Does Pilates-Based Approach Provide Additional Benefit over Traditional Physiotherapy in the Management of Rotator Cuff Tendinopathy? A Randomised Controlled Trial

Eda Akbas* and Emin Ulaş Erdem
Department of Physiotherapy and Rehabilitation, Bulent Ecevit University, Turkey

Abstract

Aim: The aim of this study was to observe the possible effects of a Clinical Pilates exercise programme on pain and disability level additional to conventional physiotherapy in patients with rotator cuff tendinopathy.

Methods: A total of 19 RCT patients (control group n=10, mean age=50.60 ± 11.70 years) (Pilates group n=9, mean age=51.44 ± 9.88 years) participated in the study. All patients were treated with hot-pack therapy, ultrasound therapy and home exercise program five times a week, total of fifteen sessions (three weeks). Pilates group also trained with Clinic Pilates exercise program especially focused to shoulder complex supervised with expert. Pain intensity (at night, resting, flexion, abduction, internal rotation, external rotation) was assessed with Visual Analog Scale (VAS). Disability level was assessed with Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire and Shoulder Pain and Disability Index (SPADI), general health level was assessed with Health Assessment Questionaire Disability Index (HAQ-DI), and anxiety level was assessed with Beck Anxiety Inventory (BAI).

Results: Night pain, pain in internal rotation, external rotation, DASH and SPADI scores significantly got better in both groups after therapy (p<0.05). Resting pain, pain in flexion and abduction HAQ-DI and BAI scores did not advanced in control group while significantly improved in the Pilates Group (p<0.05).

Conclusions: Pilates exercises are associated with better quality of life values, especially in the dimensions of physical functioning, general health and mental health. Our results indicated that well-designed Clinic Pilates programme customed to shoulder complex may be beneficial option additional to conventional therapies in RCT patients.

ABBREVIATIONS

RCT: Rotator Cuff Tendinopathy; VAS: Visual Analog Scale; DASH: Disability level was assessed with Disabilities of the Arm, Shoulder and Hand; SPADI: Shoulder Pain and Disability Index; HAQ-DI: Health Assessment Questionaire Disability Index; BAI: Beck Anxiety Inventory

INTRODUCTION

Shoulder pain is a common musculoskeletal problem with up to half of the population experiencing at least one episode per year [1]. Particularly tendinopathy of the rotator cuff as one of the frequent causes of shoulder pain, can be the source of considerable pain, disability, anxiety and leads to limitations in activities of daily living, and may result in time away from work [2].

The causes of the rotator cuff tendinopathies include intrinsic factors such as anatomical variants, muscle imbalance, nutrition, age and extrinsic factors such as occupation, physical load and overuse. Although shoulder tendon problems are very frequent, they are not always easy to manage [3]. A range of interventions, both conservative and surgical, are currently used to treat this condition [4]. A conservative treatment option of RC tendinopathy generally includes rest, nonsteroidal anti-inflammatory drugs, and rehabilitation interventions such as hot-cold ajants, exercise, manual therapy, tapping, and electrotherapeutic modalities [5].

Over recent years evidence has emerged supporting the value of loaded exercises for the management of tendinopathy and more recently this has been applied to the rotator cuff. However, such exercises are usually painful to perform, and such exercise prescription does not align with the clinical reasoning processes of many physiotherapists [6].

Originally called “Contrology”, Pilates is an exercise system designed by Joseph Pilates to condition the body based on Eastern theories of body-mind-spirit interaction [7]. This became a popular method of rehabilitation in the 1990’s among practitioners dealing with orthopaedic, geriatric and chronic pain patients. The exercises are always adapted to the patient’s condition, respecting the difficulties, characteristics or abilities of each individual and include such basic principles as concentration, control, centering, diaphragmatic breathing, lightness, precision, strength and relaxation [8].

The Pilates method is associated with better quality of life values, especially in the dimensions of physical functioning, general health and mental health [9]. Over the past decade, Pilates has changed to becoming popular in the exercise arena and in injury rehabilitation. Many connective tissue lesions, such as osteoarthritis, osteoporosis, degenerative disk disease, chronic system arthritis, fascial pain syndromes, and cartilage and ligamentous tears and repairs, can benefit from pilates exercises that facilitates compressive and decompressive forces on the connective tissues [10].

Today, despite an increased number of health care practitioners using the Pilates-based approach in rehabilitation, there is a lack of supportive literature examining the Pilates-based techniques in the field of rehabilitation especially in shoulder problems [10]. According to the potential benefits of Pilates exercises on connective tissue and overuse injuries the aim of the study is to determine in a randomised controlled trial if a modified Clinical Pilates exercise programme for the shoulder problems [10].

