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Comparing the Effectiveness of Isotonic and Isometric Exercises on Balance and Ability in Patients with Multiple Sclerosis

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ABSTRACT

Aims Active and progressive resistance training has a key role in functional recovery and quality of life in patients with MS. Therefore, this study aimed to investigate the effects of isotonic and isometric exercises on balance and ability in patients with MS.

Materials & Methods In this randomized clinical trial, 60 patients with MS admitted to MS Special Diseases Center in Yasuj during 2016-2018 were selected by convenience sampling method and randomly divided into two equal groups of isotonic and isometric exercise. The expanded Disability Status Scale (EDSS) and the Berg Balance Scale (BBS) were used to measure the disability and balance status. Each exercise was performed 3 days per week for 8 weeks. Both groups were evaluated before intervention and on days 28 and 56 of treatment.

Findings 28 and 56 days after treatment, the mean scores of BBS increased, and the mean scores of EDSS decreased in both groups; such that the increase in the BBS score was significant on day 56 after treatment compared to the pretest in the isometric group ($p<0.05$). Also, the mean scores of EDSS decreased significantly on day 56 after treatment ($p<0.05$) compared to the pretest in the isotonic group and on days 28 ($p<0.05$) and 56 ($p<0.01$) after treatment compared to the pretest in the isometric group.

Conclusion Eight weeks of isotonic and isometric exercise are an effective treatment for MS patients without any advantage of one type of exercise over another.

Keywords Multiple Sclerosis; Balance; Disability Evaluation; Exercise

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Introduction

Multiple Sclerosis (MS) is a neurological disease and cause demyelinating of the nerve in the central nervous system. Neurological deficits in the MS disease cause muscle function weakness, fatigue, and reduced the balance and ambulatory potential of the patients with MS [1]. Lack of balance in MS patients decrease mobility and adaptability and lead to falling and impacts on activity of daily living [2]. Demyelinating the sensory or motor nerve in the brain and spinal cord can impair postural stability, motor function, and autonomic systems [3].

Because there is no successful MS disease treatment, management of treatment procedures for MS patients' reduced symptoms is very important. Although exercise and physical activity decrease pain, improve functional stability, aerobic volume, and tolerance, and protected to maintain postural stability, there are some arguments about the MS patients' exercise results [4]. A document indicated that resistance exercise leads to a rise in body temperature and worsens symptoms in some patients with MS [5]. Whereas, Hosseini *et al.* demonstrated that physical activity and resistance exercise are an efficient strategy and have a beneficial effect on improving balance, strength, and increased endurance and managing MS patients' symptoms [6]. Physical activity and rehabilitation can improve activity and increase MS patients' independence [7].

One Clinical study indicates that limiting exercise activities leads to worsening, fatigue, and posture and balance in multiple sclerosis patients with higher disability scores [7].

The outcome of different exercise protocols was evaluated on MS patients based Expanded Disability Status Scale (EDSS) or multiple sclerosis functional composite (MSFC) [8]. Also, the examination of balance and measurement of the lower and upper extremity activity and gait analysis is used to determine the level of muscular or physical function in MS patients [8]. The EDSS test is a common clinical measure for neurological deficits in patients with MS [9]. Although there is an ongoing debate about the reliability of the EDSS test, it is well documented that for disability below 3.5 is an appropriate measure test, and there is a relation between the performance measure and EDSS scale [10]. Furthermore, according to the previous study, this test is suitable for measuring the quality of life and disability in MS patients [11].

Depending on the Expanded Disability Status Scale (EDSS), different exercise programs, including aerobic and resistance training, bodyweight support, and stepper exercise, were considered for MS patients. Isometric exercise is another physical activity for improving muscle function and used in early rehabilitation following MS disease or used for different joint movement when the motion is limited by pain [12]. Evidence indicated depends on contraction duration; isometric exercise is very important for functional recovery, muscle strength, and adaptations [12].

There is an ongoing debate about isotonic and isometric exercise on torque, endurance, fatigue, and strength muscle [13]. Existing evidence suggests both exercises have a similar significance in the muscle's recovery function and strength, while Limonta et al. demonstrated that isokinetic training has better results [14]. Therefore, in the present study, we aimed to determine whether a progressive isotonic than the isometric exercise would improve postural ability and balance in MS patients.

Materials and Methods

In this randomized clinical trial, out of 93 patients with inactive multiple sclerosis admitted to MS Special Diseases Center in Yasuj during 2016-2018, 60 eligible patients were selected by convenience sampling method and randomly divided into two equal groups of isotonic and isometric exercise. Patients with MS were confirmed by a neurologist with a diagnosis of at least 2 years of MS. Inclusion criteria included the ability to walk, participation in the full exercise program, the absence of other neurodegenerative diseases such as Alzheimer's, Parkinson's, Huntington's, epilepsy, heart diseases, and inflammatory joint disease. Exclusion criteria included not being able to exercise for any reason or not being allowed to exercise.

