



Implementation Of Action Observation Therapy In Optimizing The Process Of Motor Recovery In A Six Year Old Male Child With Spastic Diplegic Cerebral Palsy: A Case Report.

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ABSTRACT

Introduction: Cerebral palsy (CP) is a prevalent cause of motor impairment in children, often stemming from prenatal or perinatal brain disturbances. This case report presents a six-year-old male child with a history of premature birth and delayed development. Clinical evaluation revealed manifestations typical of spastic diplegic CP, including gait abnormalities, muscular stiffness, and poor balance. Various outcome measures, including the Pediatric Balance Scale (PBS) and the Modified Tardieu Scale (MTS), were employed to assess motor function and spasticity. A tailored multimodal physiotherapy approach was formulated to address the diverse challenges faced by the child.

Method: A six-year-old male child visited the Pediatric Physiotherapy Outpatient department with issues related to standing and walking. In this case study, throughout the intervention, the patient's progress was monitored using the Gross Motor Function Measure Scale (GMFCS) and the Trunk Impairment Scale (TIS), revealing improvements in motor function and balance. Interactive storytelling sessions and playful therapeutic activities were utilized to foster engagement. Specific interventions targeting muscle tightness, impaired balance, and compromised lower limb strength were implemented, including exercises using therapeutic training pads, hydrotherapy, and targeted stretching routines. Strategies focusing on gait training, postural correction, and enhancement of pelvic and ankle stability were also integrated into the treatment plan. This case emphasizes the importance of a comprehensive and integrated physiotherapeutic approach in addressing the complex motor challenges faced by a child with spastic diplegic cerebral palsy.

Result: The results showed benefit in overall functional development of the child. The improvement was seen on Modified Tardieu Scale, Pediatric balance scale, and GMFCS level.

Conclusion: The implementation of physiotherapeutic interventions, including play therapy, task-oriented approaches, and action observation therapy, results in significant improvements in the child's functional abilities over time. Action observation therapy, in particular, plays a pivotal role in enhancing motor learning

and functional independence by facilitating the imitation of motor actions and activating motor neurons. The results showed benefit in overall functional development of the child.

Keywords: Cerebral palsy, Spastic diplegic cerebral palsy, Action observation Therapy.

INTRODUCTION

Cerebral Palsy is a group of permanent disorders of movement and posture causing activity limitation which is attributed to the non-progressive disturbances occurring in the developing foetal or infant's brain. Cerebral palsy (CP) is a leading cause of childhood motor impairment. CP is characterized by lifelong, non-progressive motor and postural problems that begin in early childhood, affecting approximately 1.5 to 3.0 per 1000 live births¹.

Cerebral palsy-related movement issues encompass four categories: spasticity, dyskinesia, ataxia, and mixed/other. Spasticity, affecting 80% of children with cerebral palsy, is the most common. Risk factors for cerebral palsy include preterm delivery, perinatal infection, growth restriction². Spastic diplegic's typical brain injury is periventricular leukomalacia (PVL), marked by bilateral necrosis of periventricular white matter in the frontal and parietal regions. Tone, posture, and gait problems are common in patients with spastic diplegia. Standing and walking are slowed down, with the ankles in an equino-varus position, as a result of calf muscle stiffness³.

For children with CP, there are several therapy options available. Children with CP have access to 13 intervention modalities that target postural stability and orientation, including functional electrical stimulation, gross motor training, hippotherapy, simulators, resistance exercise, balance training, treadmill training, trunk-focused exercises, upper limb interventions, visual biofeedback, and virtual reality⁴. There is moderate evidence that backward gait training enhances balance, gross motor function, step length, and walking speed in children with cerebral palsy⁵. One effective way to minimize trial and error and save time while teaching new actions is to conduct imitation exercises by watching others. Since imitation helps people acquire cognitive and perceptual skills, imitation activities are crucial to human growth. This facilitates effective learning and the growth of motor skills. Action Observation Therapy was introduced to effectively double the effects of task-oriented training, hence inducing neuroplasticity⁶.

This case report focuses on the management related to Action observation Therapy, in a spastic diplegic child.

