RESEARCH ARTICLE

EFFECT OF SENSORY INTEGRATION THERAPY ON GROSS MOTOR FUNCTION IN CHILDREN WITH CEREBRAL PALSY

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Abstract

Objective

The primary problem in children with cerebral palsy (CP), frequently referred for occupational therapy, is gross motor dysfunction. The current study was designed to investigate the effects of sensory integration therapy (SIT) on gross motor skills in CP patients.

Materials & Methods

Twenty-four children with diplegic spastic CP were randomly divided into two groups: First group (n=14,6 girls, 8 boys), age range 2 to 6 years, mean age 3.9 years; the second or control group (n=10, 5 girls, 5 boys), age range 2 to 6 years, mean age 3.4 years. SIT training was given to the first group and only the home program was given for the second group. All children were evaluated with gross motor function measurement (GMFM 88) for rolling, sitting, crawling, standing and walking position before and after intervention. Treatment duration for both groups was 1 hour, 5 days per week for a period of 12 weeks.

Results

Gross motor function in children of the case group improved significantly better that in the control group, after intervention in sitting (P=0.02), crawling (P=0.001) and standing (P=0.03) positions; however no significant difference was seen in rolling (P=0.65) and walking (P=0.69) ability assessment.

Conclusion

This study showed the beneficial effects of the SIT training program for children with CP; the SIT intervention had a significantly positive effect on gross motor function in the children with diplegic spastic CP. Moreover the results of the present study showed that sensory integration and vestibular stimulation were effective in children with cerebral palsy.

Keywords: Cerebral palsy, Children, Gross motor, Occupational therapy, Sensory integration

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Introduction

Cerebral palsy (CP), a common, non-progressive, but not necessarily unchanging neurological disorder of childhood (1), is clinically classified as spastic, athetoid, ataxic, and hypotonic; the most prevalent form is spastic CP (2), which affects motor and postural development and causes sensory disorders and learning disabilities (1). The primary problem in CP is gross motor dysfunction (3). CP occurs in every to 2/1000 to 2.5/1000 live births (4).

Although there is no epidemiological research on the prevalence of CP in Iran, a high prevalence rate is predicted because of the high incidence of some risk factors such as consanguineous marriage, diseases in pregnancy and early childhood, and negative conditions at birth. Occupational and physical therapy in children with CP is performed for the prevention of abnormal muscle tone and posture, treatment of muscle and joint deformities, and reduction of cognitive and sensory disorders (1).

One approach to help children with CP achieve their optimal level of functioning is Sensory Integration Therapy (SIT), which is a treatment approach that was originally developed by Jean Ayres (5) and aims to provide the child with graded sensory experiences. It is typically given by an occupational therapist with training and expertise in sensory integration (6). SIT is an active therapy, and the activities usually involve the use of large pieces of equipment such as big rolls and balls, trampolines, swinging hammocks, which provide intense proprioceptive, vestibular and tactile experiences (7, 8, 9). it is a process occurring in the brain that 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 (10). Although SIT is widely used by pediatric therapists in the treatment of children with CP, there is little research evidence regarding its efficacy (11, 12, 13). The aim of this study was to investigate the effectiveness of the sensory integration therapy approach for children with CP, in improvement of their gross motor function.

Materials & Methods

Of 207 children referred to the occupational therapy clinic, twenty-seven children with diplegic CP were selected from a population of individuals with spastic diplegic CP who had been followed up at Baqiyatallah Hospital. Inclusion criteria were: A diagnosis of CP (patient's diagnosis of CP confirmed by an expert pediatrician and a neurologist), no other severe abnormalities such as seizure, no participation in other therapeutic programs except for occupational therapy, age 2 to 6 years, and referral to the occupational therapy clinic of children with disabilities, Baqiyatallah hospital, for a 12-week course of therapy. Our exclusion criteria were: Receipt of medical procedures likely to affect motor function such as botulinum toxin injections, orthopedic remedial surgery, mental retardation or learning disability. Participants were divided into a treatment group and a control group, Gross motor function of patients was evaluated according to Gross Motor Function Measure (GMFM). The treatment group received and participated in sensory integration treatment for 12 weeks, while the control group got home exercise, which includes routine occupational therapy for 12 weeks done by parents and controlled by an occupational therapist. No statistically significant differences in physical and clinical characteristics of the groups were found before treatment ($p>0.05$).A convenience sample was used. Ethical approval was granted for the study and informed consent statements were signed by all the parents. One standardized validated measure of function was used: The GMFM (GMFM-88) is a clinical measure designed to assesses 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 (14,15). In children with CP, the GMFM has been shown to be sensitive to change during periods of therapy (16, 17, 18). This measure has been studied for its reliability and validity (14).

