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RESEARCH ARTICLE
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EFFECT OF NEURO-DEVELOPMENTAL ABDOMINAL ACTIVATION ON GROSS MOTOR FUNCTION AND MUSCLE TONE IN SPASTIC DIAPLEGIC CEREBRAL PALSY CHILDREN

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ABSTRACT

Background: Cerebral palsy is the static encephalopathy with primary lesion not progressive and secondary problems may change according to the development of brain. Spasticity is the most common problem related to CP. Bobath therapy is a facilitation technique that was used to activate muscles, improve gross motor functions and to reduce spasticity.

Aims and Objectives: The aim of the study was to determine the influence of the effects of abdominal activation as to determine the change in gross motor function and reduction in muscle tone.

Methods and Methodology: A quantitative, randomize clinical trial was conducted allocating patients randomly into two groups. One was control group (G1) and the other was treatment group (G2). Baseline treatment was given to the control group which included lower limb passive stretching exercises and interrupted direct Current (IDC). However, baseline treatment with Bobath (facilitation) technique was given to the treatment group for Abdominal Muscle Activation. The measuring tool used for assessment was GMFS 88 to check motor functions of lower limb, GMFS for gross motor function, Modified Ashworth scale to analyze spasticity.

Results: The study showed significant improvements in gross motor functions and reductions in spasticity in children with diaplegic cerebral palsy. For Gross Motor Functional Scale the treatment group improved significantly (mean difference 1.541, p-value 0.000). For Modified Ashworth Scale the treatment group showed significant improvement (mean difference 2.761, p-value 0.000). In Gross Motor Function Measure (GMFM-88) significant improvement was observed in the treatment group (mean difference 3.928, p-value 0.000). Pre- and post-treatment comparisons revealed that

neuro-developmental techniques effectively enhanced motor function and reduced muscle tone in the participants over the course of 8 weeks.
Conclusion: The study showed significant improvement in gross motor functions and decrease in spasticity of lower limb in children with cerebral palsy.

Key words: Cerebral palsy (CP), Gross motor function measures (GMFM), interrupted direct current (IDC).

INTRODUCTION

Cerebral palsy is the group of non-progressive disturbance occurred in developing fetal or infant brain, a group of permanent disorders of development of movement and posture, causing activity limitations. The disturbance of sensation, perception, and cognition, behavior, by epilepsy and by other musculoskeletal problems are the motor defects of cerebral palsy (1). It results in motor impairments secondary to abnormalities arising in developmental stages. Secondary to lesion of the brain or abnormalities present in early development, cerebral palsy is a group of non-progressive motor impairment (2).
Spasticity is an increase of the reflex of passive muscle stretching, which alters movement speed, and shows up an involuntary muscular activation. Spasticity is sensorimotor dysfunction which causes functional limitations. More musculoskeletal repercussions like pain, joint dislocations and deformities also take place over time (3). Spasticity has long been well-thought-out the primary damage in children with cerebral palsy, the manifestation of weakness accompanying with the upper motor neuron lesion is resulted in increasing muscle tone (4). The type of cerebral palsy called spastic cerebral palsy is characterized by increased tone of muscles which affects the movement by resisting it when movement is performed. As well as, it may leads to joint deformities, mal-positions and contractures which moreover weaken the muscles and limits the activity (5).
Most classification systems for cerebral palsy have been supported with the severity of the disorder but this can be very specific and thus unreliable (6, 7). Some classifications developed with the indication of Functional capacity of patient. Therefore, Gross Motor Functional Measurement scale was created to specify more accurately about functional capacity of cerebral palsied. It indicated the degree of severity in patients with limitation of activity. According to literature, the therapeutic classification also presented with the treatment requirement of cerebral palsy person. The classes involved the patient with no requirement of treatment, patient with bracing and minimum treatment and patient with long term requirement of treatment (8).
The core muscles contract to increase the stability of the spine. The activation in muscle occurred in typical synergies best matched to complete a specific activity (9). In cerebral palsy the limited abdominal muscle activation and absence of motor planning permitting the precise speed and force of muscle contraction is obvious which leads to contribute in balance and postural control disturbances (10). The activation in muscle occurred in typical synergies best matched to complete a specific activity. The reduced abdominal muscles activation, absence of motor control and delayed muscles activation is often documented with postural dysfunction in cerebral palsy (8).Trunk control measurement is the clinical scale to assess the trunk control during functional activities in children with spastic cerebral palsy (11). The body's capacity of movement and position control can be explained by "Core stability". It will train the muscles of abdomen, spine, pelvis, shoulders to preserves the posture and helps to provide the starting to movement of extremities. Spinal stability relies on the core stability which further is important for the movement production and acquires the endurance, strength and sufficient power from core muscles. The core muscles are power house for generating the movement of limbs, it's like a double-walled cylinder in which the para-spinals are the back and abdominal is front, the diaphragm acts as the roof, and the musculature of the hip girdle and pelvic floor serves as the basement of the house. (2).
Some treatments used in cerebral palsy rehabilitation are neurodevelopmental (NDT) techniques