PRESENTATION OF CASE

Patient Information:

A six-year-old male child visited the Pediatric Physiotherapy Outpatient department with issues related to standing and walking. His birth history is noteworthy. He was born prematurely, at just 1.6 kg, due to maternal complications during pregnancy. The mother was 19 years old during delivery, and it was a third-degree consanguineous marriage. Although regular sonography during pregnancy revealed no maternal health issues, the child's first breastfeeding took place seven days post-birth. After discharge, the baby's growth was noticeably delayed, prompting a visit to the hospital, where physiotherapy treatment was initially initiated in December 2019 but was disrupted by the COVID-19 crisis. The patient returned for further physiotherapy in July 2023. This case highlights the potential impact of premature birth, low birth weight, and familial factors on a child's development, necessitating ongoing physiotherapy intervention.

Developmental history

GROSS MOTOR	at what age
Head control	5 months
Rolling	6 months
Sitting (tripod fashion)	9 months
Sitting without support	12 months
Stands with support	2 years
Creeping, stand without support	} Not Achieve
Walks alone	
Runs	
Walks up and down	
Rides tricycle	
Hops on one foot	
FINE MOTOR	Achieved/ not

Bidextrous reach	} Achieved
Unidextrous reach	
Immature pincer grasp	
Mature pincer grasp	
Imitates scribbling	
Scribbles	
Vertical/ circular strokes	
Copies circle	
Copies cross	
Copies triangle	

Table no. 2: fine motor milestones

SOCIAL SKILLS ANS SPEECH	Achieved/ not
Social smile	} Achieved
Recognizes mother	
Recognizes strangers	
Waves bye bye	
Comes when called	
Jargon	
Copies parents	
Asks for food	
Shares toys	
Plays cooperatively	
Helps in tasks	

Table no. 3: social skills and speech milestones

VISUAL SKILLS	Achieved/ not
Visual fixation	} Achieved
Visual tracking	
Visual scanning	

Table no. 4: visual skills

Clinical findings

An ectomorphic child presented himself with good consciousness, vital stability, and bilateral ankle-foot orthosis. Physical examination revealed forward head posture, increased kyphosis, slight knee flexion and ankle plantar flexed, and the hamstrings had more tone, a grade of 2 on the modified tardieu scale. Upper limbs depicted better strength (grade 4) than lower limbs (grade 3), with exaggerated deep tendon reflexes and tight hamstrings, adductors, and calf muscles in both legs. The child could transition from supine to roll and sit unassisted but exhibited a scissoring gait with toe walking during assisted walking. Standing and walking unaided were challenging for the child.

TONE	ON ASSESSMENT	AFTER 2 MONTHS
Hip flexor	Grade 1	Grade 0
Hip extensor	Grade 2	Grade 1
Hip adductors	Grade 2	Grade 1
Knee flexor	Grade 1	Grade 0
Knee extensor	Grade 1	Grade 0
Ankle plantar-flexor	Grade 2	Grade 1
Ankle dorsi-flexor	Grade 1	Grade 0
Ankle invertors	Grade 1	Grade 0
Ankle evertors	Grade 0	Grade 0

Table no. 5: Grading of muscle tone according to Modified Tardieu Scale.

Deep tendon reflexes	Grading	Result
Patellar tendon/ knee jerk	Grade 3+	Brisker than average, slightly hyper-reflexic
Achilles tendon jerk	Grade 3+	Brisker than average, slightly hyper-reflexic

Table no. 6: Deep Tendon Reflexes

Outcome measures

- I. The Pediatric Balance Scale (PBS), a modification of Berg's Balance Scale, assesses balance in school-age children with mild to severe motor impairments⁷. It consists of 14 items, each rated on a 4-point scale, showing strong reliability⁸.

