Effectiveness of Sensory Integration Therapy on Gross Motor Function and MMAS in Spastic Diplegic Cerebral Palsy Children

Dr.Rajesh G.Padnani[1] & DR R. ARUNACHALAM[2]
[1]PhD Scholar, Department of Physiotherapy, Madhav University, Abu -road, Rajasthan, India
[2]Professor, Department of Physiotherapy, Madhav University, Abu -road, Rajasthan, India

Received: March 02, 2019 Accepted: April 07, 2019

ABSTRACT: : INTRODUCTION: *Cerebral palsy (CP), a common, nonprogressive,but not necessarily unchanging neurological disorder ofchildhood. Spastic diplegia, the most prevalent form of CP, ischaracterized by motor in-coordination, primarily in the lowerextremities, that impairs many functional abilities, most notablyambulation. The evidence supporting theeffectiveness of sensoryintegration therapy on gross motor function in spastic diplegic CP isscarce.*
METHODS: *40 Children, both males and females,diagnosed with diplegic spastic CP were taken from Department ofPaediatrics, GGS Medical College and Hospital and OPD,University College of Physiotherapy, Faridkot, Punjab. Childrenwere randomly divided into two groups: Group A (n=20) and GroupB (n=20) with age 3 to 7 years. All children were evaluated withGross Motor Function Measurement (GMFM - 88) scale for rolling,sitting, crawling, standing and walking dimensions and for spasticitywith ModifiedModified Ashworth Scale (MMAS) at the beginning and followup was done at the end of 2nd and at the end of 4th month onehour/day with 5 days/week for 4 months. Group A receivedconventional physiotherapy and Group B received sensoryintegration therapy along with conventional physiotherapy.*
RESULT: *Gross motor function in Group B improved significantly(P< 0.05) better than in Group A, after intervention in rolling (P=0.03), sitting (P=0.0) and crawling (P=0.21) positions however, nosignificant difference was seen in standing (P=0.303) and walking(P=1.00) using independent t- test. MMAS scores showed significantimprovements in reducing spasticity with significance p=0.003(p<0.05) in both groups but the mean of Group B = 0.76 showedmore marked decrease in spasticity than that of Group A =2.00.*
CONCLUSION*: This study showed the significantly positive effectof sensory integration therapy on gross motor function and MMAS in spasticdiplegic CP children.*

Key Words:

INTRODUCTION

"Cerebral palsy describes a group of permanent disorders of the development of movement and posture, causing activity limitation that is attributed to non-progressive disturbances that occurred in the developing fatal or infant brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication, behaviour, epilepsy and by secondary musculoskeletal problems [8].

Cerebral palsy affects males and females in equal numbers [5]. Worldwide; the prevalence of cerebral palsy is reported to be between 2–2.5 per 1000 live births according to many studies. The incidence of cerebral palsy in United Kingdom is 2.4 per 1000. It varies between 1.5 and1.8 per 1000 in the USA. It is 1 per 1000 in France and 1.7 per 1000 live births in Sweden
[1].

Sensory integration refers to the process by which the brain organizes and interprets external stimuli such as touch, movement, body awareness, sight, sound, and gravity. It occurs in the brain context and requires balance between the central and peripheral nervous system as well as between excitatory and inhibitory neurological systems [3, 6].

Problem in sensory integration leads to sensory integration dysfunction (SID) which is defined as '' the inefficient neurological processing of information received through senses causing problems with learning, developmental and behaviour" [10]. Sensory integration dysfunction is thought to impair the vestibular, proprioception and tactile systems. One approach to help children with CP achieve their optimal level of functioning is Sensory Integration Therapy (SIT). Jean Ayres defines the construct of sensory integration as ''the neurological process that organizes sensation from one's own body and from the environment and makes it possible to use the body effectively within the environment'' [2]. It appears that cerebral palsy children share an abnormal degree of sensory processing, whether decreased or increased. Its aim is to provide the child with graded sensory experiences. It enables the child to make sense of their world by receiving, registering, modulating, organizing and interpreting the information that comes to their brains

from their senses. SIT helps to overcome problems experienced by many young children in absorbing and processing sensory information. Encouraging these abilities ultimately improves balance and steady movement. So, Sensory integration therapy (SIT) is designed to restore effective neurological processing and increase the individual ability to integrate sensory information by enhancing each of these sensory systems [4]. The aim of this study was to investigate the effectiveness of the sensory integration therapy on gross motor function in spastic diplegic cerebral palsy
children.