(3).The concept of bobath or Neurodevelopmental techniques followed the concept of plasticity of central nervous system along with motor control techniques that practice the continuous patterns of inhibitory postural reflexes and normal patterns of movements from daily activities of life (12). Neuro-developmental techniques are the most generally acknowledged and applied approach of treatment in order administer as the rehabilitation of children with Cerebral Palsy worldwide. It is a system approach including multiple dealing techniques centered on the facilitation of active movement to promote motor learning and skill attainment. Handling techniques emphasis on accomplishment the functional, goal-directed events through facilitating transitions between postures, abdominal muscle activation and weight shifts adjustments. The neuro-developmental techniques are anticipated to use in investigation of movement and to make treatment goals. Any treatment followed in order to achieve these treatment goals should be based on evidence. It was estimated that 88% of physiotherapists dealing their patients with neurological disorders were NDT trained in UK. The NDT concept concluded that the motor deficits in children with CP were due to their physical deterioration and if spasticity and abnormal reflexes are inhibited then improvement could be seen into functional mobility. Moreover, these techniques cannot stop the release of neurotransmitter but facilitatory techniques can be used in NDT with repeated tasks (13).
The Bobath procedure or Neurodevelopment Treatment (NDT) is concerned with the neuroplasticity of the nervous system along with the postural control mechanisms and motor learning. The framework of NDT focused on the examination of movement and movement dysfunction and enhanced the ability to produce coordinated sequences of movement. According to the new concept of the NDT, the incorporation of posture and movement during task and the use of facilitatory techniques by sensory stimulation promoted the motor learning (12).

METHODS

This was the Randomize Control Trial research. A quantitative, randomize clinical trial was conducted allocating patients randomly into two groups. However, randomization of the patients in two groups was done in such a way that one was control and other was the treatment group. Baseline treatment was given to the control group as well as treatment group which included the lower limb passive stretching exercises and interrupted direct current. However, Neuro-developmental technique along with baseline treatment was given to the treatment group. The measuring tool used for assessment was GMFS 88 for gross motor function, GMFS for assessment of general level of mobility, modified Ashworth scale to analyze spasticity.
It included the CP spastic diaplegic children with GMFS level 1-3. The measurement of spasticity was taken with Modified Ashworth Scale and children with readings of (0-2) were included. Patient analysis was done with GMFMS 88. Pre and post-intervention measurements were taken.
The principal of beneficence was observed in both the control and intervention groups continued to receive their physiotherapy intervention three times a week, thus ensuring no harm in loss of treatment time. The only possible side effect of treatment with electrical stimulation (contra-indications mentioned in the exclusion criteria) could be minor skin reactions. This adverse effect was not encountered by any of the participants. Individuals decided on their own comfort level in terms of electrical stimulation intensity and informed their treating physiotherapist if they would like to either increase or decrease this intensity during use, thus respecting the principal of non-maleficence.

