< 0.01*	1.47
ODI	2.27 ± 1.8	1.07 ± 0.99	< 0.01*	0.99

*Statistically Significant difference p < 0.05; NS- Not significant

Figure 3: Comparison of difference in improvement of VAS and ODI between groups



DISCUSSION

The primary aim of this study was to determine performing Motor Control exercises (specific stabilization Exercise) and the Core Stabilization resulted in reducing back pain and disability more effectively.

The group A subjects were allowed to perform Motor control exercises and group B performed Core stabilization exercises.

In order to check the effectiveness, the following parameters were taken for evaluation- Visual Analog Scale: the pain reduction on VAS scale in Group A (Motor Control) was statistically significant compared to Group B with p < 0.01* and effect size of 1.47. Oswestry Disability Index: the reduction in disability on ODI score in Group I

(Motor Control) was statistically significant compared to Group II with $p < 0.01^*$ and effect size of 0.99.

The improvement in pain and disability in both the groups may be due to improvement in strength and endurance level in both the groups or due to a combination of learning and training.

The significant improvement in Motor Control Exercise group compared to core stabilization, which may be due to the following reasons- Motor control training changes trunk muscle behavior during functional task. The mechanism included reduced load and improved quality of movement.[18] Plastic changes at the brain due to exercising the specific muscle (isolation). Howard A Knudsen,[14] stated that, No other treatment approach targeted the specific deep stabilizing muscles of lower back region, multifidus, transverse abdominis, and pelvic floor. These in particular become dysfunctional after experiencing back pain, so the function and dysfunction of these local muscles is important to treat the back pain. Reprogramming the brain for optimal stabilization targeting right muscle-for - right task. The subjects were more focussed and attentive towards the exercise during the training, The minimal changes could have been due to short duration exercise program i.e., 2 weeks.[19]

The minimal changes in core stabilization group, some subjects showed significant changes in outcome measures.[19] It is possible that some subjects volitionally contracted their trunk muscles to provide stability. It is also possible that individuals may be influenced through verbal encouragement. Additionally, the variability may have been due to slight variation in participant posture or task performance. While exercise standardization was sought through verbal correction, it is possible that difference in task performance between the subjects still occurs.

The effect of exercises as a whole in the present study is shown improvements. This is not to say that other physical therapy technique is worthless, but just that they do not target the specific cause of pain which may be due to the weakness of the deep "stabilizing" muscles, therefore these muscles are not rehabilitated properly.[20] The current study has found out that the rehabilitation of specific muscles through Motor Control exercises on pain and disability has shown the better effect than the Core Stabilization exercise program to reduce back pain and disability in non specific mechanical low back ache subjects.

CLINICAL IMPLICATION

- In a very short period of time there was a significant reduction in back pain and disability associated with it.
- It is an inexpensive method and helps in reducing pain and disability.
- It doesn't require any sophisticated tools.
- It is not a time-consuming program, individuals can take out the time conveniently even in their busy schedules and can implement in Daily practice.
- It is easy to learn and perform these exercises if focus, once learned assistance is not required.

LIMITATIONS

- In current study the sample size was small
- Limited outcome measures and non usage of sophisticated instrument for investigating the muscle function and fitness level.
- No measurements were made to determine the compressive or shear loading on the spine during task. This type of kinematic is optimal when determining the safety and tissue loading properties of various movements.

RECOMMENDATIONS

- Further measures should be taken to check core muscle strength and endurance separately.
- Further research may be done to determine the influence of the trunk muscle activation levels during resistance exercise
- Real time ultrasound imaging of deep muscles, to examine diagnose and treat.
- EMG biofeedback can be used for quantifying muscle activity.
- Exercise duration should be more to perform motor control exercise in functional Activities.

Conclusion

The Motor control exercises showed statistically significant improvement in reducing back pain and disability when compared to the Core Stabilization exercises. Thus, performing Motor Control exercises reduces pain and disability significantly compared to Core stabilization among non specific mechanical low back ache subjects.

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Conflicts of interest: None

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