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Prevention and Rehabilitation

The implementation of a reflex locomotion program according to Vojta produces short-term automatic postural control changes in patients with multiple sclerosis

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ABSTRACT

Background: Imbalance is common in people with multiple sclerosis.
Objective: To examine the effectiveness of a Vojta locomotion reflex program as short-term automatic postural control in patients with Multiple sclerosis.
Methods: Quasi-experimental controlled trial with a pretest-post-test design. Participants: People with Multiple Sclerosis (N = 21) able to walk 100 m but unable to maintain 30-s tandem stance with arms alongside the body.
Intervention: in two consecutive weeks two interventions were conducted: Vojta group(A) and standard therapy group(B). Primary outcome were: Berg Balance scale (BBS), Tandem test, 10 m Walk in the 1st session (pre and post) then at the end of the study 2 weeks later.
Results: Intervention A had significant results in contrast to intervention B in BBS when referred to equilibrium variables ($p = 0.026$) and Tandem test ($p = 0.01$). In the 10 m Walk test a significant improvement was seen in both interventions, $p = 0.00$ in group A, $p = 0.038$ in group B. In addition, an association was found between the variable Core activation and the main equilibrium variable (BBS) in the intervention A.
Conclusions: The results suggest that Vojta therapy has a short-term effect improved balance in everyday skills according to BBS and the other tests (walking) in people with MS compared to a standard therapeutic procedure. www.ClinicalTrial.gov.
Registration number: NCT03887507.

Location where Project is carried out:

- *Intervention A*: Numen Foundation physiotherapy department from Madrid, Spain (Address: C/Tabatinga 11, 28027 Madrid).
- *Intervention B:* physiotherapy department of Multiple Sclerosis Foundation from Madrid (address: Av. de Asturias, 35, 28029 Madrid) and Rehabilitation Clinic Fisiovillalba, Spain (Address: C/Camino del Berrocal nº2, 28400 Collado Villalba, Madrid).

1. Introduction

Multiple sclerosis (MS) is one of the most common causes of neurological disability that affects young adults (Rosati, 2001). Balance problems are one of the most common symptoms of the disease even in the early stages affecting more than 75% of people with MS (Pike et al., 2012). These balance dysfunctions are manifested not only in gait, with a great risk of falling, but affect most of the daily life activities, having a great impact on quality of life (Gunn et al., 2013). Therefore, attention to this problem has to be taken as a priority.

Core musculature, mainly the deep abdominal muscles are considered essential for the stability and balance in walking

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(Ketelhut et al., 2015). There is evidence that both people with MS and brain damage have limited trunk stability (Chung et al., 2013). Therefore, improvement is a common goal of physical therapy (Lanzetta et al., 2004) which can be approached with different therapeutic techniques, ranging from the classical training imbalance in sitting or using unstable surfaces (Kramer et al., 2014); from adapting methods of fitness as Pilates, the combination of several sensory, motor and cognitive strategies (Carling et al., 2017), to the use of virtual reality (Eftekharsadat et al., 2015).

The Vojta therapy (VT), best known for its application in neuropediatrics (Vojta and Peters, 1995), is incorporated into the range of therapeutic strategies applied to people with MS who have shown positive results (Laufens et al., 1991). However, the level of evidence is still insufficient. The VT consists of the activation of innate reflex patterns by pressing specific areas based on certain positions. Automatic postural control forms the contents of the Locomotion reflex (LR) described by Vojta (1991) although their effects on equilibrium dysfunctions have not yet been investigated thoroughly.

The aim of this study was to compare the short-term effect on automatic postural control between Vojta therapy and a standard physiotherapy program, established in 2 consecutive weeks.

2. Method

The study was Quasi-experimental controlled trial with a pretest-post-test design. The blinding of intervention A is explained by the fact that it is a reflex activation where patients are unaware of the motor responses produced and their possible relationship with the evaluated tests. In contrast, in intervention B, the patient had to understand the exercises and actively collaborate in their execution. The study was conducted in two different places for each type of intervention. The intervention A was applied in the Neurorehabilitation service of adult patients with neurological diseases, and was performed by a specialist explorer in Vojta therapy for adults. The intervention B in an equivalent population, inclusion and exclusion criteria, size and physical characteristics same as group A conditions were studied (Table 1). This intervention B was carried out in two different centers and performed by physiotherapists specialized in treating people with MS. In both intervention casual selection criteria was followed.

Inclusion criteria: Final diagnosis of MS. Walkability with or without assistance (4.0–6.5 in EDSS). Dysfunctions defined by the inability to hold the tandem position for 30 s with the arms close to body. Older than 18 years-old. It was necessary to go to the sessions accompanied by a family member or close person.

