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Original Research Article

EFFECIVENESS OF NEURODEVELPMENTAL TECHNIQUE (NDT) ON GAIT PARAMETERS IN CHILDREN WITH SPASTIC DIPLEGIA

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ABSTRACT

Introduction: Walking is the main aspect of mobility and independence. Therefore emphasis should always be given to improve it in children with spastic diplegia. There are many studies that are carried out to reduce spasticity with conventional physiotherapy approaches to improve gait. But there are few studies where intervention as Neurodevelopmental Technique (NDT) approach used with specific treatment strategy. Hence this study incorporates NDT to find out the improvement on gait parameter in children with spastic diplegia.

Materials and Methods: 30 children diagnosed with spasticic diplegia between the age of 6 to 15 and Gross Motor Function Classification system levels II and III were selected for the study. Neurodevelopemental Technique (NDT) was given for 12 week period. Pre and post intervention values were measured. Outcome measures were gait parameters i.e. stride length, step length, step width and cadence.

Result: Comparison between pre and post intervention heart rate showed extremely significant result ($p < 0.0004$), GMFM values showed significant result ($p < 0.05$) and gait parameter showed significant result ($p < 0.05$) respectively

Conclusion: There was improvement in gait parameters of children with spastic diplegia when treated with Neurodevelopmental Technique (NDT). Improvement was seen on gait parameters.

KEY WORDS: Neurodevelpmetal Technique (NDT), Gait Parameters, Spastic Diplegia.

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INTRODUCTION

Locomotion or gait is defined as a translatory progression of the body as a whole produced by co-ordinated and rotatory movements of body segments. Normal gait is rhythmic, characterized by alternating propulsive and retropulsive motion of the lower extremities.[1] Gait initiation is a series or sequence of events that occur from the initiation of movement to the beginning of the gait cycle [1]. Interpretation of a gait is a complex activity. Therefore, gait has been divided into number of segment that makes it possible to identify the events that are occurring. The gait cycle includes the activities that occur from the point of initial contact of one lower extremity to the point at which the same extremity touches the ground again. One gait cycle passes through two phases i.e. stance phase and swing phase. In "Stance phase" some part of the foot is in contact with the floor, which makes up about 60% of the gait cycle. The "Swing phase" makes up 40% of the gait cycle it begins as soon as the toe of one extremity leaves the ground and ceases before heel strike or contact of the same extremity. Step length, stride duration, stride length, Width of BOS, cadence, toe out angle and walking velocity are the different gait parameters which can be measured while assessing the gait of an individual [1].

James Lance (1990) defined spasticity as 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 [2]. Recently, the definition of Lance was found too narrow and was suggested that it should be widened to disordered sensori-motor control, resulting from an upper motor neuron lesion, presenting as intermittent or sustained involuntary activation of muscles [3].

Spasticity of lower extremity can be seen many conditions like diplegia, hemiplegia, quadriplegia, meningitis etc. The most common condition is diplegia followed by hemiplegia and quadriplegia. The prevalence of spastic diplegia is highest in the most immature surviving infants and falls with increasing gestational age until after term when it may rise a little with post maturity. It affects bilateral lower extremities more than upper extremities, or lower extremities are solely involved [4]. Child's leg and hip muscles are tight. Legs cross at the knees, making walking more difficult. The gait is typically characterized by a crouch gait where the hips and knees are extensively flexed and ankles are in planter flexion [5]. Children with severe diplegia exhibited a lack of direction specificity in the leg muscles during backward body sway, which points to a basic deficit in balance and postural control. In addition, these children showed marked dysfunctions in the precise tuning of the balance and postural adjustments to task- specific conditions [6].

Spasticity can be measured by various tools and scales such as Modified Ashworth Scale, Tardieu scale etc. Modified Ashworth Scale is a subjective, 5-point ordinal scale. It is used for grading the degree of spasticity which remains the gold standard [7]. Children with lower extremity spasticity have reduced mobility in their lumbar spine, pelvis, and hip joint and show limited asymmetric pelvic tilt or pelvic rotation during gait. To compensate their reduced mobility of lower extremity these children shift their weight and maintain balance by using excessive mobility through the head, neck, upper trunk, and upper extremities. The hips stays flexed and the knees may be either flexed or extended during stance. Adduction and internal rotation at their hip and approximation of the knees is found in severe cases. The feet may be in valgus or close together in a narrow base of support in plantar flexion with the heels off of the floor [8].

Attainment of functional walking is a common goal of rehabilitation in cerebral palsy because of its impact on activities of daily living and social activity [9,10]. Among a variety of traditional interventions, neurodevelopmental treatment has been predominantly used over the years [11,12]. Therefore the purpose of this study was to investigate the effects of neurodevelopmental technique on gait paramaters in children with spastic diplegia.

MATERIALS AND METHODS

The research design used for the study was Pre-test Post-test design. The sampling design used was convenient sampling. The sample size was 30. Both boys and girls, clinically diagnosed as spastic diplegia and who were referred to Department of Pediatric Physiotherapy and willing to participate in the study. Participants were both boys and girls between the age group of 6 to 15 years, clinically diagnosed with spastic diplegia, with level II to III on Gross Motor Function Classification System (GMFCS), spasticity range from 1 to 2 (MAS).The total intervention period was 12 weeks, thrice a week. Each treatment session lasted for 50-60 minutes with adequate rest periods. The outcome measures used were gait parameters i.e. step length, stride length, width of BOS & cadence were measured.