Intervention Plan:
Baseline treatment:
It includes:
Interrupted direct current (IDC)

Duration: 100ms
Frequency: 30 per minute
Stretching Exercises:
Passive stretching of all lower limb joints (14).

Group A:
(Control group) G1
It included the Baseline treatment.

Group B:
(Treatment group) G2
It included the Baseline treatment and Neuro- developmental techniques.

Neuro-developmental techniques:
Key elements to Applying NDT are Alignment (Cannot impose normal movement on maligned joints), handling (Facilitation, Key points), and placement (Assisting patients in achieving the appropriate).

Intervention framework: It includes starting posture that begin with the most efficient posture from which to move upright and reorient to midline, missing components to Observe starting posture and make comparisons to normal, Select a movement-based functional intervention which progresses patient toward mobility goals. And use of manual cues hands on key points of control to facilitate normal posture/movement.

Follow ups and treatment sessions:
Both groups received therapy for three times weekly for two months (2).

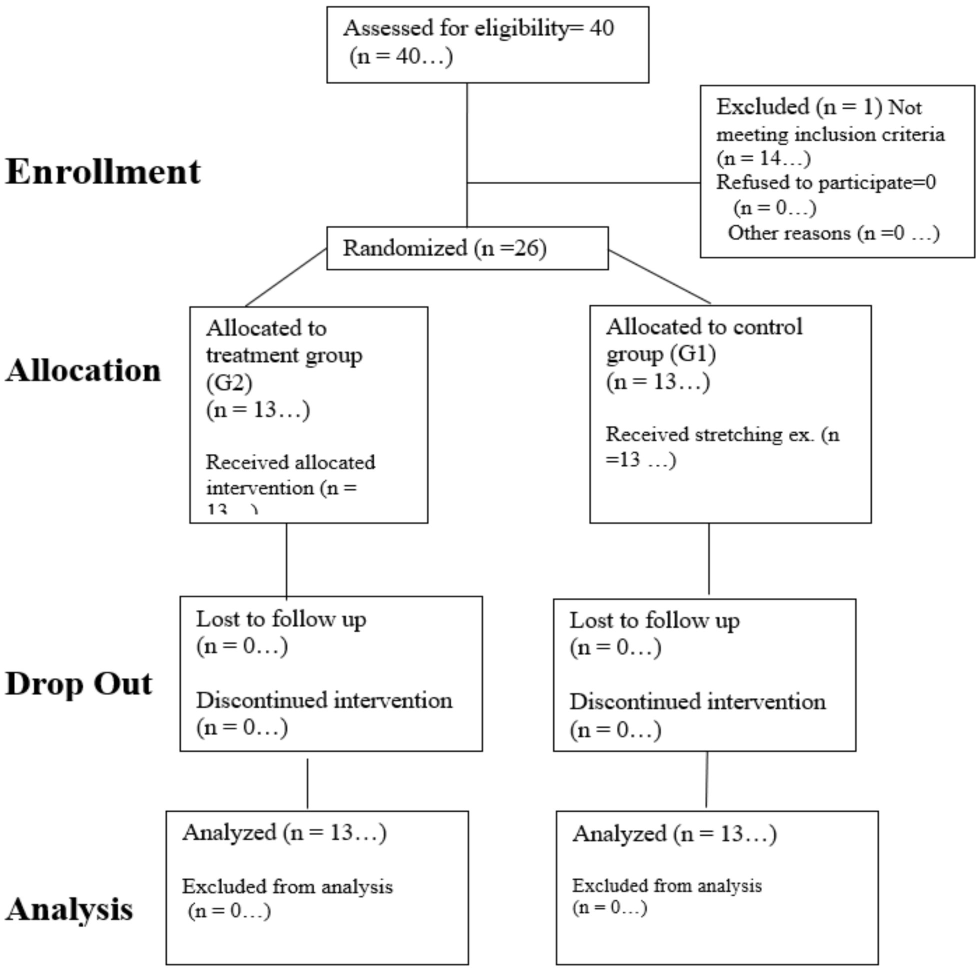

FIGURE 1. Consort diagram.

