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"EFFECTIVENESS OF NEURODEVELOPMENTAL TREATMENT AND ELECTRICAL STIMULATION ON POSTURE CONTROL AND BALANCE IN CHILDREN WITH CEREBRAL PALSY."

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ABSTRACT

INTRODUCTION: Cerebral palsy is a collection of permanent movement and postural impairments that limit activity and are caused by non-progressive abnormalities in a fetus' or child's growing brain. In children with cerebral palsy, neurodevelopmental therapy (NDT) and electrical stimulation (ES) treatments are utilized individually to improve postural control and balance (CP).

AIM: To study the combined effects of Neuro-developmental treatment (Bobath concept) and Electrical Stimulation on postural control and balance in children with cerebral palsy.

METHODS: The study comprised thirty children, divided into two groups, ranging in age from five to fifteen years. NDT+ES was given to the experimental group, while NDT was given to the control group for only 5 weeks. GMFM-88 was used to assess gross motor functions, PBS was used to assess balance, MTUGT was used to measure posture control, and SPCM was used to assess posture control.

RESULTS: There was significant improvement in the outcomes measures within both the groups individually while between group analysis of outcome measures was not significant.

CONCLUSION: 5-week NDT based posture and balance training applied to children with cerebral palsy improved their functional motor level along with postural control skills, however application of electrical stimulation also has been found effective in this study.

KEYWORDS: Neurodevelopmental therapy (NDT) and Electrical stimulation (ES), Seated postural and control measure (SPCM)

INTRODUCTION

Cerebral palsy (CP) is a non-progressive disorder of the brain that results in motor impairment[1]. 'Cerebral' refers to cerebrum, which is the affected area of the brain (although the disorder most likely involves connections between the cortex and other parts of the brain such as the cerebellum) and 'palsy' refers to disorder of movement[2].

Cerebral Palsy is caused by damage to the motor control centers of the developing brain and can occur during pregnancy (about 75%), during childbirth (about 5%) or after birth (about 15%) up to about age three[3].

All cerebral palsied children, whether spastic, athetoid or ataxic are retarded in motor development. The inability to maintain posture and balance is most obvious. According to motor control model, the movement dysfunction observed after a neural lesion is the result of loss of compensatory strategies as well as actual loss of neural tissue. A frequent clinical impairment seen in cerebral palsy is reduced force-generating ability of the affected muscle groups.

It can be seen because of decreased central nervous system (CNS) motor unit recruitment and discharge rates[4], increased antagonist co-activation during agonist contractions[5, 6] and changes in muscle morphology, including atrophy[7-9]. Muscle weakness in CP can be profound. Depending on the affected muscle group, normalized force produced by children with CP ranges from approximately 22% to 70% of normalized force produced by typically developing children[10].

Children with diplegic cerebral palsy (CP) commonly exhibit impairments such as spasticity and weakness that may limit gait, functional mobility and independence. When subjects are asked to walk, they often report feeling off balance due to presence of muscle weakness, loss of selective motor control, abnormal patterns of movement, deficits in balance and coordination, poor regulation of activity in muscle groups, spasticity and co-contraction. Even if spasticity is removed, the child would still be physically disabled[11].

The relationship between spasticity, contracture, and activity is complex in children with cerebral palsy. Spasticity is 'a motor disorder characterized by a velocity-dependent increase in tonic stretch reflexes (muscle tone) with exaggerated tendon jerks, resulting from hyper excitability of the stretch reflex'[12]. Spasticity can lead to contracture and both spasticity and contracture can limit activity.

Several studies have proved the effectiveness of stimulation in treating hamstrings spasticity in children with cerebral palsy; stimulation overloads the muscle leading to increased motor unit recruitment, hypertrophy, and increased force, potentially leading to greater strength gains compared with active range of motion for a child with decreased motor control[13]. In addition to strength training, the movement facilitated by stimulation may lead to motor learning, increasing active range of motion of the limb by improving motor control.

However, past research studies on stimulation as a therapeutic alternative for children with CP have either not been based on the principles of strength training or the methods have not been described in reproducible detail. These studies were either focused on motor control deficits to improve functional abilities using motor level stimulation or represented attempts to stimulate muscle growth with the use of sensory level stimulation[14, 15].

But this study will fill this gap as the stimulation protocol used in this study is designed to provide the benefits of spasticity reductions for a child with increased muscle tone and decreased motor control[16]. Also, we apply the principles of strength training, including overload and time for muscle repair between muscle training sessions to increase strength of the quadriceps muscle groups. So, it is designed to reduce hamstrings spasticity and improve secondary impairments like increase in quadriceps muscle strength of a child with diplegic Cerebral Palsy.

The present study assesses spasticity by investigating the activity of the agonist and antagonist muscles before and after the implementation of the stimulation with the use of a sensory level stimulus intensity over the spastic muscles, or over areas of skin that receive a similar nerve supply as the spastic muscles respectively. A few Electrical Stimulation protocols with skin electrodes have been studied. The use of skin electrodes to train muscles, or to contract muscles for exercise, have resulted in less spasticity and improved function[17].

