

A Comparative Study of Task-Oriented Training and Mirror Therapy for Improving Hand Function in Children with Hemiplegic Cerebral Palsy

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Publication Date: 2026/10/07

Abstract:

➤ *Background:*

Hemiplegic cerebral palsy is a unilateral form of cerebral palsy characterized by persistent impairment of movement and posture affecting one side of the body, with the upper limb often being more functionally affected than the lower limb. Impairments in grasping ability, hand coordination, dexterity, and the functional use of the affected upper limb may limit a child's ability to perform activities of daily living independently. Among the rehabilitation strategies used to address these difficulties are Task-Oriented Training and Mirror Therapy, which aim to facilitate improvements in hand and upper-limb function in children with hemiplegic cerebral palsy.

➤ *Aim:*

To compare the effects of Task-Oriented Training and Mirror Therapy on hand function in children with hemiplegic cerebral palsy.

➤ *Method:*

An experimental pre-test and post-test design was used to examine the effects of the two rehabilitation interventions in six children with hemiplegic cerebral palsy between 7 and 16 years of age. The participants were randomly allocated into two groups, consisting of three children each. Participants in Group A underwent Task-Oriented Training, whereas Group B received Mirror Therapy. Each intervention session lasted approximately 30–45 minutes and was conducted three times per week over a 12-week period. Hand function was evaluated using the Quality of Upper Extremity Skills Test (QUEST), while grip strength was assessed with a hand dynamometer. Measurements obtained before and after the intervention were subsequently recorded and compared.

➤ *Results:*

Improvements in hand function and grip strength were observed in both intervention groups following the 12-week training period. The mean change in QUEST scores was 7 points in Group A and 12 points in Group B. Similarly, mean grip strength increased by 1.5 kg in Group A and 2.16 kg in Group B. The observed changes were greater in the Mirror Therapy group for both outcome measures.

➤ *Conclusion:*

Both Task-Oriented Training and Mirror Therapy were associated with improvements in hand function and grip strength among children with hemiplegic cerebral palsy. The changes observed in QUEST scores and hand dynamometer measurements were greater in the Mirror Therapy group than in the Task-Oriented Training group. However, these findings should be interpreted cautiously because of the small sample size and limited duration of the intervention.

Keywords: Cerebral Palsy, Hemiplegic Cerebral Palsy, Task-Oriented Training, Mirror Therapy, Hand Function, QUEST, Hand Dynamometer, Grip Strength.

How to Cite: Wanbiang Daka Nanghuloo; Chinduja S.; Dr. B. S. Santhosh Kanna (2026) A Comparative Study of Task-Oriented Training and Mirror Therapy for Improving Hand Function in Children with Hemiplegic Cerebral Palsy. *International Journal of Innovative Science and Research Technology*, 11(9), 3157-3170. <https://doi.org/10.38124/ijisrt/26sep969>

I. INTRODUCTION

Cerebral palsy (CP) is an umbrella term for a group of permanent disorders affecting movement and posture that result from disturbances in the developing foetal or infant brain. Although the neurological lesion is non-progressive, the clinical manifestations may change over time. Children with CP can present with varying degrees of motor impairment, abnormal muscle tone, postural difficulties, and limitations in functional activities. Associated musculoskeletal, sensory, communication, cognitive, and other health-related problems may also occur and can influence participation, independence, and quality of life. The underlying disturbances may originate before, during, or after birth, including during the early period of brain development.

The occurrence of CP is strongly associated with factors such as prematurity, low birth weight, intrauterine growth restriction, and neonatal brain injury. A systematic review and meta-analysis reported an overall prevalence of approximately 2.11 cases per 1,000 live births. The prevalence was substantially higher among infants with very low birth weight and those born at extremely preterm gestational ages, with rates of approximately 59 per 1,000 among infants weighing 1,000–1,499 g and 112 per 1,000 among those born before 28 weeks of gestation. These findings demonstrate the strong association between gestational age, birth weight, and the occurrence of CP.

Unilateral or hemiplegic cerebral palsy is characterized predominantly by motor impairment affecting one side of the body. The upper extremity is frequently associated with difficulties in reaching, grasping, object manipulation, isolated joint movements, and spontaneous use of the affected hand. Such limitations can interfere with age-appropriate manual activities and participation in everyday tasks. Population-based evidence has demonstrated that hand-function difficulties are common among children with CP, although their severity and functional presentation vary according to the CP subtype.

Upper-limb dysfunction can have a considerable effect on independence because the hand is essential for activities such as dressing, feeding, writing, playing, and manipulating objects. In unilateral CP, abnormalities in muscle tone, selective motor control, strength, and coordination may restrict effective use of the affected hand. Consequently, rehabilitation commonly aims to improve proximal stability and distal control while encouraging active and meaningful use of the upper limb during functional activities.

Traditional rehabilitation approaches for children with CP have included neurodevelopmental therapy, stretching, passive mobilization, strengthening, and gross-motor exercises. These interventions may address impairments such

as abnormal tone, restricted range of motion, weakness, and poor postural control. However, contemporary rehabilitation approaches increasingly emphasize active participation, functional practice, task specificity, and opportunities for the child to use the affected limb during meaningful activities.

Task-Oriented Training (TOT) is a rehabilitation approach that incorporates purposeful and goal-directed activities into therapy. Rather than concentrating solely on isolated body movements, TOT encourages children to practice functional tasks such as reaching, grasping, releasing, manipulating objects, and performing activities relevant to everyday life. Repeated practice of meaningful tasks can provide opportunities for motor learning and may facilitate improvements in coordination, dexterity, strength, and functional hand use. The approach therefore places emphasis on active participation and task-specific practice within a functional context.

