Effect of Selected Pilates Exercise on Chronic Mechanical Low Back Pain

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Abstract

Objective: To determine the effect of selected Pilates exercise on patients with chronic mechanical low back pain.

Material and Methods: Thirty patients with chronic mechanical low back pain participated in this study, their ages ranged from 18-45 years old. They were divided into two groups, Group (A) which included 30 patients who received the traditional chronic low back pain treatment which included hot pack, ultrasonic, traditional exercises included knee to chest, bridging exercise and lower back stretch for 4 weeks at a frequency of 3 sessions per week, and Group (B) which include 15 patients who followed a program consist of hot pack, ultrasonic and six selected Pilates exercise for 4 weeks at a frequency of 3 sessions per week. Both groups were assessed pre and post-treatment for functional state, trunk muscles endurance.

Results: There was a statistical significance difference between Group A and Group B in mean values of functional scale in post-treatment group, while no statistical significance difference between Group A and Group B in mean values of flexion extension ratio in post-treatment group.

While no statistical significance difference between Group A and Group B in mean values of right bridging and left bridging ratio in post-treatment group, there was a statistical significance difference between Group A and Group B in mean values of right bridging extension ratio in post-treatment group, while no statistical significance difference between Group A and Group B in mean values of left bridging and extension ratio in post-treatment group.

Conclusion: It was concluded that the Pilates exercises have significant effect on functional scale and right bridging and extension ratio in comparison to traditional physical therapy program in chronic mechanical low back pain.

Key Words: Pilates exercises – Mechanical low back pain – Traditional physical therapy program.

Introduction

LOW back pain is a common complaint in the USA, though some people are able to deal with their low back pain, for many the pain can become unbearable and debilitating. An estimated 80% of the population will suffer from low back pain throughout their life time, this fact makes low back pain the most common cause of disability in patient younger than 45 years old [1].

Due to its high prevalence, low back pain is the second most common reason for visits to the doctor’s office [2] the 4-5% of all annual health care visits due to low back pain results in an estimated 50 million dollars that is spent annually on the condition [3].

Nonspecific low back pain is defined as pain located in the lower region of the spine (below the ribs and above the legs) due to an unknown cause. This condition can be categorized as acute (<3 months), chronic (>3 months) or recurrent [4]. Exercise is being increasingly used to treat low back pain [5] general condition programs to train strength and endurance of the spine musculature have been shown to reduce pain intensity and disability and to be useful in the treatment of nonspecific chronic low back pain [6-8].

There is a strong evidence that exercise therapy is more effective than usual care by general practitioners and that therapeutic exercise and conventional physiotherapy (consisting of hot packs, massage, traction, mobilization, short wave diathermy, ultrasound, stretching, flexibility and coordination exercise and electrotherapy) are equally effective [9].

Exercise should play a role in active rehabilitation of patients with chronic low back pain. Exercise
may be useful within an active rehabilitation program if they facilitate and participant an increase in ordinary activity and return to work [10].

Pilates exercise through the use of various approaches emphasize the strength of both abdominal and lumbar muscles while promoting good posture and body alignment [11,12].

Further studies suggested that Pilates exercises can be advocated as a secondary maintenance stage of spinal stabilization rehabilitation treatment for recurrence prevention in patients with low back pain [12].

Aim of study:

To determine the effect of selected Pilates exercise on chronic mechanical low back pain.

Material and Methods

This study took place at Al-Razy Hospital, Cairo, Egypt and during the period between March 2016 to July 2016.

Thirty patients (male and female) complaining of chronic mechanical low back pain were allocated randomly into 1 of 2 groups.

Group A received specific pilates exercise program, with ultrasonic and hot pack, while Group (B) received traditional low back pain treatment program (ultrasonic, hot pack, and back exercise in form of bridging and abdominal exercise in form of knee to chest exercise and lower back stretching exercise).

I- Functional disability:

Functional disability was assessed by the Oswestry Disability Questionnaire (ODQ) [23] it was developed as a clinical assessment tool that would provide an estimate of disability expressed as a percentage score. It consists of ten sections that assess pain, personal care, lifting, walking, sitting, standing, sleeping, sex life, social life and traveling. It is valid and reliable tool. It consists of 10 multiple choice questions for back pain; patient selected one sentence out of six that best describes his pain. High scores indicate great pain (APPENDIX 1).

II- Trunk muscular endurance testing [13]:

**Flexion endurance test:**

For evaluating flexor endurance, subjects was asked to lie in a supine position and to keep the lower extremities with 90º flexion of the hip and knee joints and then he was asked to raise his trunk from the floor and hold the new position Fig. (1).

