International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 5 Issue 1, November-December 2020 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

# A Study to Find Out the Effect of Arm Movement through Sensory Based Game on Improving Postural Control in Spastic Diplegic Cerebral Palsy

**Abhirupa Chakraborty[1], Mrs. Anurupa Senapati[2]**

[1]Occupational Therapist, [2]Assistant Professor,
[1,2]Department of Occupational Therapy, Swami Vivekanand National Institute of Rehabilitation Training & Research Olatpur, Bairoi, Cuttack, Odisha, India

## ABSTRACT

**INTRODUCTION:** Poor control of trunk postural muscles and sensory disturbance is the key feature of children with cerebral palsy. These impairments affect the activities of daily living. It has been hypothesized that arm movement through sensory based game enhance proprioceptive and vestibular integration, resulting in improvement of spatial awareness, co-contraction, postural stability and anticipatory motor or postural control.

**OBJECTIVE:** To enhance postural control following arm movement through sensory based game.

**DESIGN:** Pre test/post test experimental design

**SETTING:** Occupational Therapy department, Swami Vivekanand National Institute of Rehabilitation Training and Research, Olatpur, Odisha, 754010

**PARTICIPANTS:** 30 children with spastic diplegic cerebral palsy randomly allocated into two groups each with 15 subjects in experimental group(mean age=4.9 years) and control group(mean age=5.36 years). Baselines were collected for all subjects by using GMFCS, GMFM-88 and TCMS.

**INTERVENTION:** Subjects of both the group were provided therapy sessions for 45 minutes per day, 5 days in a week for 6 weeks. Both groups had received convensional occupational therapy for 45 minutes. The experimental group had received conventional occupational therapy for 15 minutes and sensory based game for 30 minutes. Sensory based game includes 5 games. They were intermittently structured according to sensory requirements. Post test measurements were assessed after 6 weeks.

**OUTCOME MEASURE:** TCMS,88GMFM,88 GMFCS

**RESULT**: From the statistical result of this study, it is seen that the subjects with spastic diplegic cerebral palsy improved in their GMFM and TCMS score on both the groups. However, the subjects in the experimental group have shown better effect than control group.

**CONCLUSION:** It can be concluded that conventional occupational therapy can include sensory based game which enhance active participation of children and ultimately increase motor control leads to postural control.

***KEYWORD:*** *Cerebral palsy, postural control, standing balance, arm training, sensory disturbance in cerebral palsy, sensory based game*

***How to cite this paper:*** Abhirupa Chakraborty | Mrs. Anurupa Senapati "A Study to Find Out the Effect of Arm Movement through Sensory Based Game on Improving Postural Control in Spastic Diplegic Cerebral Palsy" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-5 | Issue-1, December 2020, pp.1017-1022, URL: www.ijtsrd.com/papers/ijtsrd38159.pdf

**IJTSRD38159**



## INTRODUCTION

Cerebral palsy is the most common physical disability in childhood. It is a disorder resulting from sensory and motor impairments due to perinatal brain injury[1,2], with lifetime consequences that range from poor adaptive and social function to communication and emotional disturbances[3], Infants with cerebral palsy have fundamental disadvantage in recovering motor function; they do not receive accurate sensory feedback from their movement. Estimated incidence of cerebral palsy is 2.11 per births[4].

To date, it is known that children with cerebral palsy show deficits in anticipatory postural adjustments[5], reactive postural adjustment[6], muscular components[7] and sensory components[8] of postural control, compared with typical development. This dysfunction hampers in providing balance which is required to achieve gross motor skills such as sitting or standing[9]. Especially gait and upper limb activities such as reaching[10] and other activities.

