

EFFECTIVENESS OF EXTERNAL PERTURBATION TRAINING IN REDUCING THE RISK OF FALLS IN INDIVIDUALS WITH MULTIPLE SCLEROSIS: A SYSTEMATIC REVIEW

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Abstract: Multiple Sclerosis (MS) is a progressive, chronic, demyelinating, and inflammatory disease, of the central nervous system, with greater impact on incapacitating young people and people of different ages, ethnicities and races in a non-traumatic manner. **Objective:** To review the effectiveness of external disturbance training in reducing the risk of falls in individuals with multiple sclerosis. **Methodology:** This is a systematic review, with the inclusion of clinical trials that would allow pre- and post-intervention comparison. **The results:** The studies showed that individuals with MS can develop motor learning and retain the skills learned. **Conclusion:** the training associated with external disturbance helps the balance and motor control of individuals with MS, being beneficial in avoiding falls.

Keywords: External disturbance training, multiple sclerosis, risk of falls.

INTRODUCTION

Multiple Sclerosis (MS) is a chronic inflammatory disease, demyelinating and progressive of the central nervous system, with greater impact on incapacitating young people and people of different ages, ethnicities and races in a non-traumatic manner¹. Its prevalence in Brazil is considered low, and there are some regions with medium prevalence, as shown by studies in cities in Belo Horizonte, São Paulo and Botucatu. Although, has an overall average of 15 cases per 100,000 inhabitants^{2,3,4,5}. By affecting a wide range of neurological functions such as cognitive, vision, coordination, muscles and sensitivity, MS patients may present deficits in balance, postural control, gait reduction and independence, since two-thirds of this population maintains the ability to walk after 20 years of diagnosis^{1,6}.

Due to the disorders generated by the pathology, patients with multiple sclerosis

also have difficulties in their postural control, which is the basis of human motor control and exerts stability and conditions to movements, such as the ability to maintain the desired body position during an activity, whether dynamic or static⁸. Balance, which is the ability to maintain mass control within the support base, is a fundamental component for good motor control along with information from the muscle sensibility, cutaneous, visual and vestibular system, influencing the ability of these individuals to have a good gait, which is a repetitive sequence of the lower limbs that moves the body forward, while simultaneously maintaining stability in its own support^{7,8}. The consequences of these dysfunctions improves the incidence of falls. Studies show that 50% of individuals with MS have a fall episode between 3 and 6 months of follow-up, which causes fractures, limitations in their daily activities and reduction in their quality of life^{9,10,11}. The treatment of the symptoms of this disease are divided into immune modulator, immune suppressive and symptomatic: the first aims to control the effect of the immune system on neurons and then reduce the progression of the disease, and the second aims to treat the symptoms, where the involvement of a multidisciplinary group is of utmost importance, including the physical therapy intervention aimed so patient can become aware of having a new lifestyle with exercises focused on gait training, balance and postural control¹².

Seeing the frequency of falls of these patients, interventions that can decrease these rates are necessary, to which traditional exercises have been shown to be effective in prevention, but because they do not have an impact of generating evidence capable of reducing these falls, new programs focused on this mechanism have been gaining space, such as posture maintenance training in the face of disturbances, to which it will stimulate the

central nervous system to adopt two types of postural adjustment strategies: the anticipatory and compensatory^{13,14}. Anticipatory adjustment is characterized by the activation or inhibition of postural muscles, which occurs in milliseconds (between 0 to 500 ms) before a disturbance in the patient trunk stability^{15,16}. The compensatory postural adjustment is responsible for muscle activation after disturbance by restoring postural balance, whether it has been predicted or not¹⁷.

The training of external disturbance consists of reproducing repeated intentions of loss of balance and inducing external disturbances in order to develop neuroplasticity and facilitate the motor learning phenomenon, which causes the individual to have a permanent improvement in their performance due to practice or experience, creating new motor skills with the main purpose of making MS carriers create a better conscientiousness postural and thus be able to avoid falls^{18,19}.

However, taking into account the limitation of literature on the subject, and inability to decrease the falls in these patients, since these events can have serious consequences, including death¹², this study is necessary, that has the goal to review the effectiveness of external disturbance training in reducing the risk of falls in individuals with multiple sclerosis.

