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Comparison Of Segmental Stabilization Exercises To General Spinal Exercises, In The Treatment Of Chronic Low Back Pain: A Randomized Controlled Trial

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Abstract

Objectives: To study and compare the effectiveness of segmental stabilization exercises and general spinal exercises in the treatment of chronic low back pain.

Method: The subjects were randomly assigned to the experimental group (group 1) of 15 subjects and the control group (group 2) of 15 subjects Measurements via Visual Analogue Scale.

Result: Mean VAS on day zero in group 1 and group 2 were 29.53 ± 5.902 and 30.20 ± 5.017 respectively, whereas t – value and p-value are 0.333 and 0.741 respectively. Mean VAS on day fifteen in group 1 and group 2 were 20.67 ± 5.815 and 23.73 ± 4.148 respectively whereas t – value and p-value are 1.633 and 0.108. Mean VAS on day thirty in group 1 and group 2 were 9.07 ± 3.615 and 15.73 ± 2.987 respectively whereas t – value and p-value are 5.506 and 0.000. Mean VAS on day sixty in group 1 and group 2 were 0.60 ± 1.682 and 6.20 ± 2.624 respectively whereas t – value and p-value are 6.959 and 0. 000.

Conclusion: The study concludes that the specific exercise treatment approach directed at specific muscles is more effective than other conservative treatments commonly used in patients with Chronic Lower Back Pain.

Keywords: Segmental Stabilization Exercises, Chronic Lower Back Pain, Spine Exercises

Introduction

There is ample evidence that active approaches to the rehabilitation of patients with chronic low back pain (LBP) are beneficial [1,2]. Exercise therapy is useful after the acute stage of lower back pain which is taken into account as an approach which engages patients in activities, even the positive results are documented with differing kinds of exercises utilized by physiotherapist but there's little evidence which shows that a specific form of exercise is healthier than the others[3]. As new training methods are emerging which is currently considered as a crucial area of research and also help in better understanding of the consequences of such technique and therefore the status of patient recovery [4, 5].

One of the exercises performed by physiotherapist – Classical Trunk Exercises, helps in activate the abdominal and para-spinal muscles as an entire and at a comparatively high contraction level [6, 7]. Although there are several randomized controlled trials (RCTs) on the usefulness of classic trunk exercises[8,9,10], increasing attention recently has been paid to the preferential retraining of the local stabilizing muscles of the spine[11,12] All muscles with intervertebral attachments that are better fitted to providing intersegmental stability are categorized under this group (multifidus, transverses abdominis, internal oblique), as opposition the longer trunk muscles which are dedicated to generating movement[13].

The total range of motion of a spinal motion segment could also be divided into 2 zones: a neutral zone and an elastic zone. The neutral zone is that the initial portion of the Range of Motion (ROM) during which the spinal motion is produced against minimal internal resistance.

The portion nearer to the tip range of movement that's produced against substantial internal resistance is taken into account because the elastic portion of ROM. The dimensions of the neutral zone is taken into account to be a vital measure of spinal stability. It's influenced by the interaction between what Panjabi [14] described because the passive, active, and neural control systems: the passive system constituting the vertebrae, intervertebral disc, zygapophyseal joints, and ligaments; the active system constituting the muscles and tendons surrounding and working on the spinal column; and therefore the neural system comprising the nerves and also the central nervous system, which direct and control the active system in providing dynamic stability[14].

The recent focus within the physiotherapy management of patients with CLBP has been the particular training of muscles surrounding the lumbar spine whose primary role is taken into account to be the supply of dynamic stability and segmental control to the spine[15]. These are the deep abdominal muscles (internal oblique [IO] and transversus abdominis [TA] and the lumbar multifidus [LM]). The importance of the LM muscle regarding its potential to supply dynamic control to the motion segment in its neutral zone is now well acknowledged [16,17,18,19]. The deep abdominals, in particularly the TA, are primarily involved within the maintenance of intra-abdominal pressure while imparting tension to the lumbar vertebrae through the thoracolumbar fascia [20,21,22,23]. Additionally, there's increasing evidence that these muscles are preferentially affected within the presence of low back pain (LBP), (CLBP), and lumbar instability [24,25,26].