Exclusion criteria: Phase outbreak or outbreak in the 3 months before the study. Medication that prevents or limits the performance of the Locomotion reflex.

The study was approved by an ethics committee (Registration No. 0204201806218) and conducted according to the Helsinki declaration with informed consent collected from all subjects.

2.1. Intervention

2.1.1. Intervention A (Vojta therapy)

There were 3 Vojta therapy sessions conducted on 2 consecutive weeks with an interval of 7 days between sessions, on 1st, 7th and 14th days. Each session consisted of a 45-min Vojta therapy protocol based on three exercises, 15 min per exercise: Crawling Reflex (Fig. 1) and 1st phase and 2nd phase Rolling reflex (Fig. 2). The three face to face sessions were made by the principal investigator. The relative or close person was instructed in carrying out an exercise protocol to do at home every day for 20 min during the 2-week study. The home activity consisted of replicating the exercise with the highest reflex activation (of the three performed in the first session), for a total of 20 min. A calendar was given to each patient where to record the session: time slot used, and incidents and reflex activity observed.

2.1.2. Intervention B (standard program)

The B group performed 4 sessions of physiotherapy in the same period for two consecutive weeks, with 1 h per session in its specialized MS association, on 1st, 3rd, 8th, 10th and 15th days. This was applied by experienced physiotherapists during the treatment of people with MS. The program consisted in balance exercises targeting core stability, exercises of coordination and Pilates as well as individual sessions using the Bobath concept. Patients in this group walked at least for 20 min per day during the study period.

Description of exercises: Activation of lower limbs in supine

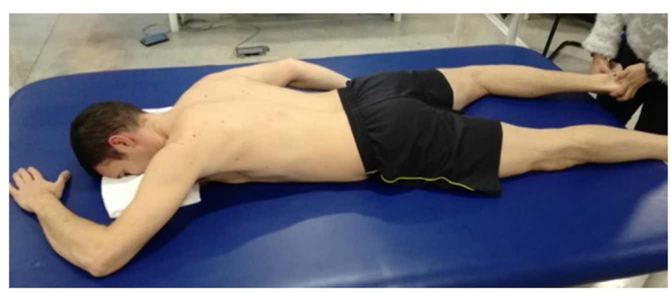

Fig. 1. Application of the Reflex Creeping exercise to a patient by a family member.

Table 1
Demographics and baseline characteristics.

Variable	Total (n = 21)	Vojta Group (n = 12)	Control Group (n = 9)
Age (years)	45.76 (SD 10.87) 52 (29.62)	45.33 (SD 10.73) 51 (29.56)	46.33 (SD 11.69) 52 (31.62)
Gender			
Male	7 (33.3%)	4 (33.3%)	3 (33.3%)
female	14 (66.7%)	8 (66.7%)	6 (66.7%)
Subtype			
Relapsing- remitting	7 (33.7%)	3 (25%)	4 (44.4%)
Secondary progressive	8 (38.1)	5 (41.7%)	3 (33.3%)
Primary progressive	6 (28.6%)	4 (33.3%)	2 (22.2%)
Years since diagnosis	10.43 (SD 6.96) 9 (2.24)	10.33 (SD 6.95) 8,50 (2,23)	10.56 (SD 7.38) 12 (2.24)
EDSS	5.23 (SD 0.87) 5 (4, 6.5)	5.33 (SD 0.80) 5 (4.5; 6.5)	5.11 (SD 0.99) 5 (4, 6.5)

Abbreviations: SD: standard deviation. EDSS: Expanded Disability Status Scale.
For categorical variables, % is presented. For numerical variables, mean (SD) median (min, max) is presented.

Fig. 2. Application of the Reflex Turning exercise to a patient by a family member.

position. Dissociation exercises of the scapular and pelvic girdles. Core stability training in quadruped and sitting on fitball. Exercises to activate equilibrium reactions in different positions. Sitting Balance Exercise Performed Using Virtual Reality. Reeducation of gait with and without obstacles. PNF exercises. Dual task.

2.2. Evaluation

The test evaluation of each patient was videotaped before and after the treatment. The study variables were taken in the same manner in both groups with the same interval duration: At the beginning and end of the first session in order to test the short-term effect, and at the end of the last session (at 14 days' group A and 15 days in group B).

Demographic variables: Table 1.

2.2.1. Outcomes

2.2.1.1. Quantitative. Berg Balance Scale (BBS); Tandem test (6 m); 10 m Walk test.

2.2.1.2. Qualitative. *Subjective perception of change* in walking after each intervention with dichotomous response: Yes/No.

Reflex abdominal contraction at least for 1 min, measured during treatment in group A by observation and palpation from the principal investigator and confirmed by a second observer with dichotomous response: Yes/No.

