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Case Study

The effects of vestibular stimulation on a child with hypotonic cerebral palsy

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Abstract. [Purpose] The purpose of this case report is to present the effects of vestibular stimulation on a child with hypotonic cerebral palsy through the use of swings. [Case Description] The subject was a 19-month-old boy with a diagnosis of hypotonic cerebral palsy (CP) and oscillating nystagmus. The subject had received both physical therapy and occupational therapy two times per week since he was 5 months old but showed little to no improvement. [Methods] Pre and post-intervention tests were completed by the researcher using the Bayley Scales of Infant and Toddler Development II. The subject was provided with vestibular stimulation 3 times per week for 10 weeks in 1 hour sessions conducted by his mother as instructed by the researcher. During this research all other therapies were stopped to determine the effects of the vestibular stimulation and to exclude the effects of other therapies. [Results] The subject demonstrated improvement of 4 months in motor skills and of 3 months in mental skills as shown by the Bayley Scales of Infant and Toddler Development II. [Conclusion] Vestibular stimulation was effective in improving postural control, movement, emotional well-being, and social participation of a child with hypotonic cerebral palsy.

Key words: Vestibular stimulation, Occupational therapy, Hypotonic cerebral palsy

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INTRODUCTION

Cerebral Palsy (CP) is a non-progressive neurodevelopmental disorder that includes a wide spectrum of syndromes related to the early onset of posture and motor impairment[1)]. Dysfunctional postural control and movement patterns lead to limitations in participation in activities of daily living (ADL)[2)]. According to Jeong et al.[3)] CP is the most common infant brain injuries in South Korea, representing 57.8% of brain injuries in the 0–9 years category. Management of children with CP requires various rehabilitative approaches that draw on the expertise of many specialists in different disciplines. Some of the current clinical therapeutic interventions include traditional physical and occupational therapy, neurodevelopmental treatment, the Vojta method, and sensory integration to improve postural control, balance, and locomotion for improved participation in ADL[4)].

Many children with CP not only exhibit neuromotor deficits but demonstrate difficulties with sensory processing and praxis[5)]. Sensory integration is a dynamic process that synthesizes, organizes and processes incoming sensory information from the body and the environment in order to create purposeful and goal-directed responses[6)]. Good sensory integration leads to the development of good body scheme, self-image, integration of primitive reflexes, balance, postural stability, ability to motor plan, coordination of two sides of the body, and eye-hand coordination[7)]. Among the sensory systems, the vestibular system is reported to be particularly important for postural control[8)]. Although it may be important to apply sensory integration treatment techniques and sensory based activities for children with cerebral palsy, therapists maybe reluctant to do so as the evaluation of vestibular processing can prove to be difficult[9)] and vestibular activities may increase muscle tone in unwanted areas[5)]. The purpose of this case report is to present the effects of vestibular stimulation on a child with hypotonic cerebral palsy through the use of swings.

CASE STUDY

This case was referred to this author via the child's occupational therapist who felt the child would benefit from this study. Inje university affiliated hospital Ethics Review Board approved this case study and informed consent was obtained from the child's mother.

SUBJECT

The subject was a 19-month-old boy with a diagnosis of hypotonic cerebral palsy (CP) and oscillating nystagmus. His medical history included bilateral cataract surgery at 100 days of age. He was born at 39 weeks of gestation via Caesarian section and there were no complications reported at birth. However his mother reported him to be a fussy

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baby who cried often and appeared to be colicky. Due to hypotonic CP, he demonstrated overall developmental delays including developmental milestones. He started to demonstrate head control at about 8 months and ability to maintain the ring-sitting position for less than 30 seconds using his hands to prop himself up when put in a seated position; however he had not made any further progress in gross motor skills since. At 5 months of age, he started to receive therapy for developmental delays, including hospital based occupational therapy 2 times per week, physical therapy using the NeuroDevelopmental Treatment (NDT) technique and the Vojta method 2 times per week, and sensory stimulation once a week. He was reported to cry incessantly and was inconsolable in all of his therapy sessions from when he started therapies at 5 months to his initial assessment for this case study.

METHOD

Pre and post-intervention tests were completed by the researcher using the Bayley Scales of Infant and Toddler Development II. After the pre-intervention test and during the intervention phase all of the subject's other therapies were stopped to control the effect of vestibular stimulation without other interventions. The subject was provided with vestibular stimulation 3 times per week for 10 weeks in 1 hour sessions conducted by his mother as instructed by the researcher. Each session started with 30 minutes of swinging on an infant swing for all 10 weeks. The vestibular stimulation protocol using different swings is shown in Table 1. All the swings used are shown in Figs 1–4.

RESULTS

The subject's mental raw score was 21 with a corresponding developmental age of 1 month, and his motor raw score was 40 with a corresponding developmental age of 6 months, pre-intervention. The subject's mental score increased to 46 with a corresponding developmental age of 4 months, and his motor score increased to 58 with a corresponding developmental age of 10 months (Tables 2, 3).

