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Research Article

Effectiveness Of Motor Control Based Early Intervention On Developmental Performance Of Preterm Born Infant: A Case Report

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ABSTRACT

We reported a case of a preterm-born male child with developmental delay. He was born prematurely out of twin pregnancies through C-section and had a low birth weight. He was admitted to the NICU and had episodes of seizures. After discharge during follow-up, at the corrected age of 7 months, the physiotherapy treatment was given. The treatment protocol was based on motor control concepts and we have taken Gross motor function measures and Sensory profile as outcome measures in pretreatment and posttreatment conditions. In our treatment protocol, we have integrated motor control training of trunk with upper limb tasks, and use of sensory input to get appropriate motor output. This enhanced the stability of the trunk. The motor control task includes the hierarchical theory concepts, based on this task, the treatment plan is carried out. The ball pool and vestibular swings were used to enhance the sensory input. The child has shown drastic improvement in sitting as assessed on Gross motor function measures and sensory processing was also improved on sensory profile. In conclusion, premature-born infants with developmental delay after NICU stay can be treated with motor control-based training to improve the sensory and motor development of the child. Physiotherapists can focus on using motor control training as a treatment approach for the developmental training of preterm-born infants.

Keywords: preterm born infant, developmental delay, motor control, early intervention physiotherapy, high-risk infant.

Introduction

Antenatal care in twin pregnancies faces a lot of complications impacting the health outcome of the mother and fetus [1]. Prevalence of lower birth weight is prominent presenting with more than 50% of twin neonates born with weight less than 2500 g [2]. The higher incidence of preterm delivery and neonatal illness is linked to a higher prevalence of low-birth-weight infants and an elevated rate of neonatal mortality in twin pregnancies [3]. The most frequent reason for a neonate's admission to the neonatal intensive care unit (NICU) is premature birth [4]. In the middle to late 1900s, medical and technological advancements in neonatal care decreased neonatal mortality and increased the survival of very low birth weight infants, which led to an increase in cerebral palsy, respiratory disorders, blindness, cognitive delays, and hearing impairments globally [5].
The early physiotherapeutic interventional strategies are crucial to the care of newborns [6]. Early intervention is the name given to a variety of multidisciplinary services provided to children from birth to age six with the

objectives of fostering adaptive parenting and family functioning, improving emerging competencies, halting developmental delays, resolving existing disabilities, and preventing functional decline [7]. There are various therapeutic approaches like Neurodevelopmental Therapy (NDT), Vojta, Motor Control etc. Motor control is defined as the ability to regulate or direct the mechanisms essential to movement [8]. Motor control is a newer approach that has potential for improvement in Gross Motor function in preterm infants and neonates [9].
Assessment and treatment of movement disorders are influenced by a variety of variables, including the cognitive status of neonates, autonomic stability, and tonal performance underpinning neurological dysfunction [10]. According to research, the movement is affected by the interaction of three factors: the individual, the task, and the environment. The work and environmental demands are taken into consideration when planning movement in adults as well as pediatric populations [11]. Multiple systems, including the motor, cognitive, and sensory/perceptual are responsible for movement performance [12]. An integrated theory of motor control that incorporates fundamental ideas from theories of hierarchies, systems, dynamic action, and ecology [13]. Therefore, the purpose of this case study was to assess the impact of early motor control training on the performance of high-risk infants.

Case presentation

Premature birth is more prevalent nowadays. Prematurity is linked to developmental delay in major aspects of health [1]. A premature male infant born at the age of 36th weeks of pregnancy at the chronological age of 8 months, however, his corrected age was 7 months presented to the physiotherapy department with complaints of developmental delay. The mother of the infant had conceived naturally. The mother underwent an emergency cesarean section and gave birth to twin infants. The infant was developmentally delayed [2]. The weight of the infant at birth was 1800 grams, he cried immediately after birth. He was admitted to the NICU as he was having low birth weight later, he had episodes of seizures and was on ventilatory support during the first 7 days out of 15 days and later shifted on oxygen support for the remaining days of NICU stay.
The infant presented with delayed motor milestones at the physiotherapy OPD, including the absence of head holding, rolling, and hand opening, as well as delayed social-emotional development, excessive irritability, and problems controlling sensory systems. The infant received physiotherapy using based motor control concept with appropriate use of environment and sensory cues. According to the FITT (frequency, intensity, time, and type) concept. The gross motor function measure (GMFM) score, and sensory profile, were used to evaluate the efficacy of the treatment methods used.

