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Case Report

Combined Physiotherapy and Orthoptic Rehabilitation for Balance Disorders in Multiple Sclerosis: A Case Series

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Abstract

Background: Balance impairment is common in people with multiple sclerosis (PwMS) and is often compounded by convergence insufficiency, increasing fall risk. Whether adding orthoptic training to balance-oriented physiotherapy provides additional benefit is unclear. **Case Presentation:** We describe a convenience sample of 12 PwMS (2017 McDonald criteria; Expanded Disability Status Scale [EDSS] 1–6.5) with convergence insufficiency (Convergence Insufficiency Treatment Trial criteria) and balance disorders (Berg Balance Scale [BBS] <45), who received physiotherapy (twice weekly) combined with orthoptic rehabilitation (once weekly), 10 sessions each. All 12 were assessed at baseline (T0) and post-treatment (T1), 10 at the 3-month follow-up (T2), and 8 during a subsequent physiotherapy-only phase (T3–T4); 7 had complete orthoptic assessments. The BBS improved by about 12 points after the combined phase (n = 12; r = 0.89, $p = 0.002$), was maintained at follow-up (n = 10; r = 0.85, $p = 0.008$), and also improved in the physiotherapy-only phase (n = 8; r = 0.95, $p = 0.008$). Mobility, the fatigue impact domain and several quality-of-life domains improved within the phase but not at follow-up. All orthoptic measures improved (n = 7; composite median 10 → 4; exact $p = 0.016$), without a significant association with balance change (Spearman $\rho = 0.34$, $p = 0.46$). **Conclusions:** In this small case series, combined physiotherapy and orthoptic rehabilitation was feasible and associated with within-phase improvements in balance. As the non-randomized phases involved the same participants, these hypothesis-generating findings require confirmation in adequately powered randomized trials.

Keywords: multiple sclerosis; postural balance; orthoptics; ocular motility disorders; rehabilitation

1. Introduction

Multiple sclerosis (MS) is a common chronic neurological disease of young adults [1], in which balance impairment is frequent and a major cause of falls. Oculomotor dysfunction, particularly convergence insufficiency, is frequent in MS and can degrade the visual contribution to postural control [2]. Balance-oriented physiotherapy improves balance and mobility in people with MS (PwMS) [3]; however, when balance impairment coexists with convergence insufficiency, motor rehabilitation alone may not address the visual component. Although gaze- and postural-stability rehabilitation has been investigated in MS [4], evidence on integrating orthoptic (binocular-vision) training into balance-oriented physiotherapy remains scarce. This case series describes the balance and functional outcomes of a combined physiotherapy-and-orthoptic rehabilitation program in PwMS.

2. Methods

Design and participants. This work is reported as a case series following the CARE (CAse REport) guidelines. It is a retrospective, observational analysis of anonymised clinical and functional data collected during rehabilitation delivered as routine care at the neurorehabilitation outpatient clinic of Policlinico Umberto I, Sapienza University of Rome. Twelve PwMS seen between May 2023 and October 2024 were included. Inclusion criteria were a diagnosis of MS according to the 2017 revised McDonald criteria [5]; an Expanded Disability Status Scale (EDSS) score of 1–6.5, the EDSS being scored from 0 to 10 in 0.5-point steps on the basis of functional system scores and ambulation [6]; convergence insufficiency according to the Convergence Insufficiency Treatment Trial criteria, i.e., a receded near point of convergence (≥6 cm), a near exophoria at least 4Δ greater than at distance, and reduced near positive fusional vergence or failure of Sheard's criterion [7]; and balance disorders, defined as a Berg Balance Scale score <45 [8]. Participants were a convenience sample: eligible patients were included according to their availability to attend the outpatient rehabilitation pathway, rather than consecutively. Patients unable to ambulate independently or with other neurological causes of imbalance or ophthalmological conditions precluding orthoptic assessment were excluded. This is an exploratory, retrospective, observational study (reported as a case series) of a sequential treatment pathway with incomplete repeated observations; only

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8 of the 12 patients entered the physiotherapy-only phase, so no complete crossover or within-subject comparative design is implied. The rehabilitation pathway and the assessment time points reflected routine clinical care, whereas the primary outcome and the statistical analyses were defined retrospectively for this report; accordingly, all inferential findings are exploratory.

