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

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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:

- Leap motion controller®
  Capture user hand(s) in 3D space
  Simple usability/inexpensive

- Exercises
  Goal-directed task in a video environment with gradual difficulty

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

EXPERIMENTAL DESIGN

RESULTS

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

Intrinsic motivation inventory

- Maximal score
- Perceived competence
- Value/usefulness
- Interest/Enjoyment

Correlations

- FMA
- RPE 6-20 NCC
- RPE 6-20 NCC
- RPE 6-20 NCC

- FMA
- RPE 6-20 NCC
- RPE 6-20 NCC
- RPE 6-20 NCC

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