

# A STUDY TO FIND THE EFFECTIVENESS OF CRYOTHERAPY WITH TASK ORIENTED TRAINING IN IMPROVING UPPER LIMB FUNCTION IN HEMIPLEGIC CEREBRAL PALSY

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## ABSTRACT

**Background:** The cryotherapy is one of the short terms benefit producing physiotherapeutic intervention on spasticity in neurological patients. Task oriented training (TOT) is used to facilitate functional control and overcome disability in hemiplegic cerebral palsy children (HCP).

**Objectives of the study:** to find out the effectiveness of cryotherapy with task oriented training in improving upper limb sensory function in HCP children.

**Methods:** This is a single group study design, included 30 diagnosed case of hemiplegic cerebral palsy children and undergone cryotherapy with task oriented training for 8 weeks. The outcome measures were modified Tardieu's scale (MTS), tactile registration and quality of upper extremity skill test (QUEST). All the measures were taken before the intervention for pretest, and posttest at the end of 2<sup>nd</sup> month.



**Results:** reduction of shoulder adductor and elbow flexor spasticity in MTS, improvement in tactile registration function in Semmes-Weinstien monofilament and increment in grasp function in QUEST scale were statistically significant at p<0.05 level.

**Conclusion:** the cryotherapy combined with task oriented training effective to improve upper limb function in HCP children but it requires further study to explore the intervention efficacy.

**KEY WORDS:** Cold Pack, task, cerebral palsy, hand function.

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## INTRODUCTION

Cerebral palsy is a common neuro-developmental disorder in childhood due to non-progressive insult to the developing brain [1]. Spasticity is the most common disabling factor in cerebral palsy children [2]. Hemiplegic cerebral palsy

(HCP) is one of the types of a cerebral palsy present with joint contracture and deformity due to spasticity [3]. The physiotherapist is one of the key members in treating HCP children and focusing on increase joint mobility and facilitates voluntary control of extremity to prevent

or postpone joint contracture [4]. Task oriented training (TOT) is one of the methods to promote functional control to overcome disability in neurological patients [5]. Despite the strong evidence for TOT, it showed effective in better motor and verbal ability HCP children [6].

The cryotherapy is one of the short terms benefit producing physiotherapeutic intervention on spasticity in neurological patients. Cryotherapy reduces the sensitivity of muscle spindle and slows down the conduction of impulses in peripheral nerves. This physiologic effect could contribute to gain better functional control in neurologic patients [7].

Since the cryotherapy and TOT were shown evidence in improving motor function in neurological conditions, none of the studies had shown the effectiveness of combining these two interventions in HCP children. So this study aimed to combine cryotherapy with task oriented training to improve upper limb function in hemiplegic cerebral palsy children.

## MATERIALS AND METHODS

This is single group study conducted by the department of physiotherapy, NITTE Hospital, Mangalore and PPG college Hospital, Coimbatore. The central ethical committee of NITTE University approved the study protocol and written informed concern was collected from parents before the commencement of this study. The study was conducted from 2016 to 2017. The study inclusion criteria were both male and female HCP children with age between 3 to 11 years, less than level III in gross motor functional classification [8] and less than level IV in manual function classification system [9]. Other than spastic type cerebral palsy children with a history of epilepsy and taken antispastic management within 12 months were excluded. This study included 30 HCP children after fulfilling the study the criteria. They have received cryotherapy with TOT. Cryotherapy was applied over the key muscles of upper limb spastic groups such as shoulder adductor, elbow flexor, forearm flexors. This study used Ice pack massage technique. The ice pack was wrapped with a paper cover and applied over the skin in the circular movement pattern. This procedure was followed for 20 minutes for all upper limb

muscles. The TOT was followed for another 60 minutes. The TOT consisted sensory motor training and functional task activity training. The sensory motor training consisted of tactile oriented games and encouraged the children to participate actively. Adequate visual and auditory guidance were given till the child mastery in sensory related games. The functional tasks were focused on paralyzed side hand and both hands using activities. Each task was encouraged to repeat for 20 times. This activity was progressed by increasing the repetition and speed. These interventions followed for 3 sessions in a week for 2 months duration.

The outcomes were assessed by using modified Tardieu scale for spasticity, quality of upper extremity skill test for upper limb function. The upper limb function was measured by using Quality of Upper Extremity Skills Test (QUEST), is a descriptive, impairment-based measure used to assess the upper limb movement abilities and hand function in children. The QUEST consisted 36 items of upper extremity function under 4 domains: dissociated movement, grasp, protective extension, and weight-bearing. This study included dissociated movement and grasp only. Each item was graded by pass, fail or not-tested. Each domain score was used to get standardized scores by special formula and expressed in the range from 0 (low ability) to 100 (high ability) [10].