**Extension endurance test:**

For measuring extensor endurance, subjects was asked to lie in a prone position while holding the sternum off the floor a small pillow was placed under the lower abdomen to decrease the lumbar lordosis Fig. (2).

During both procedures, subjects was asked to maintain their maximum flexion of cervical spine, with pelvic stabilization through gluteal muscle contraction. These cervical and pelvic alignments proved to be the most optimal posture not only for decreasing the lumbar lordosis, but also for activating trunk flexors and extensors most effectively.

During both tests, the subjects was asked to maintain the original positions for as long as possible, not exceeding a 5-minute time limit.

The performance time (seconds) for which subjects could maintain the position was calculated according to the following (Table 1).

It was suggested that the RSB/LSB ratio should not differ from unit [1] by more than 0.05 (i.e. the ratio should be between 0.95 and 1.05), mathematically this is written: $0.95 \leq \text{RSB/LSB} \leq 1.05$ ratio outside of these values the muscle balance is unacceptable (within these values acceptable) so when evaluating your RSB/LSB ratio it should be referred to these suggested values rather than the mean ratio shown in the table above.

**Flexion/extension endurance ratio ≤1.0:**

Therefore, if this ratio gives a result less than or equal to 1.0 it is acceptable a ratio greater than 1.0 is unacceptable notice that the mean ratio is 0.84 for males and 0.72 for females [13].

Statistical analysis:

- Results are expressed as mean ± standard deviation or number (%).
- Comparison between categorical data [number (%)] was performed using Chi square test.
- According to test of normality, comparison between different variables in the two groups was performed using unpaired $t$-test. Pair wise group comparison (pre versus post) was performed using paired $t$-test.
- Statistical Package for Social Sciences (SPSS) computer program (Version 19 windows) was used for data analysis. $p$-value ≤0.05 was considered significant.
Table (1): The mean endurance times (seconds) and ratios.

<table>
<thead>
<tr>
<th>Task</th>
<th>Men</th>
<th>Women</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Extension</td>
<td>161</td>
<td>61</td>
<td>185</td>
</tr>
<tr>
<td>Flexion</td>
<td>136</td>
<td>66</td>
<td>134</td>
</tr>
<tr>
<td>RSB</td>
<td>95</td>
<td>32</td>
<td>75</td>
</tr>
<tr>
<td>LSB</td>
<td>99</td>
<td>37</td>
<td>78</td>
</tr>
</tbody>
</table>

Ratios normalized to the extensor endurance test:

- Flexion/extension ratio: 0.84, 0.72, 0.77
- RSB/LSB ratio: 0.96, 0.96, 0.96
- RSB/extension ratio: 0.58, 0.40, 0.48
- LSB/extension ratio: 0.61, 0.42, 0.50

RSB: Right Side Bridge.
LSB: Left Side Bridge.
SD: Standard Deviation.

**Results**

**Patient characteristics:**

The study sample consisted of 30 patients divided equally into two Groups A & B with a mean age of (33.27±5.12) (33.60±6.94) years respectively.
Effect of Selected Pilates Exercise on Chronic Mechanical Low Back Pain

**Table (2): Physical characteristics of patients in all groups.**

<table>
<thead>
<tr>
<th></th>
<th>Group A (n=15)</th>
<th>Group B (n=15)</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs.)</td>
<td>33.27±5.12</td>
<td>33.60±6.94</td>
<td>-0.150</td>
<td>0.882 (NS)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>8 (53.3%)</td>
<td>7 (46.7%)</td>
<td>χ² = 0.715</td>
<td>0.133</td>
</tr>
<tr>
<td>Male</td>
<td>7 (46.7%)</td>
<td>8 (53.3%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data are expressed as mean ± SD or number (%).

χ²: Chi Square test.
NS: p>0.05: Not Significant.

**Table (3): Inter-and intra-group comparison between mean values of functional scale in the two studied groups.**

<table>
<thead>
<tr>
<th></th>
<th>Group A (n=15)</th>
<th>Group B (n=15)</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>41.07±10.00</td>
<td>42.67±7.73</td>
<td>-0.490</td>
<td>0.628 (NS)</td>
</tr>
<tr>
<td>Post</td>
<td>35.53±5.89</td>
<td>35.20±9.79</td>
<td>0.113</td>
<td>0.911 (NS)</td>
</tr>
<tr>
<td>Mean difference</td>
<td>5.54</td>
<td>7.47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% change</td>
<td>13.49 ↓↓</td>
<td>17.51 ↓↓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>t-value</td>
<td>4.312</td>
<td>10.425</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value</td>
<td>0.001 (S)</td>
<td>0.001 (S)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data are expressed as mean ± SD.

