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Comparison of Movement Trajectories Between Virtual Reality and Conventional Occupational Therapy Tools

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Introduction

- Rapid transition of South Korea into a super-aged society & Increasing prevalence of neurological and cardiovascular diseases
  →rising demand for rehabilitation, particularly occupational therapy (OT)
- Emergence of VR-based OT tools
  →immersive and interactive training environments
- Limited empirical evidence on accurate replication of realworld therapeutic movements
- **Study aim:** Evaluation of clinical applicability of VR-based OT tools compared with conventional OT tools

Methods

- **Participants**

Total n = 39
Patients with upper limb motor impairments (n = 20)
Healthy controls (n = 19)

- **Tasks**

ROM arc, cone, peg

- **Outcome measures**

Movement trajectory lengths

- **Motion analysis**

3D motion capture system tracking key joint points
→ extraction of frame-by-frame 3D coordinates

- **Statistical analysis**
  - R (version 4.4.2)
  - Independent t-test: patient vs. control groups
  - Paired t-test: VR vs. real OT tools within subjects
  - Significance level: $p < 0.05$

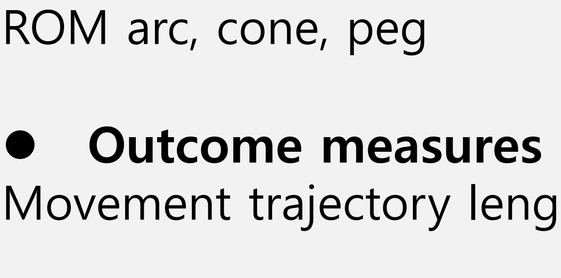

Figure 1. Participant undergoing VR-based OT

Figure 2. Example screen of a VR-based OT program

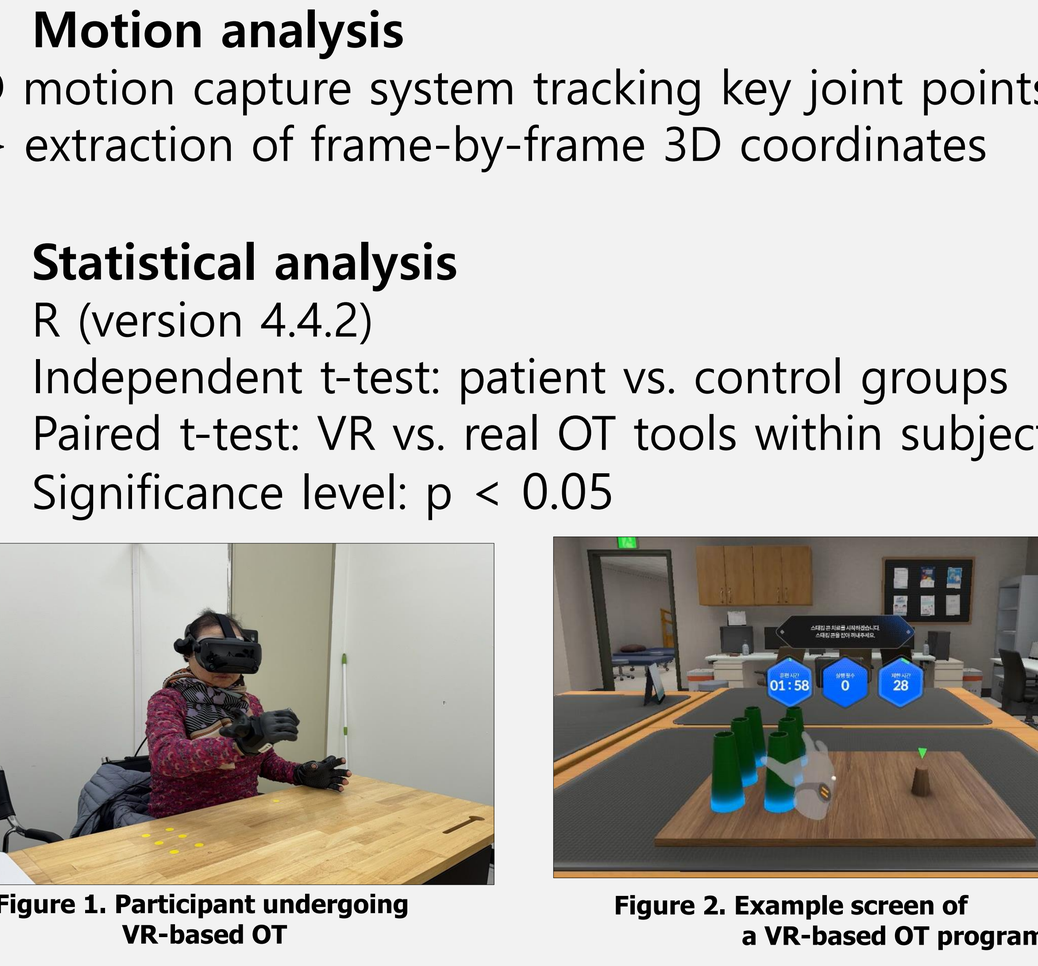

Figure 3. Real tools and VR (in order: ROM arc, cone, peg)

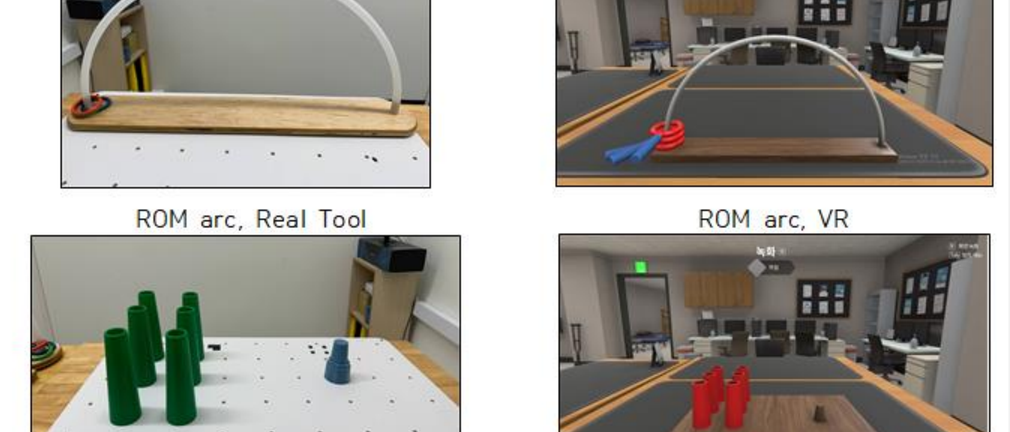

Figure 4. Example of a video-based 3D motion analysis system during therapy with real and VR tools

