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Usability of a user-centered virtual reality system for upper limb motor rehabilitation in chronic stroke patients



AG. Grosmaire, L. David, T. Koeppl, G. Bouyer, S. Otmane, O. Pila, C. Duret

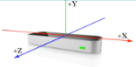
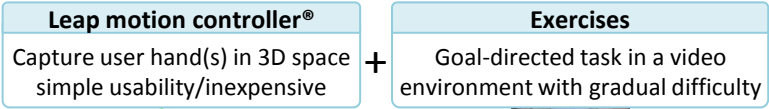
CONTEXT

Stroke → 2/3 patients with persistent upper limb motor **impairment**
Nonlinear pattern of motor recovery → >M6-M12: **decline**, especially post-discharge
Effect of community-based therapy at post-discharge → **Ineffective** on motor impairment
Value of new technologies in self-rehabilitation → Enhance **motivation**; Interactive with **feedback**; easily **transportable**; **suitable** at home; **intensive training** based on motor learning principles
Objective: To assess the **usability of a Virtual Reality (VR)-based program** using a Leap Motion Controller® designed to train pronation-supination movements in chronic patients following stroke

METHODS

Demographics: N=28 (10 F/18 I), Age: 53 ± 15y (Mean ± SD)
 Time since stroke: 71 ± 51mo, FMA score: 49 ± 8pts

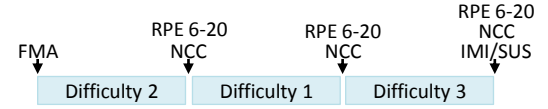
VR-based program:



Intervention: 1-day session, forearm pronation/supination tasks with 3 randomized difficulty levels (1,2, 3)

Evaluations:

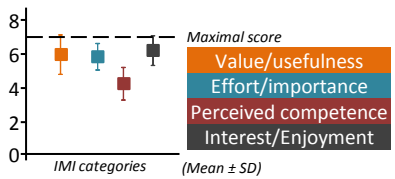
- Fugl-meyer assessment (FMA)
- Rating of perceived exertion (RPE 6-20)
- Number of coins collected (NCC)
- System usability scale (SUS)
- Intrinsic motivation inventory (IMI): Value/usefulness, interest and enjoyment, perceived competence and effort/importance



RESULTS

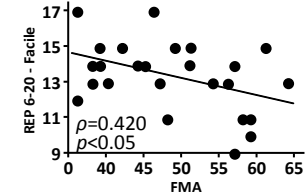
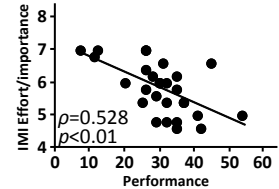
System usability scale (/100): 79 ± 15 → **Excellent usability** using the VR-based program

Intrinsic motivation inventory



→ **Good subjective experience** related to the VR-based program

Correlations



→ The more the patients **succeeded** the task, the **lower** was the perceived effort. The more the patients are **disabled** the more the perceived exertion was **greater**

CONCLUSION

- **Excellent usability** of the VR-based program / **user-centered** approach
- Intensive training (effort) related to the **difficulty**
- **Motivation ++** → long-term rehabilitation program and long-term participation
- **Close collaboration** between engineers and clinicians ++ in interface conception

Perspectives → Development of various therapeutic games/ to launch a RCT study