INTRODUCTION

This study explores the feasibility of simultaneously training the contraction of agonist muscle and relaxation of antagonist muscle for various arm and hand movements using the SynPhNe (Synergistic Physio-Neuro) platform, to rehabilitate the hand function in long-term stroke patients.

The wearable sensing device and software showed promise as a potential home-use system which can be used safely and with minimum training.

The method is unique as it trains contraction and relaxation of agonist and antagonist muscle groups simultaneously.

METHODS

TECHNOLOGY

SynPhNe (Synergistic Physio-Neuro) captures electroencephalography (EEG) and electromyography (EMG) signals in a time-locked manner in real time while the subject is performing various movements and tasks.

These are then used in a feedforward-feedback loop to help subjects “self-correct” movements in real-time.

As a first stage feasibility, the study uses video-based activity feed forward alongside only EMG agonist-antagonist feedback (due to study design as a first stage feasibility).

STUDY

14 chronic stroke subjects with hemiplegia (31-69 years; 4 females, 10 males) were recruited for the study where each completed a four week, three sessions per week protocol using the SynPhNe platform.

The protocol employed a video-based feedforward of four basic hand movements [Wrist extension and flexion, Finger extension and flexion, Pronation & Supination, and Open Grasp] and four everyday tasks [Picking up a pen, Flipping a page, Grasping a bottle and Use of Chopsticks] while subjects attempted to maintain a pre-calibrated agonist-antagonist balance during upper limb movements using the biofeedback.

Fugl Meyer Assessment (FMA), Action Research Arm Test (ARAT), Grip Strength and 9 Hole Peg Test were used to assess pre-post gross and fine motor changes.

RESULTS

ASSOCIATION OF MUSCLE CONTRACTION TO RELAXATION

On comparing the activation and relaxation as seen in the EMG, a strong association was noted between the ability to perform higher number of targeted muscle contractions successfully and volitionally relaxing the same below a set threshold, before the next contraction.

Previously non-obvious enhanced flexor side contractions during extension activities, and vice-versa were recorded by the EMG. This unconscious, maladaptive muscle use was reduced or reversed in 12 out of 14 subjects after 12 sessions each.

CLINICAL SCALE OUTCOMES

The clinical scale which showed the most improvement, were related to higher levels of function and activity, namely, ARAT.

Only high functioning subjects reported improvements in dexterity (9 Hole Peg Test), although subjects did not train for dexterous tasks in the study.

CONCLUSIONS

It is feasible to re-initiate functional recovery in long term stroke patients by facilitating an understanding of unconscious, maladaptive muscle behavior using the SynPhNe platform.

Training muscle activation and relaxation simultaneously, subjects tended to reduce maladaptive muscle behaviour by adopting timely muscle relaxation for improved function and better repetitions.

Such a therapy routine which specifically trains both activation and inhibition of muscles simultaneously can improve weakness and control issues in hand function after stroke.