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EFFECT OF FUNCTIONAL ELECTRICAL STIMULATION COMBINED WITH CONVENTIONAL PHYSIOTHERAPY IN A CHILD WITH SPASTIC CEREBRAL PALSY: A CASE REPORT

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Abstract
The most prevalent motor disability in children is cerebral palsy (CP). In children with CP, other comorbidities that influence general health and make learning new skills complex are also common. People with cerebral palsy frequently have trouble swallowing, which causes their eyes to focus on different objects more frequently. Muscle stiffness can also restrict the range of motion at different joints throughout the body. This report is about a 12-year-old female kid born at 27 weeks who was diagnosed with cerebral palsy and severe mental impairment. She had a Gross Motor Function Classification System Level V. She later developed genu valgum. A 12-week treatment regimen was designed that concentrated mainly on transitions using principles of Neurodevelopmental therapy and functional electrical stimulation. The outcome measures used were the Gross motor function measure (GMFM 88) and the modified Ashworth scale (MAS). Assessments were performed at 3 points: pre-intervention, post-intervention, and follow-up which showed tremendous improvement. This case report aimed to examine the effect of lower limb functional electrical stimulation (FES) along with other Neuro Developmental techniques and trunk-targeted Exercises in children with spastic cerebral palsy.

Keyword- Genu valgum, Physiotherapeutic Treatment, Neuro-Developmental Technique, Functional Electrical Stimulation.

CASE REPORT

A 12-year-old girl presented to the Physiotherapy OPD with complaints of an increase in tone in both lower limbs with hyperreflexia, difficulty in performing fine motor activities, drooling saliva, and syllable speech. She was born of a second-degree consanguineous marriage and was delivered at 27 weeks; she had a delayed cry for which there was a history of neonatal ICU admission for 20 days. She was diagnosed with cerebral palsy with severe mental retardation. They started some treatment at Ayurveda Hospital at the age of 3 years. Now she presented with the inability to gain weight and difficulty in performing her ADLs. Currently, the milestones achieved were neck control, rolling, and sitting with support.

The child presented with genu valgum deformity **[Fig-1]** with abnormal trunk control. She had excessive ankle plantar flexion due to tendo Achilles spasticity. Bladder and bowel sensations were intact. The manual muscle test was '2+' for lumbar flexors-extensors, flexors and extensors, core abdominals, bilateral glutei, and '3' for all the muscles of the bilateral upper limb. Hold and grasp was slow and often unsuccessful when she grasps small objects. Although the patient's upper limbs were within the functional limit, her lower limb ranges were significantly reduced. Her Intelligence quotient was 13. On Gross Motor Function Classification System (GMFCS) score she was classified as level 5[1]

PHYSIOTHERAPEUTIC INTERVENTION

The rehabilitation program was planned for 3 months and further home exercise programs were prescribed with regular follow-ups **[Table 1]**.

Goals	Treatment	Rationale
1. patient education	-psychological consultation about the condition. -Education regarding knee ankle foot orthosis. -The importance of exercise.	
2. Stretching	Prolonged stretching technique for B/L lower extremities given for hip flexors, adductors & internal rotators, knee flexors, gastrocnemius, and soleus muscle (10 rep X 30-sec hold**) [Fig-2]**.	Decrease spasticity (short term) and help prevent muscle contracture.
3. Strengthening exercises	Strengthening by use of electrical stimulation over the quadriceps and tibialis anterior along exercises such as progressive resistance exercises were modified and formulated with a progressive increase in intensity which included resisted motion and lifting tasks.	
4. Gross motor task training	The task-specific program was started for 45 min,5 sessions/week which includes repetition of simple functional gross motor like come to sit, sit to stand.	For motor relearning,
5. Exercises for trunk and pelvis control	Straight and diagonal Curl ups; bridging on a Swiss Ball utilizing various Base of Support (BOS), Runner's stance, prone on palms; prone hip Extension were among the ball exercises given **(Table/Fig-3]**.	Curl ups on the ball promoted trunk flexion mobility by performing concentric work, which permitted the spinal extensors to be recruited in a stretched position. As per Bobath, the child's position creates a reflex inhibitory posture for lower limb muscle flexor tone and permits the pelvis to be stabilized. Exercises performed on the ball improves the stabilization of hip and shoulder.
6.static weight bearing exercises	Static weight bearing (SWB) was performed by placing the child in standing frame for 5 min daily initially which was increased gradually with the practice of the child. Task-specific gentle loading was given to the child's body to alter force distribution in different directions to guide the patient to adapt himself to a new situation.	Lowers spasticity by decreasing motor neuron excitability through stretching and compressing muscle spindles, Golgi tendon organs, and joint receptors.
7. Functional electrical stimulation.	Functional electrical stimulation to lumbar and abdominal muscles in the supine position (30 min /session for 4 weeks).	The following parameters were used to give the electrical stimulation: intensity 20-30 mA; sequence pulse width 250 s; frequency, 25 Hz; sequence on for 10 sec & then off for 12 seconds.
8. Neurodevelopmental technique	Key principles used in Strategies: 1. Activation of BOS. 2. Key Point of Control 3. Child-preferred tasks 4. Including family in treatment 5. Physiotherapist guiding in the treatment. 6. Goal-oriented treatment, with age-matched goals. 7. Transition training.	Neurodevelopmental treatments (Bobath approach) are targeted at establishing normal motion patterns by normalizing muscle tone.

