ISSN : 2350-0743

www.ijramr.com

International Journal of Recent Advances in Multidisciplinary Research
Vol. 07, Issue 01, pp. 5449-5452, January, 2020

RESEARCHARTICLE

EFFECT OF PELVIC STABILITY ON BALANCE IN CHILDREN WITH SPASTIC CEREBRAL PALSY

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ARTICLEINFO

Article History:
Received 20th October, 2019
Received in revised form
19th November, 2019
Accepted 15th December, 2019
Published online 30th January, 2020

Keywords:
Cerebral Palsy
Pelvic Stability Balance.

ABSTRACT

Background: Children with spastic cerebral palsy have a pelvic instability which affect on balance ability. **Purpose:** to determine effect of pelvic stability training on balance in children with spastic cerebral palsy. **Subjects and Methods:** Thirty two children with spastic cerebral palsy participated in this study and divided into two equal groups,(control and study). Berg balance scale used for assessment before and after treatment. The control group received a designed physical therapy program; and the study group received pelvic stability program in addition to the designed physical therapy program for 12 weeks 3 times /week for both groups. **Results**: Increase in scoring of BBS in both groups with more significant difference in study group (P= 0.02). **Conclusion:** This study concluded that pelvic stability training is beneficial in improving balance in children with spastic cerebral palsy.

INTRODUCTION

Cerebral palsy (CP) is a complex neurological condition due to a non progressive lesion in the developing brain which affects the child's typical development of movement and posture. The impact of the lesion (s) on function is considerable and varying. While some children may demonstrate only slight abnormalities in movement patterns, others may be unable to perform even the most basic functional activities such as sitting independently or eating (Rosenbaum *et al*., 2007).The topographic classification of CP is monoplegia, hemiplegia, diplegia and quadriplegia; monoplegia and triplegia are relatively uncommon. There is a substantial overlap of the affected areas. In most studies, diplegia isthe commonest form (30% – 40%), hemiplegiae is 20% –30%, and quadriplegia accounting for 10% – 15%. (Chitra Sankar and Nandini Mundkur, 2005).Balance is the ability to maintain one's projected center of mass with respect to one's base of support to orient and align the body in space.1 Balance is a requisite component for successful completion of functional activities including loco motor and manipulative skills. *functional balance in children* is defined as the ability to maintain the center of mass with respect to the base of support during typical childhood activities of daily living, school, and play (Mary Rose *et al*., 2016).Balance and posture control are important for functional activities. Cerebral palsy (CP) children have poor postural balance control compared to normal children due to slowed and impaired development of their neural motor control mechanisms combined with so-called secondary musculoskeletal abnormalities(e.g. muscle spasticity, muscle weakness, low proprioception and bone deformations) (Donker, Ledebt and Roerdink, *et al*. 2008). Balance training is an important part of rehabilitation of CP children because it has been shown thatthere is a relation between constraints on balance control and functional limitations of CP children (Hsue, Miller and Su , 2009).The aim of this study was to determine effect of pelvic stability on balance in children with cerebral palsy.

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MATERIALS AND METHODS

Participants: Thirty-two children with spastic cerebral palsy participated in this study with following criteria the age from 4-7 years spasticity range from grade I+ and grade 2 and growth motor function classification system at level I and level III, the selected group was divided into control and study group, each group had 9 hemiplegic and 7 diaplegiccerebral palsy children. Children can follow orders correctly children were excluded according to any Anti spastic drugs during the period of the study Spastic cerebral palsy with any congenital, cardio respiratory condition psychiatric or behavioral disorders like autism, visual and hearing disabilities. Fixed contractures and deformities, the control group had followed the designed physical therapy program while the study group had followed the pelvic stability program in addition to the deigned physical therapy program for 12 weeks 3 session / week as the aim of

this study to determine effect of pelvic stability on balance in children with cerebral palsy.

Procedures:

Berge balance scale

The Berge balance scale (PBS), a modified version of the BBS. The 14 items that make up the PBS assess many of the functional activities a child must perform to safely and independently function within the home, school, or community: sitting balance, standing balance, sit to stand, stand to sit, transfers, stepping, reaching forward, reaching to the floor, turning, and stepping on and off of an elevated surface. Each item is scored on a 4-point scale. It can be administered and scored in less than 20 minutes using equipment commonly found in schools and clinics. This test has been shown to have good test–retest and interrater reliability when used with school-age children with mild to moderate motor impairment (Franjoine, Gunther and Taylor, 2003).

