

Instantaneous Effects of an Exergame-Based Training Intervention Using the ICAROS Guardian on Gait in Patients With Parkinson Disease



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Background

A common manifestation of Parkinson Disease (PD) is gait impairment resulting in increased risk of falling (Mirelman et al., 2019). Exergaming represents an interactive and innovative therapy approach by combining physical activity with cognitive exercises. The ICAROS Guardian offers a playful but safe training tool and requires balance, trunk control and whole-body movement (Brixius et al., 2026). However, instantaneous effects of a single ICAROS Guardian balance-training remain unclear.

Research question

What are the immediate effects of an exergame-based training intervention using the ICAROS Guardian on gait speed, spatiotemporal and kinematic gait parameters in PD patients?

Methods



Figure 1: Study design

- n=12 (3 ♀, 9 ♂), gait measured via wearable shoe sensors
- 12 spatiotemporal, kinematic and impact-related gait parameters
- Training: 7 balance-focused exergames
- Statistical analysis: descriptive statistics and repeated measurement ANOVA in JASP



Figure 2: Wearable sensors

Figure 3 (left): Exemplary exergame scenarios on the ICAROS Guardian. Source: ICAROS Guardian software

Figure 4 (right): The ICAROS Guardian. Source: icaros.com

Results

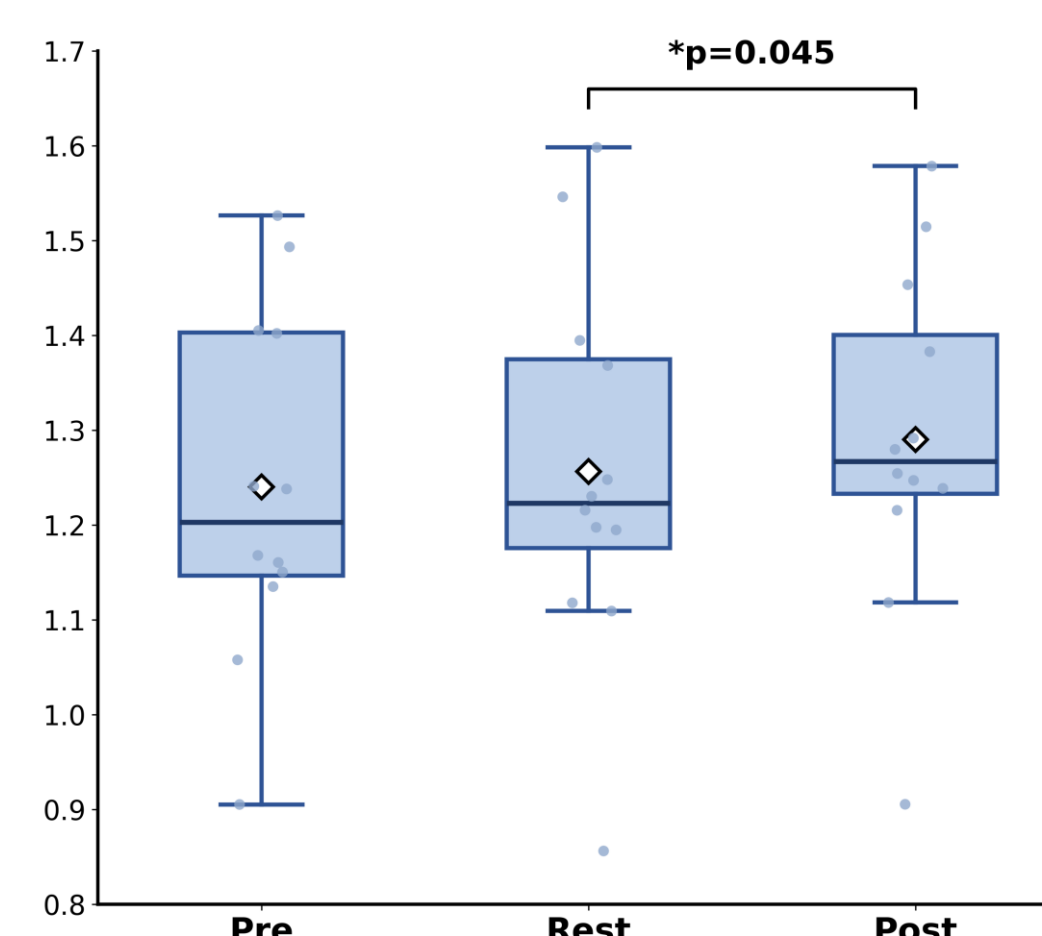


Figure 5: Primary outcome: Instantaneous effects of ICAROS training on Gait Speed (Holm corrected post-hoc *p<0,05)

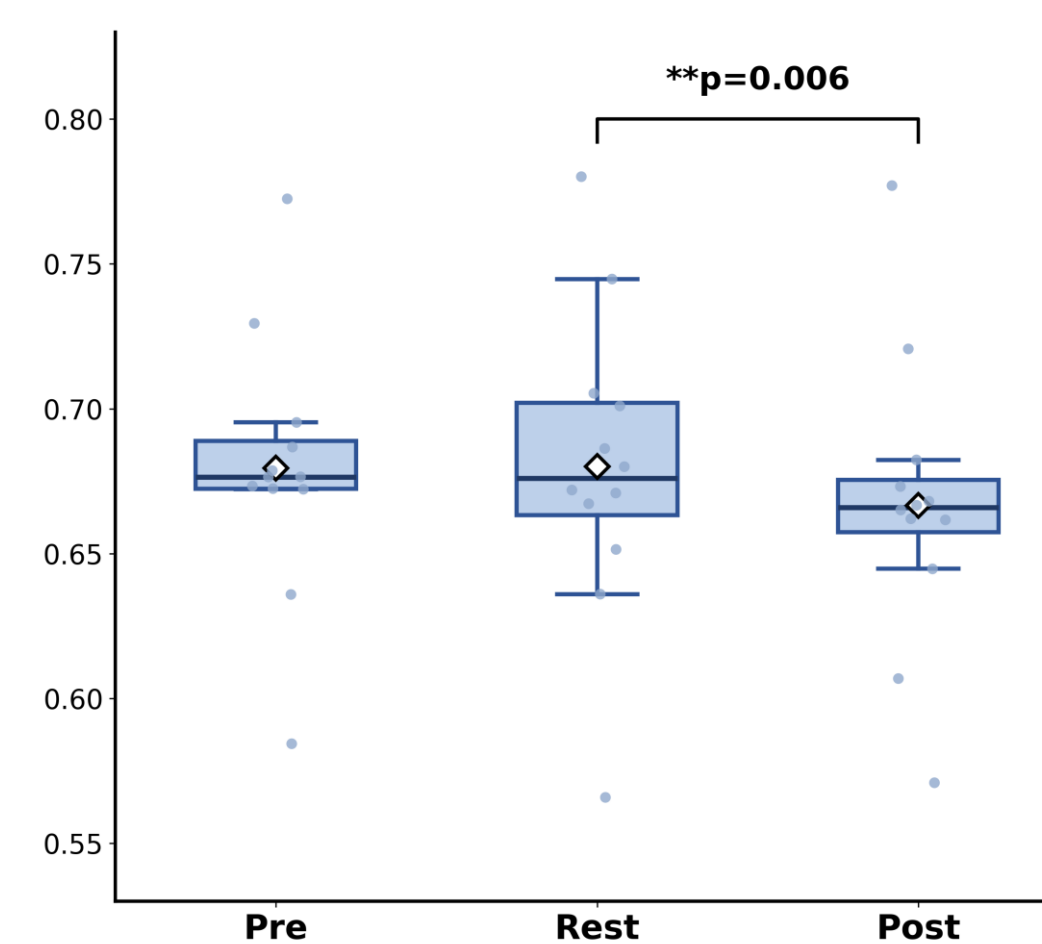


Figure 6: Instantaneous effects of ICAROS training on Stance Time (Holm corrected post-hoc **p<0,01)

