

Efficacy of the Multifidus Retraining Program in Computer Professionals with Chronic Low Back Pain

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Study Design: Randomized controlled trial.

Purpose: To contrast the efficacy of two exercise programs—multifidus retraining program (MRP) and traditional back exercises (TBE)—on pain and functional disability in individuals with chronic low back pain.

Overview of Literature: Low back pain is a common musculoskeletal disorder. Mechanical low back pain does not involve nerve roots. Stability of the spine is provided by the ligaments and muscles of the lower back and abdomen. Although weakness of the superficial trunk and abdominal muscles are the primary risk factors, recent studies have demonstrated the involvement of weakness and lack of control of the deep trunk muscles, especially the multifidus and transverse abdominis muscles. Therefore, exercises to restore optimal lumbar multifidus function are important in rehabilitation strategies.

Methods: Thirty individuals were randomly assigned to receive TBE, where exercises focused on the superficial muscles of abdomen and low back (control, group A) and MRP, where exercises focused on the deep multifidus muscles fibers (experimental, group B). Groups were examined to find the effect of these exercises on visual analog scale rated pain (visual analogical scale) and functional disability assessed by the Oswestry disability questionnaire. The exercise program lasted for 6 weeks on alternate days, with 20 repetitions of each exercise, with each move held for 5–8 seconds. Subjects were evaluated at the start of the study and after completion of the 6-week exercise program.

Results: As compared to baseline, both treatments were effective in relieving pain and improving disability ($p < 0.001$). The MRP group had significant gains for pain and functional disability when compared to the TBE group (both $p < 0.001$).

Conclusions: Both techniques lessen pain and reduce disability. MRP is superior to TBE in reducing pain and improving function.

Keywords: Chronic low back pain; Multifidus retraining; Segmental stabilization; Back exercises; Multifidus exercises

Introduction

A well aligned and flexible spine is important for an active and healthy life. Chronic low back pain (CLBP) is defined

as back pain lasting more than 12 weeks [1]. This pain is a common musculoskeletal disorder affecting 80% of people some time in their lives [2]. The majority of lower back pain stems from benign musculoskeletal problems

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and is referred to as non-specific low back pain; it may be due to muscle or soft tissues sprain or strain [3], particularly in instances where pain arises suddenly during physical loading of the back, with the pain lateral to the spine. Over 99% of back pain instances fall within this category [4]. About 60%–80% of the population in industrialized countries like India, United States, Europe, Finland, and the Netherlands suffering from back pain; it is the second most common health problem after headache [5]. Stability of the spine is provided through ligaments and muscles of the back, lower back and abdomen.

Mechanical low back pain (MLBP) is a mechanically-derived, musculoskeletal back pain not involving nerve root compression or serious spinal diseases [6]. Prevalence is higher in young and active adults [7]. Causes of MLBP typically are attributed to an acute traumatic event, but they may also include cumulative trauma as an etiology [8]. The severity of an acute traumatic event varies widely, from twisting of the back to being involved in a motor vehicle collision. MLBP due to cumulative trauma tends to occur more commonly in the workplace. A systematic study review implicated a sedentary lifestyle, defined by the authors as including sitting for prolonged periods at work and during leisure time, as a risk factor for MLBP [9].

Low back pain (LBP) is usually self-limiting, with almost 90% of cases resolving within 6–12 weeks [10]. However, recurrence is high (84%) [11]. Risk factors for recurrence include weakness [11], excessive fatigability [12], lack of multifidus muscle recovery [13] and atrophy [13,14], which eliminate segmental stability.

Weakness of the superficial trunk and abdominal muscles is an important risk factor for LBP [15]. Strengthening these muscles markedly improves CLBP and decreases functional disability [16]. Another independent risk factor for CLBP is weakness and lack of motor control of deep trunk muscles, such as the lumbar multifidus (LM) and transversus abdominis (TrA) muscles [13,17]. Dysfunction of the LM crucially influences the etiology and recurrence of LBP [13,14,18]. Therefore, exercises to restore optimal LM function are a common aspect of current rehabilitation strategies [19,20]. More recently, attention has focused on the deepest fibers of the LM [17,20,21].

Understanding the anatomical structure that is painful differs from the disorder itself, and is important in order to give proper treatment. Thinking in the terms of integrated function and dysfunction might be more appropriate in diagnosis and treatment of back pain.

Therefore, in this study, we compared the efficacy of the multifidus retraining program (MRP) with conventional strengthening of abdominal and trunk muscles on pain and functional capacity in CLBP. Our hypothesis was that the MRP is more efficient than the muscle strength in the improvement of CLBP.

Materials and Methods

This study was approved by the ethical committee and research department of the Maharashtra Institute of Physiotherapy, Latur, India.