Note: This variable is not possible to measure in the intervention B due to these exercises being performed actively and consciously by the patient rather than reflexively in this procedure.

2.2.2. Data analysis

Statistical analysis was performed using SPSS v24. Demographic and diagnostic variables are summarised using descriptive statistics. After checking the normality of the Sharipo-wilk test data (n below 30), pre and post-test quantitative variables were measured by using the Wilcoxon non-parametric statistical-samples given the low sample ($n = 21$).

To check the equivalence between the study groups, the T Student test for independent samples was used after checking normality of the data, and as result of the low sample, it was also tested with the Mann-Whitney. Qualitative variables were measured by Chi square.

3. Results

In the intervention A, 12 patients (4 males and 8 females) with a mean age of 45.33 participated (SD 10.73). In the intervention B there were 12 patients, of which 3 did not complete the study, with a total of 9 (2 males and 7 females) with a mean age of 46.33 (SD11,69). In both groups there were no significant differences pre-study in demographic variables (age $p = 0.31$) nor in the primary outcome: BBS ($p = 0.10$), Tandem test ($P = 0.23$), 10 m walk test ($p = 0.27$).

In the main variable (BBS), group A patients improved their rating significantly in the subsequent measurement to session 1 ($p = 0.01$) and remained at the last evaluation two weeks later ($p = 0.01$). However, with the same test, group B did not improve in the subsequent evaluation of the first session ($p = 0.581$) or in the last measurement ($p = 0.952$). Comparison between groups (last measurement versus initial evaluation) found significant differences ($p = 0.026$).

In Tandem test and 10 m Walk test variables, significant differences versus intervention B ($p = 0.01$ and $p = 0.00$ respectively) were found. Intervention B also had significant results in the final assessment 10 m Walk test ($p = 0.038$). The results of the measurements after the 1st and the final session in each separate group can be checked in Table 2. The registration of home sessions had a degree of compliance higher than 90% in both groups (92% in group A and 100% in group B).

Additionally, association was observed in group A between the variable “subjective perception of change” after the intervention, with the variable “observation of reflex abdominal contraction maintained more than a 1 min” (Fisher $p = 0.04$). Moreover, this variable observed in 9 of 12 participants from group A (no measured in group B) had a significant relationship ($p = 0.04$) with the main balance variable (BBS).

4. Discussion

The theory behind Vojta suggests that the changes in the tests are due to improvements in automatic postural reactions producing improvements in short-term balance. Furthermore, a relationship between equilibrium test results and the Core musculature activation during intervention with the VT (Fig. 3) can be seen in this study in the same way as described by Vojta and Peters (1995). A recent study in neurological adults with Vojta therapy supports these findings (Epple et al., 2020). The same relationship is in line with other studies, which correlate the specific Core training with a better balance performance and a decreased risk of fall in patients with MS (Nilsagård et al., 2014). Frequency and intensity are determining variables in the results in patients with MS (Pavlikova et al., 2020). For this reason, an activity program (an exercise at home) was included. The selection of walking as an activity at home in intervention B was chosen because it is the most complete and easy exercise to carry out without using elements or supervision. In this way, only group B carried out an activity object of evaluation in the tests (10 m. Walk Test) that also implies integration of equilibrium reactions. However, group A did not train any evaluated activity.

In the 10 m Walk test the difference found between the two groups is associated with a tighter postural control, in the immediate term as much as two weeks afterwards. We believe that this is due to increased Core stabilisation (a fact observed in the qualitative variables) through simultaneous activation of the diaphragm and transversus abdominis with the internal oblique, pelvic floor and multifidus muscles in conjunction with the abdominal muscles surface (rectus and external oblique), which generates sufficient intra-abdominal pressure to dynamically stabilise the spine (Noh et al., 2014).

These muscle ratios obtained from the Kinesiology description patterns of Locomotion Reflex described by Vojta and Peters (1995) support these findings, which fall under the precedent work from Laufens et al. (2004) with 21 MS patients after 3 weeks, in which the effect of VT in the walk was studied in different intervening sequences. As a differential aspect, this work contrasts the results to

Table 2
Intention to treat analysis of within-group and between-group changes.