Mirror Therapy (MT) is another rehabilitation approach that uses visual feedback to facilitate motor practice of the affected limb. During treatment, the affected limb is positioned behind a mirror while the child observes the reflection of the unaffected limb performing movements. This arrangement creates a visual illusion of movement in the affected limb. The visual feedback may engage neural networks involved in action observation and motor planning and may contribute to activity-dependent neuroplasticity. Mirror therapy has consequently been investigated as a relatively simple rehabilitation strategy for improving motor performance and functional use of the upper limb in individuals with neurological disorders.

Both TOT and MT have been investigated as approaches for addressing upper-limb and hand impairments in children with CP. TOT primarily provides repeated practice of meaningful, goal-directed activities, whereas MT relies on visual feedback and the observation of symmetrical limb movements. Although both approaches have a theoretical basis for promoting motor learning and functional recovery, their effects may differ depending on the child's characteristics, intervention protocol, and outcome measures used.

Therefore, a direct comparison of these two approaches may provide useful information regarding their observed effects on hand function in children with hemiplegic cerebral palsy. The present study was undertaken to compare Task-Oriented Training and Mirror Therapy with respect to changes in hand function and grip strength in children with hemiplegic cerebral palsy.

A. Aims & Objectives

➤ Aim:

To evaluate and compare the effects of Task-Oriented Training and Mirror Therapy on hand function in children with hemiplegic cerebral palsy.

➤ Objectives:

- To assess the effect of Task-Oriented Training on hand function in children with hemiplegic cerebral palsy.
- To assess the effect of Mirror Therapy on hand function in children with hemiplegic cerebral palsy.
- To compare the changes in hand function and grip strength following Task-Oriented Training and Mirror Therapy in children with hemiplegic cerebral palsy.

➤ Hypotheses:

- Null hypothesis(H0): There will be no significant difference between Task-Oriented Training and Mirror Therapy in improving hand function in children with hemiplegic cerebral palsy.
- Alternate hypothesis(H1): There will be significant difference between Task-Oriented Training and Mirror Therapy in improving hand function in children with hemiplegic cerebral palsy.

➤ Need of the Study

Evidence from previous research has examined the use of Task-Oriented Training and Mirror Therapy for addressing upper-limb and hand impairments in children with hemiplegic cerebral palsy. Task-Oriented Training involves active and repeated performance of meaningful functional activities, whereas Mirror Therapy provides visual input by allowing the child to observe movements of the unaffected limb through a mirror. Research findings indicate that these rehabilitation approaches can be associated with improvements in hand function and motor performance, making them commonly considered interventions in the rehabilitation of children with hemiplegic cerebral palsy.

However, there is still inconsistency in the literature regarding which intervention is more effective in improving hand function. Due to this lack of clear evidence, it is difficult for clinicians to determine the most appropriate treatment approach. Therefore, a comparative evaluation of Task-Oriented Training and Mirror Therapy is warranted to examine their respective effects on hand function in children with hemiplegic cerebral palsy.

II. REVIEW OF LITERATURE

➤ Krigger, et al. (2006) "Cerebral Palsy: An Overview" described cerebral palsy as the most common physical disability occurring during childhood. It is associated with a non-progressive disturbance of the developing brain that may arise during the prenatal, perinatal, or postnatal period. The author highlighted that upper limb dysfunction, muscle weakness, impaired motor control, and activity limitations significantly affect functional independence. The study emphasized the importance of

multidisciplinary rehabilitation approaches aimed at improving functional abilities and participation in daily activities.

- Vitrikas, Dalton, and Breish et al. (2020) in their review titled "Cerebral Palsy: An Overview", discussed the clinical presentation and management of cerebral palsy. They reported that spasticity represents the predominant motor abnormality in children with cerebral palsy, occurring in approximately 80% of cases. The authors also noted that upper-limb involvement can restrict grasping, hand function, and participation in activities of daily living. Their review highlighted the importance of physiotherapy and occupational therapy in addressing motor impairments and supporting functional abilities in children with cerebral palsy.
- Maryam oskoui, Franzina coutinho, Jonathan dykeman, Nathalie jette, Tamara pringsheim (2013) "An update on the prevalence of cerebral palsy: a systematic review and meta-analysis" The study reported a higher occurrence of cerebral palsy among infants born prematurely or with low birth weight, with particularly elevated rates among those weighing less than 1,000 g or born before 28 weeks of gestation. Despite advances in neonatal care and improved survival among high-risk infants, the overall prevalence of cerebral palsy has not shown a substantial decline. The authors acknowledged limitations, including the possibility of bias and insufficient information regarding the severity of cerebral palsy. They recommended further investigation into long-term functional outcomes and the experiences of individuals living with cerebral palsy into adulthood.
- Arnould, Bleyenheuft, and Thonnard et al. (2014) "Hand Functioning in Children with Cerebral Palsy" this study demonstrated that gross manual dexterity and stereognosis were significantly associated with manual ability. The authors concluded that improving hand function alone may not be sufficient and that activity-based interventions targeting manual ability should be incorporated into rehabilitation programs.
- Gordon, Bleyenheuft, and Steenbergen et al. (2013) "Pathophysiology of impaired hand function in children with unilateral cerebral palsy" The authors examined the neurological mechanisms underlying impaired hand function in children with unilateral cerebral palsy. Their findings indicated that alterations involving the motor cortex and corticospinal pathways may contribute to difficulties with voluntary movement, motor planning, sensorimotor processing, and coordinated use of both hands. The study suggested that upper limb rehabilitation should be individualized according to neurological involvement.
- Makki, Duodu, and Nixon et al. (2014) "Prevalence and pattern of upper limb involvement in cerebral palsy" The study investigated the prevalence and clinical characteristics of upper-limb involvement among children with cerebral palsy. Upper-extremity impairments were identified in approximately 83% of the participants, while 69% demonstrated limitations in hand control. The findings highlighted the importance of upper-limb function in performing everyday activities and maintaining functional independence among children with cerebral palsy.