MMAS having 5 gradings (0 to 4) to measure the spasticity. Noureddin Ansari et al in 2012 they define Intra-rater reliability of the Modified Modified Ashwarth Scale (MMAS) the assessment of the upper-limb muscle spasticity. [16]

GMFM-88 is a standardized observational instrument designed and validated to measure change in gross motor function over time in children with cerebral palsy.

SCORING KEY: 0= does not initiate
1= initiated
2= partially initiated
3= completes

GMFM-88 includes Lying & Rolling, Sitting, Crawling & Kneeling, Standing, Walking these five dimensions to measure gross motor function of child. In each dimension having some task associated with this particular function. Jooyeon Ko et al in 2013 they define Reliability and responsiveness of the GMFM-88 in children with cerebral palsy. [17]

MATERIALS AND METHODS

Design:

Randomization was done by simple random sampling. After baseline assessment, parents of children drew one of 30 pre-printed cards in opaque sealed envelopes from a box (15 labelled group Aand 15 labelled group B) and were placed in the intervention in accordance with the card drawn. The parents of eligible children were duly informed of the rationale and procedure for the study and were enlightened about the aim of the research in improving physiotherapy services to children with CP. All authors declare that 'written informed consent was obtained from the parents of children before starting the study for publication of this study report'.

Children, therapist and centres:

Out of 40 children referred to the physiotherapy OPD, 30 children with spastic diplegic CP were selected from a population of children, who had been followed up at University College of Physiotherapy, Faridkot, Punjab.

Inclusion criteria were: Children of both genders were taken, age groups between 3-7 years, previously diagnosed as diplegic cerebral palsy. Exclusion criteria were: Children who were waiting for surgery or has had previous surgery of the foot, leg, or ankle; other conflicting concurrent treatment, such as plaster casts, Orthoses, BONT-A injection, Baclofen pump or other treatment effecting neuromuscular transmission at any other point prior to investigation; prior orthopedic surgery; any of the following diagnosis: Haemophilia, Myasthenia gravis, Eaton-Lamberts syndrome; children with subluxation or dislocation of hip, fracture of spine or limbs, severe scoliosis, seizures, mental retardation, fixed contractures and any othercongenital deformity.

Children were divided into a Group A and Group B by randomization. Gross motor function of children was evaluated according to Gross Motor Function Measure (GMFM-88) scale and spasticity with Modified Modified Ashworth scale (MMAS). The Group B received and participated insensory integration treatment plus conventional physiotherapy for 4 months, while the GroupA got conventional physiotherapy alone, which includes routine passive range of motionexercises, stretching exercises for 4 months performed by physiotherapist on children. Assessments at 0th month, at end of 2nd month, and at end of 4th month treatment were undertaken by one physiotherapist. This study was approved by Research and Ethical committee of University College of physiotherapy, BFUHS University, Faridkot, Punjab.

INTERVENTION: In this study, the children were treated one hour/day with 5days/week for 4 months. The Group B underwent sensory integration therapy plus conventional physiotherapy. In each session, exercises and the following activities were completed by Group B; Sensory integration therapy: Visual perception activities: Block design, finding shapes in pictures, puzzles, matching geometric shapes and letters, numbers, and classification; Body awareness: Pointing to the body parts, life-size drawing, turning left and right side

and awareness of the body parts through touch; Tactile perception: Feeling various textures, touching boards and feeling shapes; Visual-motor coordination training: Ocular-pursuit training, moving ball and pegboard activities [15]. Conventional physiotherapy: Passive stretching exercises, Passive range of motion exercises.The Group A underwent the conventional physiotherapy alone.

