# SIGNIFICANCE OF SPECIALIZED HAND TRAINING WITH CONTRALATERAL HEAD AND NECK POSITIONING ON IPSILATERAL GRIP STRENGTH AND HAND FUNCTION AMONG CEREBRAL PALSY

**SIMULIA DHINJU BENJAMIN [1], L.R. SARATH ASHWATH [2], PAULRAJ MANICKAVELU [3]**

1. Associate Professor in Neurological Physiotherapy, Sri Venkateshwara College Of Physiotherapy (Affiliated with Pondicherry University), Puducherry.
2. Senior Physiotherapist, Gleneagles Global Health city (GGHC), Chennai
3. Associate Professor, Sri Venkateshwara College Of Physiotherapy, (Affiliated with Pondicherry University), Puducherry.

**CORRESPONDING AUTHOR**

**Simulia Dhinju Benjamin,**

**Associate Professor** Sri Venkateshwara College Of Physiotherapy, (Affiliated to Pondicherry University) attached with Sri Venkateshwaraa Medical College Hospital & Research Centre, Puducherry.

**Orchid No: 0000-0003-2130-1833**

**ABSTRACT:**

**BACKGROUND:** Over ages Cerebral palsy has been a broad spectrum of disorder associated with multiple disabilities and one of the most common impairments affecting the functional ability is hand function over. Emerging studies have reported the positive impact of training in ATNR positions and there prevails a paucity in addressing the position of head and neck using ATNR to train the hand function. The aim of this study is to find the significance of specialized hand training with Contralateral head and neck positioning on Ipsilateral grip strength and hand function among cerebral palsy **Methods:** 30 Cerebral Palsy children fulfilling the selection criteria were included and grouped intothis study as Experimental & Control group. The intervention group was given withspecialized hand training with ATNR position. Outcome measures such as grip strength and hand function were measured using Modified sphygmomanometer and Block &block test. The interventions were given for about 12 weeks and each session lastedupto 45 to 60 minutes, daily.

**RESULTS**: The data obtained after the treatment sessions were statistically analyzed using the Paired & unpaired 't' test at 5% level of significance. Group A (experimental group) which had undergone the specialized hand training with ATNR position is foundto be significantly effective with the 'p' value of <0.001 than the control group.

**CONCLUSION:** Therefore, this study concludes that the specialized hand training with contralateral head positioning shows significant effect on improving grip strength and hand function than the control group which was merely given with specialized hand training.

**KEY WORDS:** Hand Function, Specialized hand training, Grip Strength, Asymmetric Tonic Neck Reflex, Modified Sphygmomanometer test.

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## INTRODUCTION

Cerebral palsy is a group of permanent disorders of the development of movement and posture causing activity limitation that are attributed to non-progressivedisturbances occurred in the developing fetal or infant brain. There are various definition used for the cerebral palsy which includes these three common criteria: (1) It is a disorder of movement or posture, (2) It results from some static abnormality in the brain, and (3) It is acquired early in life [2].

The worldwide incidence of CP is approximately 2 to 2.5 cases per 1000 live birth. In India, it is estimated at around 3 CP cases per 1000 live births[4] . Moreover, it is the leading cause of chronic disability in children, making them physically and mentally handicapped and socially aloof. This was discussed in 8566 articles, of which only 309 were in rehabilitation journals. Of those 309 articles, 93 were published before 1980, 66 between 1980 and 1990, leaving 150 articles of more recent date.

The topics in the rehabilitation journals predominantly deals with : New treatment policies, motion analysis, introducing or reviewing measurement instruments, and describing specific impairments[3]. As the disabled children are of great concern to a family as well as to the society addressing their disability cause is a crucial step to be taken. As per the disability regard, particularly in children, about a quarter of chronic childhood problems are neurological in origin.

Such children are often associated with problems of motor control, sensibility, sensory processing and persistence of primitive grasp reflex. They include spasticity, dyskinesia, hyper reflexia, retained developmental reactions, and secondary musculoskeletal malformations. Negative signs, on the other hand, reflect the loss or absent development of proper sensorimotor control mechanisms resulting in weakness, poor coordination of movements, poor balance, and walking ability[5] ; commonly, delay in milestones is an important indicator of cerebral palsy.

On average head control in infants is attained at 3-4 months, sitting by6 months, crawling by 9 months, standing by 10-12 months, and walking

by 12-18 months. The diagnosis should be suspected if there is paucity of spontaneous movements during thefirst few months of life, or if the motion of both upper limbs is not symmetric. Preferential use of one hand is an important signal toward impaired neurologic status of the other limb.