The results show that the subject exhibited improved mental and motor skills of 3 and 4 months respectively which is a significant improvement at this age of development. The subject was able to ring-sit for less than 30 seconds at pre-test, and was not able to transition from supine or prone to sitting or from sit to pull to stand. However after 10 weeks of intervention he was able to walk with his hand held and independently for about 15 meters before losing balance, and he was able to transition from supine or prone to sit to pull to stand independently. As for mental skills, the subject showed no interest in toys or people and he cried throughout the entire therapy session at the beginning of this study; however once he was introduced to vestibular stimulation by swinging, he smiled, laughed and started to interact with both toys and people.

Fig. 1. Infant swing

Fig. 2. Frog swing

Fig. 3. Regular playground swing

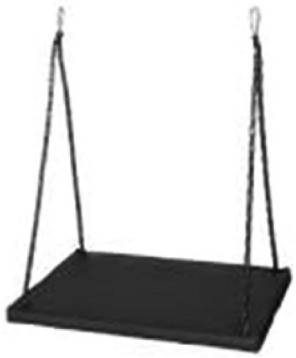

Fig. 4. Platform swing

Table 1. Vestibular stimulation protocol

Weeks	Swing / Duration
1	Infant swing /1 hour
2	↓
3	
4	
5	Infant swing / 30 min — Seated on Frog swing /30 min
6	Seated on Frog swing / 30 min
7	Prone on Frog swing / 30 min (feet touching the floor)
8	Prone on Frog swing / 30 min (feet touching the floor)
9	Seated on regular playground swing / 30 min
10	Standing on platform swing / 30 min
↓	Standing on platform swing / 30 min

Table 2. Results of Bayley

Scale	Pre-test		Post-test	
	Raw Score	Percentile %	Raw Score	Percentile %
Mental	21		46	
Motor	40		58	
Behavior rating				
Orientation E	11	1%	32	23%
Emotional R	12	1%	28	6%
Motor Q	15	1%	25	1%
Additional I	1		4	
Total R Score	39	1%	89	7%

Table 3. Results of Bayley, developmental age

	Pre-test	Post-test
Mental developmental age	1 month	4 months
Motor developmental age	6 months	10 months

DISCUSSION

Postural control is dependent on the integration of proprioception, vision and vestibular systems of which vestibular input is particularly important[10]. Adequate motor performance and postural control is needed for an infant or a young child to independently perform and participate in play, activities of daily living and social interactions. Infants diagnosed with cerebral palsy demonstrate difficulties with postural control and locomotion and can miss opportunities to explore their environment[11]. The subject in this case study was diagnosed with hypotonic cerebral palsy and demonstrated poor postural control, only being able to maintain a ring-sit position using his hands to prop himself up for 30 seconds. The subject was not able to explore his environment due to lack of mobility and he did not use his hands at the beginning of this research. One possible explanation for his incessant crying during all of his therapy sessions in the past year is that he had an inefficient vestibular system. Sensory integration of the vestibular system provides a "gravitational security" which helps with the emotional well-being[5] however, due to the subject's poor integration of the vestibular system, he may have been fearful of being moved during all of his therapies which made him resistant and cry. When the subject was presented with intense vestibular inputs on different swings, he stopped crying very quickly and responded by holding his head and trunk more erect and eventually improved his postural control enough for him to walk. At the beginning of this study, the subject made no attempt to move his body and spent most of his waking hours lying in supine. When his mother put him in sitting position or moved him, he cried and was resistant to being moved. However by the end of this research the subject demonstrated improvements in movement in space and transitioning from supine or prone to sitting and from sitting to pull to stand independently.

The vestibular system is thought to be a primary organizer of sensory information and contributes to physical and emotional security[12]. This case study shows that improving the integration of the vestibular system through the use of swings resulted in the improvement of the subject's postural control, movement, exploration, and emotional well-being. The subject's mother reported feeling anxious and helpless as she did not know how to console or interact with her crying child. However once the subject had been introduced to vestibular inputs on different swings, he responded almost immediately by not crying, and started to laugh out aloud and babbling. Both the subject and his mother appeared much more relaxed with each other and able to interact with each other better as the subject decreased crying and started to explore his environment. The subject's mother reported that at the beginning of this study she could not take him anywhere to play as he cried the entire time when she took him to playgroups and playgrounds but from about the middle of the intervention of this study, he started to feel comfortable when taken to new environments. The level of subject's comfort, exploration, interaction, and play had improved significantly by the end of this study.

This study has demonstrated that vestibular inputs through the use of swings has improved the subject's postural control, movement in space, emotional well-being, interaction with people and environment and participation in play. Therefore therapists may wish to consider providing vestibular inputs for children with hypotonic cerebral palsy in treatments to facilitate postural control and emotional well-being. Sensory based activities must be provided by a well trained and experienced therapist as children with cerebral palsy present neuromotor deficits as well as sensory issues. A limitation of this case study is that there was only one subject which makes it difficult to generalize the findings to a wider population. Therefore, further research with larger sample sizes are needed to determine the effectiveness of vestibular inputs through the use of swings on children with hypotonic cerebral palsy. Future studies should also look at the effectiveness of sensory integration and NDT in the treatment of children with cerebral palsy.

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