- II. The Modified Tardieu Scale assesses spasticity using a 5-point numerical rating system, with ratings from 0 to 4. It exhibits superior intra-rater reliability compared to the Modified Ashworth scale for measuring lower limb spasticity in spastic diplegic cerebral palsy⁹.
- III. The Gross Motor Function Measure Scale (GMFCS) categorizes a child's current gross motor function. It has five levels, with level I indicating the highest independent motor function and level V the lowest, focusing on self-initiated mobility, especially sitting and walking abilities¹⁰.
- IV. The Trunk Impairment Scale (TIS) effectively evaluates trunk disability in children with cerebral palsy, assessing static sitting balance (TIS-SSB), dynamic sitting balance (TIS-DSB), and trunk coordination (TIS-C). It consists of 17 items, each scored from 0 (poor) to 23 (best performance)¹¹.

Physiotherapy Functional assessment

Strength in both limbs was qualitatively assessed, with the lower limbs ranking lower. The patient reported discomfort in the hamstrings, short adductors, and Achilles tendons. Mobility was challenging, with toe walking and a scissoring gait when aided to stand and walk.

➤ PRE-TREATMENT VALUES:

Outcome measure	Score
Pediatric balance scale	22/56
Modified tardieu scale	Hamstrings- grade 2
GMFCS	Level 3
Trunk impairment scale	12/23

Table no. 7: Pre-Treatment Values

Physiotherapeutic interventions:

Problem identified	Cause of problem	Goal framed	Physiotherapy interventions	Dosage
Lack of participation by the child in a treatment session	Afraid of the hospital settings	To get the child interested in the therapy session	-Interactive storytelling sessions -Play therapeutic activities like walk race, ball throw and catch, child aerobics.	-For initial 15 minutes. -Everyday
Poor static and dynamic balance	Impaired proprioception	To normalize balance parameters	-Using therapeutic training pads for weight shifts -Standing on bosu ball with mirror feedback. -Hydrotherapy	-5-7 mins on one equipment. -3 days/ week
Decline in the extensibility of Hamstrings, adductors, calf muscles.	Muscle tightness	To reduce the and improve the range of motion	-Toe touching activities -Ball kicking in sitting position	10-15 seconds hold for each stretch. -3 days/week
Poor lower limb muscle strength	Compromise in the physiological harmony of agonists and antagonists muscle group.	To optimize the strength of the muscles	-Core and trunk exercises using wedge -Hydrotherapy for lower limbs -Retro kicks in quadrupedal stance with a hold of 10 seconds -Leg roll squat (modified pilates)	-3 days/week. -for 25-30 mins
Difficulty to walk independently	Ankle joint plantar-flexed, poor muscular strength in lower limbs	To make the patient independent in walking	-Walking front & back in parallel bar with mirror feedback. -Task based training.	10 repetitions with two sets each, 5 days/week.
Kyphosis of thoracic spine	Tendency of slouch sitting	Postural correction	-Bhujangasana -Appropriate positioning -Bridging -Ball throwing and catching overhead.	10-15 mins a day
Pelvic and ankle instability	Muscle imbalance, Pelvic malalignment	To enhance pelvic and ankle stability	-Mini squats with assistance and hold for 5 seconds -Pelvic PNF -Ankle PNF (Rhythmic initiation and rhythmic stabilization)	-for 20 mins -bilaterally

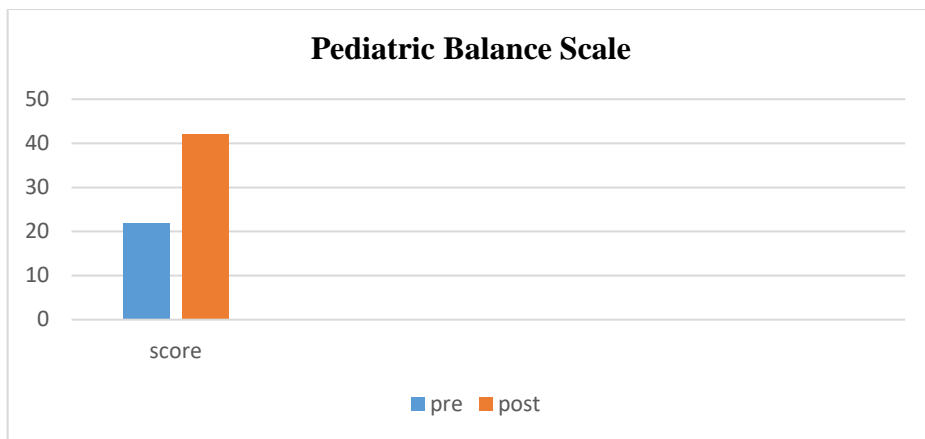
Table no. 8: Description of Physiotherapeutic interventions.