Intervention. All sessions were delivered in person at the outpatient clinic under direct supervision, with no home-based exercises, by a physiotherapist and an orthoptist who treated all participants following a standardised protocol (exercises, techniques and progression are detailed in **Supplementary Table 1**). In the combined-treatment phase, patients received ten 50-minute physiotherapy sessions (twice weekly) and ten 45-minute orthoptic sessions (once weekly). Physiotherapy followed a postural progression from supine and side-lying exercises to quadrupedal/kneeling, sitting and standing balance tasks and gait training; orthoptic sessions progressed from pencil push-ups and physiological-diplopia exercises to prism, filter-bar and vectographic fusional training. Exercises were advanced when the patient performed the current task with stable postural control or maintained single binocular vision, by reducing the base of support, adding unstable surfaces, eye closure, head rotations or dual tasks, or by bringing targets closer and increasing prism power or target separation, according to each patient's performance. After a four-month interval, eight patients underwent a physiotherapy-only phase (ten 50-minute sessions, twice weekly) with the same protocol. All 12 patients completed the ten combined-treatment sessions, and all eight completed the physiotherapy-only sessions. No adverse events occurred.

Outcomes. The Berg Balance Scale (BBS) [9] was the primary outcome; secondary measures were the 6-Minute Walk Test (6MWT), the Timed Up-and-Go test (TUG) [10], the 12-item Multiple Sclerosis Walking Scale (MSWS-12) [11], the Fatigue Symptoms and Impacts Questionnaire–Relapsing Multiple Sclerosis (FSIQ-RMS) [12], the Multiple Sclerosis Quality of Life-54 (MSQoL-54) [13], and five ordinal orthoptic measures with a composite score. Assessments were obtained at baseline (T0), post-treatment (T1) and 3-month follow-up (T2) for the combined phase, and at baseline (T3) and post-treatment (T4) for the physiotherapy-only phase. Each orthoptic measure was graded by the treating orthoptist on an ad hoc 0–3 severity scale (0 = normal, 3 = severe) with reference to established normative values for each test, and the five grades were summed into a composite score (range 0–15); the grading and reference values are reported in **Supplementary Table 2**. This composite is not a validated instrument, weights clinically different constructs equally, and is used only for descriptive, exploratory purposes.

Analysis and ethics. Within-phase changes were analysed with Wilcoxon signed-rank tests, with effect sizes derived from the test statistics ($r = Z/\sqrt{N}$); because the two phases comprised the same participants in a fixed, non-randomised order, between-phase differences are reported descriptively only. Orthoptic changes were tested with the exact Wilcoxon test, and the association between orthoptic and balance change with Spearman's correlation. Ethics committee approval was not required, as the study was a secondary analysis of fully anonymised data collected under a protocol approved by the Comitato Etico dell'Università "Sapienza" (Rif. 6041, Prot. 0786/2020); patients had consented to research use of their data. Because the primary outcome and analysis plan were defined retrospectively, the Berg Balance Scale analysis is not confirmatory and all inferential findings are exploratory. In total, more than 50 within-phase Wilcoxon tests were performed across the Berg Balance Scale, the functional and fatigue measures and the 16 MSQoL-54 domains in two phases, without correction for multiple comparisons; we therefore emphasise effect sizes and their uncertainty rather than nominal p values and treat all secondary results as descriptive. As a case series, the analyses are descriptive and hypothesis-generating by design; accordingly, no multiplicity correction was applied and p-values are reported only as descriptive indicators alongside effect sizes.

Table 1. Demographic and clinical characteristics of the sample (combined-treatment phase, n = 12; physiotherapy-only phase, n = 8).