- Halford, E., Jakubiszak, S., Krug, K., Umphress, A. et al. (2024) “What is Task-Oriented Training? A Scoping Review” conducted a scoping review to establish a comprehensive definition of task-oriented training. The review analysed 172 studies and identified key components of task-oriented training, including repetitive practice, task specificity, functional activities, intensity, client-centered goals, meaningful participation, and feedback. The authors described task-oriented training as a rehabilitation strategy supported by evidence, in which repeated practice of purposeful and functionally relevant activities may facilitate neuroplastic changes and improve functional performance.
- Moon, Jung, Hahm, and Cho et al. (2017) “The effects of task-oriented training on hand dexterity and strength in children with spastic hemiplegic cerebral palsy: a preliminary study” The study reported a statistically significant improvement in hand dexterity among participants who underwent task-oriented training compared with the control group. The findings indicated that task-oriented training may have a beneficial effect on upper-limb functional performance in children with hemiplegic cerebral palsy, supporting its application as a task-specific rehabilitation approach in pediatric neurorehabilitation.
- Madeshwaran and Senthil Kumar et al. (2024) “A Study on the Effectiveness of Task Oriented Strength Training to Enhance Upper Limb Motor Function in Children with Cerebral Palsy”. The study demonstrated significant improvements in motor function among children who underwent task-oriented strength training, indicating its potential role in facilitating functional motor performance in this population. The authors suggested that strengthening exercises combined with functional task practice provide superior outcomes in enhancing upper limb motor performance.
- Gbonjubola et al. (2021) “Physiotherapy management of children with cerebral palsy” The review emphasized the contribution of physiotherapy interventions in promoting motor function, minimizing activity limitations, and facilitating greater participation in activities of daily living among individuals with cerebral palsy. Interventions such as task-oriented training, constraint-induced movement therapy, sensory integration, and exercise therapy were discussed. The authors concluded that individualized physiotherapy programs focusing on functional activities and participation are essential for optimizing outcomes in children with cerebral palsy.
- Xiao et al. (2026) “The impact of task-oriented training on hand functionality in children with cerebral palsy under 18 years: a systematic review and meta-analysis” The results demonstrated that task-oriented training significantly improved hand function, grip strength, cognitive ability, and functional independence compared to conventional rehabilitation. The authors concluded that task-oriented training is an effective intervention for enhancing manual dexterity, upper limb function, and daily living abilities in children with cerebral palsy.
- Narimani et al. (2019) “Effect of Mirror Therapy on Dexterity and Hand Grasp in Children Aged 9-14 Years with Hemiplegic Cerebral Palsy” it states that there is significant improvement was observed in hand dexterity, whereas hand grasp did not show significant changes. The authors concluded that mirror therapy is an effective intervention for improving manual dexterity in children with hemiplegic cerebral palsy.
- Kaya Kara et al. (2020) “Combined Effects of Mirror Therapy and Exercises on the Upper Extremities in Children with Unilateral Cerebral Palsy: A Randomized Controlled Trial” it indicates significant improvements in dissociated movements, grasp, weight-bearing ability, muscle strength, occupational performance, and satisfaction scores. The authors concluded that mirror therapy combined with exercise training is a promising intervention for enhancing upper limb function.
- Park et al. (2016) “Systematic review of the effects of mirror therapy in children with cerebral palsy” it indicates improvements in hand strength, movement speed, muscle activity, hand function, and movement accuracy. The authors concluded that mirror therapy is a valuable therapeutic intervention that can enhance upper limb function in children with cerebral palsy and should be considered in rehabilitation programs.
- Gyax et al. (2011) “Mirror therapy in children with hemiplegia: a pilot study” The findings demonstrated significant improvements in grasp strength and dynamic upper-limb function following the implementation of mirror therapy. The authors reported that mirror therapy was a feasible intervention and may contribute to improvements in strength and functional performance of the paretic upper limb among children with hemiplegia.
- Bhasin et al. (2012) “Neural interface of mirror therapy in chronic stroke patients: A functional magnetic resonance imaging study” it shows significant improvements in motor function and activities of daily living. Brain imaging revealed cortical reorganization and activation of motor-related brain regions following intervention. The authors concluded that mirror therapy promotes neural plasticity and contributes to functional recovery.
- Dohle et al. (2009) “Mirror Therapy Promotes Recovery from Severe Hemiparesis: A Randomized Controlled Trial” this study demonstrated improvements in distal motor function, sensory recovery, and attention deficits. The authors concluded that mirror therapy is an effective adjunct to conventional rehabilitation and supports motor recovery through enhanced cortical activation and neuroplasticity.
- Deconinck et al. (2015) “Reflections on Mirror Therapy: A Systematic Review of the Effect of Mirror Visual Feedback on the Brain” the findings showed that mirror therapy increases neural activity in motor and sensory regions of the brain and enhances cortical excitability associated with motor recovery. The authors concluded that mirror therapy facilitates neuroplastic changes and positively influences motor control and rehabilitation outcomes.
- Thorley et al. (2012) “Construct validity of the Quality of Upper Extremity Skills Test for children with cerebral palsy” the findings suggested that QUEST domains should be interpreted separately rather than using a total score. The authors concluded that the QUEST is a useful assessment tool for evaluating specific aspects of upper limb function in children with cerebral palsy and can be

used effectively in rehabilitation research and clinical practice.