Hence, stimulation can provide a safe and inexpensive complementary therapeutic technique for children with Cerebral Palsy.

METHODS AND MATERIALS

A total of 30 subjects will be recruited for the study. Participants will be divided into 2 groups: experimental and control. Experimental group will be of cerebral palsy patients receiving Neurodevelopmental Treatment (Bobath Concept) combined with Electrical stimulation, Control group will include cerebral palsy patients receiving Neuro-Developmental Treatment (Bobath Concept) alone. In each group, an equal division of participants will be taken, with a ratio of 15:15. A registration form will be filled for the subjects defining their demographics, CP clinical type, limb involvement, medical histories, walking aid use, surgical operation history, and NDT history. Subjects will be assessed before and after the intervention through face-to-face interaction. Physiotherapists will assess the patient using various scales. Children distributed among the groups will receive training for 30 mins for 4 days for 5 weeks. Experimental Group will receive the NDT+ES. NDT includes Vestibular and proprioceptive training on balance board, Vestibular and proprioceptive training on exercise balls in different sizes. Dynamic balance training in sitting, kneeling, and standing position (eyes open and closed). Balance exercises in front of the mirror. Standing on one foot for improving the proprioceptive input (eyes open and closed). Balance training on the trampoline. Sensory stimulation for foot soles with various materials. Weight bearing exercises in sitting, crawling, kneeling, and standing position. Functional reaching and ball throwing-keeping exercises in various positions. Multi-task training. Walking training in different types. Climbing up & stepping down the stairs (supported-unsupported, symmetric, reciprocal etc.) [39] Electrical stimulation will be given over the paravertebral muscles when the subject is in sitting position. Pulse duration will be established as 14.65 microseconds with frequency of 60 Hz, and current strength will determine to form a tetanic contraction. Application duration will be 10 minutes and the application frequency were 4 days/week. [40] Electrical stimulation will be given inside lying position for gluteus maximus and in sitting position for quadriceps. During the application of neuromuscular electrical stimulation, child was positioned with the knee flexed (70-80 degree) and the hamstring will not in the lengthened position to reduce the amount of stimulation required to attain a forceful contraction and therefore improve comfort. The intervention period was of 2 weeks duration, electrical stimulation for 10 minutes each muscle, 4 days/week. Parameters used: Waveform- balance, symmetrical, biphasic; Pulse duration - 300 ms; Frequency 50 pulse/sec; Stimulation time: Rest time on: off 15:5, Ramp up – 1 sec, Ramp down-sec; Intensity - maximum tolerable intensity by the child. [41]

Table: Within group analysis of outcome measure SPCM LSS in group 1 (Neuro-developmental treatment)

Sr. No.	Outcome measure	Median (IQR)	Range (MIN-MAX)	p- Value
1	• SPCM LSS PRE • SPCM LSS POST	• 6 (5,8) • 6.87 (6,8)	• 3(5-8) • 3(5-8)	0.006

INTERPRETATION

The median, interquartile range, and range are the descriptive statistics for the outcome measure (SPCM LSS) that followed a non-normal distribution. Wilcoxon signed rank test was performed to establish the level of significance between them at baseline and after intervention in inferential statistics, which revealed a significant difference in group 1 after the intervention.

RESULTS

There was significant improvement in the outcome's measures within both the groups individually while between group analysis of outcome measures was not significant.

DISCUSSION

Cerebral palsy (CP) is a neuromuscular condition that develops in the prenatal, perinatal, and postnatal periods because of brain damage [42]. Motor issues are caused by abnormal muscle tone, muscular weakness, postural control abnormalities, as well as primitive reflex patterns seen in children with CP. For these reasons, children with CP have difficulties with motor milestones including sitting, crawling, and walking [43]. Sitting allows a child to do a variety of useful tasks, interact with their environment, and learn trunk control by utilizing their upper extremities. As a result, as soon as feasible, sitting ability should be increased. In addition, sitting without assistance promotes dynamic stabilization for the youngster [44]. The goal of this research was to see whether using Neuro-developmental treatment alone and Neuro-developmental treatment and electrical stimulation had any impact on postural control and balance in children with cerebral palsy. The combination use of these 2 therapies improved postural control as well as balance in children with CP, according to the findings of this research.

CONCLUSIONS

This study found that combining the Neuro-developmental Treatment and Electrical Stimulation apps, in addition to the NDT programme, facilitated the paravertebral muscles, Gluteus maximus, and Quadriceps. The facilitation of all three muscles by ES, as well as an increase in tactile and proprioceptive input to the central nervous system via mechanoreceptors and improvements in muscle strength and motor control, have improved postural control and balance in children with cerebral palsy, which may affect their independence. 5-week NDT based posture and balance training applied to children with cerebral palsy improved their functional motor level along with postural control skills, however application of electrical stimulation also has been found effective in this study.

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