S: p<0.05: Significant.
NS: p>0.05: Not Significant.

**Table (4): Inter-and intra-group comparison between mean values of flexion extension ratio in the two studied groups.**

<table>
<thead>
<tr>
<th></th>
<th>Group A (n=15)</th>
<th>Group B (n=15)</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>0.85±0.16</td>
<td>0.87±0.21</td>
<td>-0.295</td>
<td>0.770 (NS)</td>
</tr>
<tr>
<td>Post</td>
<td>0.83±0.15</td>
<td>0.81±0.18</td>
<td>0.381</td>
<td>0.706 (NS)</td>
</tr>
<tr>
<td>Mean difference</td>
<td>0.02</td>
<td>0.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% change</td>
<td>2.35 ↓↓</td>
<td>6.90 ↓↓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>t-value</td>
<td>0.517</td>
<td>1.404</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value</td>
<td>0.613 (NS)</td>
<td>0.182 (NS)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data are expressed as mean ± SD.

S: p<0.05: Significant.
NS: p>0.05: Not Significant.

**Table (5): Inter-and intra-group comparison between mean values of right left ratio in the two studied groups.**

<table>
<thead>
<tr>
<th></th>
<th>Group A (n=15)</th>
<th>Group B (n=15)</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>1.19±0.23</td>
<td>1.21±0.12</td>
<td>-0.396</td>
<td>0.695 (NS)</td>
</tr>
<tr>
<td>Post</td>
<td>1.19±0.14</td>
<td>1.17±0.13</td>
<td>0.406</td>
<td>0.688 (NS)</td>
</tr>
<tr>
<td>Mean difference</td>
<td>0.0</td>
<td>0.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% change</td>
<td>0.0</td>
<td>3.31 ↓↓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>t-value</td>
<td>-0.109</td>
<td>1.020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value</td>
<td>0.915 (NS)</td>
<td>0.325 (NS)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data are expressed as mean ± SD.

NS: p>0.05: Not Significant.
A previous study stated that mat based Pilates exercise was efficient in the treatment of individuals with nonspecific chronic low back pain but there was no statistical difference between the compared two groups which used mckenzie exercise and the other used Pilates exercise [20].

While another study stated that randomized controlled studies exist regarding the effect of Pilates on patients with nonspecific chronic low back pain, it was published a randomized controlled study in 2006 to evaluate the efficacy of a Pilates method called Pilates CovaTech compared to a Back-School intervention for patients with low back pain. The CovaTech method is a specific rehabilitation method utilized in Italy derived from the original Pilates method. Forty-three subjects who had nonspecific LBP for at least 3 months and were receiving treatment for this complaint were enrolled in this study. Participants were randomly placed into one of the two groups including 21 to the Pilates CovaTech method and 22 back school method, outcome measures included disability assessed the Oswestry Low Back Pain Disability Questionnaire (OLBPQD) and pain evaluated with the visual analogue scale. Assessments were made at baseline and then at 1, 3, and 6-month follow-ups. Subjective response to treatment (worse to better), adherence to home practice, level of satisfaction (dissatisfied to very satisfied), and benefit perceived (little benefit to great benefit) were also assessed in both groups.

In addition, the participants in the Pilates method reported better subjective response to treatment as compared to those in the back-school method at all follow-up time points.

The authors concluded that the equally good results obtained with the Pilates CovaTech method demonstrated it was as efficacious as the back school method in terms of both short- and long-term (6 month) outcomes. They also stated the Pilates intervention had better compliance because of subjective responses such as improvement of symptoms and satisfaction with treatment. In conclusion, the authors proposed the Pilates CovaTech method was a valid alternative in the management of patients with non-specific chronic low back pain [21].

Another study studied the effects of a Pilates-based therapeutic exercise protocol on patients with chronic low back pain as compared to a control group receiving usual care. Thirty-nine subjects with nonspecific chronic low back pain were enrolled in this study. Participants were required to have had persistent chronic low back pain for greater than 6 weeks or recurring low back pain with at least year of sufficient intensity to restrict functional activity.

These individuals were then randomized to one of the two groups including 21 to the Pilates group and 18 to the control group. The Pilates protocol consisted of exercise and performed on the mat and the exercises that were designed to train the activation of specific muscles thought to stabilize the lumbar-pelvic region.

