EFFECT OF PHYSIOTHERAPY EXERCISE INVOLVING PLAY ACTIVITIES COMPARED TO CONVENTIONAL PHYSIOTHERAPY ON BALANCE IN SPASTIC CEREBRAL PALSY CHILDREN: QUASI-EXPERIMENTAL STUDY

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ABSTRACT

Background: Cerebral palsy is a neuro-motor disorder which encompasses a heterogeneous group of early onset and non-progressive which affects the developing Fetal or infant brain. Children with CP have poor trunk control and less stable actions of muscle to control movement that leads poor sitting and standing balance. Trunk stability directly affects the performance level of functional activities in sitting and standing. Specificity in training is important to achieve a specific outcome and hence interventions which deal with reactionary control in specific postures would be vital.

Methodology: This quasi experimental study done for 3 weeks duration and subjects divided in to two group of experimental and conventional group. Each group has 15 participants which enrolled after assessment of their trunk impairment. Treatment was given for three consecutive week for five days a week and post intervention assessment done.

Results: Statistical analysis done using SPSS 23.0 version and results showed statistically significant different between group in PBS.

Conclusion: Upon this study we can conclude that the given experimental group protocol has significant improvement on balance compare to conventional group protocol.

Key words: cerebral palsy, balance, Play therapy intervention.

I. INTRODUCTION

Cerebral palsy (CP) circumscribe a heterogeneous group of congenital, non-improving, neuro-motor disorders which affect the developing Fetal or infant brain. Children with cerebral paralysis frequently have diminished gross motor skills; walking endurance; muscle strength; aerobic capability; and balance. Causes of cerebral palsy are birth asphyxia, HIE, PVL, Meconium aspiration, Preterm birth, Low birth weight, Brain damage due to meningitis, encephalitis, Prenatal infection, natal infection and post-natal infection. The prevalence of cerebral palsy in India is reported to be 2-2.8/1000 births. In India, the estimated incidence is around 3/1000 live births. Different causes affect different parts of brain that presents with different scenario in each one patient. Topographically cerebral palsy is classified as: - Monoplegia, Hemiplegia, Diplegia, Quadriplegia. [1, 2]

Amongst all topographical classification, most common type clinically found is Diplegic cerebral palsy. The incidence of other type is less in Indian population. Spastic cerebral palsy which is a common type exhibited by the involvement of pyramidal tract with indication of upper motor neuron lesion such as muscle weakness, hypertonia, hyper-reflexia, clonus and positive Babinski sign. In dystonic CP the involvement of brain structure is extrapyramidal. Due to which the involuntary movements are seen resembling athetoid, dyskinesia, rigidity and chorea. [1, 2] The tonal abnormality is associated with variations in body positions, emotions and sleep and shows associated abnormalities in postural control and co-ordination. [3]
As insult to brain will affect the muscle tone and its normal actions is to maintain the normal trunk stability and posture. Thus, they have poor trunk control and less stable actions of trunk muscles to maintain static and dynamic balance. [4] Loss of trunk control will cause the difficulties in hand movements and functional activities in sitting and standing. [5] The factors which affect the trunk stability in these children are summed up as: - Muscle firing imbalance, Abnormalities of tone like spasticity or hypo tonicity, Lack of proper motor control, Poor balance. (4, 5) Consequently, they will be dependent for daily functional activities. (6)

Postural stability or trunk balance is challenged by sudden change by moving support surface or disturbing forces produced by voluntary movement of trunk and limbs. [7] “Trunk stability is the ability to maintain active control of spinal and pelvic posture during dynamic loading and movement conditions. Such a definition implies that both neural control and muscle strength are important determinants of trunk stability.” [8] “Postural stability is defined as the ability to maintain and control the centre of mass of the body within the support base in order to prevent falls and control desired movements is called as balance.” [9]

Children with CP have reduced force generation, less proprioception around the core and diminished capacity to control between the trunk, pelvis and hip stabilizers leading to reduce control of movement.[10] In gait trunk and thorax movement is found to be higher other than normal individual that due to lack of anticipatory control of trunk and reduced lower limb movements in gait but these reduction in movement is directly related to lack of required trunk control and absence of stabilization of trunk to maintain Center of Mass inside base of support. [11]