Richardson and Jull [15] proposed that the particular sub-maximal training of those "stability" muscles of the lumbar spine and also the integration of this training into functional tasks decrease both pain and functional disability in those stricken by mechanical low back pain.

The essential component of back muscle rehabilitation were preferential retaining of the stabilizing muscles, with their initial low-level isometric activation and their progressive integration into functional tasks [27]. Some authors maintain that, when there's a deficit of the stabilizing muscles, incorrect compensation of their activity takes place from the movement muscles if classic exercise techniques are used, resulting in alterations of the acceptable muscle coordination patterns[27] and increasing the danger of re-injury of the spine[28].

The stability of the lumbar spine is set by the osteoligamentous structures and trunk muscles. Because motion takes place altogether 3 dimensions simultaneously, complex loading patterns act on the passive structures of the osteoligamentous spine and, if unprotected, the lumbar spine is susceptible to being damaged. Therefore, the motions must be precisely controlled by the lumbar and abdominal muscles to provide the stiffness required to optimize the loading on the lumbar spine and to forestall overloading injury [29,30]. The multifidus muscles are the foremost important back extensor muscles involved in providing the desired stiffness for the lumbar spine [19]. Spinal stability is additionally increased with trunk flexor-extensor muscle coactivation with increased intra-abdominal and produces abdominal spring force[18].

We concentrated on the currently unknown or less documented area that's whether stabilization exercises are better suited to certain varieties of patients or whether they can be generally applied to any patient with LBP. Unsubstantiated suggestions that stabilization training is also useful in reducing pain and disability for all patients with nonspecific LBP have appeared within the literature [31,32,27,33], but these assertions haven't been definitively demonstrated.

Methods

A total of 30 samples were selected for the study based on inclusion and exclusion criteria. The subjects were randomly assigned to the Experimental group (group 1) of 15 subjects and the Control Group (group 2) of 15 subjects.

Inclusion Criteria:

- Age group: 20 to 40 years.

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- Patients presenting with chronic nonspecific low back pain.
- Patients presenting with recurrent pain.
- Duration of symptoms: subacute and chronic according to the International Association for the Study of Pain (IASP) classification of pain Patients who can comprehend commands (e.g. excluding mentally challenged individuals etc.

Exclusion Criteria:

- Severe or excruciating pain.
- Radiating pain in the legs
- H/o fracture, surgery, tumor,
- H/o constitutional symptoms like fever, malaise, etc indicating infection, Inflammatory conditions.
- Radiographic changes showing cervical spinal malformations, osteoporosis, and bony abnormalities.
- The above-stated conditions were ruled out at the discretion of a medical professional.

Study Design:

- The study was designed as a Two-group Pre and Post Test study.
- The experimental design included a pre-test measure of the dependent variable, the independent variable, and the post-test measure of the dependent variable.
- Two groups were used - Group 1- Experimental group and Group 2 – Control group.

Variables:

- Dependent variables: Pain (P) and Disability (D)
- Independent variable: Exercises – general spinal and stabilization exercises

Procedure:

- Assessment: On the first visit, a complete orthopedic assessment was done. Subjects who were found suitable for participation in the study were requested to sign consent forms.
- Subjective Examination: Type, degree, frequency, duration, occurrence, and aggravation of pain and disability were noted. The patient was asked about pain during each test and after each exercise was performed.

Equipment:

- VAS –for measuring pain
- Oswestry disability questionnaire: Gives a percentage score that indicates each patient's level of functional disability

Figure 1. Abdominal Hollowing: Lying

Figure 2. Bridging from crook lying with isometric co-contractions of the stabilizing muscle.