Expanded Disability Status Scale (EDSS) and the Berg Balance Scale (BBS) were used in order to measure disability and balance status [15]. The EDSS test is one of the oldest methods used to assess the disability level in MS patients. This test has all the functional systems that involve the MS patient [15]. The EDSS is an ordinal clinical rating scale for neurological examination ranging from 0 (normal) to 10 (worst situation).

Berg Balance Scale (BBS) is a clinical test of a person's static and dynamic balance abilities [16]. This test has 14 items, and the balance of the MS patients evaluates on a scale from 0 (without definitive task) to 4 (normal showing on task).

EDSS and BBS were used one day before the intervention and on days 28 and 56 of treatment for both groups. A questionnaire collected demographic data such as age, sex, duration of illness, treatment duration, weight, height, occupation, and education level.

Patients with multiple sclerosis were medically evaluated to confirm their interest and the absence of any reason for isotonic or isometric exercise. All patients in the study read and signed a written consent form to participate. All measurements were performed before and after treatment, and a physiotherapist instructed the patients before each exercise.

The isotonic exercise program consisted of 6 exercises: knee flexion and extension, hip abduction and adduction, trunk flexion and extension, elbow flexion and extension, shoulder abduction and adduction, and neck flexion-extension. The hip and shoulder joints' abduction and adduction were performed while maintaining knee and elbow extension. Each exercise was performed with three sets of 10 repetitions, three times per week for 8 weeks. Each exercise started with 6 seconds (3 seconds concentric, 3 seconds eccentric), and one second was added daily to reach a maximum of one minute [5].

The isometric exercise consisted of 6 exercises, including knee flexion and extension hold, hip abduction and adduction hold, trunk flexion and extension hold, elbow flexion and extension hold, shoulder abduction and adduction, and neck flexion and extension hold. The patients performed 3 sets of 10 repetitions, three times per week for 8 weeks [13]. Each exercise's duration was 3 seconds at the start time, and one second was added gradually in the subsequent sessions. Gradually, the patient increased the time of exercise to reach a maximum of one minute.

Four patients of the isotonic and three patients of the isometric groups dropped out of the intervention because they could not perform their full exercise until the end of the study. So, 26 and 27 patients in the isotonic and isometric groups were analyzed at the end of the study.

Data were expressed as mean±SD and analyzed by SPSS 16 software. The Kolmogorov–Smirnov test was used to determine the normal distribution of variables; then, the two groups were compared at pretest and 28 and 56 days after the treatment using independent t-test and ANOVA with repeated measures.

Findings

The mean age of patients was 37.76±7.77 years old.

There was no significant difference between the two groups in terms of age, Body Mass Index (BMI), disease duration, age of diagnosis, gender, treatment duration, and the other demographic characteristics. (Table 1).

Before treatment, there was no significant difference between the two groups in terms of the mean scores of BBS and EDSS ($p>0.05$).

28 and 56 days after treatment, the mean scores of BBS increased, and the mean scores of EDSS decreased in both groups; such that the increase in the BBS score was significant on day 56 after treatment compared to the pretest in the isometric group ($p<0.05$), but there was no significant difference between pretest and posttest in the isotonic group ($p>0.05$). Also, the mean scores of EDSS decreased significantly on day 56 after treatment ($p<0.05$) compared to the pretest in the isotonic group and on days 28 ($p<0.05$) and 56 ($p<0.01$) after treatment compared to the pretest in the isometric group.

There was no significant difference between the two groups at post-treatment levels ($p>0.05$; Table 2).

Table 1) Comparison of quantitative and qualitative demographic characteristics between isotonic (n=26) and isometric (n=27) groups

Demographic characteristics	Isotonic group	Isomeric group
Quantitative characteristics (Mean±SD)		
Age (year)	37.21±8.71	38.31±6.80
BMI (Kg/m^2)	26.24±4.21	27.43±3.31
Disease duration (year)	7.62±6.44	8.38±7.12
Age of diagnosis (year)	30.33±8.22	31.56±7.14
Treatment duration (year)	3.23±1.21	4.33±2.34
Qualitative characteristics (frequency)		
Female	19 (73.1%)	21(77.8%)
Married	24(92.3%)	26(96.3%)
Employment	17(65.4%)	17(63.0%)
Education (High-school graduate)	21(80.8%)	22(81.5%)

Table 2) The mean scores of BBS and EDSS at Pre-treatment and post-treatment in isotonic (n=26) and isometric (n=27) groups