Sensory integration, defined as "the organization of sensory information for use", is a process occurring in the brain that enables the individual to make sense of their world by receiving, registering, modulating, organizing and interpreting information that comes to their brains from their senses. Therapies include stimulating touch sensations and pressures on different parts of the body. With the use of certain items, such as Styrofoam chips, or textured toys, this therapy will also motivate children to learn sequences of movements.

Assessments before and after treatment were undertaken by an occupational therapist. The treatment group that participates in the study was underwent sensory integration treatment. In each session, exercises and the following activities were completed by treatment group:

1. Visual perception activities: Block design, finding shapes in pictures, puzzles, matching geometric shapes and letters, numbers, and classification.
2. Body awareness: Pointing to the body parts, life-size drawing, turning left and right side and awareness of the body parts through touch.
3. Tactile perception: Feeling various textures, touching boards and feeling shapes.
4. Visual-motor co-ordination training: Ocular-pursuit training, moving ball and pegboard activities (6, 18, 19).

In each session, exercises included patients sustained on forearms and hands, in sitting, crawling, semi-kneeling, and standing positions, supported by the occupational therapist until tone reduction was achieved. Balance and corrective reactions were developed by using a CP ball and tilt board after the children had acquired the skill of maintaining the exercise positions. Ambulation training, appropriate to the motor development level (crawling, creeping, walking in semi-kneeling position, and walking in parallel bars) was given. The control group underwent the exercises. Duration of the treatment for the two groups was five days a week for 12 weeks, each session being one hour. The Independent sample t-test used for comparison of initial measurements in the two groups revealed no significant difference (t=1.648, p=0.119).

Statistical analysis: Normal distribution of variables was assessed with the Kolmogrov-smirnov test; Independent sample t-test used for comparison of scores between two groups. The pre-SIT and post-SIT intervention mean scores for each of the two groups were analyzed using a paired-sample t-test, to determine whether there were any significant differences. Statistical analysis was performed with SPSS (version 13.0), with P-values less than 0.05 considered statistically significant.

Results

Overall twenty-four children completed the complete duration of the treatment for 12 weeks, but unfortunately three could not be followed up due to illnesses during trial (n=2); botulinum toxin injections during trial (n=1); their data was not included in data analysis on an intention to treat basis; therefore 14 subjects participated in treatment group (6 girls, 8 boys, age range 2 to 6 years; mean age 3.9 years) and 10 in control group(5 girls, 5 boys, age range 2 to 6 years; mean age 3.4 years).

Mean, standard deviation (SD), minimum and maximum scores for the GMFM-88; pre-treatment and post-treatment measures for both groups are given in Table1.

The Independent simple t-test showed significant improvements in GMFM scores between the two groups, following sensory integration therapy, in sitting (t=2.44, P=0.02), crawling (t=1.89, P=0.001) and standing positions (t=3.20, P=0.03); however there were no significant improvements in rolling (t=0.45, P=0.65) and walking ability (t=0.39, P=0.69) (table2).

The paired t-test used for before and after measurements for the treatment group revealed significant differences in GMFM- 88 scores in rolling, sitting, crawling and standing abilities (P> 0.05). However in walking ability no significant difference was observed (P> 0.05) (table3).

The Paired-sample t-test revealed that in children of the control group, gross motor function significantly improved after intervention only in the rolling position ($p<0.05$) (table 4).

According to our results, as initially hypothesized, SIT intervention had a significantly positive effect on gross motor function in children with CP.

Table 1. Descriptive statistics in the treatment and control groups

Group	Assessment	GMFM 88			
		Mean	SD	Min	Max
Treatment	After treatment	90.1	11.62	66	124
	Before treatment	112.6	10.41	105	132
Control	After treatment	86.3	7.93	75	103
	Before treatment	88.2	7.36	80	109

GMFM, Gross Motor Function Measure; Min, Minimum; Max, Maximum

Table 2. Gross Motor Function Measure in five positions–Independent simple t-test

Ability	Group	Mean	SD	T value	P value
Rolling	Control	23.2	13.8	0.45	0.65
	treatment	21	8.8		
Sitting	Control	34.3	8.5	2.44	0.02
	treatment	25.9	8.1		
Crawling	Control	20.7	5.2	1.89	0.003
	treatment	20	6.2		
Standing	Control	19.7	4.5	3.20	0.03
	treatment	17	9.2		
Walking	Control	5	4	0.39	0.69
	treatment	4.3	4.4		

