

Incorporation of Augmented Visual Feedback in Action Observation Therapy and Motor Imagery for Parkinson's Disease: A Randomized Clinical Study

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Introduction

AOMI combines **Action Observation (AO)** and **Motor Imagery (MI)** to enhance motor learning in rehabilitation. AO involves watching a structured action, while MI engages the internal generation of visual and kinesthetic elements of movement.

The **TecnoBody® D-Wall** is an advanced rehabilitation tool integrating real-time motion analysis with **augmented visual feedback**. It features an **RGB camera**, a **force platform**, and a **digital mirror** that provides real-time feedback on joint angles, weight shifts, and center of pressure.

Our study hypothesizes that integrating **augmented visual feedback** into the physical execution phase of AOMI could **enhance rehabilitation outcomes** compared to standard physiotherapy alone. By facilitating proprioceptive awareness and sensory integration, this approach may help PD patients **bridge the gap** between imagined and actual movements, potentially improving motor performance and functional recovery.

Methods

Patients of both sexes, with a diagnosis of idiopathic PD for at least 5 years, aged 40–80 years, MMSE >24 and at Hoehn & Yahr stage ≤3 will be **included**. Patients in advanced therapies, unable to walk independently, and with other conditions that could interfere with task execution, (es. neurological disorders) will be **excluded**.

The **intervention group** will follow routine rehabilitation in the morning and undergo one hour of AOMI training with augmented visual feedback in the afternoon, three times per week. The **control group** will follow the same routine rehabilitation but will perform motor training of equal duration without AOMI, yet with augmented visual feedback.

Both groups will engage in the same afternoon exercises: **(1)** weight shifting; **(2)** weight shifting with forward, backward, and lateral steps; **(3)** sit-to-stand-to-sit; **(4)** chair circling; **(5)** obstacle crossing after weight shifting; **(6)** step-up/down; **(7)** narrow-path walking; **(8)** 180° turns; (9) upper-limb reaching movements.



Purpose

To compare the effectiveness of AOMI administration, in addition to routine physiotherapy rehabilitation and augmented visual feedback, with routine physiotherapy rehabilitation associated only with augmented visual feedback in patients with PD

Dynamic
postural control

Functional
mobility

Eligibility	Outcome
Disease duration	Mini-BESTest
Hoehn and Yahr scale	Gait analysis
MDS-UPDRS (Part III)	Muscle Activation
MMSE	Body Center of Mass
Medication therapy	MoCA
	PDQ-8

Sample size

The sample size was determined through a priori analysis using an F-test for the interaction between two groups (between-subjects) and three time points (within-subjects: T0, T1, follow-up). With **80% power**, a **5% alpha**, and a **medium effect size** ($f = 0.25$), the minimum required sample is **86 participants**.

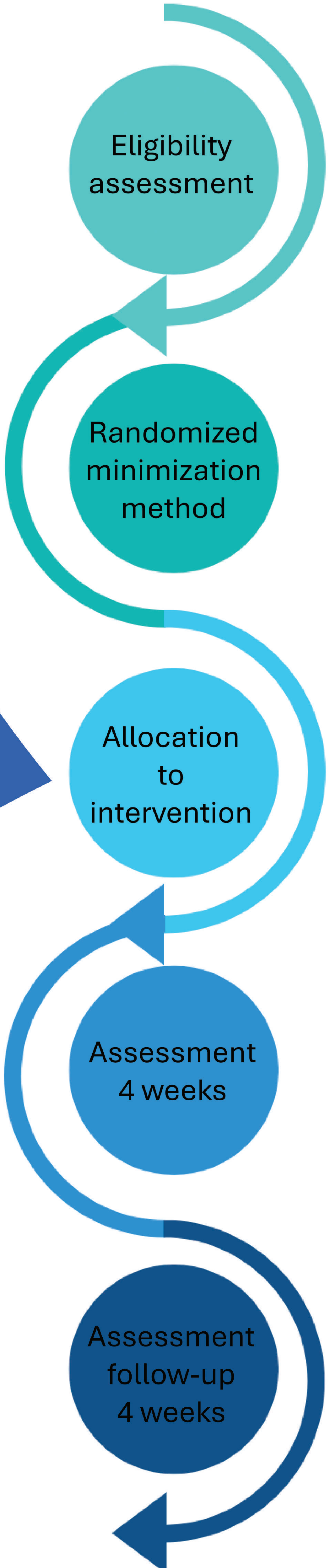
Statistical analysis

A two-way mixed ANOVA will be conducted to analyze the effects of group (intervention vs. control) and time (T0, T1, follow-up) on the **Mini-BESTest score**, the main outcome variable. Normality, variance equality, residual distribution, and sphericity will be checked. Means and standard deviations will be reported. **Baseline clinical variables** will be compared using the Mann-Whitney test for categorical data and independent t-tests for continuous data. If significant effects are found, Bonferroni-corrected post-hoc contrasts will be performed. A significance level of $p < 0.05$ will be used, and effect sizes (np^2) will be classified as small (0.01), medium (0.06), or large (0.14).

Expected results

Greater improvements are anticipated in the intervention group, demonstrating enhanced motor learning through augmented visual feedback and contributing to advancements in AOMI research for PD.

Additionally, using a control group without AOMI therapy allows for a **more precise assessment of its effects**. This is particularly relevant given the need for larger, high-quality studies to clarify both immediate and long-term outcomes. A recent systematic review with meta-analysis underscores this gap¹, highlighting that these therapies are currently supported by very low-certainty evidence.



¹Lahuerta-Martín, S., Llamas-Ramos, R. & Llamas-Ramos, I. Effectiveness of Therapies Based on Mirror Neuron System to Treat Gait in Patients with Parkinson's Disease—A Systematic Review. J. Clin. Med. 11, 1–14 (2022).