STATISTICAL ANALYSIS: The Independent sample t-testused for comparison of initial measurements in the two groups revealed no significantdifferences in 5 dimensions ($p > 0.05$). Independent sample t-test used for comparison ofscores between two groups. The intervention mean scores at 0th month, at end of 2nd monthand at end of 4th month for each of the two groups were analysed using a paired-sample t-test,to determine whether there were any significant differences. Statistical analysis wasperformed with SPSS (version 20), with P-values less than 0.05 considered statisticallysignificant.

OUTCOME MEASURES: All assessments were done at 0th month after randomization, at end of 2nd month, and at end of 4th month treatment by physiotherapist. The Standardized validated measure of function were used: GMFM (GMFM-88) is a clinical measure designed to assess gross motor abilities of children with CP in five dimensions: (1) Lie and Roll, (2) Sit, (3) Crawl and Kneel, (4) Stand, (5) Walk, Run, and Jump. This measure has been studied for its reliability and validity [15].
The Modified modified Ashworth scale [12] attempt to measure the severity of hypertonia usingclinical assessment scales. A study was conducted with $n = 30$, mean age = 59.3 (17.6) years,patients with central nervous system lesions. The found excellent inter-rater reliability using MMASbetween two experienced raters (Kendall's tau = 0.847, $p < 0.001$) [13].

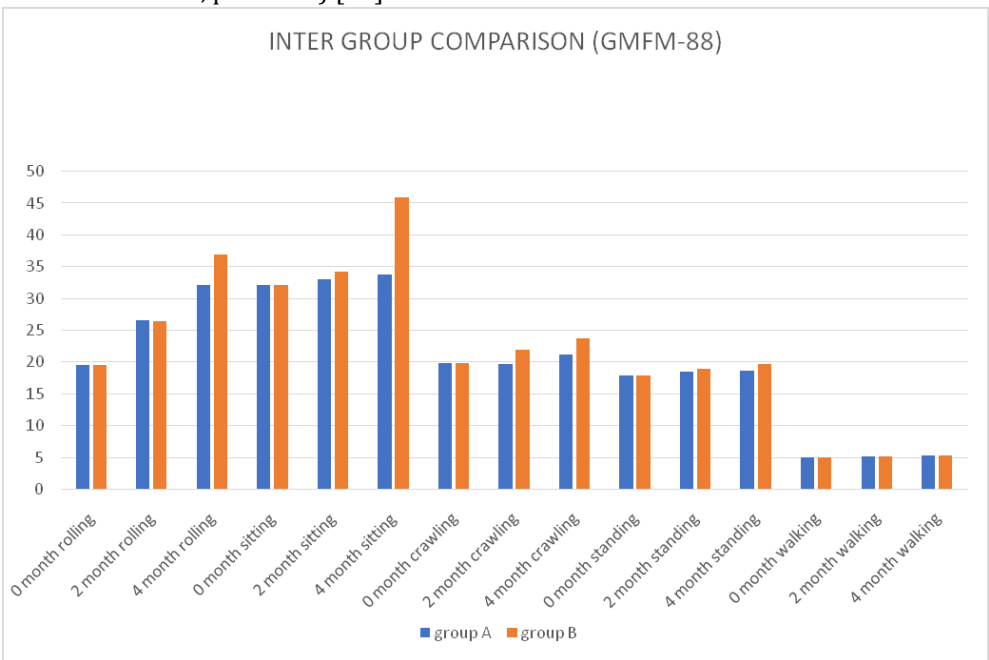


Figure 2. Inter and Intra Group comparison at 0th month, at end of 2nd month and at end of 4th month scores measurement of GMFM-88 of Group A and Group B (X- axis showing dimensions scores, Y -axis showing Mean)

