Journal of the Neurological Sciences 347 (2014) 119–123

Contents lists available at ScienceDirect

Journal of the Neurological Sciences

journal homepage: www.elsevier.com/locate/jns

3-week whole body vibration does not improve gait function in mildly affected multiple sclerosis patients—a randomized controlled trial

Thomas Wolfsegger [a,*], Hamid Assar [a], Raffi Topakian [a,b]

[a] Department of Neurology, Academic Teaching Hospital Wagner-Jauregg, Linz, Austria
[b] Department of Neurology, Klinikum Wels-Grieskirchen, Wels, Austria

ARTICLE INFO

Article history:
Received 25 July 2014
Received in revised form 11 September 2014
Accepted 17 September 2014
Available online 26 September 2014

Keywords:
Multiple sclerosis
Gait analysis
Whole body vibration
Physical therapy
Biomechanical analysis
Spatio-temporal parameters

ABSTRACT

Objective: To investigate the effects of whole body vibration (WBV) training on gait function in persons with mild multiple sclerosis (MS).
Design: A randomized controlled trial.
Subjects: 18 patients with MS were assigned randomly to WBV (intervention group) or to placebo WBV.
Methods: Both groups performed a 3-week training period under static conditions on a vibration platform. In the placebo group, the vibration platform was covered and therefore vibrations could not operate. Gait function (gait velocity, stride length, double support phase, single-step variability left and right) was assessed at baseline, after 3-weeks of WBV intervention or sham WBV, 4-weeks after baseline, and 5-weeks after baseline using a mobile plantar food pressure system and the "Timed Up and Go" test under four different gait conditions (comfortable overground gait, comfortable gait on treadmill, −20% comfortable gait velocity on treadmill and +20% comfortable gait velocity on treadmill).
Results: None of the outcome measures of gait function showed statistically significant alterations following 3-weeks of intervention/placebo WBV.
Conclusion: The applied protocol of WBV does not show a meaningful improvement of gait function in mildly affected MS patients.

1. Introduction

Multiple sclerosis (MS) is a progressive, inflammatory and degenerative disease of the central nervous system [1]. Variable neurological deficits such as motor weakness, spasticity, ataxia and sensory disturbances are common even in early stages of the disease and may lead to significant impairment of gait [2]. Gait disorders are reported by 85% of MS patients as their main complaint [3]. It has been estimated that within 10–15 years of the initial diagnosis of MS, approximately 80% of patients will experience some degree of impaired mobility [4,5]. Several studies evaluated gait impairment in MS patients and reported slower walking with shorter stride length and prolonged double support phase [6,7]. The identification of incipient gait and balance impairment in MS patients with recent disease onset suggests that motor function may begin to deteriorate in the early stages (Expanded Disability Status Scale (EDSS): 0–2.5) of the disease, even in the absence of clinical signs of pyramidal dysfunction [8].

Depending on the degree of disability, however, patients with MS may benefit from conventional exercise (i.e. aerobic and strengthening training) and physiotherapy [7]. Rehabilitation programs for MS patients frequently focus on gait training, spasticity reduction and the fitting of the necessary assistive devices (for example robot-assisted gait training [9]).

Whole body vibration (WBV) has gained extensive popularity in the last decade as an interesting alternative exercise mode for patients with upper motor neuron disorders. During WBV the platform vibrations induce involuntary muscle contractions that are initiated by sensory receptors and reduce the recruitment threshold of motor units [10]. Hence, to date, vibration platforms are being increasingly used in MS rehabilitation centers and clinical practices, although supporting evidence is lacking [11–13].

The present study investigated the effects of a 3-week WBV training program [14] on gait function in mildly impaired MS patients.

2. Methods

2.1. Subjects

18 ambulatory patients with MS, consecutively recruited from our MS outpatient clinic, gave written informed consent to participate in

* Correspondence address at: Department of Neurology, Academic Teaching Hospital Wagner-Jauregg, Wagner-Jauregg-Weg 15, 4020 Linz, Austria. Tel.: +43 732 6921 29262; fax: +43 732 6921 25704.
E-mail address: thomas.wolfsegger@gespag.at (T. Wolfsegger).

http://dx.doi.org/10.1016/j.jns.2014.09.030
0022-510X/© 2014 Elsevier B.V. All rights reserved.

this sham-controlled trial (Fig. 1). Inclusion criteria were: (1) mild or moderate disability with clinical mild spastic–ataxic gait disorder, (2) ability to stand and walk independently, without support and (3) stable phase of the disease ≥6 months.

Exclusion criteria on admission were: (1) Expanded Disability Status Scale (EDSS) > 5; (2) relapsing disease within the preceding 6 months; (3) corticosteroid treatment within the last 6 months before study inclusion; (4) clinical evidence of polyneuropathy; (5) orthopedic disease with impairment of gait function. All patients were asked to maintain their normal living habits and to not participate in any other study or physical therapeutic interventions. This study was reviewed and approved by the ethics committee of the government of Upper Austria in line with the Declaration of Helsinki (local ethics committee study number: C-38-12).

2.2. Procedures

The study participants were randomized to WBV intervention or placebo WBV by simple random sampling using a random number table.

