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Problem based exercise program in infant with agenesis of corpus callosum: A single case study

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Abstract

Introduction: The corpus callosum is the major neuronal fiber tract which connects two hemispheres of the brain. Agenesis of corpus callosum is amongst the most common brain abnormalities observed in humans. Its probable prevalence being 3-7 per 1000 birth.⁴ children diagnosed with agenesis of corpus callosum primarily have motor developmental delay.

Materials and Methods: During evaluation lower limb muscle tightness was noted and for that popliteal angle and adductor angle were measured. Gross Motor Function Measure (GMFM-88) was used to evaluate gross milestones development. After the baseline assessment problem based intervention was given for 45 minutes for 5 days in a week. After 6 months post intervention reassessment was done.

Result: After intervention, there was increase in both right and left popliteal angles and adductor angle thus reduction in muscle tightness. GMFM- 88 scores were also increased for dimension A, B and C those are lying and rolling, sitting, crawling and kneeling. Also there was significant improvement in total GMFM-88 scores.

Conclusion: Problem based exercise intervention is effective in treating a child with agenesis of corpus callosum having delayed milestones and muscle tightness.

Keywords: Exercise program, infant, agenesis, corpus callosum

Introduction

The central nervous system in human body controls the interpretation and transmission of motor, sensory and cognitive information. Into its central region lies the corpus callosum, which is responsible for transmitting the information between the cerebral hemispheres through a single tract^[1].

Corpus callosum (CC) is one out of the three inter hemispheric commissures (anterior commissure, hippocampal commissure and corpus callosum) and is the greatest of them. CC consists of around 190 000 000 axons with major role in inter hemispheric connection and coordination^[2].

The corpus callosum is the major neuronal fiber tract which connects two hemispheres of the brain. It is separated into four components anatomically, in a clockwise direction which are rostrum, genu, body, splenium. Formation of corpus callosum begins during gestation and continues until adulthood which is a series of complex and highly regulated developmental event. The disturbance in one or more events can result in disruption in corpus callosum that is agenesis of corpus callosum which is characterized by complete or partial loss of one or more components of the corpus callosum and may also result in hypoplastic or thinning of corpus callosum^[3].

Agenesis of corpus callosum is amongst the most common brain abnormalities observed in humans. Its probable prevalence being 3-7 per 1000 birth^[4].

Individuals with abnormalities in corpus callosum show a wide range of morphological architecture of the corpus callosum on magnetic resonance imaging (MRI). The morphological variants of the corpus callosum are divided into three categories based on their appearance on midsagittal MRI. Complete agenesis of corpus callosum which means lacking all the components of corpus callosum, partial agenesis is the absence of some of the parts but not all parts of corpus callosum, hypoplastic corpus callosum is structurally thin but intact corpus callosum^[3].

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It is seen that children diagnosed with agenesis of corpus callosum primarily have motor developmental delay, which is demonstrated by disturbance in performing bilateral coordination, skills and manual control deficits. Considering a rehabilitation plays a vital role in facilitating functions and motor development. This study is aimed to describe a case of agenesis of corpus callosum before and after the intervention program [1].

Procedure

This study was conducted in Pediatric Physiotherapy Department of Dr. A. P. J. Abdul Kalam College of Physiotherapy, at Pravara Institute of Medical Sciences, Loni. Child 'A' was brought to physiotherapy OPD by her mother on 1st of May 2018 with the chief complaints of difficulty holding the neck and unable to roll on her tummy by her own. Her chronological age at that time was 9 months and 28 days.

History

Child 'A' is a 4th product of non-consanguineous marriage. Mother was multigravida with age of 38 years and obstetric score G₄P₄L₃A₀D₁. On regular contraceptive pills for 10 years. She stopped the medication and after 3 months she missed her periods, she came to know about her pregnancy when she was 5 months pregnant. Mother did not maintain good health, nutrition and was not on iron folic acid medications and was addicted to mishri from her childhood. She used to do all household work, like washing clothes, lifting heavy buckets without any precautions.

'A' was full term delivered by vaginal route, with the birth weight of 1800 grams and no history of delayed cry and NICU stay. Breastfed was started immediately. On 5th day after birth she was admitted in NICU for polycythaemia and seizures. Discharged after 10 days with the birth weight of 2200 grams. Everything was apparently alright for 6 months, after that parents noticed that she was unable to hold neck. After 3 months more (9 months 28 days) she was brought to Physiotherapy OPD by her parents.

Assessment

Child was conscious and active. Her length was 71 cm, head circumference was 39 cm showing microcephaly and chest circumference was 40 cm. Tone was normal. Tightness of hamstrings and adductor muscles were noted, adductor angle being 50° and Popliteal angle was 68° on right and 66° on left. Some Primitive reflexes were still persistent such as flexor withdrawal, rooting, ATNR. Regarding the motor patterns it was observed that she was unable to move

her hand out when passively rolled to prone position from supine, there was no weight bearing on upper limbs in prone position, incomplete cervical extension and lower limb extensor pattern was seen. When passively made sit, there was no neck control and no hand weight bearing. The Gross Motor Function Measure (GMFM-88) was used to assess functional performance pre and post intervention. GMFM was selected because it reflects both quantitative and clinically important changes with certain amount of time [5].

Investigations: MRI was done when she was 9 months old which showed agenesis of corpus callosum. Blood reports were normal.

