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Effects of Pilates exercises on sensory interaction, postural control and fatigue in patients with multiple sclerosis

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ABSTRACT

Background: Decreased postural control, sensory integration deficits and fatigue are important problems that cause functional impairments in patients with multiple sclerosis (pwMS).
Purpose: To examine the effect of modified clinical Pilates exercises on sensory interaction and balance, postural control and fatigue in pwMS.
Methods: Eleven patients with multiple sclerosis and 12 healthy matched controls were recruited in this study. Limits of stability and postural stability tests were used to evaluate postural control by Biodex Balance System and sensory interaction assessed. Fatigue was assessed by Modified Fatigue Impact Scale. Pilates exercises were applied two times a week for 10 weeks and measurements were repeated to pwMS after exercise training.
Results: Postural control and fatigue (except psychosocial parameter) of pwMS were significantly worser than healthy controls ($p < 0.05$). Significant improvements occurred in sensory interaction (eyes open, foam surface) and total, physical and cognitive scores of fatigue after 10-week modified clinical Pilates training ($p < 0.05$). No significant changes were detected in postural control after the pilates exercises ($p > 0.05$).
Conclusions: Ten-week Pilates training is effective to improve sensory interaction and to decrease fatigue. Pilates exercises can be applied safely in ambulatory pwMS for enhance sensory interaction and balance and combat fatigue. More investigations are needed.

1. Introduction

Multiple sclerosis (MS) is a chronic, autoimmune, demyelinating, degenerative disease of the central nervous system (Trapp and Nave, 2008). Patients with MS (pwMS) are effected by visual, vestibular and somatosensory impairments and frequently experience postural instability, sensory disturbances and fatigue. Poor postural control and fatigue are linked to central integration deficits and suffer some adaptive problems with disability (Cameron and Lord, 2010; Cattaneo and Jonsdottir, 2009; Hebert et al., 2011; Krishnan et al., 2012; Freal et al., 1984).

Different assessment strategies have been offered for impairments in MS. Clinicians have available clinical tests to quantify postural control such as force plates and postural stabilometries (Gandolfi et al., 2015; Robinson et al., 2015; Eftekharsadat et al., 2015). However computarized stabilometry has become an important objective tool for assessing sensory integration for balance and postural control, there is no study that evaluate the sensory interaction and postural control in patients with MS by Biodex Balance System after exercise training.

Although the benefits of regular exercise for patients with MS are known, wide variety of exercise types for reduce deficits in mobility, fatigue and balance focus on strengthing, stretching, aerobic, endurance, core exercises and yoga (Motl and Sandroff, 2015; Gunn et al., 2015). Furthermore Pilates based exercises are popular form of exercise that use stabilising muscles of the body and postural stability but there is lack of scientific evidence to support the effectiveness of Pilates exercises in pwMS (Freeman et al., 2010; Guclu-Gunduz et al., 2014).

Our hypothesis was a modified clinical Pilates exercises that specifically addresses postural stability and central integration improve sensory interaction, postural control and fatigue. This study has had two aims: first aim was to compare sensory

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interaction and balance, postural control and fatigue in pwMS and healthy subjects, the second but important one was to determine the effect of modified clinical Pilates exercises on sensory interaction, postural control and fatigue in pwMS.

2. Materials and methods

2.1. Design

This was a single blind, experimental before-after cohort, controlled study. Ethical approval has been gained from Dokuz Eylül University Ethics Commitee and written informed consent was obtained from all participants to participate the study.

2.2. Participants

From March 2015 to June 2015, eleven outpatient with relapsing-remitting MS referred to the local MS society and 12 healthy matched controls were assessed. A neurologist confirmed diagnosis, eligibility criteria and Expanded Disability Status Scale (EDSS) scores. Inclusion criterias were; age between 18 and 65 years,, $2 \geq$ EDSS score ≤ 5, ability to walk independently with or without use of intermittent or constant unilateral assisstance such as walking stick, ability to stand independently without any aid for at least 3 minutes for pwMS. Exclusion criterias were; in MS relapse or relapse in previous three months, presence of paroxysmal vertigo, blurred vision, concurrent neurological or orthopeadic disorders interfering with the standing position, medical conditions that restrict participation in the Pilates, current or recent participation in another exercise programme.