Characteristic	Sample = 12	Sample = 8
Gender n (%)		
Male	5 (41.7)	3 (37.5)
Female	7 (58.3)	5 (62.5)
Phenotype (%)		
RRMS	10 (83.3)	6 (75.0)
SPMS	2 (16.7)	2 (25.0)
Previous physiotherapy before enrolment, n (%)		
Yes	6 (50.0)	3 (37.5)
No	6 (50.0)	5 (62.5)
Mean age ± SD	50.7 ± 12.5	49.0 ± 15.3
Mean height ± SD	1.72 ± 0.07	1.71 ± 0.08
Mean weight ± SD	66.25 ± 11.20	65.25 ± 11.50
Currently employed, n (%)	7 (58.3)	5 (62.5)
Mean education years ± SD	16.25 ± 4.85	15.28 ± 2.97
Mean disease duration (years) ± SD	19.75 ± 14.23	16.13 ± 15.47

Previous physiotherapy before enrolment, participants who had received physiotherapy before entering the study; Currently employed, participants in paid employment at enrolment. SD, standard deviation; RRMS, relapsing-remitting multiple sclerosis; SPMS, secondary progressive multiple sclerosis.

Table 2. Within-phase changes in the Berg Balance Scale (BBS) and the Fatigue Symptoms and Impacts Questionnaire–Relapsing Multiple Sclerosis (FSIQ-RMS).

Outcome measure	Phase baseline		Post-treatment		Within-phase change		Follow-up		Baseline–follow-up change	
	Mean ± SD	Median	Mean ± SD	Median	Z	*p*	Mean ± SD	Median	Z	*p*
Berg, CTP	39.83 ± 9.20	44.00	51.33 ± 6.00	53.50	3.074	0.002*	50.00 ± 5.50	51.50	2.673	0.008*
Berg, POP	47.25 ± 6.70	48.50	53.13 ± 2.48	54.00	2.673	0.008*				
FSIQ-RMS Symptom domain, CTP	37.42 ± 14.70	36.50	28.92 ± 15.41	28.00	–1.827	0.068	35.20 ± 12.12	35.00	–0.306	0.759
FSIQ-RMS Symptom domain, POP	38.38 ± 13.10	39.50	30.00 ± 12.64	31.00	–2.524	0.012*				
FSIQ-RMS Impact domain, CTP	21.75 ± 8.80	24.50	15.42 ± 9.24	13.50	–2.625	0.009*	20.00 ± 9.27	19.50	0.178	0.858
FSIQ-RMS Impact domain, POP	23.13 ± 11.40	26.00	20.25 ± 11.66	23.50	–2.536	0.011*				

CTP, combined-treatment phase; POP, physiotherapy-only phase; SD, standard deviation. *$p < 0.05$. Follow-up columns apply to the CTP only. n = 12 (CTP, T0–T1), n = 10 (CTP follow-up, T2), n = 8 (POP).

Table 3. Within-phase changes in MSWS-12, 6MWT and TUG.

Outcome measure	Phase baseline		Post-treatment		Within-phase change		Follow-up		Baseline–follow-up change	
	Mean ± SD	Median	Mean ± SD	Median	Z	*p*	Mean ± SD	Median	Z	*p*
MSWS-12 (0–100), CTP	61.28 ± 20.90	64.58	38.02 ± 19.79	39.58	–3.062	0.002*	47.29 ± 14.23	47.92	–1.623	0.102
MSWS-12 (0–100), POP	60.16 ± 14.02	61.46	46.88 ± 11.30	41.67	–2.536	0.011*				
6MWT(m), CTP	315.83 ± 135.01	270.00	446.67 ± 112.03	445.00	–3.063	0.002*	410.00 ± 119.82	440.00	–1.633	0.102
6MWT(m), POP	375.00 ± 111.10	400.00	461.25 ± 135.17	475.00	–2.524	0.012*				
TUG(s), CTP	14.33 ± 4.25	14.74	9.38 ± 1.97	9.57	–3.059	0.002*	11.59 ± 6.15	9.91	–1.580	0.114
TUG(s), POP	12.78 ± 6.77	10.57	8.79 ± 2.97	7.61	–2.521	0.012*				