Materials and Methods

Patients who had a current shoulder complaint and applied to orthopaedics clinic were examined. Sufficient investigations that include clinical assessment findings and diagnostic imaging methods to establish the diagnosis of rotator cuff tendinopathy were done by orthopaedic specialists and patients invited to the study who were voluntary. Informed consent was obtained from each subject prior to participation were recruited to participate in the study.

Inclusion Criteria

- 20 and 65 years of age
- Symptom duration greater than three months
- The arm pain during resisted testing (usually abduction and/or lateral rotation)

Exclusion Criteria

- Stiff shoulder such as adhesive capsulitis
- Less than 90 degrees of active elevation
- Shoulder fracture or dislocation
- Previous shoulder surgery
- Glenohumeral joint and acromioclavicular joint degeneration
- Large rotator cuff calcifications
- Neurological deficit in the neck or arm
- Cognitive impairment

On receipt of a completed consent form, patients were randomised blindly by an independent colleague into control and pilates groups.

Interventions

Both groups received Hot-Pack (HP) therapy (shoulder, 70-75, 20min. with hot-pack covers), Therapeutic Ultrasound (US) (5min, 1MHz, 1.5W/cm²) with total of fifteen sessions/ five sessions per-week [11]. Traditional upper extremity strengthening and stretching exercises were taught to the both groups of patients as home exercise programme [1]. This programme consisted of wall and wand exercises.

Patients allocated to the pilates group additionally were trained 20-30 min. duration using a pilates exercise protocol for upper extremity on mat in supine, side-lying, prone, crawling and sitting positions after HP and US therapy during fifteen sessions (Table 1). Exercises were complicated by using theraband and ball according to the patients abilities.

Outcome Measures

Outcomes were measured at baseline and after 3 weeks (Figure 1). The primary outcome measure was intensity of pain and it is assessed by using a 10cm Visual Analog Scale (VAS) in resting, night and in activity (in shoulder flexion, abduction, internal and external rotation) [12].

Secondary outcomes were:

- Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire. It is a 30-item patient self-report questionnaire concerning the patient’s health status during the preceding week that consists of the components: the function, symptom, social role component and the optional high-performance sport/music or work. The raw score is then transformed to a 0–100 scale, whereby 0 reflects minimum and 100 maximum disability [13].
- Shoulder Pain and Disability Index (SPADI). It is a self-report questionnaire developed to evaluate patients with shoulder problems and consists of 13 items in two subscales: pain (5 items) and disability (8 items. The higher the score in each subscale the higher the pain intensity and the greater the disability [14].
- Health Assessment Questionaire Disability Index (HAQ-DI). The HAQ-DI includes 20 items in eight categories that represent a comprehensive set of functional activities – dressing, rising, eating, walking, hygiene, reach, grip, and usual activities. The stem of each item assesses a patient’s functional ability using their usual equipment during the past week [15].
- Beck Anxiety Inventory (BAI). (a 21-item self-report instrument for measuring the severity of anxiety in adolescents and adults) [16,17].

All data collected during the study than the patient’s personal details are noted (Figure 2).

Statistical Analysis

Data were analyzed using PASW Statistics 18 (SPSS Inc., Chicago, IL, USA). Level of 5% was used to determine significant
RESULTS AND DISCUSSION

Results

The baseline age and BMI demographic of patients in each group were similar in the groups. Table (2) displays the descriptive features of the patients including age and body mass index (BMI).

Intensity of pain, DASH, SPADI, HAQ-DI and BAI Score of the patients were similar in the both of the goups before therapy (p > 0.05).

Statistical analysis verified that, the night pain, pain in internal rotation, external rotation, DASH and SPADI Score decreased significantly after therapy in the both of the groups (p < 0.05). Change of the night pain, pain in internal and external rotations, DASH and SPADI Score were not significantly different between groups (p > 0.05).

Also, resting pain, pain in flexion and abduction, HAQ and BAI Score did not change in the control group (p > 0.05), while significantly decreased in the Pilates Group (p < 0.05) (Tables 3, 4).

Discussion

Fewer number of subjects than expected highlights the difficulty of predicting recruitment rates for our research. During the 6 months, only 20 suitable patients meeting the inclusion criteria participated to our study and 19 of them completed the 3 weeks therapy. Following the trial, one of the patients in the Pilates group decided to leave the therapy.

All patients participating in the study had physiotherapy treatment involving the prescription of shoulder exercises. So that some of the outcomes including night pain, pain in shoulder rotations and functional performance of both of the groups improved after 3 weeks therapy as expected. In the literature many different types of exercises are defined for the management of RCT. But the content of the exercise programmes are heterogeneous across the studies, generally consisted of stretching and progressive resistance exercises. It is suggested that both home and supervised exercise programmes might be more effective than no intervention or placebo and as effective as functional brace, multimodal physiotherapy or surgery [1].

