



Research Article

Effectiveness of Vestibular Stimulation on Balance Using Swing Therapy in Children with Hypotonic Cerebral Palsy

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Abstract:

Background: Hypotonic cerebral palsy is the non-progressive neurodevelopmental disorder of the immature brain that covers a broad spectrum of syndromes which is related to motor and postural impairment, and balance problems during both gross and fine motor activities.

Objective: To assess the effectiveness of vestibular stimulation on balance using swing therapy in children with hypotonic cerebral palsy.

Methods: A single-blinded randomized clinical trial was conducted on sample of 52 patients with level-II motor functions on gross motor function classification system (GMFCS). All other types of cerebral palsy like Spastic, Athetoid and Ataxic were excluded from the study. Simple random sampling technique was used, data was collected from subjects visiting to Pediatric Physical Therapy Department, and randomly allocated into two groups; comprising 26 patients in each via lottery method. The Group A was treated with vestibular stimulation for balance by swing therapy and conventional methods of rehabilitation including; walking on parallel bars, proper positioning and stretching exercises and while in group B only conventional techniques was used. Swing therapy was given for total 8 weeks on alternate days for 15 minutes and post intervention effect was recorded on pediatric balance scale.

Results: The mean age of patients was 5.83 ± 1.92 years. For Group A and B, pre-treatment mean on pediatric balance scale was 3.07 ± 1.24 and 3.03 ± 1.31 and post-treatment mean was 1.51 ± 1.72 and 2.69 ± 1.61 . The measured value of "t" score was (-3.76) and "P" value was (0.001) showing significant change, as this was less than the reference value 0.05.

Conclusion: The current study concluded that swing therapy when integrated with other conventional methods of rehabilitation proved to be effective in improving balance in children with hypotonic cerebral palsy.

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Keywords: Vestibular Stimulation, Swing Therapy, Cerebral Palsy

Introduction:

Cerebral palsy (CP) is an irreversible neurodevelopment disorder of the immature brain that covers a broad spectrum of syndromes related to postural control and motor impairment. Impaired muscle tone and poor postural control during both gross and fine motor activities, lead to limitations in participation restriction in activities of daily living (ADL)¹. Both deficits in static and dynamic postural balance, hinders in daily activities of CP patients². The prevalence of CP in

Pakistan was 2.5 per 1000 live births³. Rehabilitative management of CP requires a holistic approach targeting both gross and fine motor functions, social interaction, speech and language, and other related medical issues by a multidisciplinary team approach including Physical Therapists, Occupational Therapist, Special Education Teachers, Speech and Language therapist, Nurses and Medical Practitioners respectively. The conventional physical therapy, neuro-developmental techniques and sensory therapies can manage these neuro-

developmental impairments via improving patient's balance, gross and fine motor functions^{1,4,5}. Children with CP not only exhibit neuromotor deficits but presents with difficulties in sensory processing and praxis. A dynamic process including sensory integration synthesizes, organizes and processes incoming sensory information from the body and the environment with the purpose of creating purposeful and goal-directed responses⁶. Good sensory integration leads to the development of good body scheme, self-image, integration of primitive reflexes, balance, postural stability, ability to motor planning, coordination of two sides of the body, and establishes eye-hand coordination⁷.

Vestibular system is considered as the integral part of sensory system which is responsible for posture and its control with optimal flexibility and mobility in all joints and muscles, targeting and treating this neglected sensory area with different rehabilitation approaches is important⁸. Physical therapist will assess vestibular system in terms of postural balance for developing the strategies to rule out the basic flaws in order to cope and uplift the balance and posture. When vestibular system has being targeted, it enhances the tone of the antigravity muscle that plays a key role in maintenance of balance⁹.

Swing therapy used for these cerebral palsy patients is being used to re-direct and orient the sensory system by pediatric physical therapists, care givers and parents as a home exercise plan. Swing therapy often helps the children to re-organize the special senses including body attentiveness, contact, vibration, and sight. Sensory integration therapy collects the information from different parts of the body via mechanoreceptors to uplift the tone of the muscles thus directing the vestibular system. This sensory therapy gives assistance to frame one's postural tone, sense of balance, proper use of sight, inducing relaxation therapy and regulate one's performance¹⁰.

Previous literatures lack much work on vestibular stimulation using swing therapy for the rehabilitation of hypotonic cerebral palsy patients for improving balance. The rationale of the current study was to find out the effectiveness of vestibular stimulation using swing therapy for the hypotonic cerebral palsy patient's balance on pediatric balance scale, which will be helpful for improving their daily life problems.

Methods:

Randomized clinical trial with single blinding was conducted on sample of 52 patients calculated by scientific WHO calculator with anticipated population proportion 0.025, absolute precision 4%, and 95% level of³. Patients aged between 5-15 years including both genders with level-II motor functions on GMFCS. All other types of cerebral palsy like spastic, athetoid and ataxic were excluded from the study. Simple random sampling technique was used for collection of data of 52 patients visiting to Pediatric Physical Therapy department, National Hospital & Medical Center DHA, Lahore during February 2019 to July 2019, and randomly allocated into two groups comprising 26 patients in each group by lottery method. Group A was treated with conventional rehabilitation techniques (parallel bars walking, positioning and stretching) and vestibular stimulation for balance by swing therapy while group B was treated only by conventional techniques. Conventional techniques comprise of walking on parallel bar and positioning for 10 minutes each with bilateral calf, Hamstring and hip flexors stretches for 3 times and Swing therapy for 15 minutes additionally in group A. Total treatment duration was 8 weeks with alternate day's sessions.

