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Effectiveness of Neurodevelopmental Treatment on Muscular Strength and Gross Motor Function in a Child with Dyskinetic Cerebral Palsy - A Case Study

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ABSTRACT

Cerebral palsy (CP) is a group of permanent disorders affecting movement, muscle tone and co-ordination. It is a neurological disorder caused by abnormal brain development or damage. Dyskinetic cerebral palsy is a type of cerebral palsy characterised by involuntary movements. It is marked by dystonia, athetosis, chorea and tremors. This is the case of 3year old female child with a history of seizures at the age of 1 year who presented with features of dyskinetic cerebral palsy who is unable to sit and stand independently and also has difficulty in holding objects with hands. Examination done on sensory examination, motor examination, trunk control and gross motor skills. Speech and language delays and the involuntary movements of upper extremity and lower extremity is present. She had an MRI which revealed that she has diffuse cerebral atrophy.

Keywords: NDT techniques; CIMT; Dyskinetic CP; GMFM

INTRODUCTION

Dyskinetic cerebral palsy (DCP) is the second most common type of cerebral palsy (CP) after the spastic type, accounting for about 15% of all CP cases. Perinatal hypoxic ischemic encephalopathy (HIE) and bilirubin encephalopathy (BE) are two major causes of DCP, but BE has become less common as preventive strategies have improved, particularly in high-income countries.[1] Dyskinetic CP is linked to damage of subcortical grey matter, including lower volumes of basal ganglia and thalamus, due to hypoxic-ischemia, as well as hyperbilirubinemia and birth asphyxia. The definition of dyskinetic CP has evolved to include dystonic a nd choreoathetoid CP. Symptoms of dyskinetic CP include both hyperkinetic and dystonic limb movements that impair function. [6] It is one of the most debilitating types of CP because it causes severe motor impairment. Children with DCP experience abnormal muscle activity stemming from the simultaneous, sustained contraction of the agonist and antagonist muscles during movement, resulting in difficulties maintaining spatiotemporal trajectories and considerable variability in their movements. The most common manifestations are athetosis, chorea, and dystonia. These involuntary movements can cause discomfort, interfere with voluntary movements, and limit or even impede upper and lower limb functions. [4]

Bobath, or neurodevelopmental therapy (NDT), is often described as “usual care” in neurorehabilitation despite evidence that more effective alternatives for improving

motor function in cerebral palsy (CP) exist. A consensus clinical framework outlines 3 primary principles of NDT, which are, movement analysis of task performance, interdependence of posture and movement and the role of sensory information in motor control. In practice, the elements of NDT are therapist-controlled facilitation of movement via handling to provide optimal sensory input to improve postural control and training movement quality to normalize motor patterns, currently termed regaining "typical motor behavior" and minimizing "atypical motor behavior." This involves training movement quality rather than using compensatory or atypical strategies to complete a task, which is discouraged in NDT . [3]

Neurodevelopmental treatment (NDT) consists of regulating neural-based motor responses in the central nervous system. The NDT approach is continuing to develop and is now considered an approach instead of a method. It includes the principles of providing CP children with a normal movement experience to minimize motor-sensory disturbances and provide functional independence during activities. Other important principles it includes are emphasizing the child's personal development and cognitive characteristics. [5]

Good trunk control is essential for higher developmental stages as the trunk is activated first when movement occurs, providing stability for the head and extremities. Children with developmental delay (DD) and CP exhibit different types of impairments in trunk control. CP limits body movement due to clinical characteristics such as spasticity, making it difficult to maintain a sitting position and to control the trunk. In contrast, DD is associated with low trunk muscle tone and a lack of stability in the trunk, resulting in more trunk sway compared with typically developing children and difficulty in controlling the trunk control and maintaining a sitting position. Trunk control is therefore a very important factor CP as well as DD**.** [7]

Therefore, the purpose of this study was to determine whether the NDT techniques, which was studied for its effectiveness in CP, is also effective in improving muscle strength and muscle activation and to give a clarity about the dosage for the intensive NDT handling in individuals with dyskinetic cerebral palsy.