Spasticity was measured by using modified Tardieu's scale (MTS). The angle of muscle reaction (R2) was noted during joint moved at very slow stretching velocity (V1) for measure available passive movement. The angle of muscle reaction (R1) was noted during joint moved at a fast stretching velocity (V2). R1 and R2 were recorded by using the standard goniometry procedure. The dynamic component was obtained by identifying the difference between the angles of muscle reaction (R2 - R1). The quality of muscle reaction was obtained by a 5 point ordinal rating scale (0 -4) while recording the R1. This study included measuring the muscle reactions of during shoulder adductor, elbow flexor and wrist flexor. All these muscle responses were recorded when the children well relaxed in supine lying position [11].

Tactile registration (TR) measured with 2.83 size filament to apply pressure 3 times over the pulp of thumb, index, ring and little finger randomly by using 20 set kit of Semmes-Weinstein monofilament (SWM). The least size monofilament identified by asking the child's respond to all selected fingers accurately [12].

These outcome measures were taken before and after the intervention application. Along with posttest measurement, a parent filled questionnaire focused on feedback about the cryotherapy combined with TOT was also obtained. This questionnaire contains 8 questions which parent had rated by using 5 point Likert's scale (1 denoted strongly disagree and 5 denoted strongly agree).

Demographic information was summarized using means, standard deviations and frequency. Paired t-test and Wilcoxon Signed rank test for within group comparison. The significance level was set at  $p < 0.05$  level. Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS, 22.0 version).

## RESULTS

**Baseline characteristics details:** This study included 30 HCP children and the average age of the participant was 6.6 +/- 1.9 years. The other characteristics at the time of baseline were mentioned in Table - 1.

**Table 1:** Baseline characteristics of all subjects.

Variables		No. of subjects (frequency %)
Gender	Male (n)	12 (40)
	Female (n)	18 (60)
Hemiparetic side	Right	15 (50)
	Left	15 (50)
GMFM	Level I	7 (23.3)
	Level II	11 (36.7)
	Level III	12 (40)
MACS	Level I	8 (26.7)
	Level II	10 (33.3)
	Level III	12 (40)

N – Number of subjects; SD – Standard deviation; GMFM – Gross motor function measure; MACS – manual ability classification system.

**Feedback from parents on safety of Cryotherapy with TOT effects:** All parents were rated more than agree in all component of the questionnaire. The parent rated feedback was

represented by a median score including minimum and maximum score of rating (Table 2).

**Table 2:** Feedback of parents on safety of Cryotherapy with TOT effects.

S.No	Items <sup>#</sup>	M.S(min - max)* n=30
1	Treatment intervention is more comfortable.	5 (5-5)
2	Treatment intervention application duration is appropriate.	4.87 (4-5)
3	Treatment intervention is simple and easy to follow.	5 (5-5)
4	No side effects were noticed after the treatment intervention.	5 (5-5)
5	Able to participate upper limb exercise after the treatment intervention.	5 (5-5)
6	Able to use the upper limb for ADL after the treatment intervention.	5 (5-5)
7	Overall, do you satisfied with the treatment intervention.	4.6(3-5)
8	Intend to continue to use this treatment intervention in the future	4.5 (3-5)

<sup>#</sup>items were graded by 5 point scale (1 - strongly disagree; 5 - strongly agree)

\*{M.S(min - max)}: {median score (minimum - maximum)}

**Upper limb function improvement after using Cryotherapy with TOT:** A significant difference was noted in this group in MTS score of shoulder and elbow component at 8 weeks ( $p < 0.05$ ). Especially the spasticity reduction was noted at the end of 8th week maximum in elbow flexor and moderate in shoulder adductor. But there was no significant difference was noted in wrist component of Tardieu score at the end of 8th week. There was a significant difference in grasp component of QUEST manual ( $P < 0.05$ ) at the 8th week (table - 3).

**Table 3:** Pretest to posttest changes in all outcome measures.

Components	Outcome measures	n	Pretest Mean ± SD	Posttest Mean ± SD	MI Mean ± SD	p value
Spasticity level in MTS (Y) R2- R1 <sup>†</sup>	Shoulder adductor	30	91.6 ± 10.1	91.1 ± 10.3	0.53 ± 1.27	0.030*
	Elbow flexor	30	80.5 ± 12.3	77.1 ± 13.1	3.40 ± 2.98	<0.001*
	Wrist flexor	30	46.5 ± 10.3	45.8 ± 10.3	0.66 ± 1.97	0.074
Sensory function in SWMF <sup>@</sup>	Tactile registration	30	5.86 ± 1.47	5.46 ± 1.43	0.4	0.001*
Upper limb function in QUEST scale <sup>‡</sup>	Grasp	30	44.6 ± 9.43	47.6 ± 9.43	3.04 ± 2.87	<0.001*