- Klingels et al. (2008) “Comparison of the Melbourne Assessment of Unilateral Upper Limb Function and the Quality of Upper Extremity Skills Test in hemiplegic CP” the study found a strong correlation between the two measures, although each assessed different dimensions of upper limb performance. The authors concluded that both tools are reliable for evaluating upper limb function and can be used effectively in clinical practice and research involving children with hemiplegic cerebral palsy.
- Le-Ngoc and Janssen (2011) “Validity and Reliability of a Hand-Held Dynamometer for Dynamic Muscle Strength Assessment” the results demonstrated excellent intra-tester reliability for measuring peak torque and total work. The device showed acceptable validity for elbow flexion measurements but limited agreement for knee extension due to the influence of assessor strength. The study concluded that the HHD is a reliable, portable, and cost-effective tool for assessing dynamic muscle strength, particularly in upper-limb muscles and weaker populations.
- Yodchaisarn et al. (2023) “Immediate Effect of Mirror Therapy Using Pegboard Training on Hand Function and Muscle Activities in Individuals with Asymmetrical Hand Function” it states that although muscle activity differences were not statistically significant, the mirror therapy group showed a tendency toward greater muscle activation. The authors concluded that mirror therapy using pegboard training can produce immediate improvements in hand dexterity and functional performance through activation of mirror neurons and cross-activation mechanisms in the brain.
- Khan et al. (2024) “Effect of Mirror Therapy on Upper Limb Function in Children and Adolescents with Hemiplegic Cerebral Palsy: A Systematic Review and Meta-Analysis” the findings demonstrated significant improvements in upper limb motor performance, hand dexterity, movement coordination, and functional task execution. Mirror therapy was found to enhance motor recovery by activating mirror neurons and promoting cortical reorganization through visual feedback. The authors concluded that mirror therapy is an effective adjunct rehabilitation strategy for improving upper extremity function and should be incorporated into paediatric neurorehabilitation programs.
- Ortega-Martínez et al. (2025) “Motor and Sensory Benefits of Mirror Therapy in Children and Adolescents with Unilateral Cerebral Palsy: A Systematic Review and Meta-Analysis” it demonstrates significant improvements in manual dexterity, hand function, motor control, and tactile perception following mirror therapy interventions. The visual feedback provided by the mirror facilitated activation of motor cortical areas and promoted neuroplastic changes. The authors concluded that mirror therapy is an effective rehabilitation technique for enhancing both motor and sensory functions of the affected upper limb. They recommended integrating mirror therapy into conventional physiotherapy programs to maximize functional outcomes.
- Oliva-Sierra et al. (2022) “Effectiveness of Mirror Therapy and Action Observation Therapy in Children

with Infantile Cerebral Palsy” the findings revealed that children who participated in mirror therapy demonstrated improvements in hand dexterity, movement quality, motor planning, and performance of daily activities. The authors concluded that mirror therapy is an effective, low-cost, and easily applicable intervention that can complement conventional physiotherapy programs for improving upper extremity function in children with cerebral palsy.

- Palomo-Carrión et al. (2021) “Mirror Therapy and Action Observation Therapy to Increase Upper Limb Functionality in Children with Hemiplegic Cerebral Palsy” the study reported significant improvements in hand function, movement quality, motor coordination, and performance of activities of daily living following mirror therapy. The findings suggested that mirror therapy may serve as a useful adjunct to conventional rehabilitation for facilitating improvements in upper-extremity functional performance among children with hemiplegic cerebral palsy.
- Alipour et al. (2023) “The Effects of Mirror Therapy on Motor and Sensory Functions in Children with Cerebral Palsy” the study investigated the potential of mirror visual feedback as a therapeutic strategy for improving upper-limb function and sensory integration. Following the intervention, significant gains were observed in hand function, motor coordination, movement precision, and sensory processing. The authors proposed that these improvements may be associated with enhanced cortical reorganization and motor learning mediated by activation of the mirror neuron system.
- Yeves-Lite et al. (2020) “Conventional and Virtual Reality Mirror Therapies in Upper Limb Rehabilitation in Children with Unilateral Cerebral Palsy” The study reported significant gains in hand dexterity, bimanual coordination, grasp performance, and movement quality following both intervention approaches. The virtual reality-based mirror therapy group demonstrated additional improvements in treatment motivation and adherence. The findings indicated that both conventional and virtual mirror therapy may support improvements in upper-limb motor performance and participation in daily activities among children with unilateral cerebral palsy.
- Yang et al. (2023) “Upper Limb Manual Training for Children with Cerebral Palsy: Effects on Motor Function and Activity Performance” The results demonstrated significant improvements in manual dexterity, movement accuracy, hand strength, and performance of functional tasks. The authors reported that intensive task-oriented practice promotes motor learning and enhances neuroplasticity.

III. METHODOLOGY

- STUDY DESIGN: Experimental study
- STUDY TYPE: Pre and Post test experimental study.
- STUDY POPULATION: Hemiplegic cerebral palsy
- SAMPLE SIZE: 6
- STUDY DURATION (INTERVENTIONS): Interventions were given for the duration of 12 weeks, 3 days a week for 30–45 minutes per session.
- STUDY SETTING: Department of Therapeutics – Physiotherapy Divisions. National Institute for

Empowerment of Persons with Multiple Disabilities (Divyangjan), Govt. of India, Chennai.