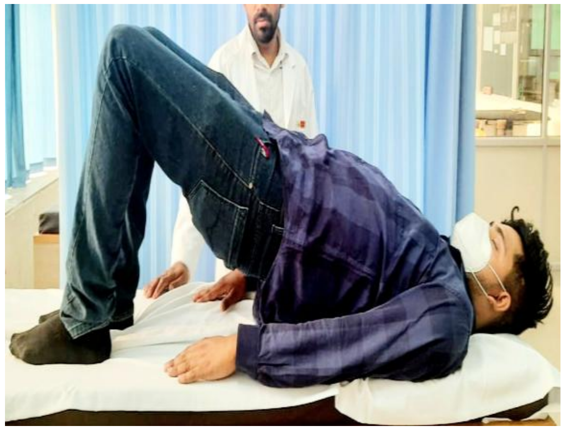

Figure 3. Four-point kneeling alternate arm and leg lift maintaining co-contraction of the stabilizing muscles.

Figure 4. Full Abdominal Crunches

Results

Statistical analysis revealed no statistically significant differences between the groups on entry to the trial. Thirty subjects, 23 males and 7 females were randomly divided into two groups – Group 1 (Experimental group) and Group 2 (Control group). Fifteen subjects were taken in both groups, 1 and 2. The mean age and standard deviation of subjects of groups 1 and 2 were 23.4±1.95 and 21.66±1.95 respectively with 12 males and 3 females in the Experimental group, 11 males and 4 females in the Control group. (Table 1)

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Table 1: Characteristics of Subjects

Groups	Number	Mean Age ± SD	Male	Female
1	15	23.4 ±1.95	12	3
2	15	21.66 ±1.95	11	4

Factor Descriptive:

The pain was measured on VAS (Visual Analogue Scale) and disability on ODI (Oswestry Disability Index) on days 0, 15, 30, and 60. Variables are described in Table: 2

Table 2: Factor Descriptive Table

Factors	Dependent Variables
VAS 1	Visual analogue scale on day 0
VAS 2	Visual analogue scale on day 15
VAS 3	Visual analogue scale on day 30
VAS 4	Visual analogue scale on day 60
ODI 1	Oswestry disability index on day 0
ODI 2	Oswestry disability index on day 15
ODI 3	Oswestry disability index on day 30
ODI 4	Oswestry disability index on day 60

Comparison of Vas Scores between Group 1 and 2:

Mean VAS on day zero in group 1 and group 2 were 29.53 ± 5.902 and 30.20 ± 5.017 respectively with a t-value of 0.333 and p-value of 0.741. Mean VAS on day fifteen in group 1 and group 2 were 20.67 ± 5.815 and 23.73 ± 4.148 respectively with a t-value of 1.633 and p-value of 0.108. Mean VAS on day thirty in group 1 and group 2 were 9.07 ± 3.615 and 15.73 ± 2.987 respectively with a t-value of 5.506 and p-value of 0.000. Mean VAS on day sixty in group 1 and group 2 were 0 .60 ± 1.682 and 6.20 ± 2.624 respectively with a t-value of 6.959 and p-value of 0.000.

Table 3: Comparison of Vas Scores between Group 1 and 2

Factors	Group 1 Mean +/- SD	Group 2 Mean +/- SD	t-value	p-value
VAS 1	29.53 ± 5.902	30.20 ± 5.017	0.333	0.741
VAS 2	20.67 ± 5.815	23.73 ± 4.148	1.663	0.108
VAS 3	9.07 ± 3.615	15.73 ± 2.987	5.506	0.000
VAS 4	0.60 ± 1.682	6.20 ± 2.624	6.959	0.000

Comparison of ODI Scores between Group 1 and 2:

Mean ODI on day zero in group 1 and group 2 were 20.44 ± 6.011 and 20.44 ± 6.011 respectively with a t-value of 0.971 and p-value of 0.340. Mean ODI on day fifteen in group 1 and group 2 were 14.52 ± 4.272 and 17.92 ±

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2.719 respectively with a t-value of 2.606 and p-value of 0.015. Mean ODI on day thirty in group 1 and group 2 were 7.106 ± 3.583 and 11.70 ± 1.319 respectively with a t-value of 4.660 and p-value of 0.000. Mean ODI on day sixty in group 1 and group 2 were 0.44 ± 1.245 and 4.59 ± 2.293 respectively with a t-value of 6.152 and p-value of 0.000.