Normally the hand dominance starts developing at about 2-3 years and is fully developed by 6 years. Early handedness, particularly apparent left handedness in small infants is often a clue that the neurologic status of the other extremity is abnormal (It indicates the right hand is spastic). Infantile reflexes like Moro's reflex, parachute reflex, tonic neck reflex are normal in a neonate but disappears by 3-6 months as the motor cortex matures and over rides them. These reflexes are retained in children with cerebral palsy.

Identification of upper limb dysfunction is usually noted by 1 year of age. Normally at 1 year an infant develops a refined pinch with opposition of the thumb to the index finger but a child with cerebral palsy does not reach this milestone, although they may develops more primitive key pinch (thumb to side of index finger). When thechild is older, sensory defects, abnormal intelligence, and poor voluntary control of various muscle groups become obvious[6] . Additionally, chronic spasticity of the hands has a negative impact over the muscle strength affecting Grip strength and Grossdexterity (hand functions).

In a emerging studies, it was reported that the body positions and upper limb positions can influence the measurement of hand grip strength. The tonic neck reflex (TNR) is a reflex phenomenon in which head positions affect limb muscle tone. Although it may influence all four limbs, it's effect is more on the upper limbs than the lower limbs. The TNR has two components including a symmetrical tonic neck reflex (STNR) and an asymmetrical tonic neck reflex (ATNR). Moreover, persistent ATNR influences movements in specific states including motion stress and relaxation.

Recommendation of the use of head-neck rotations during strengthening of upper extremity muscles was found to induce ATNR and also possible influence of head-neck position on motor unit activity in infants, healthy adults, and neurologically impaired persons.[7] were reported. The commonly reported treatment to reduce the disability of CP includes NDT for improving gross motor function[8] [9],Voitja technique, sensory integration and other techniques but none of the study has experimented ATNR position for hand function to improve the grip strength and manual gross dexterity for spastic cerebral palsy. Therefore, this study focuses on the impact of ATNR position on improving the hand function among the

cerebral palsy child. Therefore, the purpose of this study is to find the significance of specialized hand training with contralateral head and neck positioning on ipsilateral grip strength and hand function among cerebral palsy.

## METHODOLOGY

This study protocol was approved in thesis review meeting conducted, by Sri Venkateshwaraa College of Physiotherapy, Ariyur, Pondicherry. A total of 30 samples were recruited from Sri Venkateshwaraa physiotherapy department, based on the selection criteria from the target population - cerebral palsy(CP). Subjects Diagnosed with diplegic or monoplegia CP, hand grip functional score of Manual Ability Classification System (MACS) 1,2, & 3, Mini mental scoring < 27 and Ages between 5-16 years were included. The total samples were collected by Convenient sampling method. They were randomly allocated into group A and group B by simple random sampling method. Group A (experimental group) receives specialized hand function training with ATNR position and Group B conventional exercises: specialised hand function. The samples were excluded if they have any other neurological, orthopaedic condition affecting hand function or motor problems, hearing & visual challenges. The study protocol clearly explained to the patient guardian and obtained informed consent. The subject's demographic detail such as Age, Dominance of each participant were noted. Grip strength and Gross manual dexterity hand function were measured using the Modified sphygmomanometer test and Box-Block test were used pre and post treatment of 12 weeks period.

**PROCEDURE:** Experimental group received the Specialized hand training (1) given in ATNR (1.a-1.f). The most commonly used position for treatment and functional use of fine motor skills is sitting. Facilitate supination with the forearm on a surface as in weight bearing on floor, or on mat, while seated at a table the therapist place an object in the child hand, the child attempt to compensate for difficulty with supination by using wrist extension.