➤ *Selection Criteria:*

• *Inclusion Criteria:*

- ✓ Hemiplegic cerebral palsy children
- ✓ Age between 7-16 years
- ✓ Classification as levels I-III on the manual ability classification system (MACS);
- ✓ Ability to understand and follow the verbal instruction

• *Exclusion Criteria:*

- ✓ Children who had undergone orthopedic surgery or received botulinum toxin injections within the previous 6 months.
- ✓ Children whose parents or legal guardians declined consent for participation in the study.
- ✓ Children with associated medical or developmental conditions that could interfere with participation or influence the study outcomes.

• *Outcome Measures and Tool:*

- ✓ Quality of Upper Extremity Skill Test (QUEST)
- ✓ Hand dynamometer

➤ *Quality of Upper Extremity Skill Test (Quest)*

The Quality of Upper Extremity Skills Test (QUEST) is a standardized, criterion-referenced measure designed to assess upper-extremity motor performance in children with cerebral palsy, including those with hemiplegic involvement. The assessment evaluates the quality of movement and functional abilities of the upper limb across four domains comprising a total of 34 items. Results are reported as percentage scores, with higher values representing better upper-extremity performance. The QUEST has demonstrated satisfactory psychometric properties, including high inter-rater and intra-rater reliability and good evidence of validity, supporting its use as an outcome measure in pediatric rehabilitation.

- Dissociated movement (selective control of upper limb movements)
- Grasp (ability to hold and manipulate objects)
- Weight bearing (support through the upper extremities)
- Protective extension (protective reactions of the upper limb)

➤ *Hand Dynamometer*

A hand dynamometer is an objective assessment instrument used to quantify grip force generated by the hand and forearm musculature. It is frequently utilized in clinical and research settings to evaluate upper-extremity strength in children with cerebral palsy. The participant is asked to squeeze the device with maximum effort in a standardized position, and the reading is recorded in kilograms. It has high reliability and good validity, making it a dependable tool for measuring grip strength in clinical research. Usually, three

trials are taken, and the highest value is considered for analysis.

- Measures maximum grip strength
- Assesses hand muscle function
- Uses standardized testing position
- Best of three trials recorded

➤ *Procedure & Exercise Protocol:*

Children with hemiplegic cerebral palsy who fulfilled the predetermined eligibility criteria were recruited for the study. The study procedure was explained in detail to the parents or legal guardians, and written informed consent was obtained before commencement of the intervention. Baseline assessment was subsequently performed using the Quality of Upper Extremity Skills Test (QUEST) to evaluate upper-extremity function and a hand dynamometer to measure grip strength.

Following the baseline assessment, participants were randomly allocated into two intervention groups:

- Group A – Task-Oriented Training
- Group B – Mirror Therapy

A customized intervention protocol was designed according to the child's abilities based on reference articles.

The intervention was given 3 days a week for 30–45 minutes per session, following the respective protocols for each group, over a duration of 12 weeks.

Following completion of the intervention period, post-intervention assessments were conducted using the same outcome measures applied at baseline. Changes in hand function and grip strength were determined by comparing the pre-intervention and post-intervention measurements. Hand function and grip strength constituted the primary outcome parameters of the study.

➤ *Group A: Task Oriented Training (N=3)*

Participants in Group A underwent task-oriented training, which focused on improving hand function through meaningful and functional activities. The exercises were planned according to each child's ability, with emphasis on active involvement and repeated practice.

Each session started with a short warm-up, including: active-assisted wrist flexion and extension, forearm pronation and supination, gentle stretching of wrist and finger.

• *This was Followed by Specific Task-Oriented Activities Such as:*

- ✓ Cup stacking activity
- ✓ Ring activity
- ✓ Picking up a coin
- ✓ Clay manipulation
- ✓ Peg board activities.

Each activity was performed for 10–15 repetitions for 2–3 sets, depending on the child's tolerance and

performance. A rest interval of approximately 1–2 minutes was allowed between sets to minimize fatigue and facilitate adequate recovery.

Progression was incorporated by gradually increasing the difficulty of tasks, such as reducing the size of objects, increasing the reaching distance, improving the speed of performance, and decreasing the level of assistance. More precise and coordinated movements were encouraged as the child improved.

Each session lasted 30–45 minutes, conducted 3 days per week for a duration of 12 weeks.

➤ *Exercises:*

- *Cup Stacking Activity*



Fig 1 Cup Stacking

- *Ring Activity*



Fig 2 Ring Activity



Fig 3 Ring Activity

- *Picking UP A Coin*



Fig 4 Picking up a Coin

- *Clay Manipulation*



Fig 5 Clay Picking



Fig 6 Clay Squeezing

- *Pegboard Activity*



Fig 7 Pegboard Activity

➤ *Group B: Mirror Therapy (N=3)*

Participants assigned to Group B underwent Mirror Therapy, which was administered to facilitate hand function through visual feedback. A mirror was positioned vertically along the body's midline, with the unaffected limb placed in front of the reflective surface and the affected limb concealed behind it. This arrangement provided the visual impression of movement occurring in the affected limb. Each treatment session commenced with a brief warm-up consisting of: active-assisted wrist flexion and extension, forearm pronation and supination, gentle stretching of the wrist and fingers.

- *The Activities Include:*

- ✓ Hand movements
- ✓ Clay manipulation
- ✓ Cup stacking activity

- ✓ Picking up a coin
- ✓ Peg board activities

Each activity was performed for 10–15 repetitions for 2–3 sets, depending on the child's tolerance and performance. A rest interval of approximately 1–2 minutes was allowed between sets to minimize fatigue and facilitate adequate recovery.

Progression was incorporated by gradually increasing the difficulty of tasks, such as reducing the size of objects, increasing the reaching distance, improving the speed of performance, and decreasing the level of assistance. More precise and coordinated movements were encouraged as the child improved.

Each session lasted 30–45 minutes, conducted 3 days per week for a duration of 12 weeks.