Table 3. Pre and Post Gross Motor Function Measure in the treatment group

Ability	GMFM Score		SD	df	P value
	Pre	Post			
Rolling	19.5	32.2	9.7	13	0.001
Sitting	32.2	36.7	4.9	13	0.04
Crawling	19.8	23.7	3.8	13	0.002
Standing	17.8	19.7	1.2	13	0.010
Walking	4.9	5.3	1.5	13	0.306

Table 4. Pre and Post Gross Motor Function Measure in the control group

Ability	GMFM Score		SD	df	P value
	Pre	Post			
Rolling	19.5	32.2	9.7	9	0.001
Sitting	32.2	33.7	1.9	9	0.40
Crawling	19.8	21.1	2.1	9	0.23
Standing	17.8	18.6	2.4	9	0.10
Walking	4.9	5.3	1.5	9	0.306

Discussion

Occupational therapy and Neuro-rehabilitation approaches are important components in the treatment of CP patients. Various occupational therapy methods have been applied to obtain normal motor development, to prevent postural abnormalities, sensory defenses, gross motor dysfunction and deformities and to increase functional capacity. Although Neuro-rehabilitation of CP varies are according to clinical types, but the sensory integration therapy is one of the effective approaches for treatment of all CP variants (7, 8, 10, 20).

The treatment group that received sensory integration therapy, according to GMFM 88 score abilities in three positions, i.e. (sitting, crawling and standing) showed significantly better improvement than the control group. However in the second group that no received sensory integration, there was only significant improvement in rolling ability, that was not different with our experienced group.

To date, few studies had investigated the effects of SIT on gross motor function improvements in similar intervention periods (a few weeks). In a randomized controlled trial by Carlsen, individuals were assigned to control group (n=6) and SIT group (n=10), which received 2 hours of therapy per week over 6 weeks, This is an intervention time almost similar to that of the present study. The outcome measures concerned motor development: Gross Motor Function Measurement. The group receiving SIT had significantly more improvement in sitting and crawling abilities compared with the control group that this finding is in line with our study. More over in a randomized controlled trial by Palmer and colleagues; 48 infants with spastic diplegia were assigned to receive 12 months of SIT. The SIT was aimed at improving sitting and crawling abilities (21). Outcome measures included the Bayley Motor Scale (22) and observation of defined motor skills. The group receiving sensory integration performed significantly better than those receiving home exercise.

In this study, based on the pre and post-treatment scores, a significant improvement in gross motor function was seen over the 12-week sensory integration therapy (SIT) period; this effect might be anticipated as the sensory integration therapy concept focuses on preparing, practicing, and gaining new functional skills (23). Studies in the published literature have shown that sensory integration therapy programs have been used to facilitate motor functions. Each type of treatment (SIT or exercise) might be expected to yield different changes in motor performance. Because the SIT approach included goals of improving gross motor function and postural stability, it may be that the treatment effects would be most obvious in the postural set used for gross motor function (24). The SIT approach attempts to facilitate normal development and improve the child's ability to process and integrate sensory information (visual, perceptual, proprioceptive, auditory, etc). One important aspect of choosing the SIT approach is that the motivation of the child plays a crucial role in the selection of the activities. Most children tend to seek out activities that provide sensory experiences which will be beneficial to them at that point in their development. It is this active involvement and exploration that enables the child to become a more mature, efficient organizer of sensory information (25). Sensory integrative therapy, perceptual–motor training, vestibular stimulation and play therapy have been used as treatment programs according to the needs of the child with CP (5, 6, 7, 26).

In conclusion, Within this population sample, children improved significantly in gross motor function, as measured on the GMFM following a 12-week course of sensory integration therapy. Most improvements occurred within areas in which therapy goals were set. This conclusion justifies the need for more sensory integration therapy in CP patients. Future evaluative research is required to assess objectively the effectiveness of SIT in CP patients.

References

1. Bobath K, Bobath B. The facilitation of normal postural reactions and movements in the treatment of cerebral palsy. Physiotherapy 1967; 50: 246–9.
2. Kuben KCK, Leviton A. Cerebral palsy. N Engl J Med 1994 Jan;20; 330(3): 188-95.
3. Scherzer AL, Tscharnuter I. Early Diagnosis and Therapy in Cerebral Palsy: A Primer on Infant Development Problems. New York: Marcel Dekker; 1982.P.87-101.
4. Stanley FJ, Blair E, Alberman E. Cerebral Palsies: Epidemiology & Causal Pathways. London, England: Mac Keith Press; 2000.P.29-41.

