18.12.2018

The effects of isokinetic exercises on muscle strength, joint position sense, and kinesiophobia in patients with multiple sclerosis: a randomized controlled trial

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The study has no trial registration number yet.

Approval date and reference number of Ethics Committee of Aksaray University Training and Research Hospital, Aksaray, Turkey: 29.07.15, 603/5070

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ABSTRACT

Objective: To evaluate the effects of isokinetic exercises on muscle strength, knee joint position sense, pain, kinesiophobia, and quality of life in patients with multiple sclerosis.

Design: Randomized controlled trial.

Setting: Outpatient clinic.

Participants: Sixty patients with multiple sclerosis.

Interventions: Fifty patients were randomized to an isokinetic exercise (n:25) or home exercise programme (n:25).

Outcome measures: The outcome measures were the peak torque/body mass index of quadriceps and hamstring muscles at 60°/s and 180°/s velocities, the hamstring/quadriceps ratios at the same velocities, absolute angular errors of the 15°, 45°, and 60° and the mean absolute angular error of joint position sense of the less and more affected knees, and the scores of Multiple Sclerosis Quality of Life-54, Visual Analogue Scale, and Tampa Scale of Kinesiophobia.

INTRODUCTION

In one study, the muscle strength of the quadriceps and hamstring, which were tested with the isokinetic muscle strength test, were found to be lower in patients with multiple sclerois (MS) than the controls (1). In another study, bilateral muscle strength of the quadriceps and hamstring were shown to be related with walking speed, balance, and functional capacity (2). Therefore, the authors concluded that muscle strengthening exercises for the quadriceps and hamstring should be included in the rehabilitation program of MS patients.

It is known that slowing afferent proprioceptive conduction and impaired central integration of the proprioception are the main causes of balance deficit in MS patients. Proprioception impairment, often seen in patients with MS, negatively affects the joint position sense (JPS), balance, and posture. Joint repositioning, muscle strengthening, plyometric, balance, coordination and vibration exercises are recommended to improve JPS, proprioception, and balance in this patient group (3).

It has been reported that exercise training improves and/or maintains functional capacity, strength, endurance, fatigue, quality of life (QoL), depression, cognition, and chronic disease risk factors among MS patients. The current evidence suggests that exercise training is generally safe for MS patients and not associated with an increased relapse risk. Resistance and endurance training modalities are the major types of exercises in MS patients (4).

There are not enough studies on isokinetic muscle strengthening exercises in MS patients with muscle weakness. Robineau et al. (5) and Aubry et al. (6) reported that isokinetic knee flexion-extension exercises improved quadriceps and hamstring muscle strength and control of the knee in this patient group. Manca et al. (7) investigated the efficiency of isokinetic ankle dorsiflexor training, and the muscle strength of ankle dorsiflexors improved significantly in MS patients.

Kinesiophobia is defined as “an excessive, irrational and debilitating fear of physical movement and activity resulting from a feeling of vulnerability to painful injury or reinjury” and is related with the disability level (8). MS patients show fear avoidance beliefs and behaviors which are related with pain. Although catastrophizing and fear avoidance beliefs and behaviors have been reported in MS patients, they have not been investigated in detail (9).

To the best of our knowledge, no study has explored the effects of isokinetic training on knee JPS, pain, kinesiophobia, and QoL in MS patients. Therefore, in the current study, we aimed to observe the knee JPS and kinesiophobia level, their relationships with QoL, and the effects of isokinetic exercises on these variables.

METHODS

Following the Helsinki Declaration, the study was approved by the Ethics Committee of Ankara Training and Research Hospital, Health Sciences University (29.07.15, 603/5070). This prospective randomized controlled trial aimed to recruit 60 patients with MS from the physical medicine and rehabilitation clinic of Ankara Training and Research Hospital, Health Sciences University, Ankara, Turkey (June 2016 to June 2017).

Participants

Individuals were included if they had definite relapsing remitting MS and secondary progressive MS diagnosis, mild and moderate MS determined by Kurtzke Expanded Disability Status Scale (EDSS) scores below 6.5, and a disease duration of more than one year. The exclusion criteria were; having an acute exacerbation within the last three months, intravenous pulse steroid therapy in the last four weeks, grade 3-4 spasticity according to the Modified Ashworth Scale, severe vision impairment, severe fatigue and depression, past knee surgery, other neurologic diseases, systemic diseases, pregnancy, and having received an exercise program within the last four weeks. Fifty patients who met the inclusion criteria were enrolled in the study (Figure 1).

Procedure

Fifty patients were randomized to two groups: isokinetic exercise (Group 1) (n=25) and home exercise (Group 2) (n=25). Randomization was completed using sequentially numbered, opaque envelopes by the investigator. All patients gave informed consent before the assessment. The outcome measures were assed initially and at eighth week after the treatment. Group 1 performed isokinetic concentric quadriceps and hamstring strengthening exercises under supervision and Group 2 performed lower extremity muscle strengthening and balance exercises at home.

Outcome measures

The patients completed the questionnaire about age at diagnosis, disease duration, type of disease, and medical history.