Role of physiotherapy in recovery of cerebral palsy kids is to make the child independent in his daily activity and do functional activity at its optimal level depending upon age and severity three general points can be distinguished in aim of improving quality of life: - Increase skill repertoire, Maintain wellness capability, General administration and minimization of contracture and deformities. A composite of all components is to be given as mixed training in all aspects of fitness. Different protocol is been used to treat the cerebral palsy child. Postural control interventions are managed on basis of postural control elements: Neuromuscular synergies, Adaptive mechanism, Anticipatory control, Sensory systems, Musculoskeletal segments. [12]

The commonly used therapy is Gross motor tasking which includes repetitions of normal gross motor activities. Hippo therapy or hippo simulator which enhance sitting balance and postural control in sitting and standing in the patients of ambulant and non-ambulant cerebral palsy children. Neurodevelopmental therapy (NDT) is combined with conventional rehabilitation treatments. It improves postural alignment and movement patterns to normalise the movement and functional task. Progressive resistance training is lifting loads or applying resistance task to improve muscle strength. Reactive balance training is the one in which repeated balance recovery practice is done over wobble board in all directions in laboratory settings. [12]

Improvement can be provided by activity-based exercise which improves participation in mobility and quality of life of CP child. The components to achieve this goal are muscular strength, power, synchronization of motion, and balance and movement viability. [4]

Core muscles are first activated prior to any distal joint movement. Muscle strength of trunk muscles is directly related with functions of daily activity which require trunk balance and need to train core stability and strengthen the core muscles. Balance training and perturbation have found to be effective for reactive balance control and tend to improve the stance control in children with cerebral palsy. [13] Additionally, training the core component on a challenging surface (e.g. physio ball) improves the balance, stability and proprioceptive capabilities to enhance the precision of movement. [14]

Vestibular inputs increase the alert level in children with CP, thereby promoting interactive interpretation with other sensory inputs. [15] These games were primary designed for fun and not for rehabilitation, therefore for some intensely disabled patients it is not obvious to integrate them into rehabilitation. No previous studies have compared the effectiveness of play activities with conventional therapy. Hence, specific patient recreational activities must be developed from real clinical determinants including rehabilitation aspects and therapists’ expectations; only such integration can answer the practical rehabilitation field questions. [18] Aim and objective of study to see and compare whether balance is improving in child with CP as compared to the conventional physiotherapy exercises or not.
II. METHODOLOGY

Participants:
This quasi-experimental study was conducted from January 2019 to March 2019. 30 children with age group 5 to 18 years were recruited from Mogri Special School, Anand and from Kashiben Govardhandas children hospital, Vadodara with prior written permission. Upon parents’ agreement to participate, children were screened for inclusion and exclusion criteria. Every consecutive child diagnosed with Cerebral Palsy, both genders, GMFCS level I, II and III, Age between 5 to 18 years, Spastic CP were included in the study. Children diagnosed with Dystonic CP, Ataxic CP and Hypotonic CP, Age below 5 years, and those who had already developed spinal deformity were excluded from the study. The characteristic and purpose of the study was described to the parents. Signed informed consent was obtained from parents of participants. The subjects were split up into two treatment groups (i) conventional, (ii) experimental group. A total of 34 participants were screened, among which 2 were excluded as they did not match study age group and 2 were excluded as they had other types of cerebral palsy. All participants were given treatment intervention for 45 minutes, 5 days a week for 3 consecutive weeks. Every group had 15 participants. All participants were assessed post-intervention using outcome measures for trunk control, balance. Each group received pre-designed protocol for five days a week for three weeks for the duration of 45 minutes for each session. The parent of participants was asked to fill the data collection form providing information on demographic data and type of CP. The procedure of data collection drawn in flow chart. Basic demographics are shown in table 1.

Protocols:
Experimental group treatment is detailed in table 2.

Conventional group treatment protocol is given in table 3.