Postural control can be defined as the ability to control the body's position in space for the purposes of stability and

orientation[11]. Postural stability or balance is the ability to maintain and/or regain the centre of mass within the BOS where gravity is the vector[12]. The trunk, centre of our body, plays a crucial role in postural control and the organization of balance reaction[13]. During sitting and standing humans voluntarily move their arm; their postural muscles of the lower limb and trunk that control posture are activated in advance of the focal muscles that move the arm voluntarily[14]. This type of posture known as, *Anticipatory Postural Adjustment* (APA).

APA, is believed to reduce the effects of forthcoming perturbations caused by voluntary movement on posture and equilibrium[15]. APA, probably play an important role in adequately performing various voluntary movement while standing[16]. This ''anticipatory'' contraction of the abdominal ones is thought to contribute to preparatory stabilization of the spine against reactive forces resulting from limb movement.

Disturbances in the processing of sensory information exists in cerebral palsy children[18]. An physical adaptive response might be an increase in physical postural control[19]. Anticipatory postural control and voluntary arm movement are thought to be controlled by different but parallel descending pathways. There parallel control mechanisms need to be integrated for effective activity completion without loss of postural control or a fall.

Hence, arm movement through sensory based game, enhance proprioceptive and vestibular integration, resulting in improvement of spatial awareness, co-contraction, postural stability and anticipatory motor or postural control. Because, sensory feedback is only used to refine the skill, hence it is postulated that with the use of this strategy, it may be helpful in enhancing Anticipatory Postural Control. Upto date, no such studies that defines the postural control improvement in spastic diplegic cerebral palsy using arm movement through sensory based game. So, we want to find the effects of arm training through sensory based game in sitting, kneeling and standing position in spastic diplegic crebral palsy.

**AIMS:**

- To evaluate the effect of arm movement through sensory based game on postural control in spastic diplegic cerebral palsy.

**OBJECTIVES:**

- To enhance postural control following arm movement through sensory basedgame.

**ALTERNATE HYPOTHESIS:**

- Arm movement through sensory based game will be effective on postural control.

**NULL HYPOTHESIS:**

- There will be no effect onpostural control following arm movement through sensory based game.

**METHODOLOGY**

**Study Design:** Pre test / Post test experimental design

**Sample size:** 30 children with spastic cerebral palsy were taken. 15 children were taken in control group and 15 in experimental group.

**Inclusion criteria:**

- Spastic diplegic cerebral palsy children who does not have fixed hip, knee, ankle deformity
- Age – 4-10 years
- GMFCS-2,3
- Able to follow simple command
- Have gross grasp

**Exclusion criteria:**

- Children with mental retardation
- Chidren with athetoid, ataxic, hemiplegic and flaccid cerebral palsy
- Any congenital deformity