Pilates exercises outclass to home exercises in resting pain, pain in shoulder elevation and HAQ-DI and BAI Scores in our study. At this point, main question is what might be the reason of this difference?

Pilates exercises are designed to increase muscle strength and endurance, to improve posture and balance and is evident in the additional focus on breathing and concentration during the execution of these exercises [18]. Breathing should be done with concentration, control, and precision and coordinated with movement. The goal is the efficiency of movement. Joseph Pilates stated, even if the practioner follow no other instructions, he should learn to breathe correctly at least. Keays et al. [19] stated that all participants improved in average level of ER from baseline to intervention training with Pilates exercises in breast cancer patients. 3 of 4 participants also improved in flexion and abduction. No participant improved in average level of IR from baseline to intervention. Also all participants had decreasing...
pain during the baseline. In another study Pilates method presented full body benefits for the tennis player body including increased core strength, upper and lower body strength, balance, flexibility, joint stability, and concentration [8]. In our study, range of motions of shoulder did not assessed cause there was no stiffness due to RCT. Patients are seemed to have active limitation of motion due to pain and fear. Breathing principle of pilates is thought to provide pain free movement possibility to RCT patients in this study.

A large portion of connective tissue is avascular or hypovascular. This lack if vasculature would imply that nutrients are received through changes. This is a controversial point

Table 1: Pilates Exercise Protocol for study group.

<table>
<thead>
<tr>
<th>Position</th>
<th>Exercise</th>
<th>Number of Repetitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warming Up</td>
<td>Ribcage Arms</td>
<td>5-10 repeats</td>
</tr>
<tr>
<td>Supine</td>
<td>Snowangel</td>
<td>5-10 repeats</td>
</tr>
<tr>
<td>Sidelying</td>
<td>Telescope Arms</td>
<td>5-10 repeats</td>
</tr>
<tr>
<td>Sidelying</td>
<td>Pinwheel Exercise</td>
<td>5-10 repeats</td>
</tr>
<tr>
<td>Prone</td>
<td>Swimming</td>
<td>3-5 repeats</td>
</tr>
<tr>
<td>Crawling</td>
<td>Quadruped Shoulder Flexion</td>
<td>5-10 repeats</td>
</tr>
<tr>
<td>Crawling</td>
<td>Single Arm Single Leg Extensions</td>
<td>5-10 repeats</td>
</tr>
<tr>
<td>Sitting</td>
<td>Spine twist</td>
<td>5-10 repeats</td>
</tr>
</tbody>
</table>

Cooling down (3-4 minutes)
Table 2: Demographic Features of the Patients.

<table>
<thead>
<tr>
<th></th>
<th>Control Group</th>
<th>Pilates Group</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>50.60 ± 11.70</td>
<td>51.44 ± 9.88</td>
<td>0.49</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>28.67 ± 4.66</td>
<td>27.58 ± 4.05</td>
<td>0.82</td>
</tr>
</tbody>
</table>

Abbreviations: BMI: Body Mass Index

Table 3: Analysis of Pain Intensity After Therapy.

<table>
<thead>
<tr>
<th></th>
<th>Control Goup</th>
<th>P</th>
<th>Pilates Group</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Night Pain</td>
<td>B 6.45 ± 2.99</td>
<td>0.008</td>
<td>B 7.83 ± 3.06</td>
<td>0.018</td>
</tr>
<tr>
<td>Resting Pain</td>
<td>B 3.42 ± 3.24</td>
<td>0.123</td>
<td>B 4.33 ± 2.90</td>
<td>0.012</td>
</tr>
<tr>
<td>Pain in Shoulder Flexion</td>
<td>B 4.06 ± 3.30</td>
<td>0.068</td>
<td>B 5.55 ± 2.12</td>
<td>0.007</td>
</tr>
<tr>
<td>Pain in Shoulder Abduction</td>
<td>B 4.59 ± 2.55</td>
<td>0.114</td>
<td>B 5.05 ± 2.24</td>
<td>0.007</td>
</tr>
<tr>
<td>Pain in Shoulder Internal Rotation</td>
<td>B 4.13 ± 2.22</td>
<td>0.008</td>
<td>B 4.16 ± 2.90</td>
<td>0.012</td>
</tr>
<tr>
<td>Pain in Shoulder External Rotation</td>
<td>B 4.69 ± 2.42</td>
<td>0.046</td>
<td>B 4.72 ± 3.33</td>
<td>0.012</td>
</tr>
</tbody>
</table>

Abbreviations: VAS: Visual Analog Scale

Table 4: Analysis of Scales After Therapy.