Table 4: Comparison of Odi Scores between Group 1 and 2

Factors	Group 1 Mean +/- SD	Group 2 Mean +/- SD	t-value	p-value
ODI 1	20.44 ± 6.011	20.44 ± 6.011	0.971	0.340
ODI 2	14.52 ± 4.272	17.92 ± 2.719	2.606	0.015
ODI 3	7.106 ± 3.583	11.70 ± 1.319	4.660	0.000
ODI 4	0.44 ± 1.245	4.59 ± 2.293	6.152	0.000

Comparison of VAS Scores within Group 1:

A comparison of the VAS score of day zero with day fifteen gives the mean deviation of 8.867, standard error of 1.203, and significant p-value of 0.000. Comparison of the VAS score of day zero with day thirty gives the mean deviation of 20.467, standard error of 0.970, and significant p-value of 0.000. Comparison of the VAS score of day zero with day sixty gives the mean deviation of 28.933, standard error of 1.270, and significant p-value of 0.000.

A comparison of the VAS score of day fifteen with day thirty gives the mean deviation of 11.600, standard error of 1.090, and significant p-value of 0.000. A comparison of the VAS score of day fifteen with day sixty gives the mean deviation of 20.067, standard error of 1.282, and significant p-value of 0.000. A comparison of the VAS score of day thirty with day sixty gives the mean deviation of 8.467, standard error of 0.798, and significant p-value of 0.000.

Table 5: Comparison of Vas Scores within Group 1

Factors	Mean Deviation	Standard Error	'P' Value
VAS 1 v/s VAS 2	8.867	1.203	0.000
VAS 1 v/s VAS 3	20.467	0.970	0.000
VAS 1 v/s VAS 4	28.933	1.270	0.000
VAS 2 v/s VAS 3	11.600	1.090	0.000
VAS 2 v/s VAS 4	20.067	1.282	0.000
VAS 3 v/s VAS 4	8.467	0.798	0.000

Comparison of VAS Scores within Group 2:

Comparison of the VAS score of day zero with day fifteen gives the mean deviation of 6.467, standard error of .940and significant p-value of .000. Comparison of the VAS score of day zero with day thirty gives the mean deviation of 14.467, standard error of 1.362 and significant p-value of .000. Comparison of VAS score of day zero with day sixty gives the mean deviation of 24.000, standard error of 1.461 and significant p-value of .000.

Comparison of the VAS score of day fifteen with day thirty gives the mean deviation of 8.000, standard error of 0.867, and significant p-value of .000. Comparison of the VAS score of day fifteen with day sixty gives the mean deviation of 17.533, standard error of 1.467 and significant p-value of .000. Comparison of VAS score of day thirty with day sixty gives the mean deviation of 9.533, standard error of 1.199 and significant p-value of .000.

Table 6: Comparison of VAS Scores within Group 2

Factors	Mean Deviation	Standard Error	p-value
VAS 1 v/s VAS 2	6.467	0.940	0.000
VAS 1 v/s VAS 3	14.467	1.362	0.000
VAS 1 v/s VAS 4	24.000	1.461	0.000
VAS 2 v/s VAS 3	8.000	0.867	0.000
VAS 2 v/s VAS 4	17.533	1.467	0.000
VAS 3 v/s VAS 4	9.533	1.199	0.000

Comparison of ODI Scores within Group 1:

A comparison of the ODI score of day zero with day fifteen gives the mean deviation of 5.926, standard error of 0.986, and significant p-value of 0.000. Comparison of the ODI score of day zero with day thirty gives the mean deviation of 13.335, standard error of 1.266, and significant p-value of 0.000. Comparison of the ODI score of day zero with day sixty gives the mean deviation of 19.997, standard error of 1.355, and significant p-value of 0.000.