**Independent Variables:**

- Conventional exercises
- Sensory based game

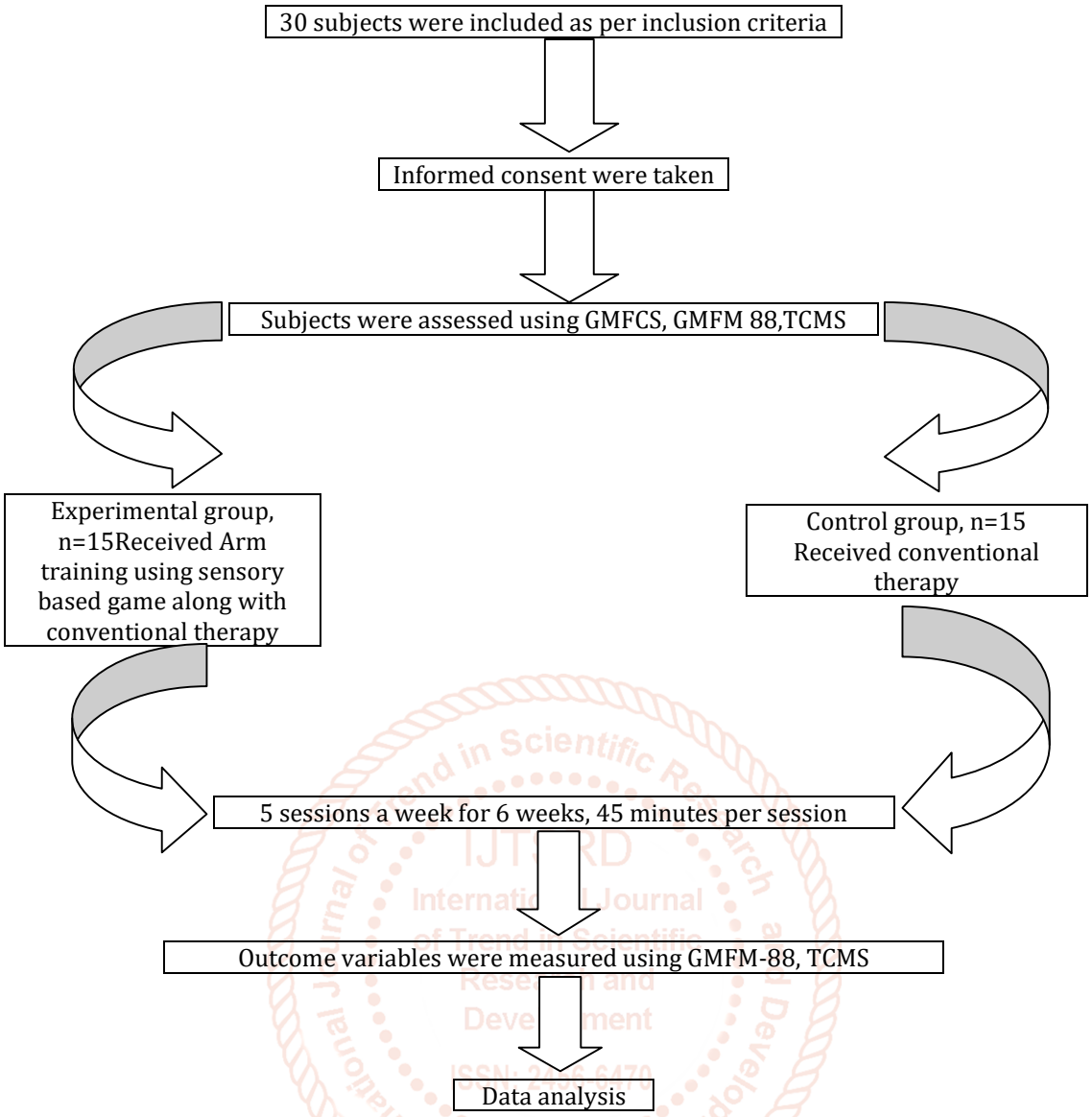
**Dependent variables**:

- Motor Functional Measurement Scale (GMFM) -88
- Gross Trunk Control Measurement Scale (TCMS)

**PROCEDURE**

- Subjects were collected from department of Occupational Therapy, SVNIRTAR.
- Parents of subjects were explained about the study and informed consent were taken from them.
- Baseline data were collected for all subjects by using GMFCS, GMFM-88 and TCMS.
- Before beginning the intervention each subjects were randomly divided into two groups as control and experimental group.
- Subjects of both groups were provided therapy sessions for 45 minutes per day, 5days in a week for 6 weeks.
- The subjects of control group had received conventional Occupational Therapy for 45 minutes such as trunk strengthening exercise
- Whereas subjects in experimental group had received conventional Occupational Therapy for 15 minutes and sensory based game for 30 minutes.
- Sensory based game, it includes 5 games, these were intermittently structured according to sensory requirements.
- At the end of 6 weeks, all the subjects were administered GMFM-88 and TCMS and were collected as pre and post intervention data.
- Both pre and post data will be taken for statistical analysis.