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Table (6): Inter-and intra-group comparison between mean values of right extension ratio in the two studied groups.

<table>
<thead>
<tr>
<th>Group A (n=15)</th>
<th>Group B (n=15)</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>0.56±0.19</td>
<td>0.63±0.27</td>
<td>-0.768</td>
</tr>
<tr>
<td>Post</td>
<td>0.49±0.13</td>
<td>0.52±0.13</td>
<td>-0.562</td>
</tr>
<tr>
<td>Mean difference</td>
<td>0.07</td>
<td>0.11</td>
<td></td>
</tr>
<tr>
<td>% change</td>
<td>12.5↓</td>
<td>17.46↓</td>
<td></td>
</tr>
<tr>
<td>t-value</td>
<td>2.771</td>
<td>2.635</td>
<td></td>
</tr>
<tr>
<td>p-value</td>
<td>0.015 (S)</td>
<td>0.020 (S)</td>
<td></td>
</tr>
</tbody>
</table>

Data are expressed as mean ± SD.

$S : p < 0.05$: Significant.

NS : $p > 0.05$: Not Significant.

Table (7): Inter-and intra-group comparison between mean values of left extension ratio in the two studied groups.

<table>
<thead>
<tr>
<th>Group A (n=15)</th>
<th>Group B (n=15)</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>0.52±0.19</td>
<td>0.53±0.24</td>
<td>-0.170</td>
</tr>
<tr>
<td>Post</td>
<td>0.48±0.14</td>
<td>0.49±0.15</td>
<td>-0.125</td>
</tr>
<tr>
<td>Mean difference</td>
<td>0.04</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>% change</td>
<td>7.69↓</td>
<td>7.55↓</td>
<td></td>
</tr>
<tr>
<td>t-value</td>
<td>2.132</td>
<td>1.828</td>
<td></td>
</tr>
<tr>
<td>p-value</td>
<td>0.051 (NS)</td>
<td>0.040 (NS)</td>
<td></td>
</tr>
</tbody>
</table>

Data are expressed as mean ± SD.

$S : p < 0.05$: Significant.

NS : $p > 0.05$: Not Significant.

Discussion

The data of present study was conducted to evaluate the effect of selected Pilates exercise on chronic mechanical low back pain.

This study focused on chronic nonspecific low back pain that persist more than months and affect functional abilities and trunk muscle endurance timing.

Back pain is one of the most widely experience health related problems in the western world in a recent survey for the United Kingdom 40% of 5500 people intervened had experienced back pain within a single year with pan exiting they at the year in 15% of these cases.

A previous study stated that mat based Pilates exercise was efficient in the treatment of individuals with nonspecific chronic low back pain but there was no statistical difference between the compared two groups which used mckenzie exercise and the other used Pilates exercise [20].
In addition, the Pilates participants were asked to complete a 15min home program 6 days per week which involved similar exercises performed on the floor. The control group received usual care as defined by the authors as "consultation with physicians and other health care professionals as necessary". The control group was also instructed to continue participating in their usual physical activity.

Outcome-measures included functional disability assessed with the 24-point Roland Morris Disability Questionnaire (RMQ) and average pain intensity measured with a 101-point numerical rating scale. Outcomes were evaluated at baseline and end of treatment in both groups; in addition, retention of treatment effect for disability was tested at 3, 6, and 12 months' post-treatment in the Pilates group.

There were significantly lower levels of disability and pain following intervention in the Pilates group compared to the control group. For functional disability, the mean Roland Morris Disability Questionnaire (RMQ) score in the Pilates group was 2.0 compared to 3.2 in the control group at end of treatment. For average pain intensity, the mean number in the Pilates group was 18.3 compared to 33.9 in the control group at end of treatment. In addition, improved disability scores were maintained in the Pilates group for up to 12 months' post-treatment.

The authors concluded that treatment with a modified Pilates-based-approach was more efficacious in reducing functional disability and pain intensity than usual care a population with chronic low back pain. They noted a major limitation of their study was the results were potentially not generalizable to other CLBP patients who had more disabling pain precluding them from being as physically active or did not have altered performance of the gluteus Maximus [22].

Conclusion:

From the obtained results of this study, it can be concluded that exercise is an important intervention for treatment of chronic mechanical low back pain to treat muscle imbalance and regain muscular endurance.

Pilates exercise need further investigation and further research.

References

Appendix I

Oswestry Low Back Pain Disability Questionnaire
Oswestry Disability Index

Please complete this questionnaire. It is designed to tell us how your back pain affects your ability to function in every day life.