CTP, combined-treatment phase; POP, physiotherapy-only phase; MSWS-12, 12-item Multiple Sclerosis Walking Scale (scores converted from a raw score range of 12–60 to a 0–100 scale, with higher scores indicating greater walking impairment); 6MWT, 6-Minute Walk Test; TUG, Timed Up-and-Go test. *$p < 0.05$. n = 12 (CTP, T0–T1), n = 10 (CTP follow-up, T2), n = 8 (POP).

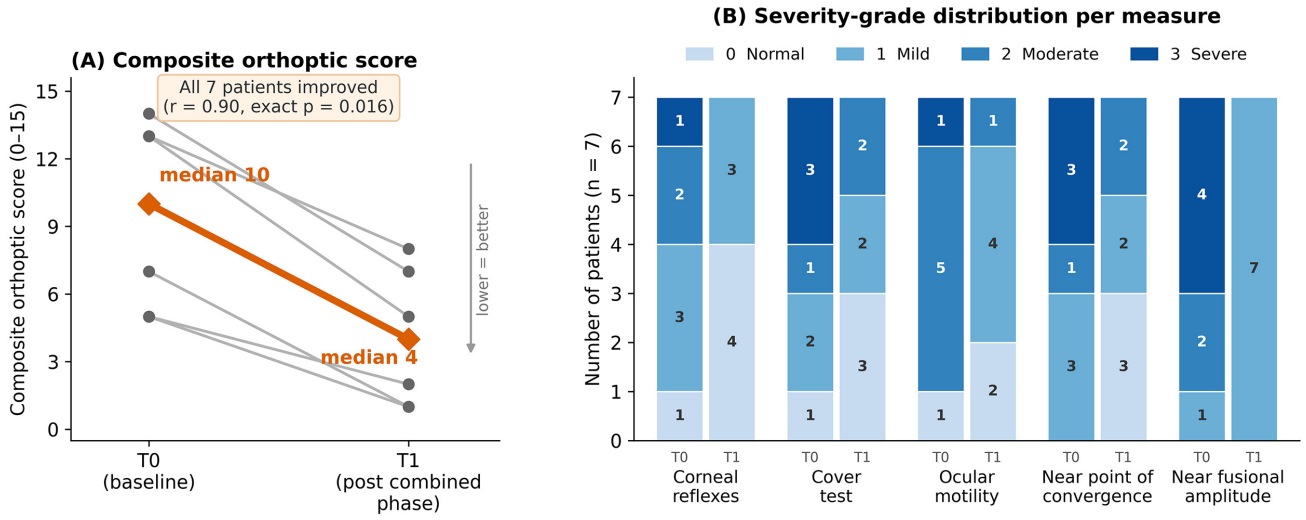


Fig. 1. Orthoptic outcomes in the seven patients with a complete orthoptic assessment, from baseline (T0) to the end of the combined physiotherapy-and-orthoptic phase (T1). (A) Individual trajectories of the composite orthoptic score (range 0–15; lower = less impairment; group median 10 → 4). (B) Distribution of clinical severity grades (0 = normal to 3 = severe) for each measure at T0 and T1. The orthoptic scale was applied ad hoc and results are exploratory.

Table 4. Orthoptic outcomes: within-phase changes between baseline (T0) and the end of the combined-treatment phase (T1) in the seven patients with a complete orthoptic assessment.

Orthoptic measure	Median (IQR) T0	Median (IQR) T1	Improved/stable/worsened (n)	Effect size r	*p* (exact Wilcoxon)
Corneal reflexes	1 (1–2)	0 (0–1)	6/1/0	0.88	0.031
Cover test	2 (1–3)	1 (0–1.5)	5/2/0	0.78	0.062
Ocular motility	2 (2–2)	1 (0.5–1)	6/1/0	0.88	0.031
Near point of convergence (grade)	2 (1–3)	1 (0–1.5)	6/1/0	0.86	0.031
Near fusional amplitude	3 (2–3)	1 (1–1)	6/1/0	0.86	0.031
Composite orthoptic score (0–15)	10 (6–13)	4 (1.5–6)	7/0/0	0.90	0.016

IQR, interquartile range. n = 7.

