Changes in Neurophysiology and Upper Extremity Activity After 15 hours of Hand Function Training in Chronic Stroke

Meltzer J.A., de Grosbois J., Marshall M., Dumais E., Alibhai-Najarali S., Wang G., Rogojin A., Heleno M., Pan S., Arya A., Shao J., Nelson A., Johnson V.B.K., Harris J.E.

Stroke is the leading cause of adult disability with ~ 60% of persons with stroke (PWS) experiencing long-term hand function impairments.

Hand and upper limb recovery in the chronic stage of stroke is attributable to changes in plasticity.
Cortical excitability is an important determinant of hand function post stroke.

The primary objective of this study was to explore the cortical and functional impact of a novel passive hand function therapy (HFT) device, the MyHand™ System, on finger and hand disability.

Main Findings

Significant functional improvements were observed in the mean scores for Action Research Arm Test (ARAT). These changes met the minimal clinically important difference (MCID) criteria.

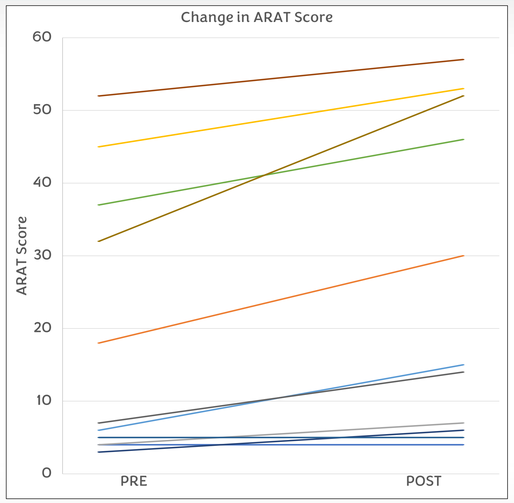

Figure 1: Changes in each participant's ARAT score pre and post - 3 week motor intervention with IRegained MyHand™ System.

Of 9 participants who underwent TMS testing before and after treatment, 3 exhibited a motor-evoked potential in the affected hemisphere. In all 3 cases, cortical excitability of the affected hemisphere increased after treatment (indicated by a reduction in resting motor threshold). In the unaffected hemisphere, the nine participants also exhibited significantly increased excitability (reduced threshold) after treatment, PRE: 57.11±13.1, POST: 52.22±14.8, p= 0.016, ES= -1.01.

The increase of excitability in the unaffected hemisphere was significantly correlated with the improvement in function measured by the ARAT (Figure 2).

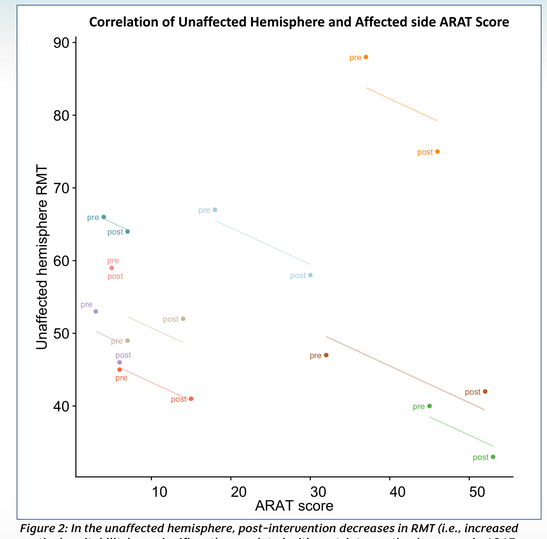

Figure 2: In the unaffected hemisphere, post-intervention decreases in RMT (i.e., increased cortical excitability) are significantly correlated with post-intervention increases in ARAT scores (i.e., improved upper limb performance) (rrm(8) = -0.73, 95% CI [-0.931, -0.184], p = 0.017). Observations from the same participant are given the same color, with corresponding lines to show the repeated measures correlation fit for each participant. ARAT, Action Research Arm Test; RMT, resting motor threshold.

Methods

Eleven subjects who sustained stroke ≥6 months prior to the start of the study were recruited. Nine also underwent TMS testing before and after treatment.

Participants were assessed prior to the start of the study, and upon completion of the HFT programme.

All participants were trained for 1-hour/session, on pincer, tripod, quadripod and spherical grasp finger strengthening/coordination exercises using the MyHand™ System 5 times/week for 3 weeks.

Experimental Protocol

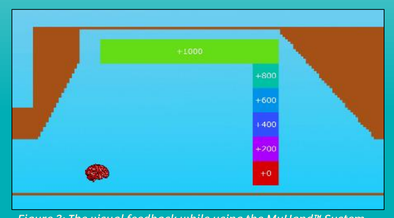

Figure 3: The visual feedback while using the MyHand™ System. One is advised through flexing and extending each finger to guide the brain through the course while avoiding the brown blocks.

Figure 4: MyHand™ System MK 2.45

Conclusion

Results from this study indicate that fully passive Hand Function Training devices can increase function and reduce impairment of the hand in chronic PWS.

TMS results suggest that functional improvement is linked to increased cortical excitability in both the unaffected and affected hemispheres.

Further studies should investigate using larger sample sizes to better understand the benefits of passive HFT and make informed recommendations for transfer to clinical practice