I have “Chronic Pain” or pain that has bothered me for 3 months or more:

☐ Yes   ☐ No

Check one of the following:

☐ Prior to Surgery  ☐ After Surgery 3 Months  ☐ After Surgery 1 year
☐ After Surgery 6 weeks  ☐ After Surgery 6 Months  ☐ After Surgery 2 years

Please answer each section below by checking the one Choice that applies the most to you at this time. (You may feel that more than one of the statement relates to you at this time, but it is very important that you please check only choice that best describes your problem at this time.

Section 1: Pain Intensity

☐ I can tolerate the pain I have without having to use pain killers. [0 points]
☐ The pain is bad but I manage without taking pain killers. [1 point]
☐ Pain killers give complete relief from pain. [2 points]
☐ Pain killers give moderate relief from pain. [3 points]
☐ Pain killers give very little relief from pain. [4 points]
☐ Pain killers have no effect on the pain and I do not use them. [5 points]

Section 2: Personal Care

☐ I can look after myself normally without causing extra pain. [0 points]
☐ I can look after myself normally but it causes extra pain. [1 point]
☐ It is painful to look after myself and I am slow and careful. [2 points]
☐ I need some help but manage most of my personal care. [3 points]
☐ I need help every day in most aspects of self care. [4 points]
☐ I do not get dressed wash with difficulty and stay in bed. [5 points]

Section 3: Lifting

☐ I can lift heavy weights without extra pain. [0 points]
☐ I can lift heavy weights but it gives extra pain. [1 point]
Oswestry Low Back Pain Disability Questionnaire

Oswestry Disability Index

Section 3: Lifting (Cont.)
- Pain prevents me from lifting heavy weights off the floor but I can manage if they are conveniently positioned for example on a table. [2 points]
- Pain prevents me from lifting heavy weights but I can manage light to medium weights if they are conveniently positioned. [3 points]
- I can lift only very light weights. [4 points]
- I cannot lift or carry anything at all. [5 points]

Section 4: Walking
- Pain does not prevent me walking any distance. [0 points]
- Pain prevents me walking more than 1 mile. [1 point]
- Pain prevents me walking more than 0.5 miles. [2 points]
- Pain prevents me walking more than 0.25 miles. [3 points]
- I can only walk using a stick or crutches. [4 points]
- I am in bed most of the time and have to crawl to the toilet. [5 points]

Section 5: Sitting
- I can sit in any chair as long as I like. [0 points]
- I can only sit in my favorite chair as long as I like. [1 point]
- Pain prevents me sitting more than 1 hour. [2 points]
- Pain prevents me from sitting more than 0.5 hours. [3 points]
- Pain prevents me from sitting more than 10 minutes. [4 points]
- Pain prevents me from sitting at all. [5 points]

Section 6: Standing
- I can stand as long as I want without extra pain. [0 points]
- I can stand as long as I want but it gives me extra pain. [1 point]
- Pain prevents me from standing for more than 1 hour. [2 points]
- Pain prevents me from standing for more than 30 minutes. [3 points]
- Pain prevents me from standing for more than 10 minutes. [4 points]
- Pain prevents me from standing at all. [5 points]
Oswestry Low Back Pain Disability Questionnaire
Oswestry Disability Index

Section 7: Sleeping
☐ Pain does not prevent me from sleeping well. [0 points]
☐ I can sleep well only by using tablets. [1 point]
☐ Even when I take tablets I have less than 6 hours sleep. [2 points]

Section 7: Sleeping (Cont.)
☐ Even when I take tablets I have less than 4 hours sleep. [3 points]
☐ Even when I take tablets I have less than 2 hours of sleep. [4 points]
☐ Pain prevents me from sleeping at all. [5 points]

Section 8: Sex Life
☐ My sex life is normal and causes no extra pain. [0 points]
☐ My sex life is normal but causes some extra pain. [1 point]
☐ My sex life is nearly normal but is very painful. [2 points]
☐ My sex life is severely restricted by pain. [3 points]
☐ My sex life is nearly absent because of pain. [4 points]
☐ Pain prevents any sex life at all. [5 points]

Section 9: Social Life
☐ My social life is normal and gives me no extra pain. [0 points]
☐ My social life is normal but increases the degree of pain. [1 point]
☐ Pain has no significant effect on my social life apart from limiting energetic interests such as dancing. [2 points]
☐ Pain has restricted my social life and I do not go out as often. [3 points]
☐ Pain has restricted my social life to my home. [4 points]
☐ I have no social life because of pain. [5 points]