3. Results

Twelve patients (7 women, 5 men; mean age 51 ± 12 years) were included; their characteristics are shown in Table 1. All 12 patients were assessed at T0 and T1. Two patients missed the 3-month follow-up (T2) and did not enter the physiotherapy-only phase; of the ten assessed at T2, two further patients did not enter the physiotherapy-only phase, leaving eight who were assessed at T3 and T4. A complete orthoptic assessment was available in seven patients. The reasons for missing assessments were patient availability to attend the outpatient clinic and personal or family reasons. The full participant flow is shown in **Supplementary Fig. 1**.

For the primary outcome, the combined-treatment phase showed a significant within-phase improvement in the BBS of nearly 12 points (T0–T1, r = 0.89, $p = 0.002$), maintained at the 3-month follow-up (T0–T2, r = 0.85, $p = 0.008$); a significant within-phase BBS improvement was also observed during the physiotherapy-only phase (T3–T4, r = 0.95, $p = 0.008$) (Table 2). Mobility and endurance (MSWS-12, 6MWT, TUG) improved significantly within the combined phase, with generally large effect sizes (r ≈ 0.50–0.90). For fatigue (FSIQ-RMS), the Impact domain improved significantly in the combined phase (Z = –2.625, $p = 0.009$), whereas the Symptom domain did not reach significance (Z = –1.827, $p = 0.068$); both FSIQ-RMS domains improved in the physiotherapy-only phase. Several gains were not maintained at follow-up (Tables 2,3). Within-phase improvements in some MSQoL-54 domains were also observed (**Supplementary Table 3**).

All five orthoptic measures improved after the combined-treatment phase in the seven patients with a complete orthoptic assessment, with no individual worsening; the composite orthoptic score decreased from a median of 10 to 4 (r = 0.90, exact $p = 0.016$) (Table 4, Fig. 1). The improvement in orthoptic status was not significantly associated with the improvement in balance (Spearman ρ = 0.34, $p = 0.46$). Descriptively, within-phase changes tended to be numerically larger in the combined-treatment phase than in the physiotherapy-only phase; no statistical comparison between phases was performed.

4. Discussion

In this small case series, a combined physiotherapy-and-orthoptic rehabilitation program was associated with a clinically meaningful within-phase improvement in balance, maintained at three months. The magnitude of the BBS change is consistent with balance-oriented, task-specific rehabilitation in PwMS reported in a dose–response meta-analysis [3], and the integration of orthoptic training adds a component rarely addressed in motor rehabilitation. To our knowledge, this is among the first reports to integrate structured orthoptic rehabilitation into balance-oriented physiotherapy in people with MS and convergence insufficiency, and the consistent within-phase improvement across all five orthoptic measures, with no worsening, supports its feasibility and provides a rationale for future controlled evaluation. A randomized trial of gaze- and postural-stability training in MS reported within-group improvements but no advantage over an active strengthening comparator [4], underscoring that the specific benefit of visually targeted training remains uncertain; our uncontrolled findings should be interpreted in this light. Similarly, a randomized controlled trial in PwMS found comparable improvements in walking endurance after intensive interdisciplinary rehabilitation and after regular community physiotherapy [14], indicating that within-group gains may occur across different rehabilitation approaches. Recent systematic-review evidence likewise indicates that vestibular and gaze-oriented rehabilitation can improve balance and dizziness in MS, although the specific contribution of binocular-vision training remains undefined [15]. Moreover, the improvement in binocular vision was not significantly correlated with the improvement in balance, so a mediating role of orthoptic gains on postural control remains unproven and may reflect the very small sample.