Following study inclusion, baseline (BL) measurements were performed in the following specified order (measurement protocol): (1) “Timed Up and Go” test (TUG), (2) biomechanical gait analysis (GA) on overground walking with comfortable gait velocity (20 m), (2) GA during comfortable gait velocity on a treadmill, (3) GA during reduced (−20% vs. comfortable) gait velocity on treadmill and (4) GA during increased (+20% vs. comfortable) gait velocity on treadmill (EN B0 system Reha, Belt area 50 × 150 cm, Bonte Zwolle BV®, Netherlands).

Walking on a treadmill leads to an alteration of the phases of the walking cycle and balance related gait parameters via different afferent inputs and modulation of the central pattern generator [15,16]. We analyzed gait coordination during different gait velocities, as coordinative motor functions in the lower legs are best examined at fast gait velocities, while gait supporting functions become more relevant at slow gait velocities.

Both groups underwent a protocol of a 3-week WBV or placebo WBV (Zeptoring® multidirectional stochastic platform, Scisen GmbH, Germany).

According to the overload principle, training volume and intensity were increased gradually over a 3-week training period (with an increase in applied vibration frequency and the duration and numbers of sets, and a shortening of the rest period): week 1: frequency with 2.5–3.0 Hz, sets: 5, vibration duration: 45 s, rest between sets: 60 s; week 2: frequency with 3.5–4.0 Hz, sets: 6, vibration duration: 60 s, rest between sets: 45 s; week 3: frequency with 4.5–5.0 Hz, sets: 7, vibration duration: 60 s, rest between sets: 30 s.

Each WBV exercise session started and ended with 5 min of ergometer cycling (30 W, 50–70 rpm, Proxomed® medical engineering, kardiomed bike, Germany).

While standing on the platform of the Zeptor-med system, subjects were instructed to maintain a squat position with slight flexion at the hip, knee and ankle joints (Fig. 2). In the placebo group, the vibration platform was covered with a stable wooden cover panel and therefore vibrations could not operate.

According to protocol, gait analysis was carried out after 3 weeks of WBV/placebo WBV, 4 weeks after baseline, and 5 weeks after baseline.

2.3. Gait analysis

We analyzed gait velocity (km/h), stride length (m), double support phase (% gait cycle), single-step variability (% standard deviation) on a pressure measuring mobile insoles system (T&T Medilogic®, Germany, sensor number between 35 und 64 sensors per sole and a sole diameter of 2 mm, sample rate 200 Hz, proband modem weight: 180 g; size: 145 mm × 60mm × 30mm). Foot pressure insoles were placed in neutral shoes (2 mm ethylene-vinyl acetate without any supports and heel wedges) and adapted to the shoe size of the probands. All data were collected by the sensor adapter, passed to the proband's modem, and then transmitted to the computer modem and via an USB interface to the computer.

After the start of the measurement, the first ten steps were discarded. The following twenty steps were used for data analysis only (walking distance of 20 m).

Regarding the TUG, we recorded the time (in seconds, using a stopwatch) needed to get up from a chair without armrest, walk 3 m,

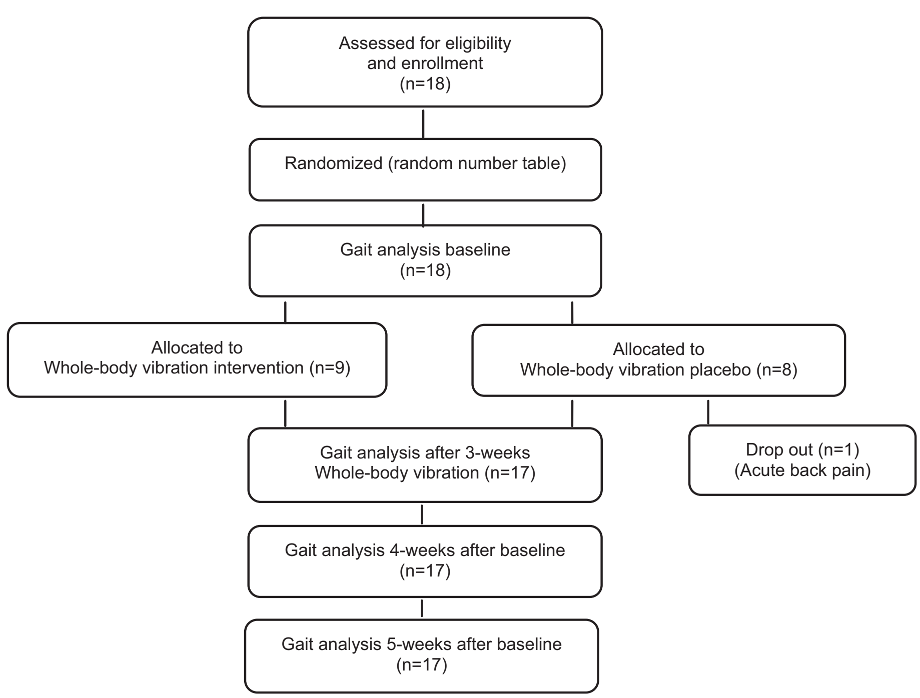

Fig. 1. Study flow diagram.