Virtual Reality based Upper Limb Neurorehabilitation in Acute Stroke: A Single-Case Study

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BACKGROUND

- Recent evidence suggests that functional gains are highest during early post-stroke recovery, due to unique neuroplasticity conditions that exist in a limited time-window [1, 2].
- Virtual Reality (VR) based motor rehabilitation allows for intensification of the therapy dose and results in improved arm function [3].
- Similar to mirror therapy, VR mirror training activates the neural mechanisms underlying motor recovery even when the patients have very low motor function of the paretic arm [4, 5].

Virtual Reality platform for early motor rehabilitation

MindMotionPRO (MindMaze SA, Switzerland)

- The platform contains interactive task-oriented exercises that engage a patient's shoulder, elbow and wrist movements with various levels of difficulty.
- Exercises are administered in a game-like scenario to enhance patient motivation to increase upper limb motor training.

HYPOTHESIS

- The administration of VR based upper limb neurorehabilitation during the first few weeks of stroke recovery in an acute stroke is feasible and well accepted.

PATIENT DETAILS

- A 60-year-old right-handed (Edinburgh Test > 95) male
- Left paramedian pontine ischemic stroke resulting in hemiparesis on the right side
- National Institute of Health Stroke Score, NIHSS = 6 on 8th day post stroke

INTERVENTION
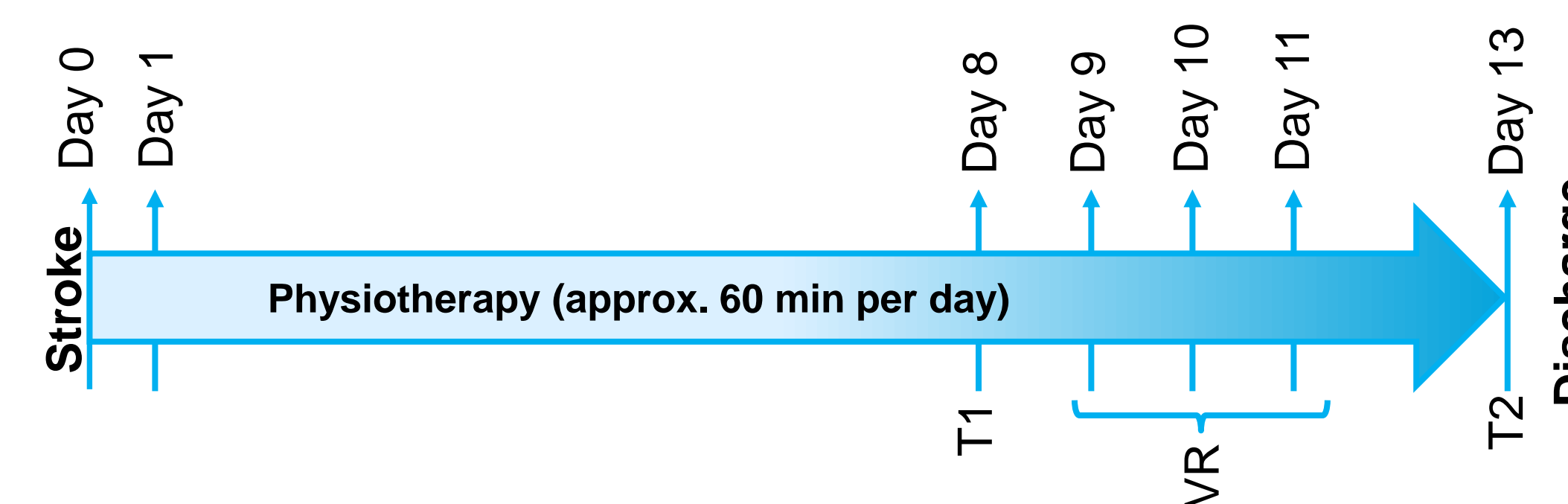
- VR-based exercises incorporating active shoulder and arm motion was delivered over 3 consecutive days (Day 9, 10 & 11).
- Assessments are made at Day 8 (T1) and Day 13 (T2).
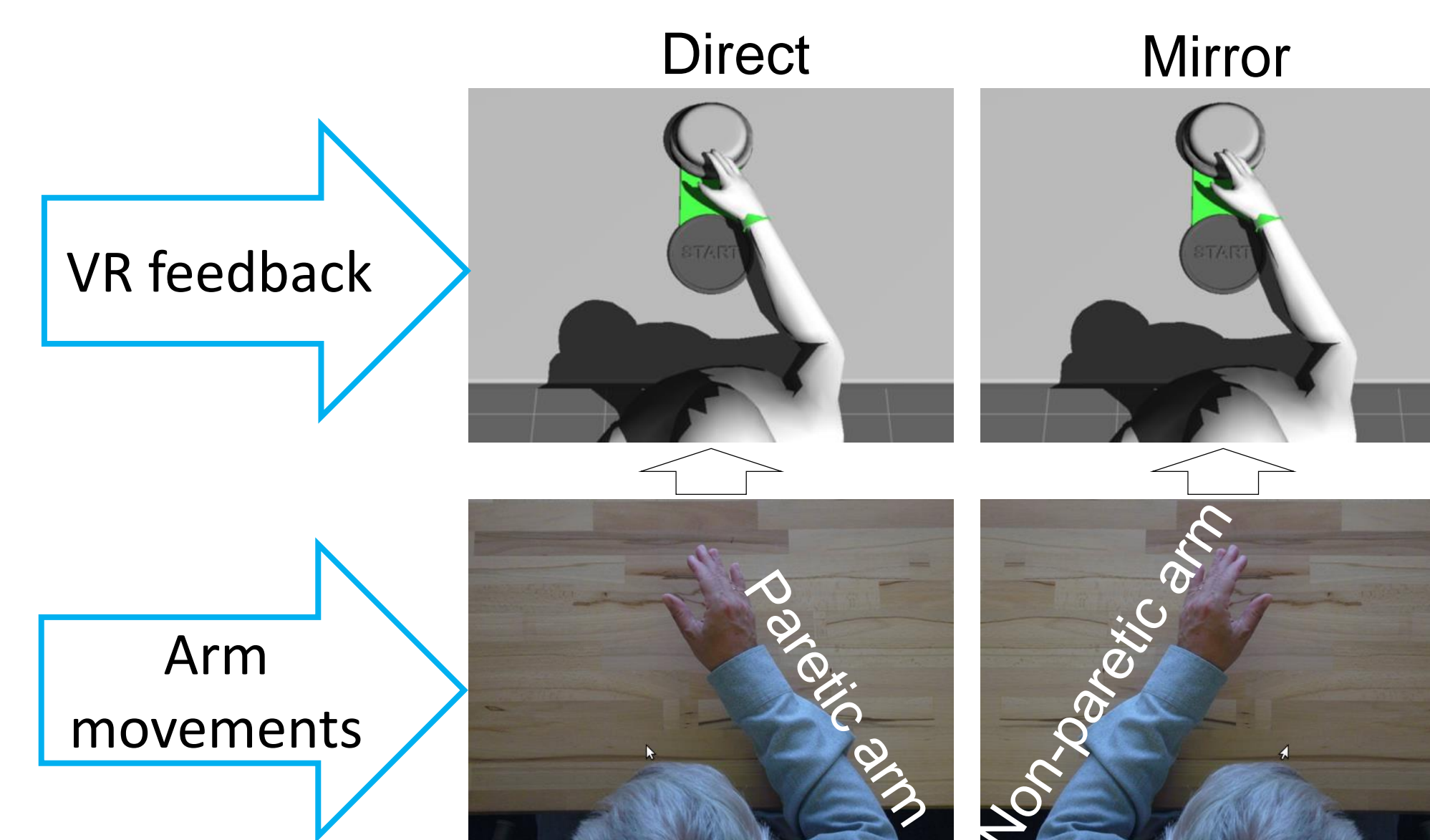
- Virtual mirror training, similar to mirror therapy, was applied when the patient reported fatigue of the paretic arm.