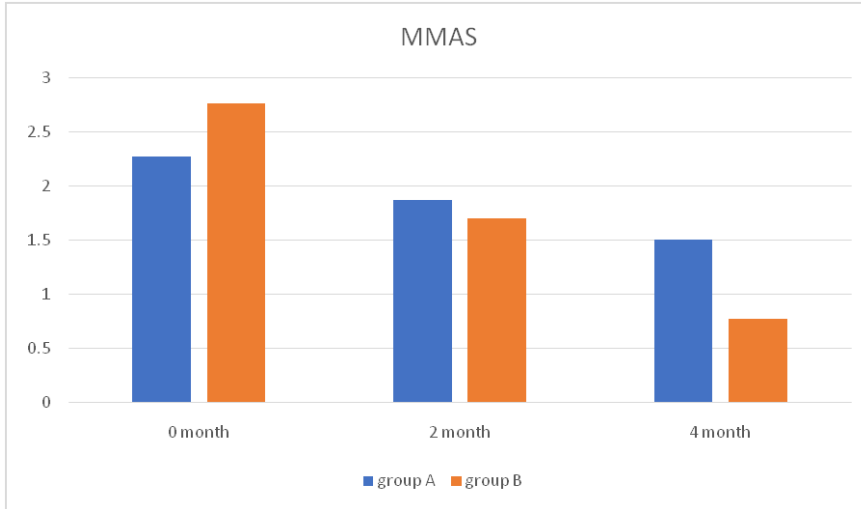
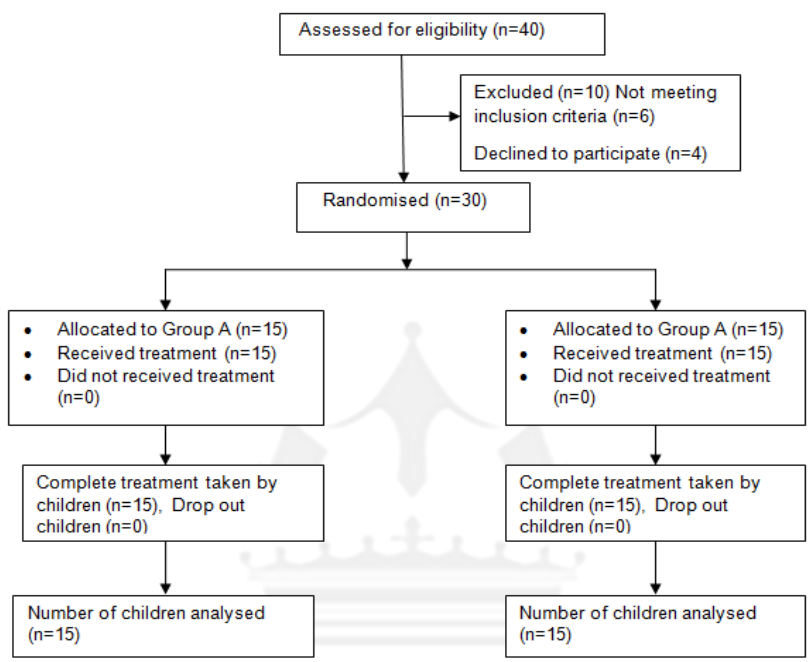


Figure 3. Comparison at 0th month, at the end of 2nd month and at the end of 4th month of MMAS measurement of Group, A and Group B.

DATA ANALYSIS AND RESULTS: Overall 30 children completed the complete duration of the treatment for 4months. 15 in Group A (6 females, 9 males, age range 3-7 years; mean age 4.86 years) and 15 in Group B (5 females, 8 males, age range 3-7 years; mean age 5.0 years).

Independent t-test was performed for inter group comparison between Group A and B to analyse the changes in gross motor function and muscle tone at 0th month to end of 2nd month, at end of 2nd month to end of 4th month and 0th month to end of 4th month using GMFM-88 scale and MMAS, respectively. An alpha level of $p < 0.05$ was the level of significance for the test. ROLLING: The value of GMFM-88 (Rolling) did not show significant improvement ($p>0.05$) at end of 2nd month as compared to 0th month. However, at 0th month to end of 4thmonth the scores of rolling in GMFM-88 showed significant improvement ($p<0.05$) that is $p= 0.003$ and $t = 3.256$ compared to both at 0th month and end of 2nd month;