Intervention activities based on motor-control theory

In task 1, the mobility task with no manipulation requirement while sitting that is in a closed environment child was sitting on the mat and held a toy with upper extremity support. To have an appropriate environmental set-up, the sessions were conducted in a more private location of the clinic, where the environment could be managed to the fullest, and environmental distractions were reduced. The progression of the activity was done by adding visual components e.g., by shining a torch on a ball. Further progression was done by changing the color of the ball.
In Task 2, the mobility task with manipulation requirement in sitting is given in a closed environment and the child's one hand is supported and the other hand is used to give reachouts and the mobility task was given in sitting. Environmental distractions were minimized as above. The reachouts were given within the Base of support (BOS). The progression of the activity required reachouts to be given within the Base of support (BOS). Supported sitting was maintained with the exchange of objects.
In Task 3, We make the child sit in a 90-90 position on the stool or lap. The environmental set-up was such that the environmental distractions were minimal. The reachouts were given within the Base of Support (BOS)The progression of the activity required reachouts to be given out of the Base of Support (BOS).90-90 sitting was maintained with the exchange of objects. The progression of the activity required the addition of the visual component and the progression was made by shining a torch on the ball it can also further be progressed by shining a torch on the different colored balls.
In task 4, We made the child sit on a tilt board. In the environmental set-up, the environmental distractions were minimized. The progression of the activity was done by giving reachouts in antero-lateral and postero-lateral directions on both sides.
In task 5, We make the child sit on a platform swing. In the environmental setup the environmental distractions by minimized. The progression of the activity was done by giving reachouts in antero-lateral and postero-lateral directions on both sides. Visual inputs with torch and ball were also given as a progression.
In task 6, The child was made to sit in a ball pool. In the environmental set up the environmental distractions were minimized. The progression of the activity was done by giving reachouts were given in antero-lateral and postero-lateral directions on both sides. The position and color of the ball in the pool were changed.

Discussion

The study is carried out on a preterm infant born from LSCS through a twin pregnancy. This study was carried out to evaluate the effects of motor control-based early interventions and physical therapy on a high-risk infant with developmental delay. To improve the motor performance of the child, the protocol of using motor control

theories was practised [14]. The motor control theories focused on the development of postural control and righting reactions [13]. Motor control works on the principle of central process generators [13]. It utilizes the neural plasticity of the brain to make the work done [13]. So a movement repeatedly performed gets registered in the brain and the infant can easily grasp it [15].

The infant has shown marked improvement with motor control on GMFM and sensory profile. Pretreatment the GMFM score was 66% for the infant. The GMFM score was improved significantly up to 101% where major improvement was seen in the sitting component. Pretreatment The Sensory Profile scores for the Auditory component Pre-treatment score was 35 much more than others Posttreatment score was 25 more than others, Visual Component the pretreatment score was 36much more than others and the posttreatment score improved to 25 more than others, Activity level component for pretreatment score is54much more than others and posttreatment score is18Just like the majority of others. The Taste/Smell component for the pretreatment score is 32much more than others and the posttreatment score is 14. Just like the majority of others.

The Body Position component for the pretreatment score is 43 much more than others and the posttreatment score is 19. The Movement component for the pretreatment score is 58 much more than others and the post-treatment score is 28 i.e. More than others. The Touch component for the pretreatment score is 28 more than the others and the post-treatment score is 21 just like the others. The Emotional/Social component for the pretreatment score is 31 just like the others and the posttreatment score is 60 i.e., much more than others.

The treatment was focused on the motor milestones to be achieved according to the infant's age [16]. The focus of the therapy was to develop gross motor skills [16]. The infant was training his body and his mind with the repetition of the activity [17]. The ability to focus and attend to the given task helped the infant in his cognitive development [18]. The introduction of different color balls helps in the development and improvement of eye tracking and visual skills [19]. This level progresses with the introduction of light using a small troch in the colored balls [19]. Each level of the therapy had a progression, the visual cues through the introduction of a light torch through the black and white balls [20].

This protocol utilized the exercise aimed at the attainment of independent sitting milestones. This therapy was given in a closed room to discourage the fear and reduce the stranger's anxiety [21]. It gives the infant a secure environment and one-to-one eye contact [21]. Tripod sitting position helped to develop postural control using the motor control theories [22]. The motor control theory of reflex control works well for this position [22]. The use of dependent sitting comes into development. The Hierarchical theory /Reflex theory works on the principle of organization of a system hierarchically [22]. It is a top-down approach [22]. The role of these theories in integrating postural control is established [22]. There are top-down programming theories too. There is the Systems Theory which explains the role of a central command that results in the interplay between the external and internal forces [22]. Supported sitting with reachouts in all directions and worked on the Systems theory. One more approach-based concept of motor control is Parallel Distributed Processing Theory which works well when applied to a task [22]. This theory was used to explain how we acquire new skills. The way a task is taught is by making him sit on a tilt board. The dynamic control helps to develop the postural control [22]. The position is developed to allow the center of gravity to fall within the base of support. This helps in maintaining the position of the infant in an upright position [23]. The vestibular system also worked on infants in this position [24]. The use of platform swing helped to integrate the vestibular system and activate it [25]. The swinging motion causes the semicircular canals to get activated thereby increasing the postural control and balance righting reactions [25]. Sensory integration therapy was also used with the infant immersed in a colored ball pool [26]. It reduced irritability and promoted the visual skills to develop. Thereby integrating gross motor grasp with the use of feedforward and feedback mechanisms [27]. In this study, we used many different skills to tackle the sensory, motor, cognitive, vestibular and visual systems.

Conclusion

This Protocol of integrating motor control through a task-based system for upper limbs resulted in the improvement of motor performance with the achievement of age-appropriate developmental milestones. Improvement was seen in cognitive, sensory, vestibular and visual skills as well as strangers' anxiety and the fear of new environment had also reduced to a great extent.GMFM and sensory profile also showed marked improvement in gross and sensory skills of higher-risk preterm-born infants. Hence motor control-based physiotherapy treatment approach can be used as an effective approach for improving the gross motor and sensory development of the preterm infant. Further clinical trials need to be conducted shortly to generalize the results.

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