A comparison of the ODI score of day fifteen with day thirty gives the mean deviation of 7.409, standard error of 0.986, and significant p-value of 0.000. A comparison of the ODI score of day fifteen with day sixty gives the mean deviation of 14.071, standard error of 0.937, and significant p-value of 0.000. A comparison of the ODI score of day thirty with day sixty gives the mean deviation of 6.663, standard error of 0.812, and significant p-value of 0.000.

Table 7: Comparison of Odi Scores within Group 1

Factors	Mean Deviation	Standard Error	p-value
ODI 1 v/s ODI 2	5.926	0.986	0.000
ODI 1 v/s ODI 3	13.335	1.266	0.000
ODI 1 v/s ODI 4	19.997	1.355	0.000
ODI 2 v/s ODI 3	7.409	0.986	0.000
ODI 2 v/s ODI 4	14.071	0.937	0.000
ODI 3 v/s ODI 4	6.663	0.812	0.000

Comparison of ODI Scores within Group 2:

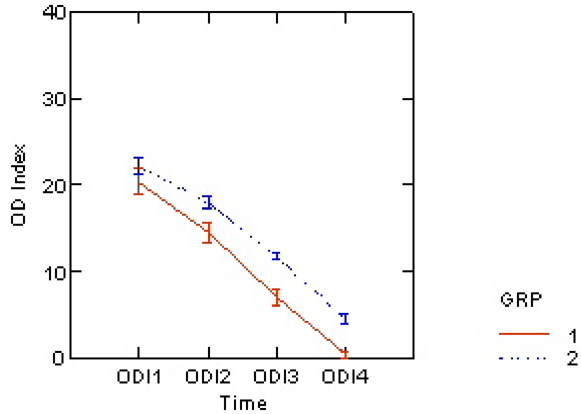
A comparison of the ODI score of day zero with day fifteen gives the mean deviation of 4.297, standard error of 0.765, and significant p-value of 0.000. Comparison of the ODI score of day zero with day thirty gives the mean deviation of 10.517, standard error of 1.093, and significant p-value of 0.000. Comparison of ODI score of day zero with day sixty gives the mean deviation of 17.631, standard error of 1.115and significant p-value of 0.000.

Comparison of ODI score of day fifteen with day thirty gives the mean deviation of 6.221, standard error of 0.658and significant p-value of .000. Comparison of ODI score of day fifteen with day sixty gives the mean deviation of 13.334, standard error of .970and significant p-value of 0.000. A comparison of the ODI score of day thirty with day sixty gives the mean deviation of 7.113, standard error of 0.657, and significant p-value of 0.000.

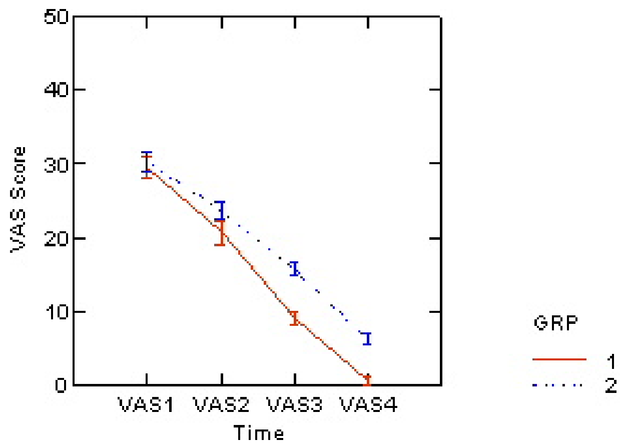
Table 8: Comparison of Odi Scores within Group 2

Factors	Mean Deviation	Standard Error	p-value
ODI 1 v/s ODI 2	4.297	0.765	0.000
ODI 1 v/s ODI 3	10.517	1.093	0.000
ODI 1 v/s ODI 4	17.631	1.115	0.000
ODI 2 v/s ODI 3	6.221	0.658	0.000
ODI 2 v/s ODI 4	13.334	0.970	0.000
ODI 3 v/s ODI 4	7.113	0.657	0.000

