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EFFECTIVENESS OF TREADMILL TRAINING COMBINED WITH DYNAMIC AFO AND DE ROTATIONAL STRAP ON BALANCE AND CADENCE IN DIPLEGIC CEREBRAL PALSY

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KEYWORDS :

INTRODUCTION

Cerebral palsy is a group of permanent, non-progressive disorders of movement and posture that arise from an injury or disturbance in the developing brain during prenatal, perinatal, or early postnatal life. It is one of the leading causes of childhood physical disability and is frequently associated with limitations in gross motor function, gait, balance, coordination, and functional independence. The condition may affect one or more limbs and is commonly accompanied by abnormal muscle tone, impaired selective motor control, muscle weakness, and secondary musculoskeletal deformities.[1]

The aetiology of cerebral palsy is related to damage or abnormal development of the immature brain, and this may occur before birth, during birth, or shortly after birth. Prenatal causes include congenital brain malformations, maternal infections, placental insufficiency, maternal illness, and exposure to harmful substances during pregnancy. Perinatal causes include prematurity, low birth weight, difficult labour, birth asphyxia, and complications that reduce oxygen supply to the brain. In some children, the exact cause cannot be identified, even though a brain injury is clearly present. These etiological factors interfere with the normal development of motor pathways and lead to the characteristic movement and posture abnormalities seen in cerebral palsy.[3]

Spastic diplegic cerebral palsy is reported as the most common clinical type of cerebral palsy. It is especially common among premature infants, and the incidence of diplegia in this group is reported to be very high. Because of this, cerebral palsy remains a major concern in paediatric rehabilitation services. Children with this diagnosis form a substantial proportion of patients seen in physiotherapy and neurodevelopmental centres. The condition often persists throughout childhood and adolescence, requiring long-term management. Due to the chronic nature of gait, balance, and posture problems, there is strong interest in interventions that can improve functional mobility and reduce disability.[4]

The physiological basis of treadmill training lies in motor learning and neuroplasticity, because repeated stepping stimulates the nervous system to organize more efficient movement patterns. Repetitive gait practice improves timing of muscle activation, weight shifting, and symmetry of lower-limb movement. Dynamic AFO works by improving mechanical alignment of the foot and ankle, which enhances stability and reduces compensatory movements at the knee and hip. The de-rotational strap applies an external corrective force that decreases internal rotation of the lower limb and promotes more normal gait mechanics. Better alignment improves the muscle length-tension relationship, balance control, and efficiency of force generation. These physiological effects help reduce fatigue, improve cadence, and support safer ambulation.[16]

Studying the combined effect of these interventions is clinically meaningful and may provide evidence for more effective rehabilitation planning. This makes the topic highly relevant for improving balance, cadence, and walking efficiency in children with diplegic cerebral palsy.

Objectives of the Study

- To determine the effect of treadmill training combined with dynamic AFO and flexible derotational strap along with conventional exercises on Balance and cadence in diplegic CP.
- To determine the effect of gait training with dynamic AFO and flexible de-rotational strap with conventional exercises on balance and cadence in diplegic CP.
- To compare the effect of treadmill training combined with dynamic AFO and flexible de-rotational strap along with conventional exercises on Balance and cadence in diplegic CP versus conventional physiotherapy.

METHODOLOGY

MATERIALS AND METHOD

Study Design: postcomparative study
Study Subject: Children with Spastic Diplegic Cerebral Palsy
Sample Size Calculation
Sample Size – 30 participants (15 in each group)
Sample Design: Convenient Sampling.
Study Setting and Source of Data: Bangalore Child Neurology and Rehabilitation Centre
Study Duration: 4-6 months

Sample Selection

Inclusion Criteria

1. Age 6-12 years.[37]
2. Subjects of both the Genders[38]
3. Spastic Diplegic Cerebral Palsy walking with AFO (GMFC I and II)[39]

Exclusion Criteria

1. Children with Botulinum toxin–A injections within the last six months.[41]
2. Children with musculoskeletal disorders[42]
3. Children having undergone orthopaedic surgery within the last six months.

Method of Data Collection

Ethical clearance has been obtained from ethical committee of Florence college of physiotherapy Bangalore.

Procedure

30 subjects were divided into two groups (Group A and B) by using Convenient Sampling. Group A was given Treadmill Training with AFO and De-Rotational Strap along with conventional exercises while Group B was given Conventional Physiotherapy along with gait training with AFO and de-rotational strap. Pre and Post intervention analysis of balance and cadence has been taken for both the groups.

Intervention for Group A: For Group A: Experimental Group (Treadmill Training with AFO and flexible de-rotational strap along with conventional physiotherapy exercisesFollowing conventional exercises will be given: Manual standing on the mat grasping the child around his knees. Manual standing on the mat with step forward and step backward grasping the child both knees. Kneeling and half kneeling on the mat to facilitate creeping position. Changing position exercises from prone to standing and from supine to standing position.

