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Effect of Pilates' mat exercise program on pain, disability and lumbo-pelvic stability in patients with mechanical low back pain

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Abstract

Background and purpose: To compare the effect of Pilates' mat exercises with Conventional spinal exercises on pain, disability and lumbo-pelvic stability in Mechanical Low Back Pain (MLBP) patients.

Methods: Thirty six patients divided into two groups by random allocation. One group received Pilates' Training Program (Group A), and the other, received Conventional program (Group B). Fourteen participants in Group A and 17 in Group B completed the study. Both groups attended a 30 minute therapist supervised session, 5 days a week, for 4 weeks and outcomes were measured in terms of Pain, Disability, Core muscle endurance & Lumbo-pelvic stability.

Results: All the participants showed significant improvement ($p<0.05$) in pain, disability and core muscle endurance. On comparing groups no significant difference was found with respect to pain, disability and lumbo-pelvic stability. However, core muscle endurance improved significantly ($p=0.02$) in Group A as hold time increased by 2.941±1.71 seconds as measured at end of week 4.

Conclusion: It was concluded that Pilates' mat exercises as well as Conventional Spinal exercises are equally effective in the rehabilitation of patients with MLBP. However Pilates exercises lead to better improvement in the core muscle endurance.

Keywords: Pilates', Mechanical low back pain, exercise

Introduction

The number of health issues that are encountered in today's age is strikingly significant, of which the most prevalent is low back pain (LBP). It is the major cause for work related disability [1] and work absenteeism in young adults under the age of 45 years in industrialized societies [2]. Pain in the lumbosacral region, buttocks or thighs, in individuals mostly aged between 20–55 years, in whom pain varies with physical activity and over time, are the criteria's for terming a condition as mechanical low back pain. Multiple factors may lead to mechanical LBP, but the aetiology remains ill- defined [3]. It is thought to be directly related to social demographic characteristics, habits, as well as physical and psychosocial factors [4].

A wide variety of therapeutic interventions are available for the treatment of chronic low back pain [5]. Conventionally used Spinal Exercise Program is a multidisciplinary exercise program which includes awareness about the condition, ergonomic advice, postural correction, strength and endurance training for the superficial and deep spinal musculature and flexibility exercises [4,6]. Joseph H. Pilates was the first to develop this comprehensive body conditioning program for the development of the body and mind that promotes better body awareness and improves posture [7,8]. It is based on the principle of "Contrology" known as the Pilates' method; the Pilates' approach though a relatively new and is increasingly being applied to enhance body aesthetics and therapeutic benefits [9,10]. Its techniques aim to specifically train all the core muscles, also called the 'powerhouse', and mainly involve isometric contractions of these muscles. They serve as the muscular centre which is responsible for the static and dynamic stabilization of

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Figure 1: Exercises taught in the first week

1a: HundredsFigure 1b: Shoulder Bridge 1c: Clam

the body. These exercises are considered to be similar to spinal stabilization exercises [10].Unlike conventional form of exercise, Pilates do not overdevelop some parts of the body and neglect others. Although the focus is improving the core strength, it trains the body as an integrated whole. The probable etiological factors like physical, educational and psychological elements are also important aspects to be considered when aiming to treat back pain. All these are encompassed within the principles of Pilates training [10].

The effectiveness of therapeutic exercise in the treatment of chronic low back pain is still debated in systematic reviews and in the adoption of therapy recommendations [6]. A systematic review of low back patient treatments suggested that exercise is one of the most effective treatments for LBP in both long and short term because it reduces pain and disability. However, it also suggested that the Pilates method is among the techniques that need to be studied as it is a technique with unknown efficacy [11]. Previous studies have been performed to compare the effects of Pilates-based exercises to those of a control intervention in healthy participants who were not subjected to any treatment. The results have shown a significant improvement in flexibility, body composition, and resistance of abdominal and spinal extensor muscles [12]. However there is still a lack of supporting literature examining the phenomena associated with Pilates' based techniques within the field of rehabilitation.