**PROTOCOL**




**DETAILED PROTOCOL FOR EXPERIMENTAL GROUP**

**BASKET BALL**

- Type of ball: Light ball, woollen ball, heavy ball
- Distance from basket ball stand: Short distance, increase distance
- Position of the child :

1. Standing without support, if needed give intermittent support
2. Standing without support
3. Stand on floor
4. Stand on cushion
5. Stand on equilibrium board

**DART PLAY**

- Equipment: Dart and target
- Position of the subject:

1. Standing (Change the position of the target so that the subject will be
2. encouraged to extend knee and maintain upright position).
3. Stand on floor
4. Stand on cushion
5. Stand on equilibrium board
6. Modify the dart handle with different texture
7. Target point may be changed to make the activity more complex

**RODS AND RINGS**

- Equipment: Rods and plastic rings
- Position of the subject:

1. Standing – cross the midline and take the ring using either hand and insert into the rod
2. Sitting on medicine ball – cross the midline and take the ring using either hand and insert into the rod

**HOCKEY**

- Equipment: Plastic Hockey stick, heavy hockey stick and ball
- Position of the subject :

1. Standing – hold the hockey stick and hit the ball in target
2. Distance will be increased gradually from the target point
3. Different texture attached to hockey stick

**WALL MOUNTED PUZZLE ACTIVITY WITH RESISTANCE**

- Equipment: Wooden puzzle, Velcro
- Position of the subject:

1. Standing – Adjust the height of the board that will facilitate hip-knee extension
2. Ask the child to put puzzles
3. For resistance-velcro will be attached in puzzle(block) and on wooden board

**DATA ANALYSIS**

After collecting all the data, data analysis were done by using SPSS version 23.0.

Mann Whitney U test were used to analyze the changes in GMFM-88 and TCMS scores between experimental group and control group and Wilcoxon signed rank test was used to analysethe changes within the groups. Level of significance were set at p ≤0.001.

**RESULTS**

The analysis of data gives the following tables showing the demographic characteristic and test results. The master chart showing the details of individuals scores on outcome measure for both groups shown in appendix. The individual characteristics of both groups are in table 1.

**TABLE 1 SHOWS DEMOGRAPHIC CHARACTERISTICS OF SUBJECTS**

| SL NO. | BASELINE CHARACTERISTICS | GR. 1 (EXPERIMENTAL GROUP) | GR 2 (CONTROL GROUP) |
|---|---|---|---|
| 1 | No. of subjects (male and female) | 15 (M=8, F=7) | 15 (M=9, F=6) |
| 2 | Age range (years) | 4-10 years | 4-10 years |
| 3 | Mean age | 4.9 years | 5.36 years |

The Table 1 shows mean age of all the participants in the study. The mean age of experimental group subject was 4.9 years and control group was 5.36. s

**TABLE 2 SHOWS DESCRIPTIVE STATISTICS OF OUTCOME MEASURE:**

| OUTCOME MEASURE | EXPERIMENTAL GROUP(N=15) | | | | CONTROL GROUP (N=15) | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean test score | | Standard deviation | | Mean test score | | Standard deviation | |
| | Pre test | Post test | Pre test | Post test | Pre test | Post test | Pre test | Post test |
| GMFM 88 | 48.83 | 71.64 | ±7.21 | ±7.81 | 48.87 | 58.37 | ±5.55 | ±5.21 |
| TCMS | 20.06 | 33.53 | ±3.97 | ±6.18 | 20.14 | 25.53 | ±3.24 | ±3.73 |

Table 2 shows mean value of pre test and post test score and standard deviation of GMFM 88 and TCMS for both the groups. The mean pre test score for GMFM88 experimental group 48.33 and control group 48.87. The mean post test score for GMFM 88 for experimental group 71.64 and control group 58.37. The mean pre test score for TCMS experimental group 20.06 and control group 20.14. The mean post score for TCMS experimental group 33.53 and control group 25.53. The pretest SD for experimental group 7.21 and control group 3.24; post SD for experimental group 33.53 and control group 3.73.