[Table /Fig-2]: Pre and post-interventional score.

OUTCOME MEASURE

Modified Ashworth scale [2] and gross motor function measure-88 [1] outcome measures were used to compare pre and post intervention scores**[Table 2].**

Outcome measure	Pre-score	Post-score
MAS	1+	1
GMFM 88	43	52

[Table 2]: Pre and post-interventional score.

The progress was more noticeable in her cognitive abilities such as Multiple simultaneous attention, Pattern Recognition and thinking. After the physiotherapeutic interventions for three months, her sitting balance improved as she was able to maintain her posture. She was able to stand with limited help using a Knee Ankle Foot Orthosis (KAFO).

DISCUSSION:

The most frequent clinical subtype of cerebral palsy seen in developed nations is spastic diplegic cerebral palsy (CP), and the second most prevalent form in underdeveloped nations [3]. According to recent studies, the percentage of spastic diplegic cases increased from 22% to 34.5% over the past decade [4]. Around 30% of those with cerebral palsy have severe forms and are non-ambulatory [5]. Spastic CP individuals show a variety of neuromuscular and musculoskeletal abnormalities, such as spasticity, contractures, poor coordination, restricted range of motion (ROM) and weakness [6]. These limitations could make ambulation less efficient [7]. In people with spastic CP and neuromuscular symptoms, such as sensory impairment and increased muscle tone, loss of the ability to control muscle activity and movement abnormalities, ankle plantar flexor spasticity and ankle dorsiflexors weakness are contributing factors to gait deviations. In between 70 and 80 percent of CP patients, spasticity is present. Adults with CP may also be more susceptible to medical issues like metabolic syndrome and coronary heart disease [8].

Despite these dangers, adults with CP have less opportunities than children with CP to engage in physical exercise, and little study has been done to address this issue [9]. The majority of children with CP live into adulthood, thus effective therapies are crucial for this population.

When the index patient first entered the rehabilitation centre, it was determined that she needed to work on her muscle tone, lower extremity ROM, strength, balancing reactions, and functional mobility, including transfers and bed mobility. Due to discomfort, lower extremity weakness, and increased muscular tone, her functional mobility was restricted. She needed the most support to move from lying supine to sitting, as well as the most aid to move backwards. All transfers required a dependent lift for her. This study aimed to show the effects of physiotherapy on gross motor function for diplegic cerebral palsy, and it shown that physiotherapy was beneficial for this diplegic child.

Typically, children with CP have a normal anatomical hip alignment at birth. The combination of soft tissue anomalies and delayed milestones, such as an imbalance in muscle tone between weaker hip extensors and abductors and strong hip flexors and adductors then alters development. In addition to increasing the risk of hip instability, this can result in decreased ROM in the bone deformities and muscles such coxa valga, femoral anteversion, and acetabular dysplasia [10].

A thorough evaluation of the orthopaedic issues that persons with severe CP face is uncommon, despite the fact that these issues are likely to have a lifetime clinical impact on the individual. Joints, contractures, and atypical body postures must be carefully observed in order to identify them and take immediate action to help stop additional difficulties. The child's motor activity at home changed functionally as a result of the improvement reported in outcome assessments for this child. Both the parents and the physical therapist in this case observed improvements in the child's motor function, which were accompanied by changes in the child's capacity to interact with family members. The result was a change in the GMFM-88 score. In this scenario, the child's long-term prognosis would also be impacted by the acquisition of new functional motor abilities.