Thirty subjects (18 males and 12 females) who were computer professionals and who had at least a 2-year history of CLBP were selected and divided into two groups by purposive random sampling with 15 subjects (9 males and 6 females) in each group. One group (group A) was treated with traditional back exercise (TBE) and the other (group B) with MRP. All subjects completed the Handler 10-minute screening test for chronic back pain to rule out psychological pain. The inclusion criteria for the study were back pain felt between T12 and the gluteal folds that had lasted at least 3 months, age between 20 and 35 years, willingness to participate, ability to participate in an exercise program safely and no cognitive impairments that would limit their participation. The exclusion criteria were previous spinal surgery, trauma, rheumatologic disorders, spine infections, spine exercise training in the 3 months before the onset of the study, vertebral fracture, spinal abnormalities (scoliosis, kyphosis), inter vertebral disk prolapse, spondylolisthesis, pregnancy, malignancy, congenital abnormalities, ankylosing spondylitis, hernia, visceral problems, fibromyalgia and myofascial pain. Participants received a clear explanation of the study and provided their written informed consent.

1. Procedures

Demographic data including age, sex, height and weight were documented for descriptive statistical analysis (Table 1). The subjects were familiarized with the Oswestry disability questionnaire and visual analogue scale (VAS) rating of pain. These instruments were designed to give information about the back pain, which affects their ability to manage in everyday life. The patients were asked to answer all questions by placing a mark in the one box that most closely described their present condition. The pre-

Table 1. Demographic data and homogeneity of variance

Variable	Traditional exercise group	Multifidus retaining program	F-value	F critical one-tail	Homogeneity of variance
Male (n)	9	9	-	-	Equal
Female(n)	6	6	-	-	Equal
Age (yr)	26.87±2.17	27.06667±2.09	1.078775	2.483726	Identical
Duration of LBA (m)	3.73±0.80	3.8±0.86	1.164179		Identical
Height (cm)	160.2±3.67	160.53±4.07	1.230007		Identical
Weight (kg)	55.07±4.88	55.8±4.46	1.195881		Identical
Pre-test value (VAS)	6.27±0.70	6.6±0.74	1.096154		Identical
Pre-test value (MODQ)	22.33±3.90	22.67±4.58	1.375		Identical

Values are presented as mean±standard deviation.

LBA, low back pain; VAS, visual analogue scale; MODQ, Oswestry disability questionnaire.

test scoring of both the assessment tools were done and documented. Functional outcome and pain perception were assessed with Oswestry disability questionnaire and VAS, respectively. Subjects were then randomized to the two groups as describe above. Homogeneity of variance between the groups were identical in terms of age, height, weight, pre-VAS and Oswestry disability questionnaire (MODQ) score (Table 1).

Both groups received exercise for 6 weeks. Based on the previous research [20,22], the exercises for MRP were designed to retrain the multifidus muscle. TBE consisted of strengthening and stretching of superficial abdominal and back muscles (Table 2). The exercise program was supervised by a physiotherapist in the outpatient department and the exercise register for each subject was maintained. Each exercise was meant to be repeated 20 times with a 5–8 seconds hold of each exercise. Exercise was on alternate days for 6 weeks. Subjects were allowed to rest for 2–4 minutes in between each set of exercise. The study was a pre-test and post-test experimental two group study. The subjects underwent pre-test at the starting of the study and the post-test was recorded after completion of the exercise program for 6 weeks.

2. Assessments

Assessment of severity of pain and functional disability was done at baseline and at the end of the treatment.

3. Pain

Pain was assessed using a VAS consisting of a 10 cm line,

with the left extremity indicating “no pain” and the right extremity indicating “unbearable pain.” Participants were asked to use the scale to indicate their current level of pain. Higher values suggested more intense pain. The pre- and post-exercise values of both MRP and TBE were documented and the mean and standard deviation (SD) was calculated for statistics.

4. Functional Disability

Functional disability was estimated by the Oswestry disability questionnaire, a functional scale assessing the impact of LBP on daily activities. There are many functional questionnaires available for the measurement and evaluation of LBP; we felt the Oswestry questionnaire was the most appropriate. The scoring was done by adding the values circled by the subject for each of the 10 individual questions and the disability is commanded as mild or no disability (0%–20%), moderate disability (21%–40%), severe disability (41%–60%), incapacity (61%–80%) and restricted to bed (81%–100%). The pre- and post-exercise values of the TBE and MRP groups were documented and the mean and SD was calculated and recorded for statistical analysis.