**TABLE 3 SHOWS THE RESULT OF WILCOXON SIGNED RANK TEST FOR GMFM AND TCMS WITHIN THE GROUPS**

| GROUPS | MEAN DIFFERENCE | z- VALUE | P(2 TAILED) |
|---|---|---|---|
| GMFM SCORE | | | |
| EXPERIMENTAL GROUP | 22.81 | -3.408 | .001 |
| CONTROL GROUP | 9.5 | -3.408 | .001 |
| TCMS SCORE | | | |
| EXPERIMENTAL GROUP | 13.47 | -3.440 | .001 |
| CONTROL GROUP | 5.39 | -3.413 | .001 |

The z value of GMFM score in experimental group is -3.408 which corresponds to <0.001 which reveals that there is significant improvement in gross motor function of experimental group. The z value of GMFM score in control group is -3.408 which corresponds to <0.001 which reveals that there is significant improvement in gross motor function of control group. The z value of TCMS score in experimental group is -3.440 which corresponds to <0.001 which reveals that there is significant improvement in trunk control of experimental group. The z value of TCMS score in control group is -3.413 which corresponds to <0.001 which reveals that there is significant improvement in trunk control. Mean score difference of GMFM and TCMS of experimental group is higher than control group. So, there is a significant improvement in postural control in experimental group.

**TABLE 4: SHOWING RESULTS OF MANN-WHITNEY U TEST BETWEEN THE GROUPS FOR GMFM AND TCMS**

| GROUP | MEAN RANK | SUM OF RANK | U VALUE | P VALUE |
|---|---|---|---|---|
| **PRE GMFM** | | | | |
| EXPERIMENTAL GROUP | 13.47 | 202.00 | 82.000 | .217[b] |
| CONTROL GROUP | 17.53 | 263.00 | | |
| **POST GMFM** | | | | |
| EXPERIMENTAL GROUP | 22.17 | 332.50 | 12.500 | .000[b] |
| CONTROL GROUP | 8.83 | 132.50 | | |
| **PRE TCMS** | | | | |
| EXPERIMENTAL GROUP | 15.73 | 236.00 | 109.000 | .902[b] |
| CONTROL GROUP | 15.27 | 229.00 | | |
| **POST TCMS** | | | | |
| EXPERIMENTAL GROUP | 20.87 | 313.00 | 32.000 | .000[b] |
| CONTROL GROUP | 10.13 | 152.00 | | |

Mann-whitney U test between control and experimental group for pre test score of GMFM shows U value of 82.000 which corresponds to significance of 0.217 which is >0.05, hence the pre test value of both the groups do not differ widely. The post test score of GMFM shows U value of 12.500 which corresponds to significance of 0.000 which is <0.05 hence there is significant difference between the two groups. The pre test score of TCMS shows U value of 109.000 which corresponds to significance of >0.05, hence the pre test value of both the groups do not differ widely. The post score of TCMS shows U value of 32.000 which corresponds to significance of 0.000 which is <0.05, hence there is significant difference between the two groups.

**DISCUSSION**

The present study was conducted to find out the effectiveness of arm movement through sensory based game on improving postural control in spastic diplegic cerebral palsy. This study was conducted in the Occupational Department of SVNIRTAR and the study included 30 children with spastic diplegic cerebral palsy between, the age of 4 to 10 years and randomly distributed into experimental and control group. Data was collected using GMFM, GMFCS and TCMS.

The objective of the study was to enhance postural control following arm movement through sensory based game.

Postural control is an integral part of all motor skills and impaired postural control is a primary feature in children with cerebral palsy.

Experimental group to whom arm training through sensory based game were given, had shown significant improvement in postural control which may associated with feed forward proprioception training which is substantially supported by Blackburn, T, 2011 who stated that, increased proprioception and muscular strength are equally effective in promoting joint stability and balance maintenance and strength training increased dynamic balance capabilities.