RESULTS

Patient practice (Number of movement repetitions)

	Direct	Mirror	Total
Day 9 (VR: 33 minutes)	10	40	50
Day 10 (VR: 67 minutes)	85	95	180
Day 11 (VR: 54 minutes)	90	80	170
Total	185	215	400

Clinical Outcomes

Test		T2 (T1)
NIHSS (Max: 42)		**3 (6)** ☺
Frenchay Arm Test (Max: 5)		**3 (3)**
Fugl-Meyer Upper Extremity (FM-UE) Score		
A	Upper Extremity Synergies of Shoulder, elbow and forearm (Max: 36)	24 (18) ☺
B	Wrist (Max: 10)	0 (2)
C	Hand (Max: 14)	3 (2) ☺
D	Coordination/Speed (Max: 6)	5 (4) ☺
Motor Function (Total A-D; Max: 66)		**32 (26)** ☺
Sensation (Max: 12)		8 (8)
Passive joint motion (Max: 24)		21 (22)
Joint pain (Max: 24)		24 (21) ☺

DISCUSSION

- The administration of VR-based upper limb motor rehabilitation in the acute stroke is feasible with training sessions of an hour per day.
- The patient showed an improvement of 6 points in the FM-UE score mainly in shoulder, elbow and forearm synergies.

REFERENCES:

1. Murphy TH, Corbett D. Plasticity during stroke recovery: From synapse to behaviour. Nat Rev Neurosci. 2009;10:861-872
2. Zeiler SR, and Krakauer JW. The interaction between training and plasticity in the poststroke brain. Current opinion in neurology 26: 609-616, 2013.
3. K. Laver, S. George, S. Thomas, J. E. Deutsch, and M. Crotty. Virtual reality for stroke rehabilitation. Cochrane Database of Systematic Reviews 2015.
4. V. S. Ramachandran and E. L. Altschuler. The use of visual feedback, in particular mirror visual feedback, in restoring brain function. Brain, 132(7), 2009.
5. L. Avanzino, A. Raffo, E. Pelosin, C. Ogliastro, R. Marchese, P. Ruggeri and G. Abbruzzese. Training based on mirror visual feedback influences transcallosal communication. Eu. J. of Neurosci., May, 2014.

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