Abstract Title: Evidence of Neuroplasticity with robotic therapy: Pilot Study for post-stroke Neurorehabilitation

Neha Singh [1], Megha Saini [1,] Nand Kumar [2], M.V. Padma Srivastava [3], Amit Mehndiratta [1,4]

[1] *Centre for Biomedical Engineering, Indian Institute of Technology, New Delhi, India;*
[2] *Department of Psychiatry, All India Institute of Medical Sciences, New Delhi, India;*
[3] *Department of Neurology, All India Institute of Medical Sciences, New Delh, India i;*
[4] *Department of Biomedical Engineering, All India Institute of Medical Sciences, New Delhi, India;*

Abstract (not more than 300 words)

Background:
Stroke is a chronic and disabling disease that affects daily living (ADL) activities and hence, quality of life. ADL is difficult to perform due to impaired voluntary muscle control. Most of the upper limb rehabilitation devices that are commercially available focus on proximal joints instead of distal-joints. These often concentrate on individual joint movements, are costly with the necessity of huge dedicated set-ups in the hospitals and less accessible to patients compelling them for regular hospital-visits.

Methodology:
A 3D-printed hand-exoskeleton for upper-limb rehabilitation was conceived in-house at IIT, Delhi. It focuses on flexion and extension of the wrist and fingers in a synchronized manner to improve ADL. Control mechanism and embedded system allow device to be voluntary-initiated with adaptive visual-performance feedback as per the voluntary-effort by the patient. The system is lightweight and portable. Sixteen right-handed patients with stroke were enrolled (eight in each group)- robotic-therapy and dose-matched physiotherapy-control group.

Results:
Pre and post-therapy sessions clinical-scales and cortical-excitability measures were acquired. Twenty therapy-sessions of 45min each were given to patients in robotic-therapy group. Significant reduction in spasticity at wrist-joint was observed in robotic-therapy group (1.81±0.25 to 1.37±0.35) as compared to control-group (1.87±0.35 to 1.7±0.7), $p<0.05$. Significant improvement, as per upper-limb Fugl-Meyer Scale, in sensorimotor-control was observed in both groups-robotic-group (35.3±5.8 to 48.3±5.07) and control-group (33.6±7.6 to 41.3±7.7). Cortical-excitability measures in robotic-group-Resting Motor Threshold (87.3±3.02 to 72±7.4) and amplitude of Motor Evoked Potential (33.3±63.2 to 106.2±68.3) showed significant decrease ($p<0.05$) versus control-group RMT (84.3±8.6 to 80.3±10.6) and control-group MEP (21±40 to 21.3±30.6).

Conclusion:
The clinical-scales and cortical-excitability in patients has reported clinical-improvement post-therapy compared to control-group. Cortical-excitabilty showed an increasing tendency reflecting neuroplasticity, as a consequence of use-dependent plasticity and neuroplastic-reorganization. It can be interpreted that motor-function recovery could be a consequence of plastic reorganization and plasticity depending on use.

Keywords—*stroke, neurorehabilitation, robotic therapy, neuroplastiocity, cortical excitability*

Professional Biography (100-150 words)

Neha Singh has completed her PhD in Biomedical Engineering from Indian Institute of Technology, Delhi and currently working as a senior scientist in Indian Institute of Technology, Delhi. She has done masters and graduation in Biomedical Engineering. Her research interest lies in neurostimulation, neurorehabilitation and neuroengineering.



Email Id: nehasingh0407@gmail.com