Encourage the use of 45 to 90 degrees of supination followed by grasp of an object with elbow in 90 degrees of flexion, the child encouraged to keep thumb up as reaching andgrasping large birthday candles then put them into cake that require supination. Encourage lateral reach followed by grasp most of the children with limited use of supination find it easier to combine humeral abduction with external rotation and supination than to use humeral flexion with external rotation and supination. Object presented

laterally to the child allow the child to use abduction rotation which allow for supination. Encourage reaching by using shoulder flexion and external rotation by placing the object between leg and shoulder in sitting position depending on the child ability to control external rotation and supination while completing the reach. Encourage reaching across midline following strategies suggested for reaching in frontof the shoulder

**Grasping training:** Grasp training can be conducted according to size, shape, weight, texture, time, speed, accuracy and number of trials. **Reaching:** (Any one of the following could be used in your training program depending upon theaccessibility of the CP children) A. By using water mat game, have sponged objects floating within, encourage reaching and touching to make the object move. B. Busy boxes and rattles attached to playpen some of them are secured with table top with suction cup reaching is rewarded with sound movement. Or touching the colorful objects placed in front of the children along with All exercises for grasping used for reaching **Voluntary release:** Strategies used to enhance voluntary release: Hand weight bearing help the child to develop improved co contraction at the scapula-humeral area, the elbow and the wrist. Reaching activities that involve touching a desired target and holding that position fora few second be helpful.Teaching the child to stabilize the arm against the body or on a surface prior to opening the hand be helpful compensatory strategies. Facilitation of supination, abduction and external rotation make it easier for the child to use elbow extension and supination which allow for voluntary release with wrist extension.Releasing into the container placed on the floor or at lower than the seat of the child chair teach the child to relax finger flexors. As children develop more control with voluntary release therapist can graduallydecrease object, weight, stability, and size of the area used for object placement. Note : Training performed using contralateral head rotation were done with the use of mirror in order to fix the task target and better performance were obtained through activating the biofeedback system as well as the Executive function, namely cognition.

**General principles for developing hand manipulative skills: A.** Provide somato-sensory stimuli: Typical activities used for sensory awareness may include: finding objects in beans, rice, or sand (graded finger movements are used to get the grains of rice or sand off the object), pulling pieces of clay off a ball of clay, pushing fingers into therapy putty or clay, stretching rubber bands around fingers. **B.** Facilitate the use of intrinsic muscles in grasp and hand functions: pulling clay to facilitate use of intrinsic muscles, facilitate the use of metacarpophalangeal flexion with

interphalangeal extension due to this pattern require use of intrinsic muscles. Emphasis on spheric grasp that use a combination of long flexor activity and intrinsic activity.**c.** Encourage use of bilateral manipulation: infants manipulate objects between two hands, in normal development babies develop gross symmetric bilateral skills such as (holding object with two hands, clapping, banging objects together), then stabilize objects with one hand while the other is manipulating (holding paper while coloring, holding a container while putting objects in), then manipulate objects with both hands simultaneously (stringing beads, tying a knot).**d.** The child may hold his hand on the paper while therapist draw a picture and ask child to guess what is being drawn, gradually the child is asked to do more with manipulated hand while using the stabilizing hand to maintain materials on the surface or in the grasp, padlock in which a key can be put into, markers with caps to put on, a box with a lid and objects to put inside the box, hold a cup with one hand while putting object in with other hand, buttoning with both hands, tying a bow and doing craft project, fitting blocks together.

**Fig 1.a**

**Fig 1.b**

**Fig 1.c**

**Fig1.d**

**Fig 1.e**

**Fig 1.f**

**FIGURE 1 SPECIALIZED HAND TRAINING WITH ATNR POSITIONING**

Fig 2.a Specialized hand function training for grasping (head in neutral position)

Fig 2.b Specialized hand function training for Reaching (head in neutral position)

**STATISTICAL ANALYSIS & RESULTS:**

The pre and post outcome values obtained were statistically analyzed using paired **'t'** and unpaired **'t'** with Statistical significance set at $p<0.001$. Results of within the group analysis of Grip strength (table 1.1) using paired 't' test for Group A 't' value is 11.93 & Group B is 6.87 and Hand function(1.2) for Group A 't' value is 18 and Group B is 7.62 and were presented in the figures (3.1) & (3.2).