Muscle strength and JPS testing

Muscle strength and knee JPS were tested by an isokinetic dynamometer (Biodex System 3 Pro Multijoint). Before muscle strength and knee JPS testing, the patients were informed about the procedure. First knee JPS was tested, and then muscle strength was measured. The machine was calibrated before the procedure. Before muscle strength testing, the patients performed quadriceps and hamstring stretching exercises and on-site counting for five minutes for warming-up. The seat angle was set to 85° and the patient was asked to sit down. Appropriate parts for knee testing were placed in the dynamometer. The lateral femoral condyle, which is the rotation axis of the knee, was aligned to the rotation axis of the dynamometer. The patients were stabilized by thoracic, pelvic and thigh belts. The patient’s leg was bound to the leverage equipment from the upper part of the medial malleolus. During the test, the patients were asked to place their arms sideways. After determining the range of motion and gravity correction for the mass of the limb, the patients performed three submaximal warm-up contractions at 60°/s angular velocity. After warming up, the patients rested for 10 seconds, and then performed five maximal concentric knee flexion-extension at 60°/s and 10 maximal concentric knee flexion-extension at 180°/s angular velocities, separated by 20 seconds of seated static recovery. Both the more and less affected legs were tested in order, two minutes after the seated static recovery period. During the test, the quadriceps and hamstring peak torque (PT), the peak torque (PT)/body mass index (BMI), and the hamstrings/quadriceps (H/Q) ratio were evaluated at 60°/s and 180°/s angular velocities in Newton/meter (N/m) (10).

After the preparation, positioning and stabilization, knee JPS was tested according to the active-active angular reproduction method. The position of the knee at 90° flexion was accepted as the starting angle; i.e., 0°. The patients moved their leg from 0°(starting angle) to 45°, 15° and 60° extension direction in sequence to prevent a learning effect. With eyes open, the patients held their leg at the starting angle for 10 seconds and then moved it to 45° (target angle), held the leg at that angle for 10 seconds, and then returned to the starting angle. This procedure was repeated three times and the patient was encouraged to focus on maintaining the target angle. After keeping their leg at the starting angle for 10 seconds with eyes closed, the patients were asked to move their leg to the 45° angle. The angle predicted by the patients was recorded and the same process was repeated three times. Estimating the target angel procedure was repeated at 45°, 15°, and 60° and for both the more and less affected legs. After the JPS testing, three angles estimated by the patients were averaged, and the angular error (AE) was calculated for each target angle. Absolute angular error (AAE) was calculated by averaging the AEs, regardless of the numbers being negative or positive. The AAE values of the three target angles were averaged to obtain the mean AAEs (MAEs) (11, 12).

Evaluation of pain and kinesiophobia

Pain intensity was evaluated with the Visual Analogue Scale (VAS). Using a ruler, a 10 cm line was drawn which provided a range of scores from 0-100. Then the patients marked the point that showed their pain intensity on this line. A higher score in VAS indicates greater pain intensity (13). Kinesiophobia was evaluated using the Tampa Scale of Kinesiophobia (TSK), which is a 17-item self-report survey based on a four-point Likert scale developed as a measurement tool for fear of movement and/or (re)injury. If the total score was above 37 points, the patient was considered to have a high level of kinesiophobia (14).

Evaluation of quality of life

The Multiple Sclerosis Quality of Life-54 (MSQoL-54) is a multidimensional health-related QoL measure that combines both generic and MS-specific symptoms in a single instrument. The cross cultural adaptation and validation of the MSQoL-54 inventory in a Turkish population was undertaken by Idıman E. et al. in 2006 (15). In the current study, we used the total, physical and emotional composite and pain scores of the Turkish MSQoL-54.

Interventions

Isokinetic training program

Before the exercise program, the patients performed hamstring and quadriceps stretching exercises and on-site counting for five minutes. After the warm-up, the patients did concentric/concentric quadriceps and hamstring muscle strengthening exercises in increasing intensity, to the extent that they could tolerate. The isokinetic exercise program was implemented over eight weeks, twice a week on non-consecutive days under the supervision of a doctor. The number of repetitions undertaken by the patients over the program were as follows: first week 5 at 60°/s and 10 at 180°/s, second week 10 at 60°/s and 15 at 180°/s, third week 15 at 60°/s and 20 at 180°/s, fourth week 20 at 60°/s and 30 at 180°/s, and in the last four weeks 20 at 60°/s and 40 at 180°/s angular velocities. Each block of 10 repetitions were performed as a set.

Home exercise program

The patients undertook lower extremity strengthening and balance exercises three times a week for eight weeks without supervision. They started with three repetitions, which was gradually increased to 10-15. The patients were called two times a week to inquire about exercise continuity and encouraged to undertake the recommended exercises.

Statistical Analysis

The data were analyzed using the Statistical Package for the Social Sciences (SPSS) software version 15.0. The sample characteristics were summarized using descriptive statistics. Descriptive statistics tables were created for numerical variables, and frequency tables were constructed for categorical variables for both groups. The Kolmogorov-Smirnov test was used to test the normality of data. The Mann-Whitney U test was conducted to compare the two groups. The Wilcoxon test was performed for the comparison of before and after treatment values within the groups in terms of muscle strength, knee JPS, kinesiophobia, and QoL variables. The Spearman correlation test was utilized for the evaluation of relationships between muscle strength and knee JPS. The level of statistical significance was set at $p<0.05$.