

HEAD-MOUNTED VIRTUAL REALITY: A NOVEL CASE COMPARISON IN MILD TRAUMATIC BRAIN INJURY RECOVERY

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Introduction

Mild Traumatic Brain Injury (mTBI)

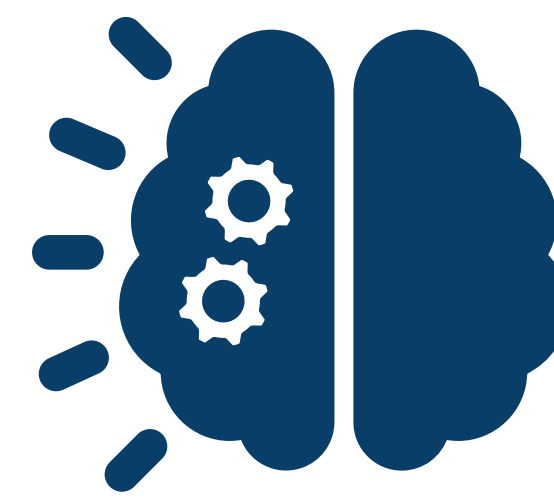
- Results in persistent symptoms including visual motion intolerance, photophobia, phonophobia, impaired balance, and vestibular dysfunction.¹

Virtual Reality (VR)

- Enables graded exposure to complex sensory environments and functional tasks.²

Current Literature

- Supports VR as a complementary tool in conjunction with vestibular rehabilitation.³
- Is lacking for assessing the effectiveness of VR head-mounted display (HMD) for vestibular rehabilitation



Purpose

This case comparison investigates 1) tolerance of HMD VR as an intervention and 2) effectiveness of VR on visual motion tolerance, activity avoidance, dizziness-related disability, balance confidence, and dynamic balance.

Case Description

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- Setting:** outpatient vestibular physical therapy
- Patients:** 4 with mTBI
- Intervention:** 2 received VRT + VR via Virtualis
 2 received VRT only (vestibular rehabilitation therapy)
- VRT + VR patients were case matched:
 - Relative age
 - Visual motion sensitivity
 - Mechanism of injury



Intervention: VRT+ VR Group

- Patient 1:** 63 y/o F, hit head on metal detector at work, medical history unremarkable
- Patient 2:** 32 y/o F, 2 back-to-back motor vehicle accidents (MVA), whiplash, post-traumatic stress disorder (PTSD)

Case Control: VRT Only Group

- Patient 3:** 58 y/o F, ground-level fall at work
- Patient 4:** 26 y/o F, hit by a door that swung open, previous motor vehicle accident with whiplash and no loss of consciousness, history of previous concussion

Protocol

Data Collection

- 5+ visits for the VRT + VR group and the VRT-only group
- 30-40 minutes of VRT
- 20-30 minutes of VR intervention

Table 1. Virtual Reality / Virtualis System Tolerance

Intensity	Reported Dizziness	Clinical Description	Clinician Response
Light	0-1	Minimally dizzy; full comfort	Continue VR exposure, progress task complexity, duration, speed
Moderate	2-3	Mildly dizzy; some discomfort	Maintain intensity, monitor symptoms, progress gradually
High	4+	Moderately dizzy; full discomfort	Pause VR exposure, visual fixation and grounding

Functional Outcome Measures

- Visual motion sensitivity: Visual Vertigo Analog Scale (VVAS)
- Behavioral Avoidance: Vestibular Activities Avoidance Instrument (VAAI)
- Perceived Disability (PD): Dizziness Handicap Inventory (DHI)
- Activities Specific Balance Confidence (ABC) Scale
- Dynamic Balance: Functional Gait Assessment (FGA)

Tolerance + Functional Outcomes

Figure 1. Subject reports of VR intensity (scale of 1 to 10).