Outcome was based on improvement in balance as assessed by pediatric balance scale. It judged activities like sitting to standing, transfers, standing unsupported, sitting unsupported, standing on one foot, turning to 360 degrees, and placing alternate foot on stool. Statistical Package for Social Sciences (SPSS) version 21 was used for records entry and analysis. The qualitative variables were presented in form of frequencies and quantitative in form of mean. Data were normally distributed and parametric test (independent sample "t" test with extension Levene's test) was applied to find out change in p value. Informed Consent was being taken from the parents and administration of Hospital. Permissions were obtained from ethical committee.

Results:

The mean age of patients was 5.83 ± 1.92 years. Out of 52 patients, 46% were males and 54% were females.

For Group A and B, pre-treatment mean was 3.07 ± 1.24 and 3.03 ± 1.31 and post-treatment mean was 1.51 ± 1.72

Table 1: Demographics of study participants

Variables	Statistics
Age	Mean (5.83), Standard Deviation (1.92)
Gender	Boys (46%), Girls (54%)
Tone on Modified Ashworth scale	Hypotonia (100%)

Table 2: Group statistics regarding mean of pre and post therapy

Treatment	Groups	N	Mean	Std. Deviation
Pre-treatment	Group A	26	3.07	0.2405
	Group B	26	3.03	0.3154
Post-treatment	Group A	26	1.51	0.7259
	Group B	26	2.69	0.6123

Table 3: Comparison of pre and post therapy groups

Balance	Variance	Levene's test for equality		T test for equality of means					
		F	Sig	T	df	Sig (2 tailed)	Mean diff	SD diff	95% level of confidence Upper Lower
Pre Rx Balance	Equal variances assumed	1.905	.171	.313	78	.755	0.050	0.159	-0.267 0.36
	Equal variances not assumed			.313	76.3	.755	0.050	0.159	-0.267 0.36
Post Rx Balance	Equal variances assumed	2.379	.127	-3.76	78	0.001	-0.80	0.212	-1.222 -0.37
	Equal variances not assumed			-3.76	76.3	0.001	-0.80	0.212	-1.222 -0.37

and 2.69 ± 1.61 respectively. The mean for group A was less than group B after treatment, indicating improvement in the balance. The measured value of "t" score was (-3.76) and "P" value was (0.001) showing significant change.

Discussion:

Swing and conventional therapy were compared to conventional therapy alone for balance improvement in hypotonic cerebral palsy patients. For both groups, there were significant changes in mean values. The mean value of conventional therapy combined with swing therapy was lower than conventional therapy alone; indicating that group A had improved. The determined "t" value was -3.76, with a p value of 0.001, which is less than the reference value of 0.05, indicating that the balance has improved.

Children with spastic CP may benefit from a combi-

nation of active vestibular therapies and occupational therapy to improve their functional balance, according to an RCT. It could be linked to the reorganization of the vestibular system (utricle and saccule) generated by the controlled and exact application of stimuli (forward backward and sideways swing). Forward and backward swings stimulated the utricle, which is responsible for linear balance, whereas sideways swings stimulated the saccule, which is responsible for rotating balance. In the current study, these two swing strategies improved their global balance on the pediatric balance scale¹¹.

The Results of another study were supporting the current study. During comparison, the control group (group B) (parallel bars walking, positioning and stretching) and the experimental group (group A) (conventional rehabilitation techniques and swing the-

rapy for balance), noted an improvement in group A compared with the group B as change in mean value for group A, B was 1.72 and 2.02 respectively, indicating the balance improvement through swing therapy in cerebral palsy patients¹².

A systematic review was conducted to highlight Semi-circular canal stimulation in cerebral palsied children with conclusion that vestibular stimulation has valid and reliable impact on balance and gross motor function outcome measures with CP patients as observed in this study¹³.

A systemic review, Effects of vestibular stimulation on motor development of cerebral-palsied children concluded as vestibular stimulation is an effective therapy for cerebral-palsied children as observed in current study that vestibular stimulation by swing therapy improved their balance¹⁴.

Vestibular stimulation therapy will improve postural control by enhancing tone in antigravity muscles and movement pattern, as shown in the current study. Swing therapy improved balance and movement status while integrating postural reflexes (symmetrical tonic neck reflex and tonic labyrinthine reflex)¹⁵.

Another previous literature emphasized on importance of backward training using swing therapy in order to improve balance performance thus improving motor system, proprioception as in current study forward and backward swing therapy was performed and significant change in balance was noted¹⁶.

The striking feature of this study is to utilize swing therapy to address the semicircular canals for updating the tonicity of hypotonic cerebral palsy patients. Previous studies have largely focused on physical therapy exercise including home program, gait training and gaze Stabilization exercise to improve balance. Additionally, both genders were enrolled for the study providing heterogeneous distribution.

There was a small sample size so, results cannot be generalized. Secondly, during this treatment only balance is measured on pediatric balance scale, while the other domains of development like gross motor, fine motor and gait should be focused in future.

Conclusion:

The current study concluded that swing therapy when integrated with other conventional methods of rehabilitation proved to be effective in improving balance in children with hypotonic cerebral palsy.

Ethical Approval: Given

Conflict of Interest: The authors declare no conflict of interest.

Funding Source: None

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