Graph 1: Percentage Change Over A Period Of Time (Reduction In Disability)



Graph 2: Percentage Change Over A Period Of Time (Reduction In Pain)



Discussion:

The results of this study support the initial hypothesis that specific exercise training of the "stability" muscles of the trunk is effective in reducing pain and functional disability in patients with CLBP. Analysis of the pain and functional disability score data within

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the experimental group revealed that this treatment approach was more effective than other conservative treatment approaches applied by the control group, which mainly involve general exercise programs. These findings support Punjabi's (1992) [34] hypothesis that the soundness of the lumbar spine is relies not solely on the basic morphology of the spine, but also on the proper functioning of the neuromuscular system. Also, Radebold A [35] (2000) stated that muscle recruitment and timing patterns play a vital role in maintaining lumbar spine stability. Therefore, exercises specifying the isolated contraction of the Multifidus muscle were incorporated within the EG, in contrast to the non-specific back exercises within the control group. Hence, it gets clearer that the significantly better end up in the EG are due to the correct recruitment of the particular back muscles. Hodges and Richardson [36] showed that the co-contraction of the TA and MF muscles occurred before any movement of the limbs.

By definition, the deep-trunk muscles act as 'stabilizers' and don't seem to be involved in producing movements, but instead use static or isometric contractions. Furthermore, they have to act as stabilizers continuously during everyday activities further as sport, then require superb endurance of low-level forces. Muscle impairments don't seem to be more of strength but rather problems in motor control. This will be what was kept in mind while planning the exercise regime of the EG, which enhanced the spinal segmental support and control. The subjects in the EG were trained to selectively contract the stabilizers and later worked on improving their endurance in terms of static control. This way of specific training at low levels of activation supports the recent findings of Cholewicke and McGill[28] (1996) that only low levels of maximal voluntary contraction of the segmental muscles are required to create sure the stableness of the spine in vivo. It's also in line with the assertion that motor learning and control don't seem to be simply a process of strength training, but rely on patterning and inhibition of motor neurons, with the acquisition of skills occurring through selective inhibition of unnecessary muscular activity, also because the activation of additional motor units. Addition to the current, Tesh KM [37] (1987) has also suggested that the muscles of the anterolateral abdominal wall increase the soundness of the lumbar region of the spine by tensing the thoracolumbar fascia and by raising intra-abdominal pressure. Of the rear extensor muscles, the LM is taken into consideration to have the most effective potential to produce dynamic control to the motion segment, in its neutral zone [Kaigle A (1995), Panjabi M (1989), Wilke H (1995)]. This study was considered important on account of the particular proven fact that patients with CLBP would always seek not only relief from pain but also the power to perform ADL without discomfort. Hence, the patients must be trained not only for static control but also for dynamic functional independence. With this view in mind, the exercises of the EG focused on the appropriate strengthening of the deep back muscles specified it can lead to alleviation of pain during motor tasks additionally, thus aiming at complete recovery. The foremost significant finding of the current study was the sustained reduction in symptoms and functional disability levels within the experimental groups at the 15th, 30th, and 60th-day follow-up. The findings of this study support the view that a change within the motor program had occurred within the EG after the intervention, specified the automated pattern of recruitment of the abdominals to stabilize the spine during a motor task incorporated higher levels of deep abdominal muscle activity. This appears to represent an enhanced ability, in those within the experimental group, to stabilize dynamically their spine during functional tasks. Hence it can okay be stated that stabilization exercises do appear to provide additional benefits to patients with sub-acute or chronic low back pain who don't have any clinical signs suggesting the presence of spinal instability (George A Koumantakis et al[38] 2005). Therefore, the population of CLBP patients must be identified and treated with specific stabilizing exercise intervention based on motor control and motor learning to achieve efficient relief of excessive load from the spine, enhance segmental stabilization, and control pain in an exceedingly functional manner.

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