Hence, the main purpose of this study was to evaluate the efficacy of a Pilates' Exercise Program on pain, disability and lumbo-pelvic stability for active individuals with chronic mechanical back pain and also to compare its efficacy to that of a conventional spinal exercise programme. It was hypothesized that the individuals with non-specific low back pain will benefit more from Pilates' program in terms of reducing pain and disability, and enhancing lumbo-pelvic stability.

Table 1: Levels of core progression

Progressive limb loading →		
A) Lift bent leg to 90°hip flexion	B) Slide heel to extend knee	C) Lift straight leg to 45°
Level1: Core	Draw in and hold for 10 seconds	
Activation		
Level 2:	Opposite LE on mat, bent leg fall out	
Level 3: A, B or C	Opposite LE on table	
Level 4: A, B or C	Hold opposite LE at 90°hip flexion with UE assistance	
Level 5: A, B or C	Hold opposite LE at 90°hip flexion without UE assistance	
Level 6: A, B or C	Bilateral LE movement	

Methods

Design: This was a randomised clinical trial done in tertiary orthopaedic hospitals. The study was approved by the Institutional Review Board.

Subjects: Thirty-six patients (males and females) between the age group of 20 to 40 coming to tertiary orthopaedics hospitals having mechanical low back pain without radiation to lower limbs, for more than 6 weeks were enrolled in the study. Patients with any systemic disorder or who were undergoing intervention

Figure 2: Exercises introduced in the second

2a: Side Figure 2b: Swimming 2c: One Leg

Figure 3: Exercises given to Group B

3a: Straight Leg RaiseFigure 3b: Dorsolumbar Fascia Stretch 3c: Trunk Extension in proneFigure 3d: Prone on hands 3e: Abdominal Curls

Table 2: Mean and standard deviation of pain measured by VAS in both the groups.

VAS	Pre (Mean±SD)	Post (Mean±SD)	p value
Pilates Group	5.11±1.53	1.88±0.92	0.001*
Conventional Group	5.5±2.44	2.78±1.31	0.001*

*p value significant as p≤0.05

Table 3: Mean and standard deviation of Disability score in both the groups.

Disability	Pre (Mean±SD)	Post (Mean±SD)	p value
Pilates Group	14.70±8.18	6.47±4.38	0.001*
Conventional Group	17±7.47	9.71±6.74	0.0001*

*p value significant as p≤0.0

Table 4: Mean and standard deviation of endurance- hold time (sec) in both the groups.

Endurance	Pre (Mean±SD)	Post (Mean±SD)	p value
Pilates Group	5.82±2. 2	8.76±1.4	0.001*
Conventional Group	4.64±2.09	6.42±2.40	0.001*

*p value significant as p≤0.05

Table 5: Mean and standard deviation of lumbo-pelvic stability in both the groups.

Lumbo-pelvic stability	Pre (Mean±SD)	Post (Mean±SD)	p value
Pilates Group	0.117±0. 33	0.529±0.71	0.008*
Conventional Group	0.071±0.26	0.214±0.57	0.082

*p value significant as p≤0.05

Table 6: Inter group significance values

Sr. No.	Outcome measure	p value
1	Pain (VAS)	0.165
2	Disability	0.3
3	Endurance	0.02*
4	Lumbo-pelvic stability	0.05*

*p value significant as p≤0.05

for the same were excluded. Subjects having a history of spine surgery were also not included. A written consent from each patient was taken. Patients were randomly divided into 2 groups using concealed allocation by lottery method. Group A consisting of 19 participants with the mean age of 27.47(±5.41) years, average height of 161.23±7.88 cm and weight 59.05±7.45kg received the Pilates exercises. Group B consisted of 17 participants with the mean age 30(±5.77) years, average height 158.14 ±5.30cm and weight 58.21±7.66 kg received the conventional spinal exercises. Subjects were assessed at the start of treatment and then at the end of 4th week i.e. post intervention. There were five loss to follow-ups observed in this study which left a total of thirty-one subjects who completed the intervention. Group A comprised 17 subjects and Group B had fourteen. Subjects in both groups attended a 30 minute therapist supervised session 5 days a week for 4 weeks.