RESULTS

Descriptive statistics

Table 1- Age distribution of control group and Treatment Group

GROUP OF CONTROL	YEARS	FREQUENCY	PERCENTAGE
CONTROL	8	3	23.1
	9	3	23.1
	10	2	15.4
	11	1	7.7
	12	2	15.4
	13	2	15.4
	Total	13	
TREATMENT	9	1	7.7
	10	1	7.7
	11	2	15.4
	12	2	15.4
	13	2	15.4
	14	2	15.4
	15	3	23.1
	Total	13	

G1 included 3 patients (23.1%) aged 8, 3 patients (23.1%) aged 9, 2 patients (15.4%) aged 10, 1 patient (7.7%) aged 11, 2 patients (15.4%) aged 12, and 2 patients (15.4%) aged 13. G2 included 1 patient (7.7%) aged 9, 1 patient (7.7%) aged 10, 2 patients (15.4%) aged 11, 2 patients (15.4%) aged 12, 2 patients (15.4%) aged 13, and 3 patients (23.1%) aged 15.

Table 2- Description Statistics of Age of Patients

AGE OF PATIENTS (YEAR)			
CONTROL	N	Valid	13
		Missing	0
	Mean		10.15
	Std. Deviation		1.864
	Minimum		8
	Maximum		13
TREATMENT	N	Valid	13
		Missing	0
	Mean		12.62
	Std. Deviation		1.981
	Minimum		9
	Maximum		15

This table explained descriptive statistics of both groups, minimum age were 8 and maximum age were 13 with mean $\pm$S.D, 10.15 $\pm$ 1.864 in G1 and G2 minimum age were 9 and maximum age were 15 with mean $\pm$ S.D, 12.62 $\pm$ 1.981.

Table 3- Gender distribution

Gender	Frequency	Percent
Male	18	69.2
Female	8	30.8
Total	26	100.0

Table-3 explains the Gender of patients that are included in study. Out of 26 patients were included in this study in which 18(69.2%) were male and 8(30.8%) were female.

Table 4- Assessment for Control Group

Control Group		Mean	Df	Std. Deviation	p-value
Pair-1	Pre-Gross motor functional scale classification & Post-Gross motor functional scale classification	1.85	12	.801	.165
Pair-2	Pre-Modified Ashworth scale & Post-Modified Ashworth scale	1.38[a]	13	.506	.124
Pair-3	Pre-Gross motor function scale 88 Post-Gross motor function scale 88	4.07692	12	1.75412	2.115

This table explains paired t test results, which revealed that total 13 patients were lied in each group. There was no significant difference in this pair-1 (p-value 0.165) with Mean ± SD (1.85 ±0.801) and pair-3 (p-value 2.115) with Mean ± SD (4.077 ±1.75). There were significant results in this pair-2 (p-value 0.124) with Mean ± SD (1.38±0.506).

Table 5- Pair T Test for Treatment Group

Treatment group		Mean	Df	Std. Deviation	p-value
Pair-1	Pre-Gross motor functional scale classification & Post-Gross motor functional scale classification	1.541	12	.376	.148
Pair-2	Pre-Modified Ashworth scale & Post-Modified Ashworth scale	2.761	12	1.236	.000
Pair-3	Pre-Gross motor function scale 88% Post-Gross motor function scale 88	3.928	12	1.412	.000

This table explains paired t test results that there were no significant results in this pair-1 (p-value 0.148) with Mean ± SD (1.541 ±0.376). There were significant result in this pair-2 (p-value .000) Mean ± SD (2.761 ±1.236) and pair-3 (p-value .000) with Mean ± SD (3.928 ±1.412).