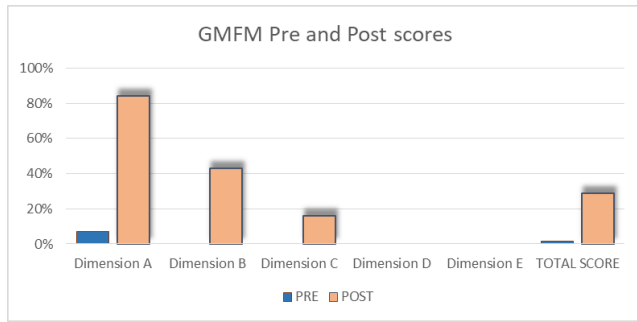
Intervention

Based on this assessment the individualised intervention protocol was set with the goal to decrease tightness of muscles, promote rolling on her tummy, achieve neck extension against gravity in prone position, facilitate weight bearing in prone position, improve bimanual midline activities and hand to mouth coordination, to strengthen leg flexors. The intervention was based on proprioceptive inputs, facilitation techniques which were used when necessary to initiate movements or to maintain positions and strengthening, Swiss ball activities to promote neck holding, rolling, weight bearing, activities on mat such as kicking in the supine position by moving the limbs reciprocally into flexion and extension, Stroking diagonally across the child's abdomen and legs to encourage active kicking, Strengthen extensor muscle groups by Prone, weight-bearing, promoting head extension, facilitate creeping in prone lying, moist heat therapy and stretching were given to decrease tightness. Therapy was conducted using Swiss ball, wedges, bolsters, toys. Parents were called 5 times in a week and sessions were conducted for 45 minutes. Her mother actively participated in the therapy by giving feedback regarding the child's activities, comforting the child when crying, performing exercises at home taught by the therapist. The family education and home program included providing information and adaptations of handling techniques into daily life, positioning which will help to increase child's communication and interaction with environment and help in achieving normal motor development.

Reassessment was performed after 6 months of therapy when the child was 16 months old. Post intervention assessment of GMFM-88 showed a significant improvement with total score 28.6% (Table-1.1). Popliteal angle was 68° on right and 66° on left. Adductor angle was 56°.

Table 1.1: Pre-Intervention and Post-Intervention scores of Gross Motor Function Measure (GMFM)-88

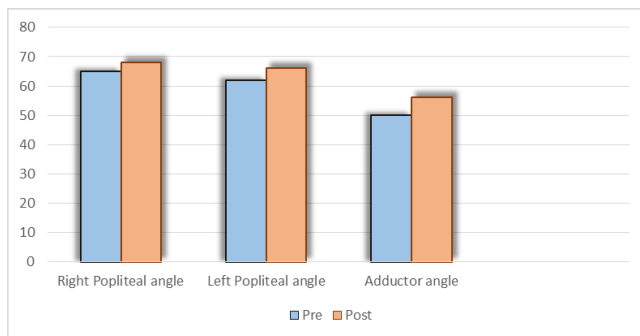
	Dimension A (Lying & Rolling)	Dimension B (Sitting)	Dimension C (Crawling & Kneeling)	Dimension D (Standing)	Dimension E (Walking, Running & Jumping)	Total Score
Pre-Intervention	7%	0%	0%	0%	0%	1.4%
Post-Intervention	84%	43%	16%	0%	0%	28.6%



Graph 1.1: GMFM Pre-Intervention and Post-Intervention Scores

Table 1.2: Pre-Intervention and Post-Intervention measurement of Tightness

	Popliteal Angle		Adductor Angle
	Right	Left	
Pre-Intervention	65°	62°	50°
Post-Intervention	68°	66°	56°



Graph 1.2: Pre-Intervention and Post-Intervention Bilateral Popliteal and Adductor angles

Discussion

The purpose of the study was to describe the results of Individualised Physical Therapy Rehabilitation Program for a child diagnosed with thin corpus callosum. The therapy was aimed primarily at providing with the achievement of gross motor developmental milestones. After the intervention, improvement was seen in A, B and C dimensions of GMFM. On GMFM-88, Pre-Intervention score was 7%, 0%, 0%, 0%, and 0% for Dimensions A, B, C, D and E respectively. After the intervention, scores were improved and the scores were 84%, 43%, 16%, 0% and 0% for Dimensions A, B, C, D and E respectively. So the improvement was seen in Dimensions A, B and C, those are lying and rolling, Sitting, Crawling and Kneeling Component. Dimensions D and E were not yet achieved. Also the total score was increased from 1.4% to 28.6% after the intervention (Table 1.1). Pre-Intervention popliteal angle was 65° on right and 62° on left side. After the intervention popliteal angle increased to 68° on right side and 66° on left side by decreasing tightness in the muscles. Also Pre-Intervention adductor angle was 50° and after intervention adductor angle was increased to 56° (Table 1.2).

Sheila Cristina da Silva Pacheco described a clinical report on pre- and post-neurofunctional intervention in a case of agenesis of the corpus callosum in preterm infant. The intervention was conducted with primary focus on function, postural control and guiding the family to continue care at home. After intervention, there was improvement in body reactions, postural control and movement acquisition of hands and limbs. The intervention also showed

improvement in functional performance.

Matteo Chiappedi and Maurizio Bejor in their review have explained the importance of physiotherapy mainly to decrease the motor problems, improve coordination and decrease complexes in neurodevelopment. The treatment should be started as soon as possible so as to prevent secondary complications. They have also suggested that any rehabilitative treatment has to be individually tailored by using various different interventions according to the specific needs of every single patient [4].

Therefore, this article was written with the intention to introduce agenesis of corpus callosum to Physical Therapist, familiarize them with this population and to offer them clinical experience in applying physical therapy interventions for these individuals.

Conclusion

From this case study we conclude that, problem based Physical Therapy intervention helps the child with agenesis of corpus callosum in achieving their milestones and decreasing muscle tightness hence improving the functions.

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