Intervention: The designed Physical Therapy training was range of motion exercises for upper and lower extremities, stretching exercise to maintain length and elastic properties of muscles ,strengthening of ant gravity muscles especially back muscles ,push up exercises on both hands , stop and recovery exercise ,gait training, climbing up and down staires and increase weight gradually on both ankles and balance training from different positions from quadruped, kneeling ,half kneeling and standing positions and it last for 3 Sessions for 1 hour and half for 12 Weeks for control and study groups.

Pelvic stability program for the study group

Pelvic bridge: Child in crook lying position with least involved leg crossing over the most involved leg, Unilateral pelvic bridge with postural sway, Dynamic pelvic stability in sitting: While seated on an unstable support surface and feet kept on another the rapod the child is instructed to reach forwards, sideways and diagonal directions. Clamp shell exercise for gluteus medius: child was lying on the most involved side with both hips and knees flexed to 90°. Therapist places the hand at the distal 1/3 of the lateral aspect of thigh i.e., above lateral femoral condyle and the other hand stabilizing the patient's pelvis. child was instructed to abduct the top hip against the therapist's manual resistance while keeping both knees flex (Lavnika etal., 2017).

Dynamic Stability Bridge Series

- Double Leg Bridge.
- Circuit ex

Prep Exercise for Circuit B: Pelvic Drop

- Step onto the edge of the box and balance on L leg. Place hands on hips. Stand tall with abdominals engaged. The R hip should be lower than L hip at start position. Then lift R hip on stance leg up to level of L hip. Be sure not to hip hike L hip, as the focus is on the R hip. Fatigue should be felt in the R hip and gluteal.

Exercises: Hip Flexion, Abduction, Abduction with Internal Rotation: Abduction with Hip Extension, Hip Extension: Large Clockwise Circles, Large Counterclockwise Circles:, Single Leg Box Squat:

Advanced Lateral Hip and Gluteal Strengthening Exercises

Fire Hydrants

Position and Movement: On all fours, hands directly under shoulders and knees over hips. Abdominals are engaged. Lift leg up and out maintaining 90 degrees of hip flexion and knee flexion. Avoid rotating hips or arching back as you lift the leg. Goal is to lift thigh to level of torso. Foot is flexed the entire time.

Reps: 8-10 lifts

Sets: 2-3 on each side

It last for 3 sessions for half an hour for 12 weeks for study group.

Data analysis: Descriptive statistics and unpaid t-test conducted for comparison of subject characteristic between both groups. Chi squared test was conducted for comparison of sex and type of CP distribution between control and study groups. The level of significance for all statistical tests was set at $P < 0.05$. All statistical analysis was conducted through the statistical package for social studies (SPSS) version 22 for windows (IBM SPSS, Chicago, II., USA)

RESULTS

I- Pre treatment mean value of BBS of the control and study groups: The mean ± SD BBS of the control group pre treatment was 40.25 ± 5.06 while that of the study group was 40.37 ± 7.72. The mean difference between both groups was -0.12. There was no significant difference in the BBS between the control and study groups pre treatment ($p = 0.95$). (Table 1).

Post treatment mean value of BBS of the control and study groups: The mean ± SD BBS of the control group post treatment was 40.87 ± 5.58 while that of the study group was 46.25 ± 7.38. The mean difference between both groups was -5.38. There was a significant increase in the BBS of the study group compared with that of the control group post treatment ($p = 0.02$). (Table 2)

DISCUSSION

The aim of this study is to detect the effect of pelvic stability on balance in children with spastic cerebral palsy. Children with cerebral palsy (CP) have impaired muscle tone and abnormal postural control, both of which affect functional balance. Balance and upright postural control are the fundamental components of movement; they involve both the ability to recover from instability and the ability to anticipate instability and avoid It. Static and dynamic balance reactions of children with CP are poorer than those of healthy children. As balance skills are an integral part of gross motor abilities, poor balance causes difficulties in functional tasks of daily living (Sook-Hee *et al*., 2012). Children with CP experience difficulties with controlling the body's position in space, performing anticipatory adjustments for executing functional