Outcome measures:
PBS (Pediatric Balance Scale) is as like berg balance scale. This scale has 14 items scoring. The items included in test is sitting, transferring and various activities in standing. Each item score ranges from 0 to 4. Maximum scoring is 56. [18, 19]

FSST (Four Square Step Test) is a functional scare to measure dynamic balance in standing. This test measures time to be taken by participants who covers the all squares in clockwise and anti-clockwise direction. Two trials prior to actual testing can be given after demonstration of the test. [20]

III. RESULTS

Between group comparisons of all scales shown statistically in table 4. The result of between group analyses shows no statistically significant difference in between FSST scale value of conventional and experimental groups after intervention at significant level of 0.05. However, it shows statistically significant difference in PBS with p-value 0.048. at significant level of 0.05

IV. DISCUSSION

The primary goal for treating children with CP is to be functionally independent, as many functional tasks requires trunk stability and balance in various environment and circumstances. The given protocol is formed in a way to challenge children’s capability of maintain stability and balance in a various task. In conventional group the exercises which were given are practiced regularly in clinical set up as a formed protocol. Comparison of this research is cannot be done with previous research as the protocol is formed in experimental group were quite different than another which research done prior.

For conventional physiotherapy group, three weeks training focuses over different aspects of trunk stability and balance in sitting as well as in standing posture. Post-intervention, there were significant changes in trunk control, balance, and motor function. There are minimal muscle contractions which increases endurance of trunk control and strength of trunk muscles to hold the particular posture of body in position. Additionally, this core muscle activation also evokes the lumbar-pelvic-hip chain mobility and enhance standing trunk posture also. [10]
In experimental group treatment which is applied was Swiss ball or vestibular ball therapy that was found to be effective as it causes vestibular stimulation, leading to facilitation of postural reactions by activation of muscle through anticipatory control to maintain body erect over any challenging surfaces. That can be seen due to increasing challenge from static to dynamic way. That simultaneously also activates cervical musculature to keep erect posture. [15]

Literature suggests that cerebral palsy children have difficulty in maintaining dynamic balance and organization of movement during a particular motor task, and they need to transfer weight during stepping sequence and remembering test sequence also. With regards to changes in Four Square Step test, time required to complete test improved in a statistically significant manner for within group comparisons (p-value-for conventional 0.003, for experimental 0.001). Thus, both the protocols are proven to be effective for dynamic balance control for children with CP as to transfer body mass and maintain center of mass at position in standing posture. [20]

The 14 functional tasks of Pediatric balance scale are commonly performed in regular day to day static and dynamic balance including sitting, sitting to standing and standing. The protocol included some of exercise which are specified and modified on tasks based such as throwing and reaching activities in various positions. The participants who had more functional impairment shows longer time to complete the test. The programs which are formed in experimental group were as play activity as a task to fulfil any functions in a generalized play, throwing with maintaining postural stability are more specific towards improving dynamic balance control by means of COP displacement. From this given strategy they adjust their body and strategies to change their goals for fulfilling the tasks. [22]

Balance is important to incorporate in and communicate with the environment by day-to-day tasks, and has been portrayed as a stay for deliberate movement and functional activities in CP. Pediatric balance test (PBS) was employed to determine change in balance in these patients. The play therapy group showed statistically significant improvement in PBS scores compared to conventional therapy group. This might be attributed to the greater complexity and COP displacement of play therapy exercises. For example, activities on vestibular ball and trampoline challenged balance to higher levels compared to conventional exercises. This is in line with the findings of the previous study which stated that increase in motor level of child with CP had an effect on balance, positively. Better balance and postural control empower child to walk progressively advantageous and quick, use limbs better, for this situation is increasingly fruitful and more independent in their daily activities. [23]

This study provides an exhaustive protocol based on play therapy which can be incorporated to child with low to moderate CP. This study included reliable and valid outcomes which measures trunk stability and balance in sitting as well as standing positions. Participants with all ranges of impaired trunk stability and balance are included in the study. This study proposed the unprecedented idea of incorporating aspects like core strengthening and stability, playing, self-initiated perturbations, facilitation of balance reactions in designing the rehabilitation protocol for patients with impaired trunk control and postural stability. Limitations in this study was that follow-up analysis of outcome measures was lacking in the study and study participants included cerebral palsy children with spastic variety only. So, the study findings cannot be applied over children with other types of cerebral palsy.

V. CONCLUSION:

The play-based protocol only had greater influence over balance of spastic cerebral palsy patients. Hence one experimental treatment approach is beneficed in terms of balance over conventional treatment.