Results

Statistical analysis was done using the SPSS ver. 16 (SPSS Inc., Chicago, IL, USA) software to find the average and the standard deviation of age, duration, height, weight, VAS and disability score in both groups. “F” test was done identify the equality of the variance between the group

Table 2. Exercise program

Multifidus retaining program		Traditional back exercises
1	Bridging Unilateral knee extension while keeping hips in bridging position. The subject kept their hips in the bridged position and extended their right knee for 10 seconds. Repeat for the left knee.	Supine lying Straight leg raising (unilateral): flex the hip with extended knee. As progression do straight leg raising (bilateral): keep the knee in extension, tilt the pelvis posteriorly and flex the hips.
2	Prone lying Unilateral hip extension while prone with knees bent the subject lay prone with both knees in 90° flexion, and lifted his/her legs in turn a few centimeters from the floor for 10 seconds.	Prone lying Prone straight leg raising: with the extended knees, do extension of the hip.
3	On 4's position (quadruped) Contralateral arm and leg lift on 4's position On 4's position, the contra-lateral upper and lower limb is lifted to horizontal plane for 10 seconds.	On 4's position (quadruped) Cat and camel: instruct the patient to move the low back up and down to increase and decrease the lordosis of lumbar spine.
4	Prone lying on table/couch Unilateral leg extension with upper body prone on the board (table). The subject laid their upper body prone on the board and lifted their right leg to the horizontal level for 5 seconds. Repeat the same for the left side.	Prone lying Thoracic elevation: begin with the arms at the side, progress to behind the head or reaching overhead as strength improves. Tell the patient to tug in the chin and lift the head and thorax.
5	Bilateral leg extension with upper body prone on the board (table). The subject laid their upper body prone on the board and lifted their both legs simultaneously to the horizontal level for 5 seconds.	Supine lying Isometric abdominals: instruct the patient to hollow his abdomen by drawing the belly button towards the spine.
6	Sitting Weights in hands and altering shoulder flexion while sitting with trunk in 30° flexion. Subject sat with their feet on the floor and held weights in the hands (men, 2 kg; women, 1 kg) with slightly flexed elbows, moving the weight up and down in the frontal plane while sitting with the trunk in 30° flexion.	Supine lying Partial curl ups: lift the shoulders until the scapulae and thorax clear the mat, keeping the arm horizontal.
7	Standing Pelvic tilt The subject stood with his/her hands on pelvis and tilted his/her pelvis continuously forward and backward (40 time/minute).	Supine lying Double knee to chest: tell the patient to tilt the pelvis posteriorly, then bring both the knees to the chest and return back.
8	Weights in hands and altering shoulder flexion while sitting with trunk in 30° flexion. Subject sat with their feet on the floor and held weights in the hands (men, 2 kg; women, 1 kg) with slightly flexed elbows, moving the weight up and down in the frontal plane while sitting with the trunk in 30° flexion.	Prone lying Superman exercise: progress the extension exercises by having the patient lift both upper and lower extremities simultaneously.

and showed identical in all the above factors between the groups (Table 1). Analysis using paired *t*-test of pre and post value for both the groups showed significant improvement in both groups. Pain after exercise in group A (4.467) and group B (2.867) were analyzed using unpaired T-test value (6.32) at $p \leq 0.001$ levels. Similarly the functional disability after exercise in group A (17.067) and group B (9.467) were analyzed using unpaired T-test value (6.62) at $p \leq 0.001$ level showed that MRP produced greater improvement than TBE (Tables 3, 4, Figs. 1, 2).

Discussion

This study aimed to compare the efficacy of MRP and TBE in the relief the pain and improving the functional disability of CLBP among computer professionals with an extended history of LBP. Both exercise regimens were effective in relieving pain and in decreasing functional impairment, but MRP provided better relief of pain and improved functional outcome in the CLBP patients.

Bergmark [13] categorized the trunk muscles in to local and global muscle system based on their main mechani-

Table 3. Data analysis and result of the VAS score between group A and B

Group	Pre-test	Post-test	Result ($p \leq 0.001$) significance
Group A	6.267±0.703	4.467±0.640	t=10.31 significant
Group B	6.6±0.737	2.867±0.743	t=20.55 extremely significant
Result significance	-	t=6.32 significant	-

Values are presented as mean±standard deviation.