SITTING: The value of GMFM-88 (Sitting) did not improve significantly ($p>0.05$) at end of 2nd month as compared to 0th month. However, at end of 0th month to end of 4thmonth it showed significant improvement ($p<0.05$) i.e. $p= 0.000$ and $t = 6.329$ compared to both at 0th month and after 2nd month; CRAWLING: The value of GMFM-88 (Crawling) showed significant ($p<0.05$) improvement in GMFM scores

i.e. p=0.021 and t=2.452 at end of 2nd month as compared to 0th month and also showed significant (p<0.05) improvement in GMFM-88 Score i.e. p= 0.021 and t =2.449 compared to both at 0th month and 2nd month;

STANDING: The value of GMFM-88 did not show significant (p<0.05) improvement in GMFM-88 score at end of 2nd month and at end of 4th month as compared to 0th month and at end of 2nd month to end of 4th month; WALKING: The value of GMFM-88 did not show significant (p>0.05) improvement in GMFM-88 scores i.e. p =1.00 and t = 0.0 at end of 2nd month and end of 4th month as compared to 0th month and at end of and at end of 4th month.

The independent t-test revealed that in children of Group A and B, gross motor function significantly improved after intervention in 3 dimensions: rolling, sitting, crawling (p<0.05). However, no significant improvement in standing and walking dimensions (p>0.05) (Figure 2).

Paired t-test was performed for intra-group comparison within each Group A and B to analyse the changes in gross motor function and muscle tone at 0th month to end of 2nd month, at the end of 2nd month to end of 4th month and 0th month to end of 4th month using GMFM-88 and MMAS, respectively. An alpha level of p < 0.05 was the level of significance for the test. The paired t-test for the Group A revealed significant differences in GMFM- 88 scores in rolling, sitting, crawling abilities only (p=<0.05)) i.e. p= 0.000 at 0th month to the end of 2nd month and end of 2nd month to the end of 4th month. However, in crawling and walking no significant differences were observed (p> 0.05). The paired t-test used for 0th month, at the end of 2nd month and at the end of 4th month measurements for the Group B revealed significant differences in GMFM- 88 scores in rolling, sitting, crawling and standing abilities (P< 0.05) i.e. p = 0.000, respectively. However, only in walking ability no significant difference was observed (P> 0.05) i.e. p=0.164 and t= -1.468. The Paired-sample t-test revealed that in children of Group B, gross motor function significantly improved after intervention in 4 dimensions: rolling, sitting, crawling and standing positions.

(p<0.05). However, in Group A gross motor function significantly improved after intervention only in the 3 dimensions: rolling, sitting and crawling position (p<0.05) (Figure 2).

The Independent t-test revealed that MAS scores showed significant improvements in reducing spasticity with significance p=0.003 (p<0.05). The paired t-test revealed that mean of MMAS score at 0th month, at the end of 2nd month and at the end of 4th month of Group A and Group B showed significant difference. But the mean of Group B=0.76 shows more marked decrease in spasticity than that of Group A =2.00 (Figure 3).

However, according to our results, as initially hypothesized, SIT along with conventional physiotherapy intervention had a significant positive effect on gross motor function in children with CP. Therefore, from the above statistical analysis, the alternative hypothesis has been accepted and null hypothesis rejected.

DISCUSSION

"Cerebral palsy describes a group of permanent disorders of the development of movement and posture, causing activity limitation i.e. attributed to non-progressive disturbances that occurred in the developing fatal or infant brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication, behaviour, epilepsy and by secondary musculoskeletal problems" [8]. As a result, children with CP lack normal muscle tone and less gross motor functions which effects control of limbs, head, and overall posture [14]. The purpose of the study was to evaluate the effectiveness of sensory integration therapy on gross motor function in spastic diplegic cerebral palsy children.

The previous studies and evidences were more on effectiveness of sensory integration therapy in Autism children. Less research data was available about the effectiveness of sensory integration therapy in spastic diplegic cerebral palsy children. The present study was done to evaluate the effectiveness of sensory integration therapy on gross motor function in spastic cerebral palsy children.