CASE REPORT

A case study was carried out on 3-year-old female child with bilateral cerebral atrophy and dyskinetic cerebral palsy. Parents had a non-consanguineous marriage, and mother had regular antenatal checkups during which no abnormality was noted, except that mother had hypothyroidism. Delivery was by caesarean section at 30 weeks of gestation; weak and delayed birth cry and poor respiratory effort was noted for which neonatal intensive care was given for 12 days; after which breastfeeding was started. At 9 months of age, caregiver noticed that head holding and rolling was not present; MRI taken at the time revealed diffuse bilateral cerebral atrophy. Physiotherapy treatment was started; 3 months after this, the baby developed seizures and was admitted to hospital and was discharged after 2 days with medications. Physiotherapy was continued in a local hospital and referral to the present centre was done when the baby was 3 months of age. At the time the chief complaints were not able to come to sitting independently and not able to walk independently.

EXAMINATION

On examination passive ROM was within normal limits, and active ROM was not able to be performed. Muscle tone was normal in UL and LL (grade 2+), as were deep tendon reflexes (grade 2+). Voluntary motor control grading was 3+ (2/3rd movement possible against gravity with resistance). There was no limb length or girth discrepancy. Spinal level reflexes were not integrated; Moro's reflex was absent. Brainstem and midbrain level reflexes were not integrated; protective extension of arms and legs and equilibrium reactions in sitting and standing were also absent.

The score on Toddler Sensory Profile was 166/190 and Trunk control measurement scale (TCMS) score was 0/58, indicating poor trunk control. Paediatric Balance Scale score was 0/56, indicating a high fall risk and GMFM88 score was 9.8% indicating requirement for maximal assistance.

INTERVENTIONS

Interventions		
Type	**Duration**	**Frequency**
Joint mobility	1st week – 6 days	Passive and Active range of motion exercises of upper limb and lower limb-10 repetitions; Mat and Swiss ball exercises - prone on elbow, hand, quadruped, kneeling and half kneeling – 5 minutes each
Muscle strengthening	2nd week- 6 days	Upper limb- Flexion, Extension, Abduction, and Adduction with 0.5 kg weight cuff 10 × 2 sets Lower limb- Straight leg raises, Abduction, Prone knee flexion with 0.5 kg weight cuff 10 × 2 sets Curl ups, Bridging, sit to stand and Swiss ball exercises 10 × 2 sets
Balance and coordination	3rd week- 6 days	T swing and Rocking horse– 10 minutes

RESULT

The scores of the various scales before and after the three-week treatment program is depicted in Table 1. In addition, dynamic sitting position with minimal support and walking with rollator support, which was not possible before intervention.

Table 1. Pre and post intervention score

	Pre- intervention	**Post- intervention**
Toddler sensory profile	166/190	168/190
TCMS	0/58	3/58
PBS	0/56	1/56
GMFM	9.8%	11.5%
VMC	3+	3+++

DISCUSSION

The results showed that a three weeks NDT exercise program has a positive effect on muscular strength, trunk control, balance and gross motor functional status in a child with dyskinetic cerebral palsy. NDT techniques comprise a comprehensive approach to assessing and treating individuals with neurological and developmental disorders. The current thought is that these types of exercises reduce falls by improving gross motor functions by improving muscular strength and balance, specifically improved cognitive function. The present study found that NDT training will increase the muscle endurance and postural control. It can increase the motility of the lower limb joints and activation of lower limb muscles, leading to neuromuscular involvement that improves gross motor activities skills. The activation of trunk extensors, hip extensors, knee extensors, and ankle plantar flexors is significantly related to maintaining or increasing movement velocity, and thus, an increase in gait velocity reflects an improvement in overall gait abilities.

The significant improvement in VMC scores and GMFM 88 could be attributed to the effect of vestibular stimulation over time which tends to enhance sensory integration, standing, and walking in individuals with cerebral palsy. Muscle strength, trunk control, gross motor skills and balance was seen to improve after treatment. Lee KH et al. conducted a study on efficacy of intensive neurodevelopmental treatment for children with developmental delay (DD), with or without cerebral palsy and concluded that intensive NDT showed improved gross motor function and higher compliance than conventional NDT for children with (DD). [4]

CONCLUSION

Treatment with NDT improved gross motor functions and muscle strength in the participant. NDT can be applied to improve muscle strength, gross motor skills and trunk focused intervention for children with dyskinetic cerebral palsy.

Declaration by Authors

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