METHODOLOGY

TYPE OF STUDY

Systematic review organized from the following topics: elaboration of a question directed to the search method; search of studies in various sources; definition of criteria for inclusion, exclusion and evaluation of methodological quality, through a specific protocol^{20,21}. Defined the use of the PRISMA flowchart (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)²² for the presentation of the results.

The whole process and review were guided by the question “Is there efficacy in external disturbance training in reducing the risk of falls in individuals with MS? “. The PICO protocol (Patient, Intervention, Comparison and Outcome)²² was adopted as support, in which the P (population) was represented by individuals with MS; I (Intervention) external disturbance training; C (Comparison/Control) patients with no neuro problems and O (result) represented the success in reducing the risk of falls in the target population²³. The protocol of the construction steps of this systematic review was registered in the International *Prospective Register of Systematic Reviews* (PROSPERO), under protocol number CRD42021251393.

DATABASES/SEARCH STRATEGIES

The data were collected between 25th of December and the 04th of October of 2020 by an independent researcher/author in the *National Library of Medicine* (MedLine), *Literatura Latino-Americana de Ciências da Saúde* (LILACS), *Scientific Electronic Library Online - Brazil* (SciELO - Brazil) and *Virtual Health Library* (VHL) databases, using the following terms *MeSH - Gait Slip; Mechanical Perturbation; Mechanical Perturbation Training; Perturbation Practice; Multiple Sclerosis. Multiple Sclerosis and External disturbance* were adopted as keywords. During the search, Boolean expressions “AND” and “OR” were implemented in order to locate the records where the described descriptors occurred simultaneously. At this point, broader terms were intentionally adopted in order to find a greater number of articles, preventing that some important study could be excluded from the research.

INCLUSION CRITERIA FOR ARTICLES

After selecting the articles, each one of

them were examined by abstract, title and full text, following this inclusion criteria: randomized controlled clinical studies on training techniques and external disturbance in patients with multiple sclerosis.

The exclusion aspect included text with no mention of multiple sclerosis and the ones that used internal disturbances or non-mechanical disorders (e.g., sensory) and those that the evaluation by ROBIS scale identified a high risk of methodological bias. After the selection of the texts by the researcher, a meeting was held with the advisor to reconcile agreements and disagreements, with detailed consultation of the full texts.

Randomized controlled clinical studies on training techniques were external disturbance in patients with multiple sclerosis, where the data had been evaluated and compared before and after the intervention, in order to ensure the fact that the verifiable changes are associated with the intervention and not to any other variable/condition not observed in the investigation. There was no restriction regarding the date of publication, which only occurred in relation to the language of dissemination of the works, including only those written in either Portuguese, English and Spanish.

REVIEW PROCEDURE

During the selection of the papers, the research team read and analyze the titles and abstracts of all the articles found. Then, we read the selected studies, allowing other works to be excluded because they did not meet the revision proposal. At the last moment, the main information of the articles was synthesized so that they could guide the descriptive analyses of the selected studies.

METHODOLOGICAL ASSESSMENT

To evaluate the methodological quality of the articles, the ROBIS (Risk Of Bias in

Systematic Reviews) tool was used, created by a working group with 29 specialists from various university backgrounds and coordinated by Penny Whiting and Rachel Churchill, from the University of Bristol, with the objective of assessing the risk of bias in systematic reviews. This evaluation tool consists of three distinct steps: evaluation of relevance (an optional step); identification of possible risks of bias during the review process and, finally, general assessment of the risk of methodological bias. The ROBIS tool has leading questions that help in the construction of the critical evaluation of the researcher and from the classification achieved through these questions it becomes possible to judge the general risk of bias of a review ²⁴.

FINDINGS

SEARCH IN LITERATURE

The search resulted in the identification of 51 articles. 3 articles were excluded because they were included in more than one database and 37 studies were excluded because their titles and abstracts did not address the theme investigated. A detailed and comprehensive reading of the remaining studies identified 3 potentially relevant studies and these were included in this review. The following flow diagram summarizes the search strategy. Next, the methodological quality assessment of the included articles is found in Table 1 and, finally, the description of the articles selected in this research, with authors, sample, age, gender, duration of interventions, performed Interventions, evaluated outcomes and results are in Table 2.