Outcome Measures: Visual Analogue Scale (VAS)- Visual analogue scale is the most common used scale for assessing pain [13,14]. All patients from both groups were assessed for intensity of pain using a Visual Analogue Scale. Patients were given a 10 cm scale drawn on paper with 0 marked as no pain and 10 marked as maximum pain and were asked to mark their pain level at that time on this scale.

Modified Oswestry Disability Index (MODI)- Subjects were also given a Modified Oswestry Low Back Pain Disability Questionnaire and were asked to answer all the questions by marking the statement that best describes their condition at that time [15].

Lumbo-pelvic Stability using Pressure Biofeedback unit by Chattanooga Group, Inc. Lumbo-pelvic stability was assessed using the hold time which assesses core muscle endurance and the progressive leg loading test which assesses the control of the lumbopelvic complex [16-18].

I. Hold time: Each patient was positioned in crook lying (knees bent to 90°) Pressure Biofeedback Unit (PBU) cuff was placed under lumbar spine and inflated to 40 mmHg and was allowed to stabilize. The patient was instructed to perform a drawing-in manoeuver to activate core muscles as taught previously. As the patient performed the drawing in manoeuver the pressure increased slightly and the subject was instructed to maintain this pressure as long as possible. This was measured with a stopwatch and was measured in seconds. Patient was given 3 trials and the mean of the 3 was recorded [16-18].

II. Progressive Leg Loading Test: Patient was positioned in crook lying Pressure cuff was placed under lumbar spine and inflated to 40 mmHg. Each level began with, drawing-in manoeuver to activate core muscles. Level at which patient could maintain pressure constant (stable pelvis) while performing the limb load activity was determined [16-18] (Table 1).

Each patient was given 3 trials and the mean of the 3 was recorded. Before testing patients were instructed to empty their bladder and timing of the testing was done at least 2 hours after intake of a meal. Also patients were instructed not to employ any compensatory strategies like movements of the pelvis and spine, breath holding and rib elevation. Following this patients were also given a practice of the leg loading test. The patient was given an adequate rest period before the pre-test measurement was taken.

Procedure:

Pilates' Exercise Program (Group A): The first session involved teaching basic Pilates' Principles and attaining the neutral spine position. The principles were revised at the beginning of every session. The protocol included Breathing Control, Attaining the Pilates' neutral spine position and Recruitment of core muscles during all exercises [19,20]. Exercises were slowly progressed so as to follow the Pilates' principle of Precision for every exercise. (Fig. 1 & 2) 10 repetitions of each exercise were performed once a day.

Conventional Spine Exercise Program (Group B):Patients in this group were taught a combination of exercises like strengthening for abdominal, back and hip musculature and flexibility exercises for back and thighs (Fig. 4). Ten repetitions of each exercise were performed once a day.

Results

Statistical Package for the Social Sciences (SPSS) version 14 was used. Level of significance was set as $p \leq 0.05$. Wilcoxon signed rank test was used to analyse pre and post values (intra-group) for pain, disability, core muscle endurance and lumbo-pelvic stability. Comparisons of the improvement between the two therapy groups were made by the Mann Whitney-U test. Baseline matching showed no significant difference between the groups.

Table 2: Mean and standard deviation of pain measured by VAS in both the groups.

Table 3: Mean and standard deviation of Disability score in both the groups.

Table 4: Mean and standard deviation of endurance- hold time (sec) in both the groups.

Table 5: Mean and standard deviation of lumbo-pelvic stability in both the groups.