Both the experimental and control group had received core muscle strengthening exercise and anticipatory activities, that may the reason, the both group had shown significant improvement which is substantially supported by Nicholson,2001 who stated that core stabilization training program leads to sequencing anticipatory activities and then reduces early perturbations of the centre of gravity, which is beneficial for the individual who need to remain in constant postural control.

Both the group had received midline crossing and bilateral hand activities, may be due to these reason both the group had shown significant improvement, which is substantially supported by Md. Sadique, 2015, who stated that effectiveness of arm training without explicit instruction in the improvement of trunk control in spastic diplegic cerebral palsy.

Pavao, 2015, found that sensory impairment co-exist with motor disorder in children with cerebral palsy and may contribute to the motor dysfunction. In this study,

experimental group had received proprioception, vestibular and tactile sensory input through sensory based game, which is substantially supported by Padula, 1999, who stated that, the consideration of proprioception and visual system is particularly relevant to motor control because it contributes to orientation to position in one space, provides general information about the accuracy of movement, postural control and error direction, matching information with somatosensory and vestibular system.

So, in this study activity was structured on the basis of sensory requirements which is substantially supported by Sussane Smith Roley, in the book 'Sensory Intregration with Diverse Population' who stated that physical adaptive response might be an increase in postural control. So, may be due to sensory based game that was given to experimental group had greater improvement.

**CONCLUSION**

From the statistical results of this syudy, it is seen that the subjects with spastic diplegic cerebral palsy improved in their GMFM and TCMS score on both the groups. However, the subjects in the experimental group have shown better effect than control group. Therefore, null hypothesis is rejected and experimental hypothesis is accepted. It can be concluded that conventional occupational therapy can include sensory based game which enhance active participation of the children and ultimately increase motor control leads to postural control.

**REFERENCES**


[1] Tachdjian Mo, 1958: Sensory disturbances in hands of children with cerebral palsy.

[2] Yekutiel M, 1994: Sensory deficit in the hands of cerebral palsy.

[3] Rosenbaum P, 2004: A model to guide clinical thinking practice and research in the field of cerebral palsy.

[4] Osukoui M, 2013: An update on prevalence of cerebral palsy: A systemic review and meta analysis.

[5] Silvia Leticia Pavao, 2013: Assessment of postural control in children with cerebral palsy.

[6] Jennifer Schmit, 2008: Supra-postural task performance in children with cerebral palsy: The importance of functional context.

[7] Majorie Hines Wollacott, Jody L Jensen, 1996: Posture and locomotion.

[8] LM Nashner, 1993: Apparatus and method for movement coordination analysis.

[9] HF Liao, 2003: Relations of balance function and gross motor ability for children with cerebral palsy.

[10] Rm Hoffman, 2018: Impaired anticipatory vision and visuomotor coordination affects action planning and execution in children with hemiplegic cerebral palsy.

[11] ASP Sousa, 2012: Biomechanical and neurophysiological mechanisms related to postural control and efficiency of movement: a review.

[12] Shumway-Cook, A. and Woollacott, M. H. 1995. Theories of motor control. In: Motor Control: Theory and Practical Applications.

[13] Van der Heide, 2005. Postural muscle dyscoordination in children with cerebral palsy.

[14] Hodges, 1999. Preparatory trunk motion accompanies rapid upper limb movement.

[15] Bouisset 1981. A sequence of postural adjustments precedes voluntary movement.

[16] Bouisset, S. and Do, M.C. 2008. Posture, dynamic stability, and voluntary movement.

[17] Bouisset 1981. A sequence of postural adjustments precedes voluntary movement.

[18] SL Pavao, 2017. Sensory processing disorder in children with cerebral palsy.

[19] Sussane Smith Roley. Sensory integration with diverse population.

[20] Blair E, 1997: Issues in the classification and epidemiology of cerebral palsy, mental retardation and developmental disabilities research reviews.