REFERENCES


**LEGENDS FOR ILLUSTRATIONS**

Tables and charts

**Table 1 Demographic Details**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Control Group</th>
<th>Experimental Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants (N)</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Mean Age (Years)</td>
<td>10.33 ± 3.99</td>
<td>9.27 ± 3.93</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>Female</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Type of Cerebral Palsy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hemiplegic</td>
<td>3</td>
<td>5</td>
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<tr>
<td>Diplegic</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>Quadruplegic</td>
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<td>1</td>
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<tr>
<td>GMFCS Level</td>
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</tr>
<tr>
<td>Level 1</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>Level 2</td>
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<td>2</td>
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<tr>
<td>Level 3</td>
<td>6</td>
<td>2</td>
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</table>

**Table 2 Experimental group Protocol**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description of activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core strengthening and stability</td>
<td>Thera-station exercise fore core stability</td>
</tr>
<tr>
<td>Targeted throwing while maintaining extension of trunk on vestibular ball (Image 1)</td>
<td></td>
</tr>
<tr>
<td>Playing</td>
<td>Stair climbing and descending with music rhythm</td>
</tr>
<tr>
<td>General play in which mobility of trunk can actively occur</td>
<td></td>
</tr>
<tr>
<td>Picking objects (balls) from ground and running with assistance</td>
<td></td>
</tr>
<tr>
<td>Transferring objects from one place to another place</td>
<td></td>
</tr>
<tr>
<td>Self-initiated perturbations</td>
<td>Throwing activity at kept markers in various direction Alternate leg lift while sitting on vestibular ball</td>
</tr>
</tbody>
</table>
Throwing and reach out in kneeling and half kneeling on mat
Targeted throwing of ball while sitting on balance ball, vestibular ball

Facilitation of balance reactions
  See-saw
  Swinging to and fro
  Hopping
  Stepping on squeeze ball

Facilitating postural stability
  Functional tasks such as sit to stand
  Jumping on trampoline
  Transfer from one stool to chair
  Walking over narrow base of support

Table 3 Conventional Group Protocol

<table>
<thead>
<tr>
<th>Exercise type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core stability exercise</td>
<td>Isometric abdominals, isometric trunk extension, bridging, modified bridging, curl up</td>
</tr>
<tr>
<td>Active exercise within available range</td>
<td>Specific muscle activity</td>
</tr>
<tr>
<td>Self-initiated perturbations</td>
<td>Reach outs in anterior, medial, lateral direction with various range of distances</td>
</tr>
<tr>
<td>Facilitation of balance reactions</td>
<td>In sitting and standing with balance board, bolster</td>
</tr>
<tr>
<td>Facilitating postural stability during transitions</td>
<td>In transition with help of tactile cues and feedback</td>
</tr>
</tbody>
</table>

Table 4 Comparison of two groups

<table>
<thead>
<tr>
<th></th>
<th>Conventional Mean ±SD</th>
<th>Experimental Mean ±SD</th>
<th>Mean Diff.</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSST</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRE</td>
<td>25.46±9.5</td>
<td>22.6±6.37</td>
<td>2.86</td>
<td>.646</td>
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<tr>
<td>POST</td>
<td>23.0±9.97</td>
<td>19.27±6.04</td>
<td>3.73</td>
<td>.428</td>
</tr>
<tr>
<td>PBS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRE</td>
<td>35.4±9.53</td>
<td>39.56±9.62</td>
<td>4.16</td>
<td>.073</td>
</tr>
<tr>
<td>POST</td>
<td>37.7±10.54</td>
<td>43.13±9.10</td>
<td>5.43</td>
<td>.048</td>
</tr>
</tbody>
</table>

Subject Recruitment procedure (flow chart):
Permission from the department head/concerned authority of the department or institute

Screening for inclusion and exclusion criteria
Screened = 34
N = 2 excluded for other type of CP
N = 2 excluded for did not matching age criteria

Obtaining informed consent from parent/caregiver

Nonrandomized sampling

Experimental group (n = 15)
Conventional group (n = 15)

Baseline assessment

Protocol for each group for mentioned duration

Assessment of each group post intervention