Evaluation of a Novel Hand Training Device and Program on Muscle Pattern Activity following Stroke

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Introduction

- Over 60% of stroke survivors acquire significant impairment and disability to the hand (Raghavan, 2007).
- Hand and upper limb recovery in the chronic stage of stroke is attributable to changes in plasticity (Nudo, 2003). Consequently, muscle contraction patterns are altered (Cheung et al, 2009).
- The most fundamental mechanisms that mediate recovery and/or stimulate plasticity as a result of targeted training in individuals post-stroke has been attributed to changes in synergy (Cheung et al, 2009), represented as changes in muscle contraction patterns.
- In this study a novel, custom-made, passive MSD hand function training device (Patent pending) was used to train hand function in individuals post-stroke.
- **Objective:** To estimate differences in muscle contraction patterns in people with chronic post-stroke upper limb hemiparesis as a result of 6-week hand function training program using the MSD hand function training device.

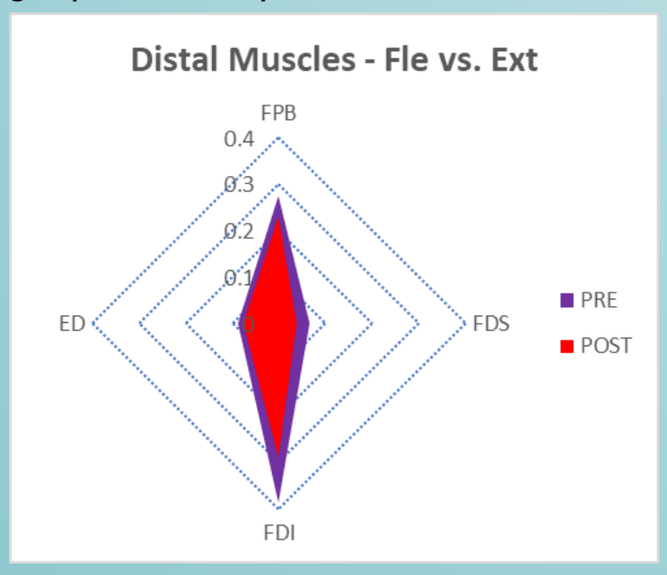
Methods

- Eight subjects (3 females) who sustained stroke ≥5 months prior to the start of the study were recruited.
- All participants were trained on pincer, tripod, quadripod and spherical grasp strengthening/coordination exercises on the MSD hand function device for 18 one-hour sessions over 6 weeks.
- Functional training characteristics (force, precision, coordination and range of motion) of the MSD device were randomly altered throughout the training process.
- EMG recordings from eight muscles (FDI, APB, ED, FDS, BB, TB, AD, PD) were assessed prior to start of study, and on completion of the hand function training program.
- **Data processing**: Raw EMG signals were rectified, band-pass filtered (10 – 500 Hz), and normalized prior to estimating the RMS values.
- **Statistics:** Data was assessed for normality. A paired sample *Student's t*-test was used to estimate the differences.

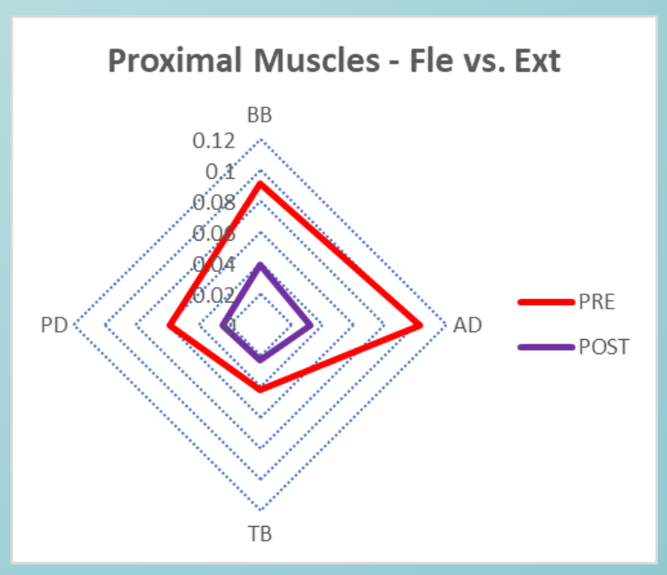
MSD Hand Function Device

Results

- All participants completed the 18 hand training sessions using the MSD device.
- EMG recordings were taken from all participants both pre and post-training while the participants grasped the device to a preset resistance isometrically for 30 seconds.
- Analysis using a paired samples *Student's t*-test revealed a significant difference in muscle contractions for flexor muscles.



The flexor pollicis brevis and flexor digitorum superficialis showed significant reductions in contractions between the pre and post-training ($t_{23} = 2.774$, $p = 0.005$), while first dorsal interossei and extensor digitorum showed no significant change.



The proximal muscle groups biceps brachii and anterior deltoid showed significant reductions in EMG contractions between the pre and post training ($t_{23} = 1.973$, $p = 0.03$), while triceps brachii and posterior deltoid showed no significant change.

Conclusions

- Results from this study indicate a positive impact on hand functionality after the six-week targeted hand training program using the MSD device.
- Improvements were seen in contractions of corresponding muscle groups (FPB, FDS), as well as reductions in the co-contraction of proximal muscle groups (BB, AD).
- Further studies should investigate a larger population to better understand the benefits, to aid in knowledge transfer to clinical practice.

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