Table 6- Independent t test on pretreatment scale

	Groups	N	Mean	S.D	P-VALUE
Gross motor functional scale classification	Control	13	2.53	1.670	.752
	Treatment	13	2.00	2.164	
		N	Mean	S.D	P-VALUE
Modified Ashworth scale	Control	13	1.99	2.116	.266
	Treatment	13	2.45	1.306	
		N	Mean	S.D	P-VALUE
Gross motor function scale 88	Control	13	70.67	15.33	.550
	Treatment	13	73.83	13.54	

Table 6 explains results of independent t test on pre-treatment G1 and G2. It showed no significant difference for Gross Motor Functional Scale (p-value 0.752), Modified Ashworth Scale (p-value 0.266) and Gross Motor Function Scale 88(p-value 0.550).

Table 7- independent t test on post treatment scale

	Groups	N	Mean	Std. Deviation	p-value
Gross motor functional scale classification	Group-1	13	2.00	.913	.000
	Group-2	13	2.78	.816	
Modified Ashworth scale	Group-1	13	2.00	.816	.050
	Group-2	13	2.38	.506	
Gross motor function scale 88	Group-1	13	69.7692	13.30510	0.040
	Group-2	13	71.3846	12.45350	
	Group-2	13	41.0769	9.33150	

Table 7 explains results of independent t test on post treatment patients. Gross Motor Functional Scale, Modified Ashworth Scale, Gross Motor Function Scale 88 showed significant improvement in the treatment group (p-value 0.000), (p-value 0.050) and (p-value 0.040) respectively.

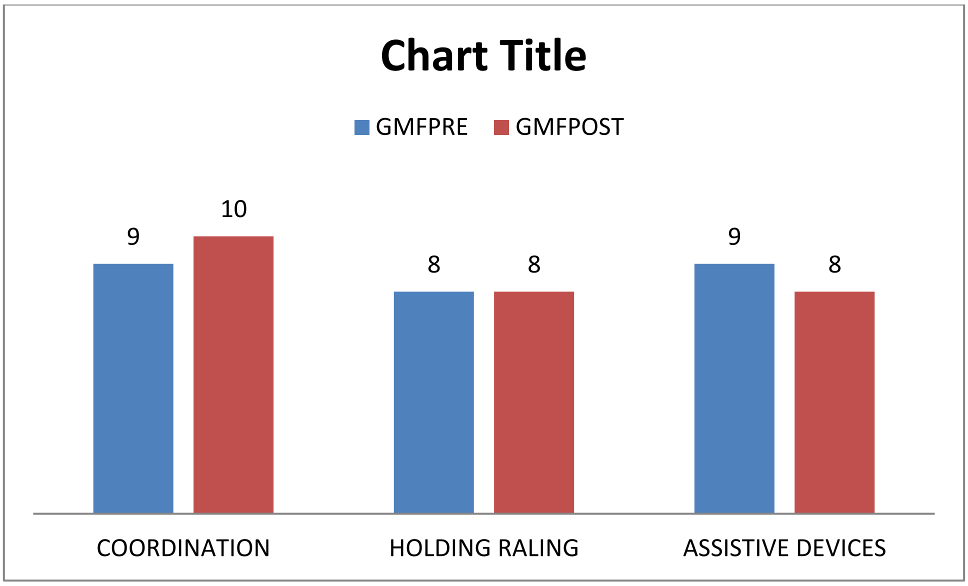

Fig 2 Bar chart of GMF effect

Bar chart showing improved gross motor function after treatment.