ASSESSMENT OF QUALITY

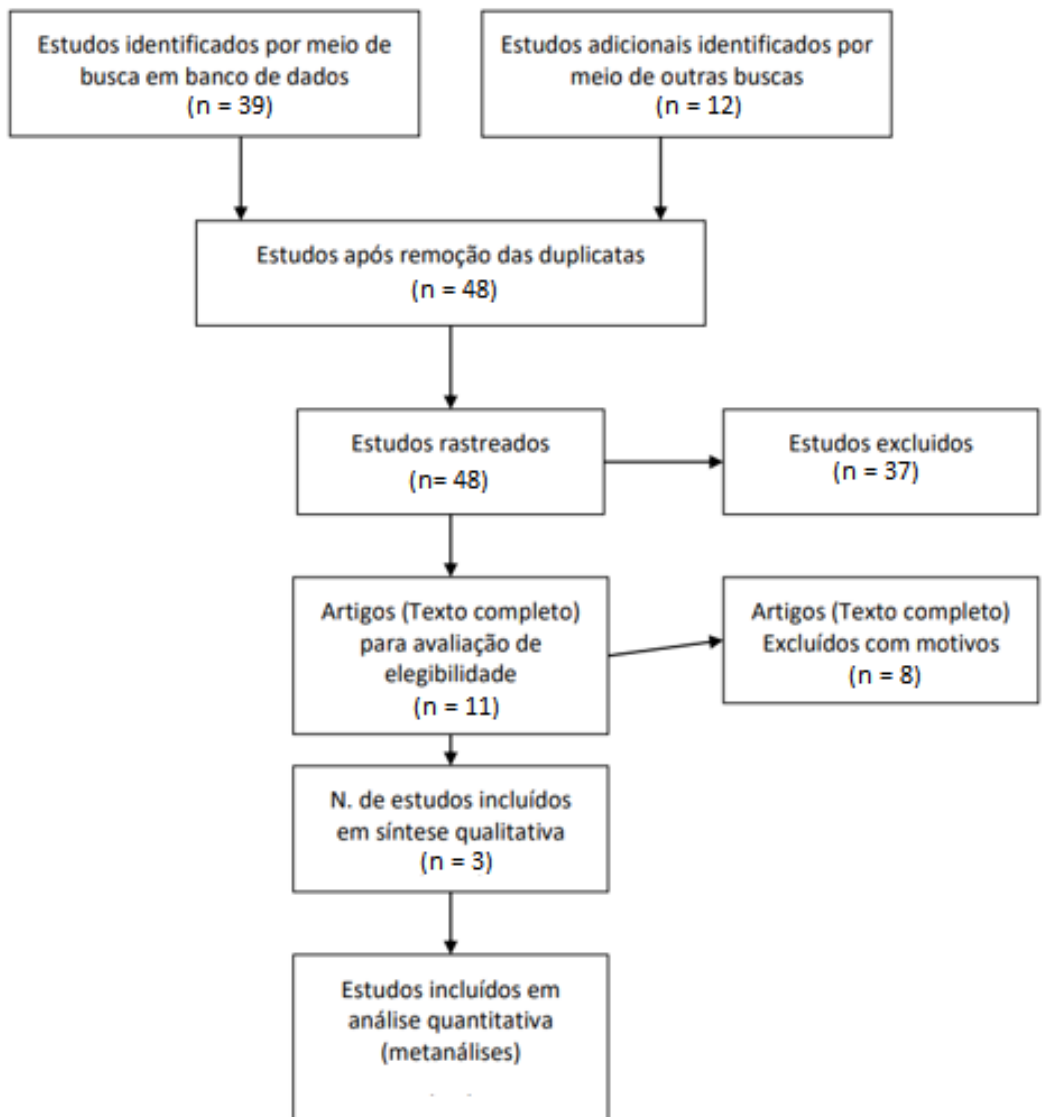
As reported in the subtopic "Methodological assessment", ROBIS-I, a collaboration tool created by Cochrane to assess the risk of bias in systematic reviews, was used in this study. This tool evaluates 7 key aspects and scores

Identificação

Triagem

Eligibilidade

Inclusão



them in three different ways: High risk of bias, Low risk of bias or Uncertain risk of bias, and the lower the risk of bias of a study, the better its methodological quality. The items evaluated by the scale are, respectively:

1. Random sequence generation.
2. Allocation concealment.
3. Blinding of participants and professionals.
4. Blinding outcome evaluators.
5. Incomplete outcomes.
6. Selective outcome report.
7. Other sources of bias²⁵.