Table 1. Comparison of pre treatment mean value of BBS between the control and study groups

	Control group	Study group	MD	t- value	p-value	Sig
	$\overline{X}$ ±SD	$\overline{X}$ ±SD				
BBS	40.25 ± 5.06	40.37 ± 7.72	-0.12	-0.5	0.95	NS

$\overline{X}$: Mean SD: Standard deviation MD: Mean difference

t value: Unpaired t value p value: Probability value NS: Non Significant

Table 2.Comparison of post treatment mean value of BBS between the control and study groups

	Control group	Study group	MD	t- value	p-value	Sig
	$\overline{X}$ ±SD	$\overline{X}$ ±SD				
BBS	40.87 ± 5.58	46.25 ± 7.38	-5.38	-2.32	0.02	S

$\overline{X}$: Mean SD: Standard deviation MD: Mean difference

t value: Unpaired t value p value: Probability value S: Significant

activities and reacting to unexpected perturbations of balance. The primary causes of the deficits in fine posture control adjustment in children with CP include the order of muscle recruitment, the rate of agonist/antagonist co-activation, in coordination of joint segments and recruitment of fewer motor units responsible for coordinating postural responses. Together, these changes increase the difficulty of controlling the body in space and define low levels of coordination between the joint segments of the body9. Therefore, the child with CP presents with increased CoP oscillation to achieve adaptive success in their daily activities4. Because of the neuromotor deficits and biomechanical changes in these children, the alignment between body segments and CoP maintenance within the limits of the support base are compromised(Liu *et al*., 2007).

The mean difference between pre and post treatment was -0.62 and the percent of change was 1.54%. There was a significant increase in the BBS of the control group post treatment compared with pre treatment (p = 0.02) while The mean difference between pre and post treatment was -5.88 and the percent of change was 14.57%. There was a significant increase in the BBS of the study group post treatment compared with pre treatment (p = 0.0001). The mean difference between both groups was -5.38. There was a significant increase in the BBS of the study group compared with that of the control group post treatment (p = 0.02). Physical therapy exercise has an effect on balance improvement as Baatile and *et al.* (2000) demonstrated that 8 weeks of exercising can lead to increase in the functional independence and life quality.

Hirch *et al.* (2003, 2007, 2009) (Hoehn and Yahr Scales). indicated that strength and equilibrium can be increased on both sides of the body by exercising after 12 weeks of strength training. Vishal *et al*., 2017who approved that pelvic training exercise help to improve control of pelvis which is a key point for maintaining trunk control, gait and balance by stimulation of muscle and joint proprioception**.** Also this agree with study hypothesized that balance and gait function would improve with pelvic control following a hip extensor strengthening exercise (HESE) program for the paretic lower extremity. This program was performed by a therapist manipulating the subjects for about half an hour a day in the supine position, side-lying position, and prone position on a treatment table. The HESE program comprised six steps: Hip extension and posterior tilt movement; Rotation extension movement of both the legs; Hip joint and pelvis movement using a therapeutic ball; Hip joint and pelvis movement using a therapeutic ball. Hip joint extension muscle strengthening movement in the side-lying position; and 6.Hip joint extension muscle strengthening movement in the prone position(Byoung *et al*., 2015).Pelvic stability refers to the ability of coordinated activity between the lower trunk and proximal hip muscles during functional balance and mobility tasks in which the pelvis serves the proximal dynamic stability as to allow for effective lower limb mobility (Lavnika *et al*., 2018).An improved pelvic stability not only show a practice effect on balance ability but also allow better stance control and limb advancement, which are the major determinants of gait speed and cadence all positively influence the balance, gait and functional performance (Park *et al*., 2015).

Limitations: Firstly small number of participants (n=32) which limits the generalizability of results .secondly we excluded children with other neuromotor types because homogeneity of participants would facilitate interpretation of results.

Conclusion

The pelvic stability training is beneficial in improving balance in children with cerebral palsy.

Acknowledgement: We are grateful to study participants.

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