RESULT:

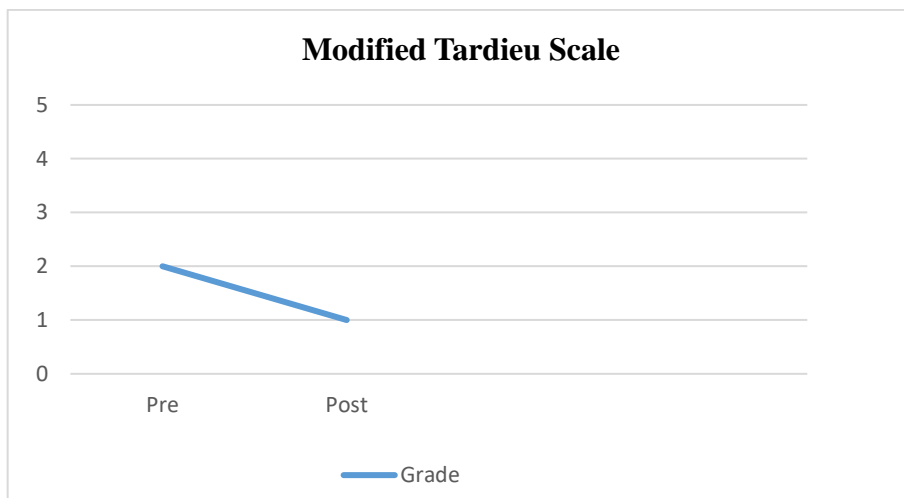
➤ POST-TREATMENT VALUES:

Outcome measure	Score
Pediatric balance scale	42/56
Modified tardieu scale	Hamstrings- grade 1
GMFCS	Level 2
Trunk impairment scale	20/23

