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The Effects of Neuromuscular Electrical Stimulation and Exercise Intervention on the Upper Limb of Children with Spastic Hemiplegia

ABSTRACT

Introduction: Children with hemiplegic cerebral palsy (CP) have a topographic distribution of spasticity unilaterally with the upper limb being more involved than the lower limb. They often have complete disregard of the affected upper limb relying solely on the unaffected arm to conduct activities of daily living (ADL). **Purpose:** This dissertation explored the combined effects of neuromuscular electrical stimulation (NMES) in addition to isometric and isotonic bicep curls on the upper limb of children with spastic hemiplegic CP, specifically addressing; flexibility, spasticity, and hand functionality.

Method: A multiple case study design was used in which nine participants aged between six and eighteen years consented to the intervention twice a week over an eight-week period. Prior to children receiving the NMES intervention, flexibility, spasticity and hand functionality were measured. Thereafter children received NMES which was applied to the biceps brachii muscle and consisted of four stages; 1) electromyography (EMG), 2) concentric stimulation, 3) electrically triggered stimulation (ETS) combined with isometric bicep curls and 4) stimulation modulation combined with isotonic bicep curls. Following the intervention, flexibility, spasticity and hand functionality were assessed and compared against outcomes obtained at baseline. Data was analysed using test pivot on Excel to extract means and Wilcoxon sign in which $p<0.050$ indicated a high significant relevance

Results: Significant improvements were noted in flexibility measurements during; shoulder flexion ($p=0.008$), shoulder abduction ($p=0.012$), shoulder internal rotation ($p=0.008$), elbow flexion ($p=0.012$), elbow extension ($p=0.008$), and wrist extension ($p=0.008$). Decreases in Ashworth spasticity scores of the shoulder, elbow, and wrist joint were noted. No improvements were noted in Tardieu spasticity scores, however; there were improvements in the joint angle range of motion at which spasticity occurred. The quality of the upper extremity skills test (QUEST) showed improvements in dissociated movements of the shoulder, elbow, and wrist ($p=0.007$), grasps ($p=0.011$), and a summary score ($p=0.008$).

Conclusion: The evidence suggests that the combined effects of NMES and bicep curl exercise improves flexibility, reduces spasticity, improves dissociation of the upper extremity, and the ability to grasp.