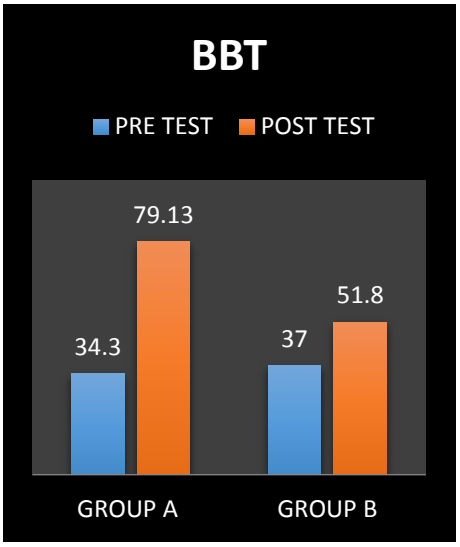


Figure 3.1

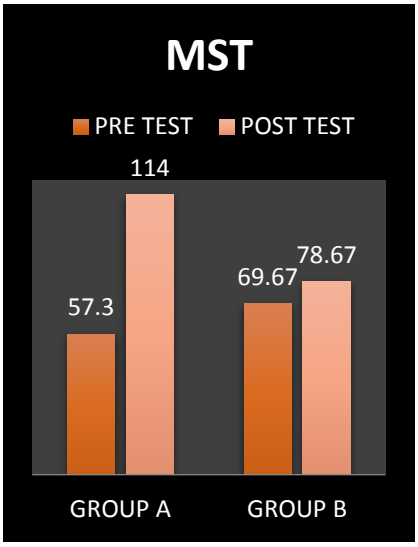


Figure 3.2

Results of between the groups (Table 2) were analyzed using unpaired 't' test and presented in the graphs for Box and Block Test (figure 3.3) with the t value of 11.71 and Modified Sphygmomanometer test (figure 3.4) with the 't' value of 4.87. Both the groups are considered to be extremely significant with the 'p' value of <0.001. Group A is found to be more significant than that of Group B based on the mean value and standard deviation.

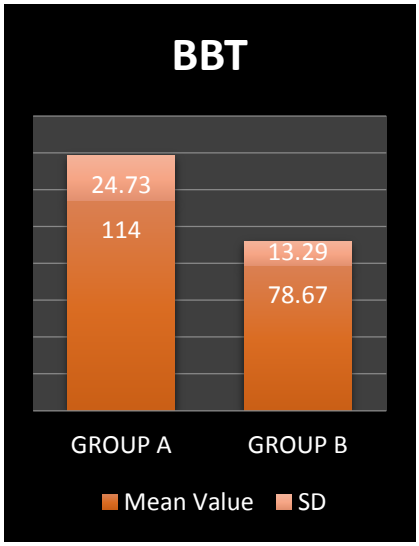


Figure 3.3

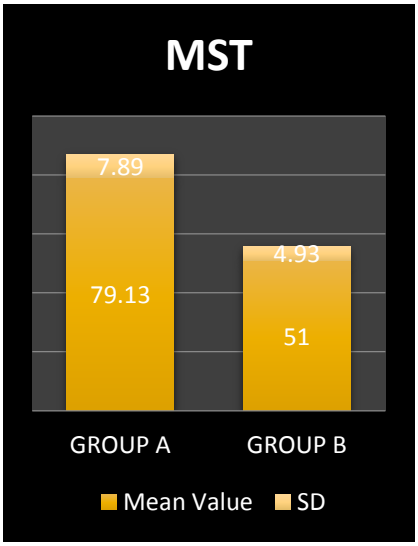


Figure 3.4

**DISCUSSION:**

The present study is the experimental study conducted to find out the "significanceof specialized hand training with contra lateral head and neck positioning on ipsilateral grip strength and hand function among cerebral palsy". This study was selected for the purpose to improve the hand dexterity through improving grip strength in the selected population.

Our target population included CP

children because it is already established that 50% of such children has arm and hand dysfunction. Fulfilling the selection criteria, 30 subjects were taken and divided into two groups as GROUP-A Experimental (n = 15; Specialized hand Training) and GROUP – B Control (n= 15; conventional therapy). The outcome is measured using the following tools: Modified Sphygmomanometer test and Box & Block test

The Pre and Post interventional data of experimental group and the control group were statistically analyzed. Both the group shows improvement but the group A which received Specialized hand Training seems to be more effective than the control Group B in the improvement of hand grip and manual dexterity (Hand function). The possibility in the improvement of the dependent variables due to the Specialized hand function training could involve the following mechanism. According to **Ahmed M. Azzam (2012)** the hand function training deals with more practice and repetition which are the key components of training. These factors leads to more sensory input, feedback and permanent changeswhich **Arcilla CK (2021)** reported that in patients with brain damages demonstrated ATNR through several voluntary resisted active rotation of the head. These primitive reflexes serve as an indicator of the reversal of the had produced new strategies and motor plan to impact on learning a new skill or restore the lost skill. The nervous system provide the: A) Sensory processing for perception of body orientation in space provided by visual, vestibular, and somato- sensory systems. B) Sensory-motor integration essential for linking sensation to motor responses (centrally programmed postural adjustments that precede voluntary movement). C) Mechanism of new motor strategy: Information coming from periphery reached to the spinal cord through spinal nerves, information coming from head and neck reached to brainstem through cranial nerves.