5. Ayres AJ. Sensory integration and learning disorders. Los Angeles, CA: Western Psychological Services; 1972. P.25-101.
6. Ayres AJ. Sensory integration and praxis test. Los Angeles, CA: Western Psychological Services; 1989.P.15-34.
7. Parham LD, Mailloux Z. Sensory Integration. In J. Case-Smith (Ed.) Occupational therapy for children.5th Ed, St. Louis MO: Elsevier Inc; 2005.P. 356-411.
8. Wilbarger P.The sensory diet: Activity programs based on sensory processing theory. Sensory Integration Special Interest Section Newsletter 1995; 18(2):1-4.
9. Bumin G, Kayihan H. Effectiveness of two different sensory-integration programmes for children with spastic diplegic cerebral palsy. Disabil Rehabil 2001 Jun 15; 23(9):394-9.
10. Ayres AJ. Southern California Sensory Integration Tests. Los Angeles: Western Psychological Services; 1980.P.23-67.
11. Ketelaar M, Vermeer A, Hart H, van Petegem-van Beek E, Helders PJM. Effects of a functional therapy program on motor abilities of children with cerebral palsy. Phys Ther 2001; 81: 1534–1545.
12. Barry M. Physical therapy interventions for patients with movement disorders due to cerebral palsy. Journal of Childhood Neurology 1996; 11(Suppl 1):51–60.
13. Carlsen PN. Comparison of two occupational therapy approaches for treating the young cerebral palsied child. Am J Occup Ther 1975; 29: 267–272.
14. Russell D, Rosenbaum P, Gowland C, Hardy S, Lane M, Plews N, et al. Manual for the Gross Motor Function Measure. Children's Developmental Rehabilitation Programme at Chedoke-McMaster University Ontario 1993; 67-73.
15. Russell D, Rosenbaum P, Cadman D, Gowland C, Hardy S, Jarvis S. The Gross Motor Function Measure: a means to evaluate the effects of physical therapy. Developmental Medicine & Child Neurology 1989; 31: 341–52.
16. Bower E, McLellan D. Effect of increased exposure to physiotherapy on skill acquisition of children with cerebral palsy. Developmental Medicine & Child Neurology 1992; 34: 25–39.
17. Bower E, McLellan D, Arney J, Campbell M. A randomized controlled trial of different intensities of physiotherapy and different goal-setting procedures in 44 children with cerebral Palsy. Developmental Medicine & Child Neurology 1996; 38: 226–37.
18. Steinbok P, Reiner A, Beauchamp R, Armstrong R, and Cochrane D. A randomized clinical trial to compare selective posterior rhizotomy plus physiotherapy with physiotherapy alone in children with spastic diplegic cerebral palsy. Developmental Medicine & Child Neurology 1997; 39: 178–84.
19. Lerner JW. Motor and perceptual development. Learning Disabilities, Houghton Miftlin: Boston; 1985.P. 264–307.
20. Ayres AJ. Sensory Integration and the Child, Western Psychological Services: Los Angeles;. 1979. p.7-32.
21. Carlsen P. Comparison of two occupational therapy approaches for treating the cerebral-palsied child. American Journal of Occupational Therapy 1975; 29: 267–72.
22. Palmer F, Shapiro B, Allen M, Mosher B, Bilker S, Harry man S. The effects of physical therapy on cerebral palsy. A randomized controlled trial in infants with spastic diplegia. New England Journal of Medicine 1988; 318: 803–8.
23. Washington, K., Scott, D. T., Johnson, K. A., Wendel, S. & Hay, A. E. The Bayley Scales of Infant Development–II and children with developmental delays: A clinical perspective. Journal of Developmental and Behavioral Pediatrics 1998; 19 (5), 346–349.
24. Mayston M. People with cerebral palsy: effects of and perspectives for therapy. Neural Plasticity 2001; 8: 51–69.
25. Linda F, JoAnn K. the effects of sensory integration treatment versus practice on the reaching of Children with spastic cerebral palsy. Physical Therapy 1996; 76: 346-58.
26. Schaaf RC, Miller LJ. Occupational therapy using a sensory integrative approach for children with developmental disabilities. Ment Retard Dev Disabil Res Rev 2005;11(2):143-8