Results

- **Non-patient group**
  - ROM arc task

comparable trajectory lengths between VR & real tools
→effective reproduction of linear/repetitive movements

  - Cone & peg tasks

significantly longer trajectories in VR
→ increased movement variability in complex tasks

- **Patient group**
  - ROM arc task

comparable performance between VR and real tools

  - Peg task

significantly longer trajectories in VR

Table 1. General Characteristics of the Participants

Group	Sex	N	Age
Non-patient (n=19)	Male	7	60.4
	Female	12	
Patient (n=20)	Male	12	67.6
	Female	8	

Table 2. Comparison of Movement Trajectories Between VR and Real Tools in Non-Patient Group

		Mean (mm)	SD (mm)	P-value
ROM arc	VR	24445.35	±4553.19	p > .05
	Real Tools	23400.41	±4442.89	
Cone	VR	46717.02	±8789.61	p < .001
	Real Tools	38306.01	±7204.5	
Peg	VR	24058.15	±5310.24	p < .001
	Real Tools	16175.47	±4144.82	

Table 3. Comparison of Movement Trajectories Between VR and Real Tools in Patient Group

		Mean (mm)	SD (mm)	P-value
ROM arc	VR	28053.28	±9982.95	p > .05
	Real Tools	26423.28	±9625.04	
Cone	VR	47541.21	±15911.13	p > .05
	Real Tools	41939.7	±7104.13	
Peg	VR	29313.79	±8685.55	p < .001
	Real Tools	23670.86	±6416.53	

Conclusion

- Clinical viability of VR-based OT tools for linear and repetitive rehabilitation tasks
- Limitations in tasks requiring fine motor control and precise manipulation
- Need for:
  - Enhanced visual guidance
  - Improved feedback systems
  - Further technical refinement
- Support for integration of VR into clinical OT practice
- Emphasis on improving precision, usability, and patient-specific adaptability