30 Children were randomly divided into two groups: Group A (n=15) and Group B (n=15) with each group n=15. Group A received conventional physiotherapy and Group B received sensory integration therapy along with conventional physiotherapy. All children were evaluated with gross motor function measurement (GMFM – 88) scale for rolling, sitting, crawling, standing, walking dimensions and for spasticity with Modified Ashworth Scale before the start of intervention and follow up was done at end of 2nd and end of 4th month with duration of 5 days per week for 4 months. The data presented in the previous chapter is discussed according to the objectives, to establish whether the children's gross motor function and spasticity improved during 4 month period. The data was examined for statistically significant information. The limitations of study were also reviewed. This study concluded that sensory integration therapy provides the spastic diplegic cerebral palsy children with graded sensory experiences. It enables the child to make sense of their world by receiving, registering, modulating, organizing and interpreting the

information that comes to their brains from their senses. It helps in significant improvement in 3 dimensions such as rolling, sitting, crawling except in standing, walking dimensions. So, it was concluded from this study that both conventional physiotherapy and conventional physiotherapy with sensory integration therapy were effective in improving gross motor functional abilities in children. Children who had received Sensory integration therapy plus conventional physiotherapy showed more improvement in gross motor functional abilities and spasticity as compared to those who received conventional physiotherapy alone. However, statistically it was concluded that Sensory integration therapy plus conventional physiotherapy is better than alone conventional physiotherapy. The findings of the study shows that following 4 month of intervention there is a marked difference in the 0th to end of 4th month. Thus, our study supported the alternate hypothesis and rejects null hypothesis.

The present study are consistent with other studies which concluded the effect of sensory integration therapy in spastic CP. Shamsoddini, Alireza *et al*.,2010 who investigated a study to determine the comparison between the effect of Neuro- developmental treatment and sensory integration therapy on gross motor function in children with cerebral palsy. 22 children with spastic CP were randomly divided into two groups, sensory integration therapy was given to first group and Neurodevelopmental treatment was given to second group. When two groups were compared, a significant difference was found in lying and rolling (P=0.003), sitting (0.009), crawling and kneeling (0.02) and standing ability (P=0.04). But no significant difference in walking, running, and jumping abilities between two groups (0.417).

This result showed that neurodevelopment treatment and sensory integration therapy improved gross motor function in children with cerebral palsy in four dimensions (rolling, sitting, crawling, and kneeling, standing) [9]. This study is relevant with the present study for the use of sensory integration therapy in spastic diplegic cerebral palsy children.

Other similar studies were also found by May-Benson *et.al*, 2010 in which twenty-seven studies were systematically reviewed to identify, evaluate, and synthesize the research literature on the effectiveness of sensory integration (SI) intervention on the ability of children with difficulty processing and integrating sensory information to engage in desired occupations and to apply these findings to occupational therapy practice. Results suggest the SI approach may result in positive outcomes in Sensory-motor skills and motor planning; socialization, attention, and behavioural regulation; reading-related skills; participation in active play; and achievement of individualized goals.

Gross motor skills, self-esteem, and reading gains may be sustained from 3 months to 2 years. This study results are inconsistent with the results of the present study which showed significant improvement using sensory integration therapy in spastic diplegic cerebral palsy children [7].

Vargas *et al*., 1999 did a meta-analysis to determining whether existing studies of treatment using sensory integration approaches support the efficacy of sensory integration treatments. Sixteen studies were used to compare sensory integration therapy with no treatment and 16 studies were used to compare sensory integration therapy with alternative treatments. Results showed a significant difference between the averages sizes of effect of the earlier studies compared to more recent studies. Earlier studies showed large treatment effects favouring SI over no-treatment controls. More recent studies did not show overall positive effects. While general limitations in the methods and statistical analysis of the primary studies were summarized, there was no description of the characteristics of the individual articles [11].

So, these studies supported that there was a future need to be done to find valid results with sensory integration therapy in cerebral palsy child.

LIMITATIONS OF THE STUDY:

The number of children was very small for the study. There were only 30 children involved in present study. Small number of samples inclusion may be affected by external validity of the study and the results might not be representative of the population. Resources were limited which have a great deal of impact on the study such as literature relevant to this topic, data collection time and financial support for conducting the research project.