Outcome measure	Vojta Group (n = 12)				Control Group (n = 9)				Difference between Vojta & Control
	Time point	Mean (SD)	Paired test	P	Time Point	Mean (SD)	Paired test	P	P t0-t2 (V) & t0-t2 (C)
Berg Balance Scale (0–56)	t0	44.58 (5.48)	t0 - t1	**012**	t0	47.56 (4.74)	t0 - t1	**, 581**	**, 026**
	t1	48.67 (5.74)	t0 - t2	**012**	t1	47.33 (4.24)	t0 - t2	**952**	
	t2	49.41 (5.83)			t2	47.55 (3.46)			
10 m walk test (s)	t0	24.49 (11.03)	t0 - t1	**003**	t0	19.92 (4.16)	t0 - t1	**110**	**, 000**
	t1	20.43 (7.65)	t0 - t2	**003**	t1	19,00 (5.09)	t0 - t2	**, 038**	
	t2	19.72 (7.40)			t2	18.97 (4.59)			
Tandem Test (s)	t0	39.83 (7.12)	t0 - t1	**003**	t0	37.06 (10.06)	t0 - t1	**259**	**001**
	t1	30.41 (7.63)	t0 - t2	**003**	t1	35.62 (7.40)	t0 - t2	**, 513**	
	t2	28.75 (8.46)			t2	36.33 (7.46)			

Abbreviations: T0: before intervention: t1: Directly after intervention; t2 at 2-week follow-up.

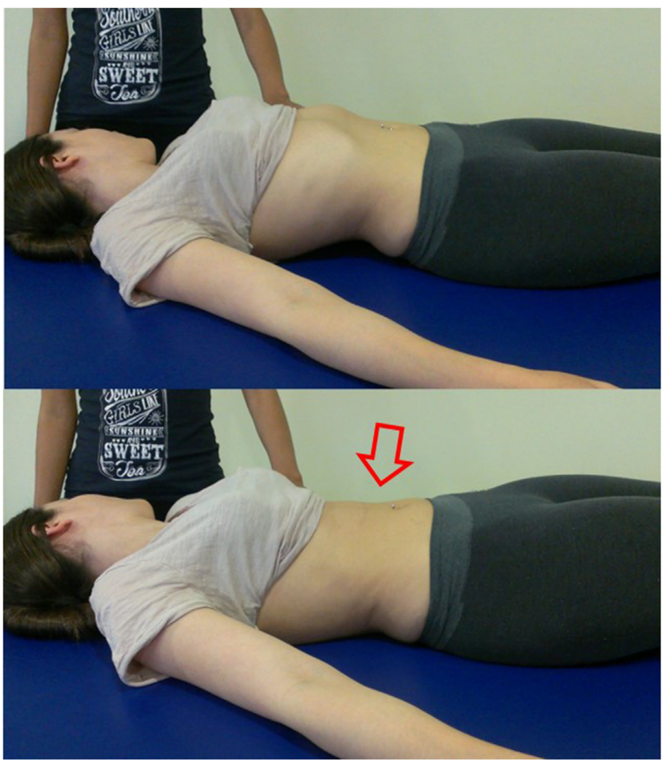

Fig. 3. Reflex activation of the core musculature

a group that performs a different intervention.

On the other hand, reflex contraction of the abdominal musculature detected by palpation during VT does not measure its intensity. This is a variable that can contain a subjective component. However, Core activation with VT (in its DNS version) has been confirmed by Yoon and You (2017) with an EMG in neurological and healthy patients, wherein said activation resulted in changes in abdominal tropism checked by ultrasound examination.

In addition, other papers have shown (with EMG) reflex contraction produced in different muscle groups following the VT application on different pathologies (Pavlu et al., 2000; Perales-Lopez and Fernández-Acenero, 2013). Therefore, this subjective component in this paper is supported by the evidence and is easily reproducible and clinically verifiable.

In this line of work, other methodologies have focused on the Core activation as a means to improve balance during gait in MS, although with much greater intervention periods (Kara et al., 2017; Kalron et al., 2017). In contrast to these procedures in the study, patients have not been previously trained for the exercises, its activation happens as a reflex, without conscious collaboration. Thus, it is eliminated the patient learning bias.

5. Study limitations

The study groups have not been randomized due to logistical reasons and with the difficulty in patient access. Therefore, luck can play a role in the distribution of patients despite the equivalence of the two groups in the demographic variables and pre-study. The small sample size is another limitation that prevents extrapolation of the results, so increasing the sample size in future studies may help clarify this aspect.

6. Conclusions

The results suggest that Vojta therapy has improved balance in everyday skills according to BBS and the other tests (walking) in people with MS compared to a standard therapeutic procedure. Additional randomized studies would be required with larger sample size and long-term tracking results.

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CRediT authorship contribution statement

Luis Perales Lopez: Conceptualization, Methodology. **Natalia Valdez Palmero:** Data curation, Writing - original draft. **Laura Garcia Ruano:** Visualization, Investigation. **Clara San Leon Pascual:** Supervision, Data curation. **Paula White Orile:** Validation. **Adrian Vegue Down:** Writing - review & editing. **Mª Dolores Gor Garcia-Fogeda:** Investigation, Formal analysis. **Silvia Toré:** Investigation, Formal analysis.

Declaration of competing interest

The authors(s) declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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The context of this paper has not been presented to other journal and has not received any.

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