30 participants were selected for the study. A written informed consent was obtained from their parents. A baseline data for gait parameter was collected and recorded on the first day of intervention. A week's trial session was given to the participants to get adapted to the intervention. 2 participants who refused to participate in the study during the trial sessions. Therefore, 28 participants were further included

in the study. The training was given once a day, thrice a week for total 12 weeks. The training duration for each session was for 50-60 minutes with 5 minutes of rest period and. Reassessment was done after the end of 12th week and data analysis was done. Statistical analysis was done using Graph Pad Instat software.

RESULTS

Using convenient sampling 30 participants were eligible for the study. There were 2 dropouts during the intervention. A total of 28 participants were examined for the study. The mean age of the participants was 10.51 with standard deviation of ±2.94. The gender ratio of boys to girls in intervention group was 08 girls and 20 boys.

Stride Length:

Right Stride Length: The pre intervention mean of right stride length score was 84.568cm ± 10.24cm and the post intervention mean of right stride length was 85.119cm ± 10.498cm. Using the 'paired t test' the p value was 0.0476 which denoted significant differences as the value of $p < 0.05$, t value=2.076 with d.f = 27.

Left stride length: The pre intervention mean of left stride length score was 84.559cm ± 10.226cm and the post intervention mean of left stride length was 85.123cm ± 10.399cm. Using the 'paired t test' the p value was 0.0458 which denoted significant differences as the value of $p < 0.05$, t value=2.093 with d.f = 27. (Table. 1)

Table 1: Comparison between the pre and post intervention mean value of Stride length.

Stride Length		Pre- intrvention	Post-intervetion	P value	t value	Results
Mean ± SD	Right	84.568±10.241	85.119±10.498	0.0476	2.076	Significant
	Left	84.559±10.226	85.123±10.399	0.0458	2.093	Significant

Step Length

Right Step Length: The pre intervention mean of right step length score was 42.420cm ±5.153cm and the post intervention mean of right step length was 42.741cm ± 5.788cm. Using the 'paired t test' the p value was 0.0314 which denoted significant differences as the value of $p < 0.05$, t value= 2.269 with d.f = 27.

Left Step Length: The pre intervention mean of left stride length score was 84.559cm ± 10.226cm and the post intervention mean of left stride length was 85.123cm ± 10.399cm. Using the 'paired t test' the p value was 0.0458 which denoted significant differences as the value of $p < 0.05$, t value=2.093 with d.f = 27. (Table No.2)

Table 2: Comparison between the pre and post intervention mean value of Step length.

Step Length		Pre- intrvention	Post-intervetion	P value	t value	Results
Mean ± SD	Right	42.420±5.153	42.741±5.788	0.0314	2.269	Significant
	Left	42.264±5.083	42.490±5.146	0.0317	2.266	Significant

Cadence: The pre intervention mean of cadence score was 15.786steps/min ±2.515 steps/min and the post intervention mean of cadence score was 16.000 steps/min ±2.653 steps/min. Using the 'paired t test' the p value was 0.0114 which denoted significant differences as the value of $p < 0.05$, t value=2.714 with d.f = 27. (Table No.3)

Table 3: Comparison between the pre and post intervention mean value of cadence.

Cadence	Pre-intervention	Post-intervention	p value	t value	Result
Mean ± SD	15.786±2.515	16.000±2.653	0.0114	2.714	Significant

Width of BOS: The pre intervention mean of step width score was 11.075cm ±1.589cm and the post intervention mean of step width was 10.911cm ±1.694cm. Using the 'paired t test' the p value was 0.0011 which denoted significant differences as the value of $p < 0.01$, t value=3.659 with d.f = 27 (Table No 4)

Table 4: Comparison between the pre and post intervention mean value of Width of BOS

Width of BOS	Pre-intervention	Post-intervention	p value	t value	Result
Mean ± SD	11.075±1.589	10.911±1.694	0.0011	3.659	Very Significant

DISCUSSION

Gait or locomotion is very important for an individual to move from one place to another place for the means of daily activity. The result of right and left stride length was assessed prior to the intervention and on 12th week of intervention. It shows significant difference it concludes that there is improvement in forward rotation of the pelvis and extension of the hip and knee on the weight bearing side. Increased in stride length and plantar-flexor generating power at push off after training was seen. This could be explained by better stability around both hip and knee that increases stability in stance and which makes it easier for the ankle plantar-flexors to push off actively. The increased stride length and push off corresponds well with the increase in muscle strength around the hips and with the increase in balance. This concludes that there is improvement in ground clearance which suggests that there is improvement in dorsiflexor strength and appropriate hip-knee flexion is achieved. There was also gradual decrease in base of support and increase in number of steps which tells that there is improvement in balance and co-ordination.

The studies has been documented that children with cerebral palsy use excessive muscle co-contraction during voluntary movement, a clinical concern is the potential for inadvertent strengthening of the spastic antagonist muscle during training of the agonist through persistent co-contraction or other neural mechanisms [14]. Improvement in the muscle recruitment increases the balance and dissociate the movement which is required for the normal gait.

CONCLUSION

Children with spastic diplegia have an improvement in gait parameters when treated using Neurodevelopmemtal technique (NDT) strategies.

Limitations: More accurate outcome measure such as 3D gait analyser could have given precise results.

Conflicts of interest: None

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