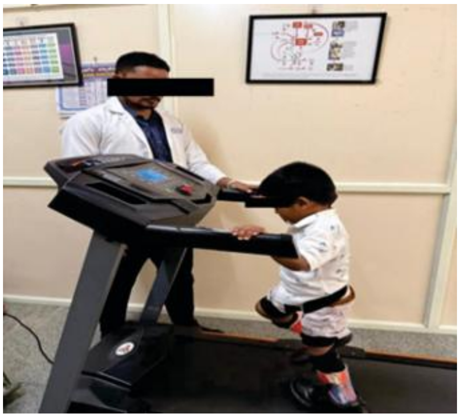

Fig 1.5 Treadmill Training with AFO and Flexible De-rotational Strap

Statistical Analysis

The collected data were tabulated and analysed using both descriptive and inferential statistics. All the parameters were assessed using statistical package for social science (SPSS) version 24, with a significance level of p value less than 0.05 and a 95% confidence interval set for all analysis.

Table-1.1 Comparison of FSST Score Between Group – A and Group - B In Pre and Post Test

Test	Group A		Group B		t - test	df	Significance
	Mean	S.D	Mean	S.D			
Pre Test	70.40	22.52	69.93	23.64	.055	28	.956*
Post Test	41.20	9.82	50.06	12.33	-2.17	28	.001**

The above table reveals the Mean, Standard Deviation (S.D), t-test, degree of freedom (df) and p-value between Group A & Group B in pretest and post test. This table shows that there is no significant difference in pre test values between Group A & Group B at $P > 0.05$.

Comparison of Cadence Score Between Group – A and Group - B in Pre and Post Test

The BELOW table shows that statistically significant difference in post test values between Group A & Group B at $P \leq 0.05$.

Test	Group – A		Group - B		t - test	df	Significance
	Mean	S.D	Mean	S.D			
Pre Test	70.93	7.43	69.60	3.60	.625	28	.537*
Post Test	87.00	7.15	77.26	3.51	4.73	28	.001**

DISCUSSION

The present study was conducted to determine the effectiveness of treadmill training combined with dynamic ankle foot orthosis (AFO) and flexible de-rotational strap on balance and cadence in children with Spastic Diplegic Cerebral Palsy. A total of 30 participants completed the study and were divided equally into two groups, with 15 participants in each group.

Group A received treadmill training combined with dynamic AFO, flexible de-rotational strap, and conventional physiotherapy, while Group B received gait training with dynamic AFO, flexible de-rotational strap, and conventional physiotherapy.

The collected data were analyzed using IBM SPSS Statistics, and the level of significance was set at $p \leq 0.05$. Balance was assessed using the Four Square Step Test (FSST). In the between-group comparison, there was no statistically significant difference between Group A and Group B during the pre-test assessment ($p > 0.05$), indicating that both groups were comparable before the intervention. Following treatment, Group A demonstrated significantly greater improvement in balance compared to Group B. The post-test mean value for Group A was 41.20 ± 9.82, whereas Group B showed a mean value of 50.06 ± 12.33, with a statistically significant difference of $p = 0.001$.

These findings indicate that treadmill training combined with dynamic ankle-foot orthosis (AFO) and flexible de-rotational strap was more effective in improving balance. Within-group comparison also revealed statistically significant improvement in both groups from pre-test to post-test. In Group A, the FSST score improved from 70.40 ± 22.52 in the pre-test to 41.20 ± 9.82 in the post-test ($p = 0.001$). Similarly, Group B improved from 69.93 ± 23.64 to 50.06 ± 12.33 ($p = 0.001$). Although both interventions were effective in improving balance, greater improvement was observed in Group A.

The present study was conducted to evaluate the effectiveness of derotational strap intervention along with conventional physiotherapy in improving gait and functional mobility in children with cerebral palsy. Cerebral palsy is one of the most common neurological disorders affecting movement, posture, balance, and gait patterns in children. Abnormal muscle tone, impaired motor control, muscle weakness, and rotational deformities significantly interfere with walking efficiency and gross motor activities in children with spastic cerebral palsy.

The results of the present study are also supported by the findings of Abd El Aziz Ali Sherief et al. (2014), who reported significant improvement in balance and lower limb performance following treadmill training combined with dynamic ankle-foot orthosis in children with spastic hemiplegic cerebral palsy. In conclusion, derotational strap intervention combined with conventional physiotherapy is effective in improving gait parameters, balance, and functional mobility in children with cerebral palsy. The intervention may contribute to improved walking ability, enhanced gross motor performance, and better quality of life in children with CP.

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