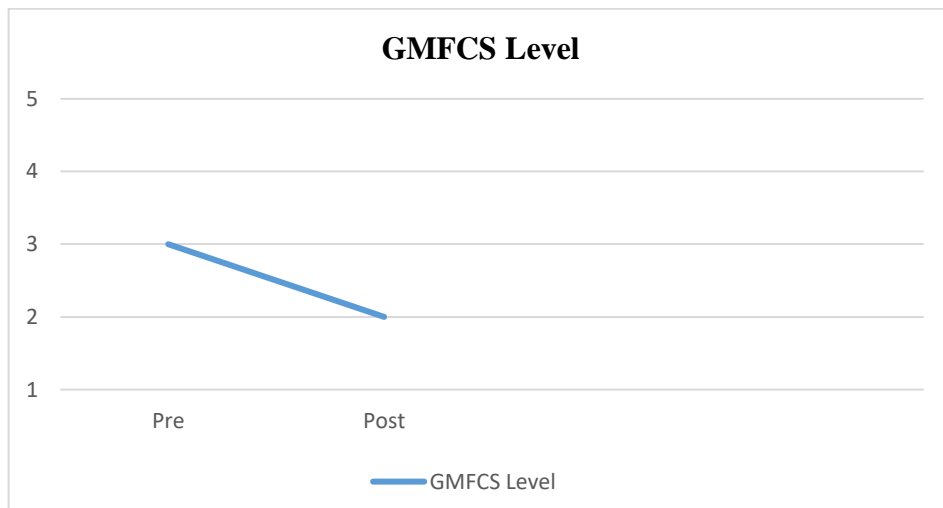
Table no. 9: Post-Treatment Values



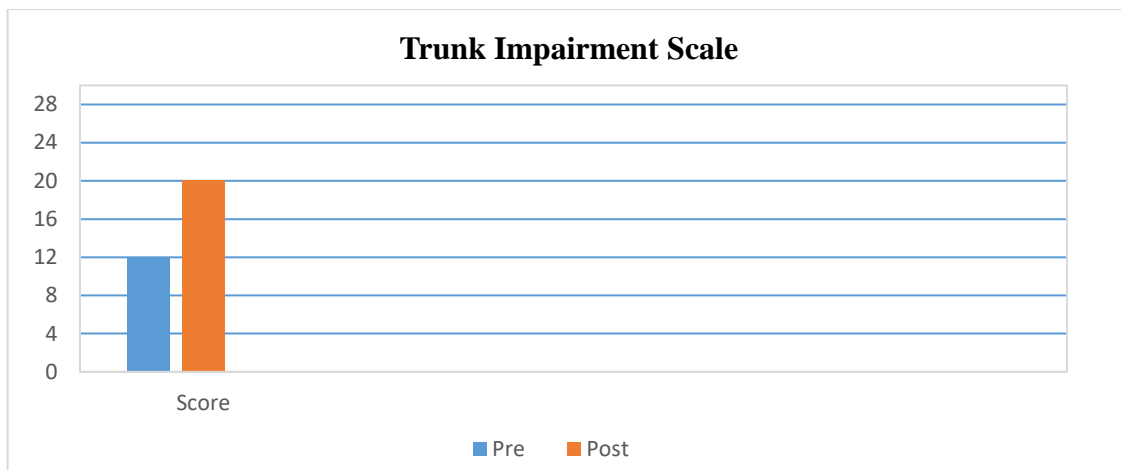
Graph no: 1



Graph no: 2



Graph no: 3



Graph no: 4



Fig. no. 1- Reach out activity on swiss ball Strengthening



Fig. no. 2- Reach out activity- for core



Fig. no. 3- Gait training with mirror feedback

DISCUSSION:

The presented research article delves into a comprehensive case study of a six-year-old male child with standing and walking issues, emphasizing the importance of pediatric physiotherapy. The developmental history of the child illustrates delayed milestones. The assessment of muscle tone and deep tendon reflexes using the Modified Tardieu Scale provides valuable insights into the child's neuromuscular status.

Outcome measures, including the Pediatric Balance Scale, Modified Tardieu Scale, Gross Motor Function Measure Scale, and Trunk Impairment Scale, serve as quantitative indicators of the child's progress and functional abilities before and after physiotherapy interventions. The physiotherapeutic interventions implemented, ranging from play therapy to task-oriented approaches, demonstrated significant improvements in the child's functional abilities over time. Notably, the inclusion of action observation therapy, played a pivotal role in enhancing motor learning and functional independence. Action observation therapy involves the observation and imitation of motor actions, facilitating the activation of motor neurons and enhancing motor learning processes. By incorporating this approach into the treatment regimen, the child was able to learn and imitate motor patterns more effectively, leading to improvements in balance, posture, and mobility.

The post-treatment outcomes demonstrate improvements across multiple parameters, including muscle tone, balance, functional mobility, and gross motor function, underscoring the efficacy of the physiotherapy interventions implemented.

Overall, this research article underscores the critical role of pediatric physiotherapy in addressing developmental challenges in children, particularly those stemming from prematurity, low birth weight, and familial factors. It emphasizes the importance of early intervention, multidimensional assessment, and tailored treatment approaches in optimizing functional outcomes and enhancing the quality of life for pediatric patients with neuromuscular impairments.

CONCLUSION:

According to this case study, the implementation of physiotherapeutic interventions, including play therapy, task-oriented approaches, and action observation therapy, results in significant improvements in the child's functional abilities over time. Action observation therapy, in particular, plays a pivotal role in enhancing motor learning and functional independence by facilitating the imitation of motor actions and activating motor neurons. The child improved, in terms of the outcome measures as well as clinically. The results showed benefit in overall functional development of the child. The improvement was seen on Modified Tardieu Scale: for lower limbs to grade 1, the Pediatric Balance Scale to 42/56 and GMFCS to level II. The child found the therapy enjoyable and recreational.

ADDITIONAL INFORMATION

Disclosures

Human subjects: Consent was obtained by all participants in this study.

Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following:

Payment/services info: All authors have declared that no financial support was received from any organization for the submitted work.

Financial relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.

Other relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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