➤ *Exercises:*

- *Hand Movements*



Fig 8 Flexion and Extension of Wrist



Fig 9 Touching the Mirror



Fig 10 Pronation



Fig 13 Clay Picking



Fig 11 Supination

- *Cup Stacking Activity*



Fig 14 Cup Stacking

- *Clay Manipulations*



Fig 12 Clay Squeezing

- *Picking Up A Coin*



Fig 15 Picking Up a Coin

- *Peg Board Activity*



Fig 16 Peg Board Activity

IV. RESULTS

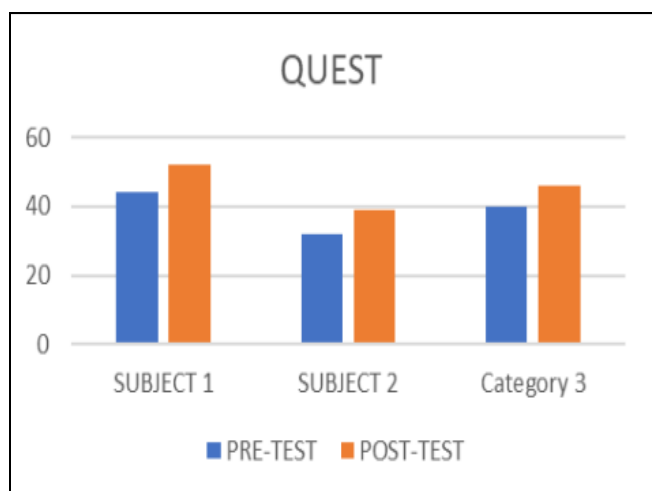
The present study was undertaken to examine and compare the effects of Task-Oriented Training and Mirror Therapy on hand function among children with hemiplegic cerebral palsy.

Table 1 Comparison of Pre- and Post-Intervention Quest Scores in Group a (Task-Oriented Training) Among Children with Hemiplegic Cerebral Palsy

GROUP A	PRE-TEST	POST-TEST	MEAN DIFFERENCE
SUBJECT 1	44	52	8
SUBJECT 2	32	39	7
SUBJECT 3	40	46	6

$$\text{Average} = \frac{8+7+6}{3} = 7$$

➤ *Graph 1:*



Graph 1 Comparison of Pre- and Post-Intervention Quest Scores in Group a (Task-Oriented Training) Among Children with Hemiplegic Cerebral Palsy

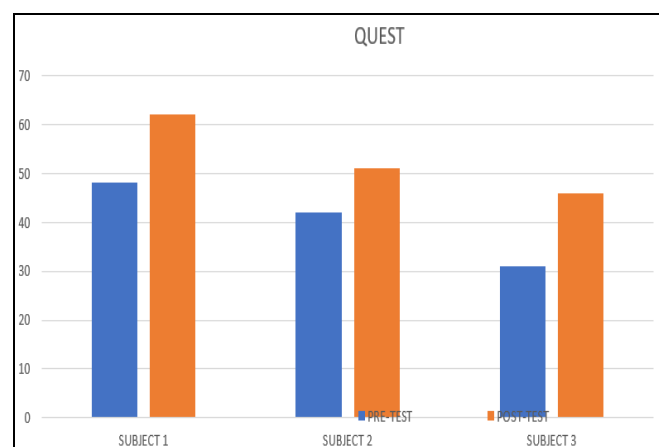
Table 1 and Graph 1 present the pre- and post-intervention QUEST scores of Group A. All three subjects showed improvement following the intervention, with scores increasing from 44 to 52, 32 to 39, and 40 to 46. The mean improvement was 7 points; the observed changes indicate an improvement in hand function among children with hemiplegic cerebral palsy.

Table 2 Comparison of Pre- and Post-Intervention Quest Scores in Group B (Mirror Therapy) Among Children with Hemiplegic Cerebral Palsy

GROUP B	PRE-TEST	POST-TEST	MEAN DIFFERENCE
SUBJECT 1	48	62	14
SUBJECT 2	42	51	9
SUBJECT 3	31	44	13

$$\text{Average} = \frac{14+9+13}{3} = 12$$

➤ *Graph 2:*



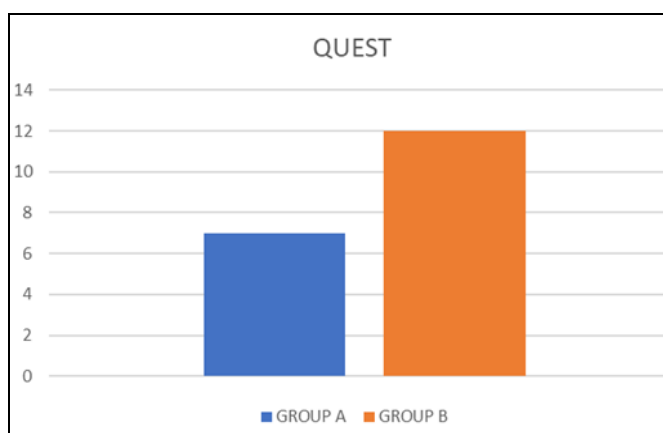
Graph 2 Comparison of Pre- and Post-Intervention Quest Scores in Group B (Mirror Therapy) Among Children with Hemiplegic Cerebral Palsy

Table 2 and Graph 2 present the pre- and post-intervention QUEST scores of Group B. All three subjects showed improvement following the intervention, with scores increasing from 48 to 62, 42 to 51, and 31 to 44. The mean improvement was 12 points; the observed changes indicate an improvement in hand function among children with hemiplegic cerebral palsy.

Table 3 Comparison of Group A and Group B Average Values for Quality of Upper Extremity Skills Test (Quest) in Hemiplegic Cerebral Palsy Child.