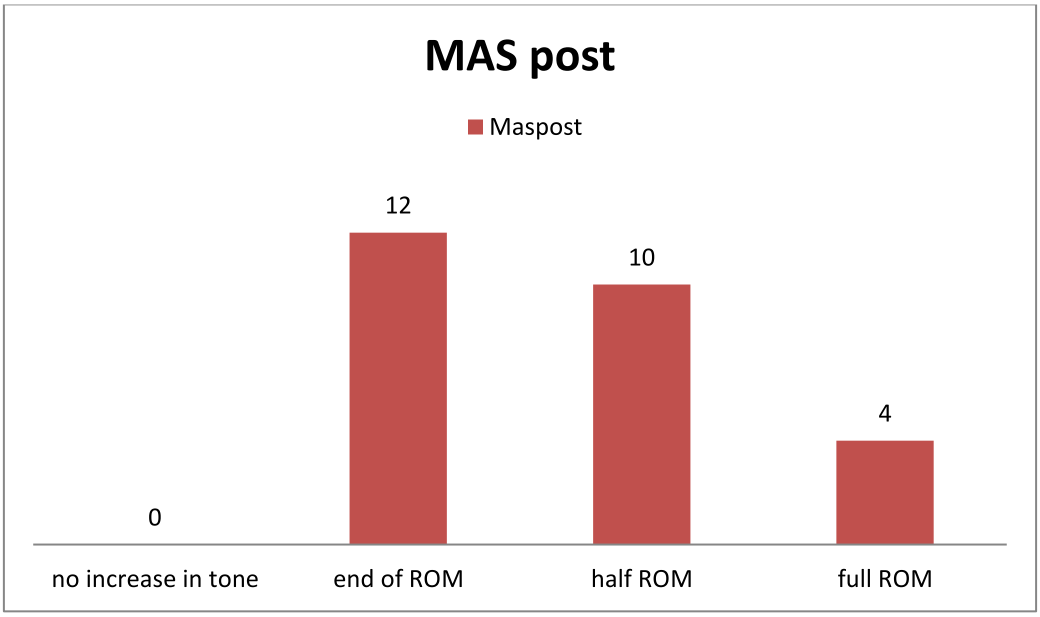

Fig 3 Bar chart of MAS effect

Bar chart showing reduced muscle spasticity after treatment.

DISCUSSION

This study was a randomized control trial conducted on convenient sample of 26 cerebral palsy children. The study parameters were compared within groups and between groups to investigate the effectiveness of abdominal muscles activation in improvement of motor functions in diaplegic cerebral palsy. The study resulted that there is significant improvement in motor functions of lower limb with activation of abdominal muscles. The most notable findings revealed on statistical analysis of results were that there is significant result in reduction of spasticity with the use of neurodevelopmental techniques. There is significant improvement in treatment group after the received intervention of two months. This significant improvement in

GMFM scores for treatment groups might be due to activation of trunk muscles. A further objective looked at whether any improvements made in functional status of children included in control group receiving baseline treatment. The findings of current study proved a link between abdominal activation and gross motor function.

Likewise, The result of another study showed the significant improvement in gross motor function measurement for both groups after intervention of two months which is due to improvement of trunk muscles strength (2). In another research improvements made in stability of the core muscles for unsupported sitting, reported in increased of functional mobility for reaching and grasp control in spastic diplegic cerebral palsy child (9).

At the other end of the spectrum, severe category of cerebral palsy showed very low improvements and did not change much. It was obvious in this study, where cerebral palsied with GMFCS Level V reached only 20% (15). In a Norwegian study of adults with cerebral palsy (aged of 20 to 58 years) with hemiplegia and in one-third of participants with diplegia.,the improvement percentages was shown as 70% of the participants with hemiplegia and 43% of participants with diplegia improved or remained unchanged in walking (16).

CONCLUSIONS

This study showed significant improvement in gross motor functions in children with cerebral palsy over 8 weeks using neuro-developmental techniques. These techniques further reduced spasticity, leading to better functional outcomes. This information can help parents and therapists choose appropriate treatments. Bobath's concept, a key neuro-developmental approach, effectively activates abdominal muscles to improve the Gross motor functions of lower limb.

CONFLICTS OF INTEREST

The authors declare no conflict of interest

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COMPLIANCE WITH ETHICAL STANDARDS

Ethical letter was obtained from The university of Faisalabad with Ref: TUF/IRB/128/2022

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