The treatment of CP is difficult and necessitates a comprehensive strategy. Different rehabilitation techniques have been used to correct movement abnormalities in cerebral palsy children [11].

Individuals with spastic CP often benefit from treatments such as baclofen, ankle-foot orthoses selective dorsal rhizotomy and botulinum toxin type A injections, to lessen gait-related deficits [12]. Physical therapy is recommended among the range of medical health services in the treatment with cerebral palsy to promote motor development and increase independence in motor skills, play activities and self-care [13]. The hypothesis of neuro-maturation serves as the foundation for conventional therapeutic strategies. The Neuro-maturational Theory places a strong emphasis on adhering to the developmental sequence and places special emphasis on the function of reflexes in motor control when it comes to physical therapy interventions for children with cerebral palsy (CP) [14]. Using the International Classification of Functioning, Disability and Health (ICF) as a framework, studies have shown that rehabilitation professionals should deliver interventions with increased intensity at the ICF level in which they hope to impact children with severe CP in order to

improve function [15]. A lack of intervention studies in adults with CP makes it difficult to make evidence-based decisions about which impairments should be treated in order to avoid or slow the worsening of gait and balance.

Functional electrical stimulation (FES) has emerged as a potential technique to enhance the effectiveness of gait in children and adolescents with cerebral palsy. FES activates a target muscle during functional activity by stimulating an undamaged peripheral nerve. Chu and Ada [16] came to the conclusion that FES utilised during functional activities (such as walking and sitting) was a more effective treatment than no FES in children with CP. They analysed five randomised controlled studies utilising FES. The use of gross motor task training to improve postural control in ambulant children with CP (two level II studies) was moderately supported by the evidence when administered for at least 10 hours per week [17]. Training in gross motor activities affects the majority of postural control components because efficient anticipatory and reactive postural changes emerge concurrently with the development of a gross motor skill. Practice variation can then be used to fine-tune control over that task.

Several researches have looked at ways to help CP kids with their balance. Children with cerebral palsy showed improved upper limb functioning and balance following trunk muscle strengthening activities, according to Choi et al. [18]. Similarly, McBurney et al. [19] observed that lower limb muscle strengthening exercises improved the strength, flexibility, postures, and gait ability of spastic paraplegic children with CP. This present report also emphasizes the importance of strengthening exercises for improving trunk stability.

Previous research, however, mainly concentrated on the effects of strengthening the muscles in the neck and the trunk as well as on the examination of the subsequent seated balance and gross motor skills [20]. The term "activity-focused intervention" describes a task-oriented strategy that emphasises the practise of practical skills that have relevance for the kid in a practical setting. This strategy is in line with modern neuroscience theories that emphasise problem-solving in practise as a means of promoting brain restructuring and neural plasticity [21]. The Bobath technique, formerly known as the neurodevelopmental treatment, is a theoretically-based strategy that seeks to enhance gross motor function and postural control by encouraging muscle action through defined control points with the assistance of the therapist. Facilitation (the use of sensory inputs to improve motor function), management of compensatory motor behaviour, and an overall management strategy are the cornerstones of neurodevelopmental treatment (a 24-hour interdisciplinary management approach) [11].

Utilizing adaptive technology is a supplement to activity-focused interventions, which are known to enhance function and lessen activity limits and participation barriers for kids with disabilities. In this case study, a 12-year-old child with GMFCS level V was treated for impairments and activity limits using a sitting activity intervention, FES, and NDT. This case study demonstrates how an evidence-based intervention strategy can be successfully applied to manage a young child with cerebral palsy while satisfying the family's cultural and resource requirements. She was able to maintain her posture, showing improvement in her sitting balance. The Achilles tendon and bilateral hamstring muscles showed improvement in terms of joint mobility. Intervention program used in this case report not only focus on FES and was comparatively broad in nature. According to her parents, the child could play while sitting with her sibling after the intervention.

CONCLUSION:

As per the findings, physiotherapy treatments such as weight bearing exercises, lifestyle modification at home, NDT, trunk exercises, FES, and the use of a KAFO improved gross motor abilities while having little effect on GMFCS. This study found that physiotherapy treatment can help children with cp improve their dexterity.

[Fig-1]: patient presenting with genu valgum deformity with abnormal trunk control

[Fig-2]: prolonged stretching for Tendo Achilles muscle

[Fig-3]: Swiss ball Exercises for trunk control.

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