	GROUP A	GROUP B
QUEST	7	12

➤ Graph 3:



Graph 3 Comparison of Group A and Group B Average Values for Quality of Upper Extremity Skills Test (Quest) in Hemiplegic Cerebral Palsy Child.

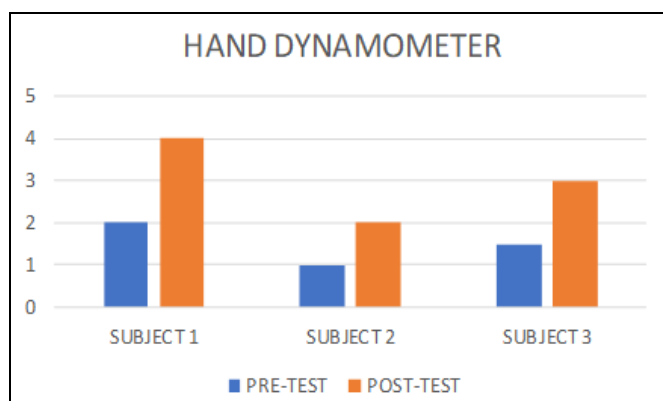
Table 3 and Graph 3 present a comparison of the average improvement in QUEST scores between Group A and Group B. Group A demonstrated an average improvement of 7 points, whereas Group B demonstrated a greater average improvement of 12 points. These findings indicate that both groups showed improvement in hand function, with greater observed improvement in QUEST scores in Group B among children with hemiplegic cerebral palsy.

Table 4 Comparison of Pre- and Post-Intervention Hand Dynamometer Values in Group A (Task-Oriented Training) Among Children with Hemiplegic Cerebral Palsy.

GROUP A	PRE-TEST	POST-TEST	MEAN DIFFERENCE
SUBJECT 1	2kg	4kg	2kg
SUBJECT 2	1kg	2kg	1kg
SUBJECT 3	1.5kg	3kg	1.5kg

$$\text{Total average} = \frac{2+1+1.5}{3} = 1.5\text{kg}$$

➤ Graph 4:



Graph 4 Comparison of Pre- and Post-Intervention Hand Dynamometer Values in Group A (Task-Oriented Training) Among Children with Hemiplegic Cerebral Palsy.

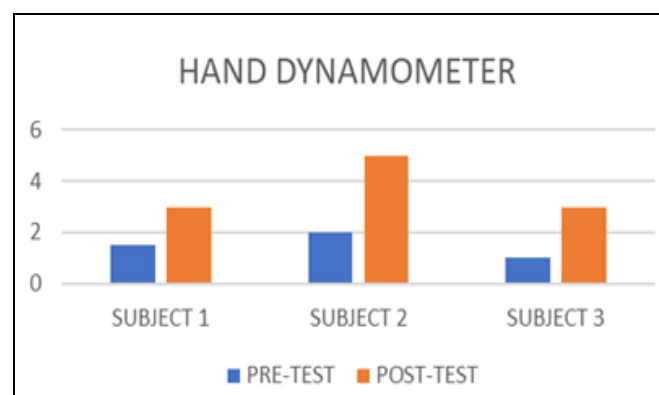
Table 4 and Graph 4 present the pre- and post-intervention hand grip strength in Group A. All three subjects showed improvement, with values increasing from 2 to 4 kg, 1 to 2 kg, and 1.5 to 3 kg. The mean improvement was 1.5 kg, indicating increased hand grip strength following the intervention.

Table 5 Comparison of Pre- and Post-Intervention Hand Dynamometer Values in Group B (Mirror Therapy) Among Children with Hemiplegic Cerebral Palsy

GROUP A	PRE-TEST	POST-TEST	MEAN DIFFERENCE
SUBJECT 1	1.5kg	3kg	1.5kg
SUBJECT 2	2kg	5kg	3kg
SUBJECT 3	1kg	3kg	2kg

$$\text{Average} = \frac{1.5+3+2}{3} = 2.16\text{kg}$$

➤ Graph 5:



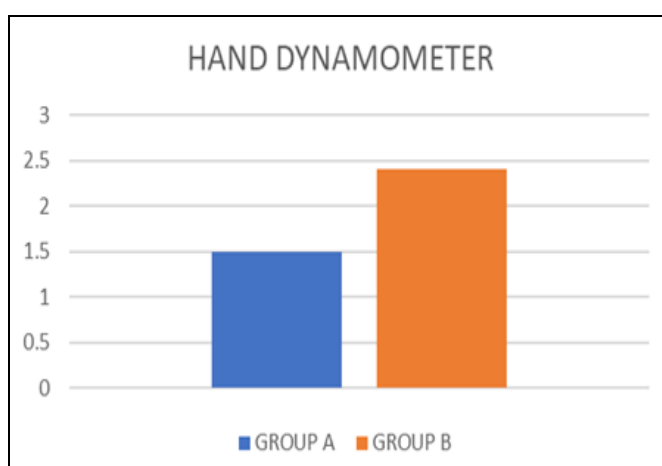
Graph 5 Comparison of Pre- and Post-Intervention Hand Dynamometer Values in Group B (Mirror Therapy) Among Children with Hemiplegic Cerebral Palsy

Table 5 and Graph 5 present the pre- and post-intervention hand grip strength in Group B. All three subjects showed improvement, with values increasing from 1.5 to 3 kg, 2 to 5 kg, and 1 to 3 kg. The mean improvement was 2.16 kg, indicating increased hand grip strength following the intervention.

Table 6 Comparison of Group A and Group B Average Values for Hand Dynamometer in Hemiplegic Cerebral Palsy Child.