CONCLUSION: It was concluded that Sensory integration therapy plus conventional physiotherapy is better than alone conventional physiotherapy.

FUTURE SCOPE: Future studies can be done which focus on the use of sensory integration therapy which should last at least six months to years (6 months to 1 year) to reap any lasting benefits; it would be interesting to study the effects of the implementation of this SIT therapy and conventional physiotherapy

with more children. So, Study can be done on large sample size; further study can be done with use of different outcomes measures; a further study could be done with good combination of the assessment and treatment.

ACKNOWLEDGEMENTS
Many thanks, to all children and their parents who participated in this study for their cooperation.

COMPETING INTERESTS
Authors have declared that no competing interests exist.

REFERENCES

1. Abeer, AF 2007,' Does combining physiotherapy with Botulinum toxin type A injections improve the management of children with spastic cerebral palsy?', University of glasgow, Riyadh.
2. Ayres, AJ 1972, 'Sensory integration and learning disorders', Journal of learning disabilities, vol. 5, pp338 – 343.
3. Bundy, AC & Murray, EA 2002, 'Sensory integration: A Jean Ayres, theory revisited', Sensory Integration: Theory and practice, 2nd ed., pp 3-34.
4. Case- Smith, J, Weaver, LL, &Fristad, MA 2014, ' A systematic review of sensory processing interventions for children with autism spectrum disorders', Pub med US National Library of medicne,vol 3(3), pp 225-7. 5. Damiano, DJ 2004, 'Physiotherapy management in cerebral palsy: Moving beyond philosophies, Management of the Motor Disorders of Cerebral Palsy', Clinician Developmental Medicine vol. 2nd , No. 161, pp 161-69.
5. Galvin Cook, D, &Dunn, W 1998, 'Controversial Therapies for Autism and Intellectual Disabilities‟, pp.191- 239.
6. May,Benson, TA 2014, ' Inter-Rater Reliability and Discriminative Validity of the Structural Elements of the Ayres Sensory Integration', American Journal of Occupational Therapy, vol 64,pp 403-414.
7. Rosenbaum & Peter L 2008, 'Development of the Gross Motor Classification System for cerebral palsy', Developmental Medicine & Child Neurology, Vol. 50, no. 4, pp 249-53.
8. Shamsoddini, Alirezajune 2010, ' Comparison between effect of neurodevelopment technique and sensory integration therapy on gross motor function in spastic cerebral palsy children', Iranian Journal of Child Neurology, Vol.4, no.1.
9. Stock Kranowitz, C 1998, 'The out- of -synch child, Recognizing and coping with Sensory integration dysfunction', Perigee Publishers, New York.
10. Vargas, S &Camilli, G 1999, 'A meta-analysis of research on sensory integration treatment', American Journal of Occupational Therapy, Vol 53, no 2, pp 189-98.
11. Bohanon, RW & Smith, MB 1987, 'Interrater reliability of a Modified Ashworth scale of muscle spasticity', Physical Therapy, vol. 67, pp 206- 07.
12. Phyllis Palm & Christopher Newman, 2012, Neurology section of the APTA, vol 7, no.3.
13. Shahanawaz, Tushar,J,Palekar& Nidhi Shah 2015, Casady, & Nichols-Larson, 2004, mcgibbon, 2009. 'Effect of Swiss Ball on Balance in Children with Spastic Diplegia, A Case Study', International Journal of Research in Paediatrics (IJRP), Vol. 1, Issue 1, pp 8-11.
14. Shamsoddini, AR &Hollisazjan 2009,' Effect of sensory integration therapy on gross motor function in children with cerebral palsy', Iranian Journal of Child Neurology, vol 9, no 2, pp 36-41.
15. NoureddinNakhostin Ansari, SoofiaNaghdi in 2012, Intra-rater reliability of the MMAS in the assessment of upper-limb muscle spasticity.
16. Jooyeon Ko, Minyoung Kim et al in march 2013, volume 93, issue 3, Physical therapy, Reliability and responsiveness of the GMFM-88 in children with cerebral palsy.