MI – mean improvement difference; \*Significant difference at  $p < 0.05$  level; # - paired t' test; @ - Wilcoxon sign rank test

## DISCUSSION

This study was mainly focused to address few questions in relation to the rehabilitation of upper limb function in HCP children. The first

question was the safety issue of cryotherapy practices in cerebral palsy children. None of the parents were selected less than agree on level rating in the questionnaire. All the parents were rated cryotherapy combined with TOT was well tolerated by the child, easy to practice and children were able participated actively during the physiotherapy sessions. And overall they are satisfied the therapy and want to continue to achieve the remaining component of upper limb function. Ice pack massage techniques may produce few adverse effects such as severe coldness and numbness [13]. But this study not found any adverse reaction oriented information from the therapist and parents. This proves the ice pack massage technique was safe to apply with TOT in HCP children.

The next question was focused on effects of cryotherapy combined with TOT on spasticity in HCP children. The MTS showed a gradual, incremental improvement pattern from the baseline values TOT group. This group showed the mean difference of 0.53, 3.4 and 0.66 respectively in shoulder adductor, elbow flexor and wrist flexor spasticity score at the end of 8th week. The mean difference score of elbow flexor spasticity was highly significant at  $p < 0.001$  level and shoulder adductor spasticity were significant at  $< 0.05$  level. This showed the cryotherapy combined with TOT effective to produce the anti-spastic effect in shoulder adductor and elbow flexor muscle groups. Similar kind of improvement was registered by Warren *et al* and found complete muscle relaxation due to the slowness of conduction from the stretch afferent receptor after application of cryotherapy [14]. In spite of the spasticity reduction after application of cryotherapy with TOT, there was a difference in achieving spasticity reduction in upper limb muscles and even there was no statistical difference found in the wrist flexor muscles. This variation in cryotherapy anti-spastic effect needs to be addressed in future studies.

The next question was aimed to identify the effects of cryotherapy combined with TOT to improve sensory function in HCP children. The mean improvement score of tactile registration was 0.4 in Semmes-Weinstein monofilament. These results showed that the cryotherapy with

TOT achieved statistically significant improvement in upper limb sensory function at end of the 8 weeks. This statement was contradicting the previous studies, which were proved the significant reduction in nerve conduction velocity after application of cryotherapy [15]. But Furmanek MP *et al* raised an important question by suspecting the relationship of proprioception sense reduction after the cryotherapy application [16]. Moreover, Hopkins JT *et al* demonstrated disinhibition mechanism, along with there was a facilitation of motor neuron pool to achieved controlled muscle action [17]. And Rubley MD *et al* found after cryotherapy, the mechanoreceptor, muscle spindle and Golgi tendon organ were provided enough input to the higher center neural system and produced adequate muscle response during the motor action in healthy subjects [18]. Since this study also used ice massage technique which can create thermal as well as tactile sensory feed forward to higher center and produced improvement in tactile recognition function in HCP children. This is essential to perform any kind of motor task by a human being. Moreover this study obtained the sensory outcome at the end of 2 month period, not immediately after the cryotherapy application. Even the TOT was followed after cryotherapy this might create sensory feedback from the local area. These mechanisms need to be studied detail in future research.

Since both reduction of spasticity and tactile sensory function improvement were created impact and contributed to the improvement of upper limb function in HCP children. The statistical evidence also supported this statement by showing the mean improvement 3.04 in QUEST score after the 8 weeks of intervention. Previous studies reported that stimulation of sensory receptor by ice created a large amount of information to higher center [17].

This might have increased the awareness of body parts from the hemiparetic side and encouraged the child to participate actively in the task oriented practice. Also, Chiang-Soon Song [19] concluded in his studies as task-oriented training could increase the skill, offer more experiences about a task, create a proper context to execute tasks in different occasion and

predicting the obstacle to performance. These studies proved the cryotherapy and TOT produced a comprehensive treatment approach to produce improvement in upper limb function in HCP children.

In spite the effects of cryotherapy combined with TOT in HCP children this study's limitations were single group study design and smaller sample size, these need to be addressed in future.

## CONCLUSION

The cryotherapy combined with task oriented training reduced the spasticity and improve the tactile registration function to lead the upper limb function improvement in HCP children. The finding of this study results need to be analysed further in a large sample and with comparing other physiotherapeutic intervention to explore the effects of cryotherapy combined with task oriented training in HCP children.

**Conflicts of interest: None**

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