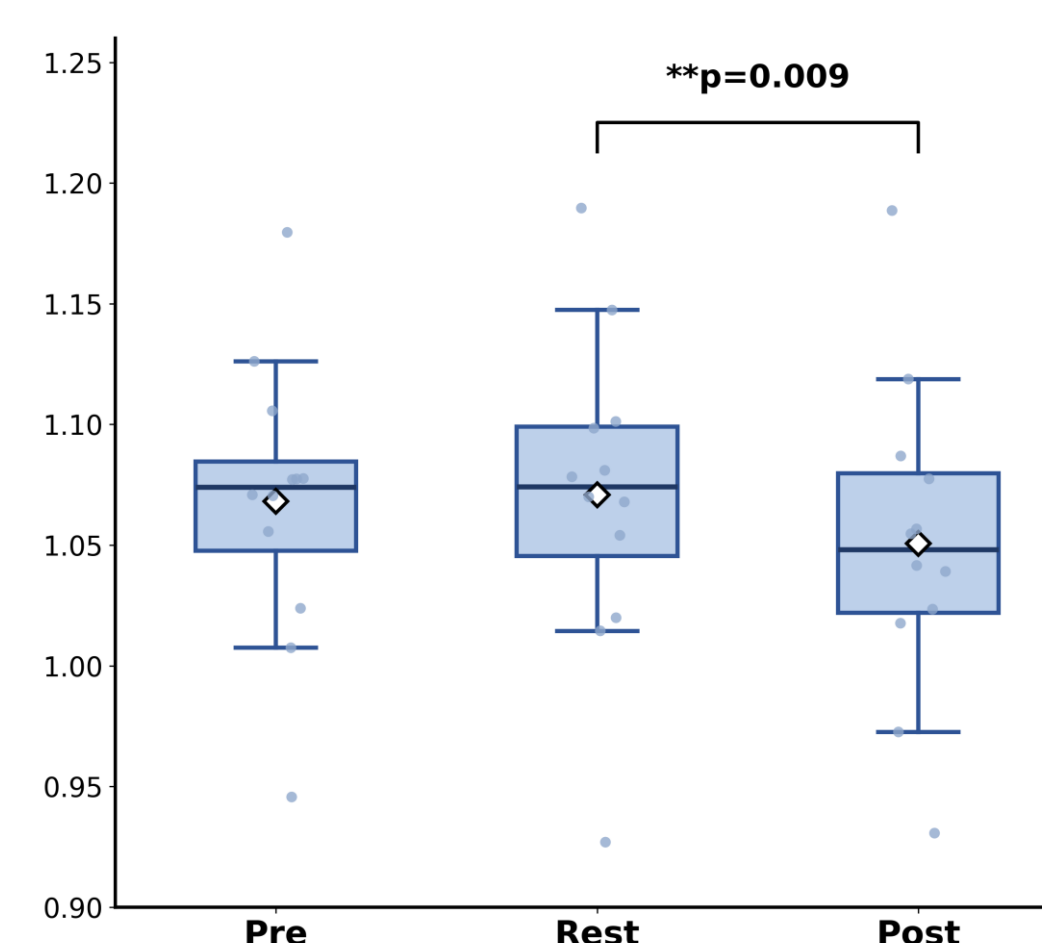


Figure 7: Instantaneous effects of ICAROS training on Stride Time (Holm corrected post-hoc **p<0,01)

- Instantaneous Training effects: Gait Speed ↑ ($F(2,22)=3.48$, $p=0,049$, $\eta^2=0,24$, $p(\text{post-hoc})=0,045$) accompanied by Stance Time ↓ $p(\text{post-hoc})=0,006$ and Stride Time ↓ $p(\text{post-hoc})=0,009$
- Control phase (Pre → Rest) stable: no learning effects
- Remaining 10 parameters: no significant main effects

Discussion

- Intervention → significant, small changes in temporal gait parameters
- Stable control measurements suggest improvements driven by intervention, not learning
- Small sample size, no control group, unclear clinical relevance → results preliminary/exploratory
- larger controlled and longterm studies needed to confirm effects