All the previous information reached to the thalamus to be sensitized then to thepost-central gyrus to be localized. Perception, cognition, new sensory strategy will be produced by sensory areas which lead to increase of efficiency of synapses. After that information reach to cerebellum and basal ganglion to be smoothening and prevention of excessive activity, then reach to pre-central gyrus to produce permanent changes and new motor behavior. The reason behind actual changes produced remains studied. central nervous system's motor control. Also, the antagonistic actions between tonic labyrinthine reflex and ATNR still manifest in these patients. Several studies had reported the strong determinants of retained spontaneous

(not evoked) ATNR in infants with high perinatal risk factors for cerebral palsy and developmental disorders with increasing age. Though at early stages, these activated reflexes affect the overall hand function adversely, later it is used to improvethe grip strength and gross motor functions in chronic spastic hand due to disuse atrophy.

Initially, **(EUN-PARK, 2017)** these children in the study had difficulties on their daily life basis due to loosen gross and hand function. The primary access for reaching movement and other hand grip function were lagged on the activities of daily life. After the implication of Specialized hand function training with ATNR position made possible changes in their daily activities such as grasping the spoon, holding the pencil, grooming and eating, combing eating and showed improvement in academic skills also like holding boxes flipping the pages etc. must have influenced the activity of the Feedback system and also positively impacted the concentration of the Cp child via improving their executive function in the better performance of gross motor function.

The mechanisms discussed above, states the reason behind the possible improvement in the outcome measures such as grip strength and hand functions of the CP child who were trained with specialized hand training using ATNR positions. And also children developed significant head control in specialized hand function training with ATNR position. The reflex may affect all four limbs, its influence is greater on the upper extremities than on the lower extremities.

This reflex is significant for posture, eye-hand coordination, and focus required in activities like sitting, swimming, playing with a ball, etc. This postural tone is influenced by cortical and subcortical structures, including somatic descending brain stem pathways, descending fiber tracts of monoaminergic systems pathways, and limbic system. **Tokizane et al** reported that using electromyographic techniques, demonstrated a change in motor unit activity attributable to change in the H-N position in infants, healthy adults, and neurologically impaired person. In addition, use of mirror

Therefore, this study states that the specialized hand training with contralateral head positioning shows significant effect on improving grip strength and hand function than the control group which was merely given with specialized hand training.

Therefore, this study concludes that the Specialized Hand Training with contralateral Head and Neck Positioning has a significant effect on Ipsilateral Grip strength and Hand function among Cerebral Palsy.

**Conflict of interest**: There is no conflict of Interest.

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**TABLE 1.1 – Within the group Analysis of BBT – Box & Block Test**

| BBT | | MEAN | SD | 't' VALUE | 'p' VALUE |
|---|---|---|---|---|---|
| **GROUP A** | PRE TEST | 34.31 | 7.98 | 18 | <0.001 |
| | POST TEST | 79.13 | 7.89 | | |
| **GROUP B** | PRE TEST | 37.87 | 5.21 | 7.62 | <0.001 |
| | POST TEST | 51 | 4.93 | | |

**TABLE 1.2 – Within the group Analysis of MST–Modified Sphygmomanometer Test**

| MST | | MEAN | SD | 't' VALUE | 'p' VALUE |
|---|---|---|---|---|---|
| **GROUP A** | PRE TEST | 57.33 | 17.51 | 11.935 | <0.001 |
| | POST TEST | 114 | 24.73 | | |
| **GROUP B** | PRE TEST | 69.67 | 13.02 | 6.873 | <0.001 |
| | POST TEST | 78.67 | 13.29 | | |

**TABLE 2 – Between the group Analysis of MST & BBT**

| MST | | MEAN | SD | 't' VALUE | 'p' VALUE |
|---|---|---|---|---|---|
| **GRIP STRENGTH (MST)** | GROUP A | 114 | 24.73 | 4.87 | <0.001 |
| | GROUP B | 78.67 | 13.29 | | |
| **HAND FUNCTION (BBT)** | GROUP A | 79.13 | 7.89 | 11.71 | <0.001 |
| | GROUP B | 51 | 4.93 | | |

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