This study has important limitations that constrain interpretation. It is small, uncontrolled and not randomised, and all patients received the combined intervention before the physiotherapy-only phase; sequence, learning and carry-over effects, natural fluctuation of MS symptoms, and attrition therefore cannot be excluded, and the design cannot isolate the specific contribution of orthoptic rehabilitation. The two phases are not methodologically comparable: they involved the same patients assessed at different times, had different baselines, and the higher Berg Balance Scale baseline before the physiotherapy-only phase leaves less room for improvement (a ceiling effect); accordingly, no between-phase or comparative-effectiveness inference is drawn, and any apparent difference in the magnitude of change between phases should be interpreted with caution and may partly reflect attrition. A large number of exploratory tests were performed without multiplicity correction, so the secondary findings are hypothesis-generating only. The mean BBS (+11.5 and +5.9 points) and 6MWT (+130.8 m and +86.3 m) changes in the combined-treatment and physiotherapy-only phases exceeded the MCIDs reported for people with MS (3 points [16] and 19.7 m [17]); however, as this is a descriptive group-level comparison, they should be interpreted cautiously given the small sample, possible practice effects, and the standardisation of the assessment procedures. Overall, the results should be read as preliminary evidence of feasibility and within-phase change rather than of comparative effectiveness; adequately powered randomised controlled trials with balanced allocation and longer follow-up are needed to confirm the benefit and to isolate the orthoptic component.

5. Conclusions

In this case series of 12 PwMS, combined physiotherapy-and-orthoptic rehabilitation was feasible, well tolerated, and associated with consistent within-phase improvements in balance and in all orthoptic measures, as well as in mobility, the fatigue impact domain and several quality-of-life domains. Its main contribution is the integration of structured orthoptic rehabilitation into balance-oriented physiotherapy for people with MS and convergence insufficiency—an approach rarely addressed to date—which this study shows to be feasible and worth investigating further. These findings are preliminary and hypothesis-generating: the uncontrolled design cannot isolate the specific contribution of the orthoptic component, the orthoptic composite is an ad hoc, unvalidated measure, and the association between visual and balance improvement was not significant, so any mediating role of visual function on postural control remains to be demonstrated. Adequately powered, controlled studies are warranted to test whether adding orthoptic rehabilitation confers additional benefit.

Clinical Messages

- A combined physiotherapy and orthoptic rehabilitation approach may improve clinical outcomes for people with multiple sclerosis (MS).
- Combining interventions that target balance, mobility, fatigue, and visual function offers a comprehensive strategy for symptom management.
- In this small, exploratory study the approach was associated with improvements in balance, mobility and quality of life; larger controlled trials are needed to confirm effects on fall risk and independence.

Availability of Data and Materials

The data are available from the corresponding author upon reasonable request.

Author Contributions

Conceptualization, GG and IR; methodology, IR and AC; software, GS; validation, AB and FP; formal analysis, GS and IR; investigation, AMi, AMP and AB; resources, FP; data curation, AMi and AMP; writing—original draft

preparation, AMi and IR; writing—review and editing, AMP, GS, AB, FP, IR, AC and GG; visualization, GS and AMi; supervision, AC and GG; project administration, GG. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

Ethics committee approval was not required for this study, as it consisted of a secondary analysis of fully anonymised clinical data collected under a protocol approved by the Ethics Committee of Sapienza University of Rome, Policlinico Umberto I University Hospital, Rome, Italy (Rif. 6041, Prot. 0786/2020). All procedures complied with the Declaration of Helsinki. Written informed consent for research use of clinical data had been obtained from all patients within that protocol.

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Conflicts of Interest

The authors declare no conflicts of interest.

Declaration of AI and AI-Assisted Technologies in the Writing Process

The authors used an artificial-intelligence language tool to assist with language editing and formatting of the manuscript. All content was reviewed, edited and approved by the authors, who take full responsibility for it; AI tools were not used to generate, analyse or interpret the study data.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.31083/RN56785.

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