Therefore, we obtained the following table:

	1	2	3	4	5	6	7
Gera 2016	●	●	●	●	●	●	●
Van Liew 2019	●	●	●	●	●	●	●
Yang F 2019	●	●	●	●	●	●	●

(Adapted from Viswanathan M et al. *ROBIS-I: a tool for assessing risk of bias in non-randomised studies of intervention*; BMJ 2016; 355@i4919)

Caption:

- Low risk of bias
- High risk of bias
- Uncertain risk of bias

The articles included in this study received an uncertain risk classification of bias in relation to random sequence generation, allocation concealment, blinding of the participants and professionals and the outcome evaluators blindness, since they did not have sufficient information about these aspects. The other aspects evaluated by the scale received a low risk of bias classification in both articles.

DESCRIPTION OF STUDIES

Table 2 shows the main characteristics of the included articles. In Gera study¹⁸, 38 participants were gathered, including men and women, 24 individuals with MS and 14 healthy individuals in the control group. In the study by Van Liew²⁶ there were 25 participants, including men and women, 14 individuals with MS and 11 healthy individuals in the control group. In Yang f study¹⁵, there was no control group, only a total of 13 individuals with MS. In the studies by Gera and Van Liew, the participants were tested for 2 consecutive days, and in the study of Yang F¹⁵, only for a day, both being divided into a block of 5 sessions of repeated slips. Regarding the outcomes evaluated, the three

Author, Year	Sample	Age	Gender	Duration	Intervention	Outcomes evaluated	Findings
Gera ¹⁸ 2016	38	10/48	M/F	2 days	External disturbances by means of a force platform.	Reflective markers were placed bilaterally in strategic locations.	Development of motor learning and ability to retain skills.
Van Liew ²⁶ 2019	25	57/76	M/F	2 days	External Disturbance by means of an Active Step.	Reflective markers were placed bilaterally in strategic locations	Improves pitch length and leg angle.
Yang F ¹⁵ 2019	13	NE	NE	1 Day	External Disturbance by means of an Active Step.	Reflective markers were placed bilaterally in strategic locations	Slip rate and falls, quickly reduced.

Table 2. Description of the selected studies.

studies used strategic markers divided into regions of the pelvis, feet and arms and data collected by a motion system using 8 different cameras in the study by Van Liew²⁶ and Yang F¹⁸, and by a Butterworth double-pass filter in Gera's study¹⁸.

DISCUSSION

The results of this research show that individuals with MS, with training, can adapt and learn to adopt strategies to avoid slipping, improving their postural responses, besides maintaining learned behaviors, proving the ability to acquire new motor skills and thus may reduce the risks of falls in patients with MS.

However, there are some limitations on the review, where in addition to the few numbers of studies on the subject reviewed, there are few articles that follow and compare the participants for higher days, because the included studies only had a maximum follow-up of 2 days, opening spaces for future researchers to have the possibility of doing a clinical study with a longer time of comparison so that a higher rate of certainty and acceptability is about the technique.

Finally, it can be said that the studies included in this review were identified with several methodological limitations, such as the number of reduced participants, that they did not specify whether there was a random distribution of the participants or even informed if there was blinding of the applicators and outcome reviewers.

CONCLUSION

It is concluded with this study that individuals with Multiple Sclerosis, with practice, have the ability to adapt and learn to adopt strategies to avoid slipping, improving their postural responses, besides maintaining learned behaviors, proving that they can acquire new motor skills and thus have efficacy in reducing the risks of falls through training with external disturbances. However, new studies with longer times of comparison, training, and greater methodological rigor regarding the random generation of groups and blinding of participants are suggested.

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