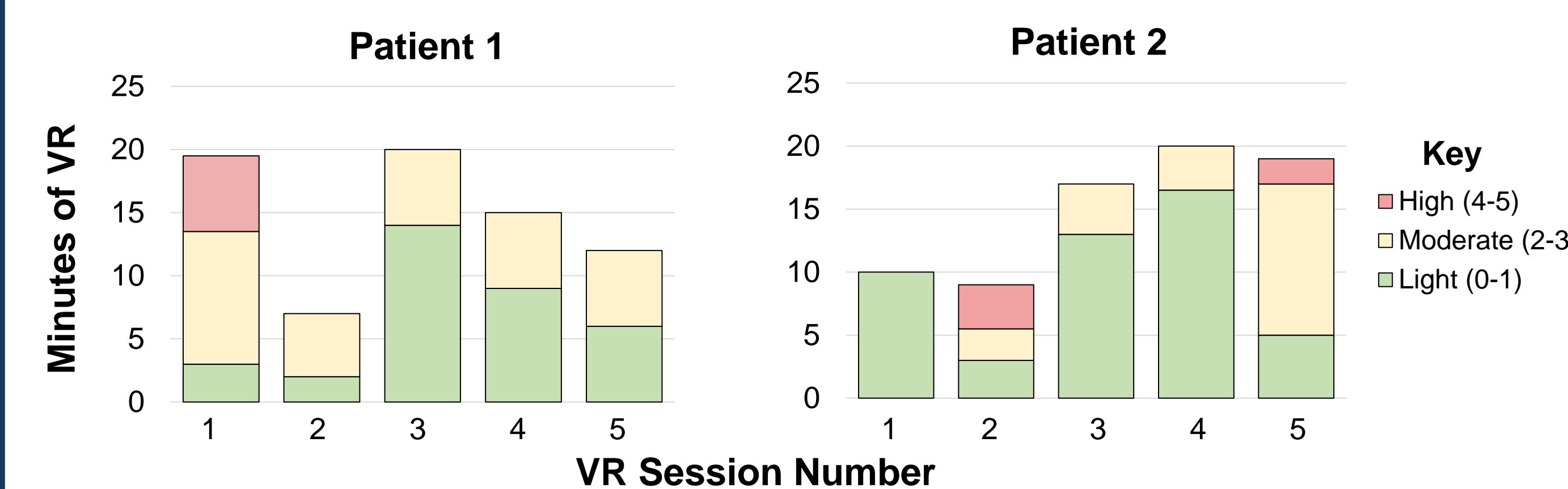


Figure 2. Difference of functional outcome scores by subject at initial evaluation and 30-day re-evaluation.

Key	VVAS	VAAI (≥26 ↑ PD) ⁴	DHI (MCID 18) ⁵	ABC (MCID 18%) ⁶	FGA (MCID 4 pts) ⁷
Met MCID					
Worse					
Patient 1	-4.5	-11	-22	+62%	+6
Patient 2	+1.1	+4	0	-7%	0
Patient 3	-3.5	-7	-28	+30%	+8
Patient 4	-3.6	-22	-46	+10%	+3

Results Summary

- Patient 1:** decreased symptom intensity over time
- Patient 2:** tolerance to longer VR sessions with higher reported intensity
- VRT group consistent improvement**
 - visual motion sensitivity
 - dynamic balance
 - perceived disability
 - balance confidence
 - activity avoidance



- VRT+ VR group variable improvement**

	VR Tolerance	Visual Motion Sensitivity (VVAS)	Activity Avoidance (VAAI)
Patient 1	↑	↓	↓
Patient 2	↑	↑	↑
Patient 3 & 4	N/A	↓	↓

Clinical Relevance

This case comparison emphasizes the variability in adaptation to VR-based interventions and reinforces the recommendation to use VR as a complementary tool for vestibular rehabilitation in patients with mTBI.

Discussion

Main Takeaways

- Clinicians should consider HMD VR for select patients in conjunction with VRT
- Psychosocial factors are strongly associated with slower recovery⁸
 - Patient 2 progress impacted by PTSD



Future Directions

- Validation studies needed for VVAS and VAAI to confirm an MCID/MDC for mTBI patients
- Longitudinal data collection to better characterize changes in visual motion tolerance over time



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References