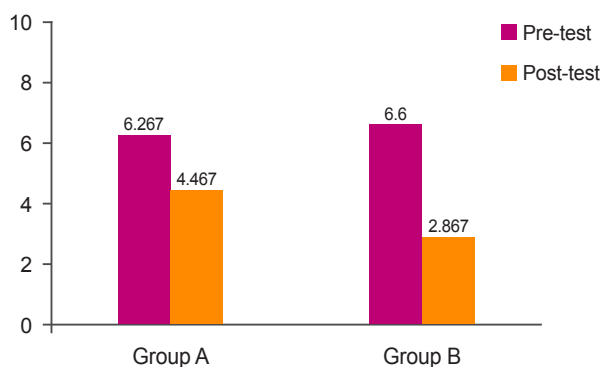
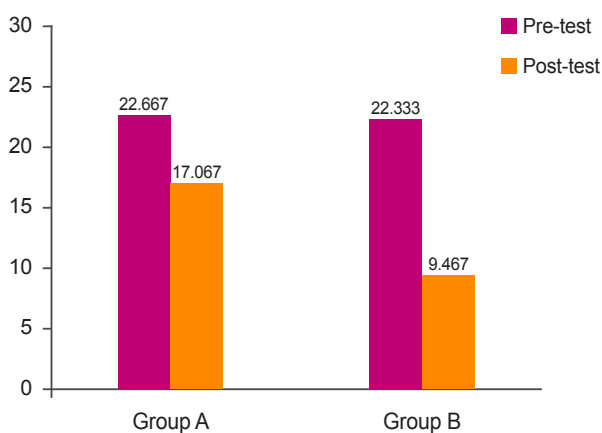
VAS, visual analogue scale.

Table 4. Data analysis and result of the ODDQ disability score between group A and B

Group	Pre-test	Post-test	Result significance
Group A	22.667±4.577	17.067±3.712	t=14 significant
Group B	22.333±3.904	9.467±2.446	t=19.26 extremely significant
Result significance	-	t=6.62 significant	-

Values are presented as mean±standard deviation.

ODQ, Oswestry disability questionnaire.

**Fig. 1.** Visual analogue scale. Group A, traditional back exercises; Group B, multifidus retraining exercises.**Fig. 2.** Oswestry disability questionnaire. Group A, traditional back exercises; Group B, multifidus retraining exercises.

cal roles in stabilisation. The local muscles are capable of controlling the stiffness and intervertebral relationship of spinal segments and posture of lumbar spine [6,23]. The current focus of back pain rehabilitation has evolved from global to local muscle systems with the recognition that local muscles are important in control of segmental spinal stability. Evidence from biomechanical, morphological, histochemical, electromyography and muscle fiber studies has implicated the multifidus muscles in 2/3 of the segmental stability of the spine.

Waddell et al. [24] concluded that LBP patients often avoid using their back in everyday life situations because of fear of pain and its consequences. We suspect that prolonged sitting posture at a computer workstation as well as lack of exercise that is the norm for many computer professionals may lead to the weakness of the multifidus muscle. This speculation is supported by previous findings that disuse leads to the atrophy of the back muscles especially the LM muscle, and an exercise program produces functional improvement [25,26]. Segmental instability may cause functional disorders and strain as well as pain [27]. Uni-segmental muscles of the lumbar spine, such as the multifidus muscle, may provide segmental control and are the primary segmental stabilizers of the spine in lumbar region [28]. One study identified selective atrophy of the LM after the first episode of back pain; the atrophy was unlikely to revert without specific training, and the lower muscular stability predisposed an individual to further episodes of LBP [17]. Our findings also support

this view; the MRP group had better outcome in comparison with the generalized back exercise program. Both multifidus and transverse abdominis muscles have been suggested as primary stabilizers of the lumbar segment, minimizing compressive forces on spinal structures [29]. The inter-segmental LM is the most important muscle in the stabilization of spine [30]. Presently, poor endurance of the multifidus muscle was linked with increased recurrence of LBP.

Although many aspects of treatment for the LBP remain controversial, the superiority of active exercise to inactivity is uncontested [29]. Presently, both the active traditional and multifidus exercises were beneficial for LBP. Specific exercise treatment is more effective than other types of other conservative management of LBP [31]. We hypothesize that the pain and the disability in these patients may be due to the segmental instability caused by the weakness of LM muscles. A specific exercise program to retrain these weak muscle fibers improves the function.

MRP showed significant improvements in relieving pain and functional disability in this study and previous research [31] when compared to TBE. The better results of the MRP group may reflect the fact that this training program concentrates on the deep back segmental stabilizer muscle, the LM, which is weak in professionals who sit for prolonged periods. The MRP regimen produced better pain reduction and functional improvement compared to TBE, which is consistent with the fact that the deep muscles provide segmental stability to the back. Subjects in the TBE group performed exercises to strengthen the superficial muscles of the abdomen and trunk. The resulting reduction of pain and improvement in the functionality of CLBP subjects is consistent with prior findings [16].

Even after pain remission in patients with LBP, proper deep muscle reestablishment often does not occur, with specific physical therapy focusing on those muscles being necessary [13]. Our findings suggest that both protocols are of clinical utility in the improvement of CLBP.

Conclusions

Both the MRP and TBE regimens reduced the pain and functional disability effectively in individuals with CLBP. The improvements were superior for those receiving MRP in computer professionals with CLBP.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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