<table>
<thead>
<tr>
<th></th>
<th>Control Goup</th>
<th>P</th>
<th>Pilates Group</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>DASH</td>
<td>B 40.50 ± 23.21</td>
<td>0.017</td>
<td>B 49.75 ± 14.59</td>
<td>0.012</td>
</tr>
<tr>
<td>HAQ-DI</td>
<td>B 9.40 ± 6.78</td>
<td>0.083</td>
<td>B 15.75 ± 9.55</td>
<td>0.018</td>
</tr>
<tr>
<td>BAI</td>
<td>B 10.10 ± 7.82</td>
<td>0.092</td>
<td>B 15.77 ± 15.63</td>
<td>0.028</td>
</tr>
<tr>
<td>SPADI (Pain)</td>
<td>B 26.34 ± 8.45</td>
<td>0.028</td>
<td>B 41.87 ± 22.36</td>
<td>0.012</td>
</tr>
<tr>
<td>SPADI (Disability)</td>
<td>B 30.16 ± 16.24</td>
<td>0.007</td>
<td>B 42.83 ± 18.11</td>
<td>0.012</td>
</tr>
<tr>
<td>SPADI (Total)</td>
<td>B 56.51 ± 23.71</td>
<td>0.009</td>
<td>B 84.71 ± 37.19</td>
<td>0.012</td>
</tr>
</tbody>
</table>

Abbreviations: DASH: Disability Level was Assessed with Disabilities of the Arm, Shoulder and Hand; HAQ-DI: Health Assessment Questionnaire Disability Index; BAI: Beck Anxiety Inventory; SPADI: Shoulder Pain and Disability Index

Because the intermittent capillary flow interruptions associated to eccentric training have been proposed as a beneficial effect. The high forces produced eccentrically seem to induce remodeling response when applied chronically and progressively. The Pilates-based exercises is hypothesised to provide a closed-chain environment that facilitates compressive and decompressive forces on the connective tissues [20]. According to the improvement in the circulation, activated healing mechanisms in the tendons increased the pain free elevation of RCT patients in our study.

The other point is dynamic stabilisation and remodelling of function provided by Pilates exercises. Shoulder lacks structural support and relies on muscles and tendons for stability in RCT patients. Pilates method provide the therapist to restore mobility to a target joint and surrounding joints and the forces can be distributed equally, minimizing destructive forces [20]. The shoulder joint is a complex of major and stabilizer muscles including the deltoid, pectoralis major and minor, levator scapula, serratus anterior, and rotator cuff muscles. The rotator cuff muscles include supraspinatus for abduction, infraspinatus and teres minor for external rotation, and subscapularis for internal rotation. In the case of dynamic stabilization, which may provided by Pilates exercises, the greatest resistance is applied in the middle of the arc of movement, where torque is greatest. So that Pilates technique focuses on recruitment of the most effective motor units and this form of recruitment provides energy efficiency and quality of performance. Motor learning
principles helps support Pilates-evolved work as neuromuscular intervention for rehabilitation [20].

Diminishing the anxiety is another important point to be noticed according to outcomes of our study. Pilates group showed significantly better BAI Score in RCT patients. Several reports have found depression and anxiety are major factors affecting quality of life for patients with musculoskeletal pain. The associated symptoms of inability to concentrate, loss of motivation, disturbed sleep, fatigue, and pessimistic mood may influence a patient’s ability to benefit from treatment and rehabilitation programs. A recent study has found high prevalence and close relationships of depression, anxiety, and sleep disturbance in patients with shoulder pain for 3 months or longer may indicate the importance of a psychological approach as well as adequate pain control [21]. Also the sensitivity of pain is related with the severity of depression, anxiety, and sleep. This vicious circle may cause to difficult the management of the disease. The disease anxiety takes place in the amygdala which is responsible for controlling emotions such as fear, worry, anxiety, aggression and arousal. Anxiety is often are suit of the amygdala over reacting to stimuli. This causes a sense of worry and urgency that is unnecessary and harmful to the human. By the way of physical acting the brain’s ability to process and carry out normal thoughts and movements to live a more productive healthy lifestyle. Pilates exercises provide to focus on body and mind at the same time by the help of breath patterns bringing fresh oxygen into their body [22].

There is a lack of studies investigating specific shoulder exercises including Pilates in the treatment of rotator cuff tendinopathy in the literature. This study investigated that Pilates exercises programme can provide additional benefit to the management of RCT in terms of, pain intensity, general health and anxiety level. If future trials in this area of research are to be conducted, then efforts should be made to include much longer period of Pilates exercises programme for the greater number of appropriate patients.

ACKNOWLEDGEMENTS

The authors would like to thank Pt.MSc. Sinem GÜNERİ for her contribution on assessment of the patients in control group in this study.

REFERENCES