Variables	Isotonic group	Isomeric group
BBS score		
Pre-treatment	41.06±4.30	40.13±3.90
28 days after treatment	44.03±5.41	45.44±6.31
56 days after treatment	47.11±7.04	47.94±7.52
EDSS score		
Pre-treatment	5.17±0.29	6.03±0.48
28 days after treatment	3.42±0.42	3.08±0.46
56 days after treatment	2.31±0.21	2.01±0.19

Discussion

This randomized clinical trial study was the first research which studied the effects of isotonic and isometric exercise on balance and ability in MS patient. In this study, Participants were educated, and they learned to do the exercise protocol. The result showed that isotonic and isometric exercise for 8 weeks improved the balance and ability clinical outcome significantly compared to the pre-intervention test in MS patients based on BBS and EDSS scale. The evaluation of the BBS scale is required in the MS patients to establish the exercise protocol, and it is necessary to evaluate the patient's balance and ability after treatment in MS patients [11]. In the present study, after 8 weeks of isometric exercise, the BBS scale increased by 17.7%, compared to the 11.1% reported by Tori *et al*. using physical treatment [17]. These differences may have been attributed to the increased baseline score of BBS (42.03) of the patients in the Tori *et al.* compare to our study (40.13) [17]. The increased number of participants in our study can be the other reason for the different results compared to the tori study [17]. In

similar to the present study, other studies indicated these conventional exercises have different improvement effects on muscle endurance, tolerance, fatigue, and balance cause with a lower risk of falling in patients with MS [18]. In the present study, different muscles such as paravertebral, quadriceps, and gastrocnemius muscles were involved in the exercise protocol, and other studies showed that these muscles effectively maintain the balance [19]. Numerous muscles surrounding the lower vertebral spine, pelvic, and trunks, such as erector spinae and gluteal muscles, have a key role in balancing and controlling lower extremities [20]. Indifference to the present study, Moradi *et al.* showed the EDSS scale improved 50% after 12 weeks, 8 weeks of a resistance training program in MS patients compared to 42% in the present study [21].

These differences may have been attributed to differences in patients' outcomes related to gender and duration of treatment because they used male patients and 12 weeks of treatment compared to the present study that used both gender and 8 weeks of treatment [21]. Improvement of balance in MS patients plays an important role in these patients' quality and independence in daily activities [22]. The present study agrees with Freedman *et al*., who reported the 8 weeks training of pilates exercise has a significant effect on improving balance in MS patients [23]. In the present study, the mean level of BBS and EDSS index for both isometric exercises were the same as a fund by Haan *et al.* [24].

Results demonstrated that both groups showed similar outcomes in the BBS and EDSS scale compared at both 4 and 8 weeks after treatment. In this way, it has been documented that isotonic and isometric exercise have a similar outcome on the corticomotor pathway's stimulation after brain stroke [25]. More recent evidence demonstrated that progressive resistance exercise training for the trunk, neck, lower, and upper extremity could improve ambulatory function, balance, and muscle endurance and strength in moderate MS patients [7]. The present study agrees with a recent document that indicated the improvement of muscle strength in response to progressive resistance exercise could enhance the ability and balance in MS patients [26]. As previously described, improving balance stability in MS patients with exercise treatment has a considerable effect on life quality [27]. Although the present study showed no statistically significant difference between the two groups at 4 and 8 weeks of intervention, this study suggested that the 17% improvement of BBS has a considerable impact on functional stability and physical activities in patients with MS. Therefore, teaching these exercises to the MS patients is valuable and can effectively improve their quality of life.

Different limitations of this research including, lack of the control group, small sample size, high cost of treatment, busy medical center have deen during the intervention

Future research is necessary to study these exercises' effects on different MS patients' disease and a larger group for a long time. Furthermore, a training program of specific muscles can improve the ability and quality of life in MS patients.

Conclusion

Eight weeks of isotonic and isometric exercise are an effective treatment for MS patients without the advantage of one type of exercise over another and showed promising results for improving these patients' balance and ability.

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Ethical consideration: This study was a double-blind clinical trial that included a pretest, posttest that was approved by the research ethics committee of the Yasuj University of Medical Sciences (Yums.REC.1394.101) and was registered in the Iranian registry of clinical trials (http://irct.ir) with IRCT No (IRCT2017011732000N1). All patients in the study read and signed a written consent form to participate.

Conflict of Interest: The authors declare no conflict of interests.

Authors' contributions: Rad P. (First author) Introduction author/Methodologist/Assistant/Statistical analyst/Discussion author (30%); Zahmatkeshan N. (Second author) Original researcher/Statistical analyst/Discussion author (30%); Delaviz H. (Third author) Introduction author/Methodologist/Statistical analyst/Discussion author (25%); Enanat E. (Forth author) Statistical analyst/Discussion author (15%).

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