2.3. Exercise procedure

Patients with MS underwent 10-week modified clinical Pilates training designed to improve their ability to integrate multisensory inputs and challenge postural control. Pilates was applied by an Australian Physiotherapy and Pilates Institute (APPI) certified physiotherapist. Activation of transversus abdominus in neutral spinal alignment and basic principles of Pilates was informed in first session. Exercises were performed in front of the mirror and different positions (supine, prone, side lying, sitting and upright position). Exercises were progressed in response to the feedback of the participants. Modified clinical Pilates exercises applied one hour a day, twice a week and every exercise was done with 10 repetitions.

2.4. Test procedure

The demographics of participants were noted before test trials. Each participant was assessed by the blinded examiner. When healthy controls were evaluated for once, pwMS were evaluated before and after exercise training.

The Biodex Balance System (BBS; SD 12.1"Display 115 VAC) was used to assess postural control and clinical test of sensory interaction and balance (CTSIB). Limits of stability (reaction time and overall score) and postural stability tests (overall, mediolateral and anteroposterior score) were used to evaluate postural control in rigit surface and eyes open during a period of 20 s. Participants stood barefoot and were not permitted to touch the handrails during the tests. The platform locked and the patients were asked to control themselves keeping the indicator in the center of target on the screen for postural balance position. Firm and foam surfaces were used and patients were asked to open or close their eyes during dynamic CTSIB test. The foot position was recorded using the platform rail. Three trials with a rest period of 10 s were performed in each condition. Postural tasks were explained to each participant before starting the measurements. Participants were fully briefed on all testing procedures. Not only lower postural stability and CTSIB scores, but also higher limits of stability scores reflect better postural control (Eftekharsadat et al., 2015; Sherafat et al., 2013).

Fatigue was evaluated with Modified Fatigue Impact Scale (MFIS). The MFIS is a 21-item shortened version of the 40-item Fatigue Impact Scale. It assesses the perceived impact of fatigue on the subscales physical, cognitive and psychosocial functioning during the past 4 weeks. Total score (0 – 84) and subscales for physical (0 – 36), cognitive (0 – 40) and psychosocial functioning (0 – 8). The 5 item version is scored (0 – 20). Higher numbers indicate greater fatigue (Larson, 2013).

2.5. Statistical analysis

Descriptive statistics were expressed as median, minimum-maximum and percentage. Mann Whitney *U* test was used for compare results of pwMS and healthy controls. The treatment effect was tested with Wilcoxon signed-rank test. Significance was set at 0.05 for the analysis. All data were analyzed using the SPSS 20.0 software package.

3. Results

Median age of MS patients was 52.0 and median EDSS score were 3.5 (Table 1).

Age, gender and working status of pwMS and healthy subjects were similar ($p > 0.05$). However postural control scores and fatigue (except psychosocial parameter) of healthy controls were significantly better than pwMS ($p < 0.05$), there was no significantly difference between the groups in CTSIB scores and psychosocial parameter of fatigue ($p > 0.05$, Table 2).

Significant improvements occurred in CTSIB (eyes open, foam surface) and total, physical and cognitive scores of fatigue after 10-week modified clinical Pilates training ($p < 0.05$). No significant changes were detected in postural control after the pilates exercises compared to baseline ($p > 0.05$, Table 3).

4. Discussion

Postural control and fatigue (except psychosocial parameter) were better in healthy individuals when compared with pwMS. Sensory interaction and balance was similar.

Fatigue was significantly decreased after ten weeks modified clinical Pilates exercise. Patients performed significantly better

Table 1
Demographics and clinical characteristics of MS patients.

Age (years) Median (IQR)	52 (35–66)
EDSS (0–10) Median (IQR)	3.5 (2.0–5.0)
Gender	
Male n(%)	7 (63.6)
Female n(%)	4 (36.4)
Working status	
Working n(%)	2 (18.2)
Not working n(%)	9 (81.8)
Assisstive devices	
Using n(%)	4 (36.4)
Not using n(%)	7 (63.6)

n:number, EDSS: Expanded Disability Status Scale, IQR: minimum-maximum