Table 6: Inter group significance values

Discussion

In this study the efficacy of Pilates' exercises was evaluated. It was found that there was a significant decrease in pain and disability scores as well as improvement in core muscle endurance and lumbo-pelvic stability reflected by reduction in VAS and MODQ scores and increase in the hold time and limb loading level respectively.

A significant improvement in pain scores was seen in both groups. It is hypothesized that the transverses abdominis is activated at a subconscious and submaximal contraction, as part of the motor plan, to provide trunk stiffness during dynamic movement [21,22]. This approach leads to improvement in motor control and as it is advocated in Pilates' based exercises may have culminated into reduction in pain [23]. This reduction in pain could be because of the improved recruitment and co-contraction of core muscles like Transverse abdominis and Multifidus which increases effective control of both local and global spinal stability thereby acting to reduce the compressive overloads, and eradicating pain perception [24-26]. Another factor which could have led to pain reduction in Pilates' group would be the importance given to breathing control. Full thorough inhalation-exhalation is a necessary part of every Pilates' exercise. It is postulated that proper and effective breathing helps reduce tension in the muscles and imparts relaxation and thus helps in pain reduction [27].

Both groups showed a significant decrease in the level of functional disability which could directly be attributed to the reduction in pain. Also exercise therapy leads to an overall reconditioning which could explain the reduction in disability [26].

Conflicting evidence was shown by Rasmussen et al. In their study they found that, as a general exercise program does not aim to train specific activity patterns, it might not improve disability in the same way as specific stabilizing exercises do [26]. However, in the present study both exercise groups significantly improved with respect to disability. Though the pretreatment disability levels in both these studies were similar, the difference in results may have been because the general exercise group in the previous study was only given walking as an exercise with few general body exercises which were not well defined. Also they assessed patients over a longer follow-up period which was addressed in the present study. Comparing the improvement in disability within both groups there was no significant difference found which showed that both forms of exercises were equally effective in reducing disability and improving function.

It is accepted that muscle dysfunction in LBP is not simply a problem of muscle strength or endurance but of altered neuromuscular control mechanisms affecting muscular stability of the trunk and movement efficiency. The Pilates exercises follow the principles of Centring, Control, Concentration, Precision and normal breathing thereby leading to improved neuromuscular coordination. Moreover, the avoidance of floppy uncontrolled movements further enhances motor control. This could be the reason for improved stability [28]. Norris [29] states that in Pilates' exercises, the onset of the limb load is predictable, and therefore the body anticipates the load and a pre-setting of the transverses abdominis occurs which could again lead to better stability.

A significant improvement in hold time was seen in both groups. However on comparing both groups, it was seen the Pilates group showed a significantly better improvement in terms of the time for which the patient could sustain the core contraction ($p<0.05$)

The improvement in core muscle endurance may be attributed to the number of repetitions performed for each exercise in both groups and also the frequency of exercise sessions attended per week. However, Pilates' exercises start with activation of core contraction and emphasizes on the maintenance till completion of that exercise. This might explain the significant higher increase in core muscle endurance in Pilates Group when compared to that of Conventional exercise group [25].

Stuart McGill [30] in his study has stated that it is more important for a person to maintain spinal stability in all activities with low but continuous muscle activation. Thus maintaining stability is not compromised by insufficient strength but rather by insufficient endurance. This shows the importance of endurance training for muscles that stabilize the spine.

So we can conclude that Pilates' mat exercises as well as Conventional Spinal exercises are equally effective in reducing mechanical low back pain and disability associated with it. However Pilates' exercises are more effective in improving the core muscle endurance and therefore may be used as an alternative exercise program for patients with mechanical low back pain.

Limitations

Long term follow-up more than 4 weeks was not assessed.

Implications for Physiotherapy Practice

Pilates' mat based exercises may be used as an alternative exercise program for patients with mechanical low back pain.

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