	GROUP A	GROUP B
HAND DYNAMOMETER	1.5kg	2.16kg

➤ Graph 6:



Graph 6 Comparison of Group A and Group B Average Values for Hand Dynamometer in Hemiplegic Cerebral Palsy Child.

Table 6 and Graph 6 present a comparison of the average improvement in hand grip strength between Group A and Group B. Group A demonstrated an average improvement of 1.5 kg, whereas Group B demonstrated a greater average improvement of 2.16 kg. These findings indicate that both groups showed improvement in hand grip strength, with a greater observed increase in Group B among children with hemiplegic cerebral palsy.

V. DISCUSSIONS

The present study was undertaken to compare the effects of Task-Oriented Training and Mirror Therapy on hand function in children with hemiplegic cerebral palsy. At baseline, the participants demonstrated difficulties in performing functional hand activities, which may be associated with impaired motor control, reduced coordination, and limited spontaneous use of the affected upper limb. Following the structured intervention programme, improvements were observed in both groups. At the end of the intervention period, participants demonstrated greater ease in performing functional tasks, along with improvements in coordination and hand performance. Overall, the findings indicate that both Task-Oriented Training and Mirror Therapy were associated with improvements in hand function among children with hemiplegic cerebral palsy.

After careful assessment and post-test evaluation, it was observed that participants in Group B (mirror therapy) showed better improvement than those in Group A (task-oriented training). The improvement in hand function, as measured using QUEST scores, was higher in Group B, with a mean increase of 12 points compared to 7 points in Group A. Similarly, hand grip strength showed a greater increase in Group B (2.16 kg) than in Group A (1.5 kg). These findings indicate that participants receiving Mirror Therapy demonstrated greater observed improvements in functional ability and grip strength of the affected upper limb.

The observed improvements following Mirror Therapy may be related to its proposed neurophysiological mechanisms. Mirror Therapy provides visual feedback by reflecting movements of the unaffected limb, thereby creating the visual perception of movement in the affected limb. This visual feedback may facilitate activation of the mirror neuron system and contribute to cortical reorganization and neuroplasticity. In children with hemiplegic cerebral palsy, where impaired motor pathways can contribute to difficulties in voluntary movement and motor control, such visual stimulation may support motor learning and functional recovery. Through these mechanisms, Mirror Therapy may facilitate motor planning, coordination, and movement execution, thereby contributing to improved hand function.

The findings of the present study are consistent with previous literature, which suggests that interventions targeting central nervous system reorganization result in more significant functional improvements compared to those focusing only on peripheral strengthening. Mirror therapy not only improves motor control but also supports movement initiation and coordination, which are essential for performing daily activities independently.

Task-oriented training also resulted in noticeable improvements, particularly in muscle strength and the performance of functional tasks. However, the extent of improvement was comparatively less than that observed with mirror therapy. This may be because task-oriented training primarily emphasizes repetitive practice and musculoskeletal strengthening, which may not fully address the underlying neural impairments associated with cerebral palsy. In contrast, mirror therapy directly influences neural mechanisms, leading to broader functional gains.

Another factor contributing to the outcomes of mirror therapy is its simplicity, low physical demand, and engaging nature. The visual illusion created during Mirror Therapy may enhance the child's interest and motivation, potentially promoting greater participation and adherence to the intervention. This increased engagement may have contributed to the improved results observed in the mirror therapy group.

Furthermore, mirror therapy is particularly beneficial for children with limited voluntary movement, as it allows them to experience normal movement patterns without requiring significant physical effort. This makes it a valuable approach, especially during the early stages of rehabilitation.

Despite the better outcomes observed with mirror therapy, task-oriented training should not be disregarded. It plays an important supportive role in improving strength and facilitating the functional application of movements in daily activities. Therefore, incorporating both approaches may provide a more comprehensive rehabilitation strategy.

In conclusion, both Task-Oriented Training and Mirror Therapy were associated with improvements in hand function among children with hemiplegic cerebral palsy. Greater observed improvements were noted in the Mirror Therapy

group in terms of functional hand performance and grip strength. These findings suggest that Mirror Therapy may support both functional performance and neurophysiological processes; however, the results should be interpreted cautiously considering the small sample size and limited intervention duration.

VI. CONCLUSION

The present study indicates that both Mirror Therapy and Task-Oriented Training were associated with improvements in hand function among children with hemiplegic cerebral palsy. Improvements were observed in QUEST scores and hand dynamometer measurements, reflecting changes in upper-limb functional performance and grip strength. Mirror Therapy may facilitate motor relearning through visual feedback, whereas Task-Oriented Training emphasizes repeated practice of purposeful, task-specific activities. Greater observed improvements in hand function and grip strength were noted in the Mirror Therapy group compared with the Task-Oriented Training group. However, these findings should be interpreted cautiously due to the small sample size, and further studies with larger samples and longer intervention periods are recommended.

LIMITATIONS AND RECOMMENDATIONS

➤ Limitations:

- The small sample size limits the generalizability of the findings to the wider population of children with hemiplegic cerebral palsy.
- The absence of long-term follow-up prevents assessment of whether the improvements observed following the interventions were maintained over time.
- The use of a limited number of outcome measures may not have captured all dimensions of hand function and upper-limb performance.

➤ Recommendations:

- Future studies should recruit larger sample sizes to improve the statistical robustness and generalizability of the findings.
- Further research may investigate the effects of Task-Oriented Training and Mirror Therapy across different clinical types of cerebral palsy to determine their applicability to broader populations.
- Future studies may examine the combined application of Task-Oriented Training and Mirror Therapy to determine whether integrating task-specific practice with visual feedback may further support improvements in hand function.

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