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A Comparative study of the acute effects of two different Inhibitory Techniques and their lasting efficacy in Spastic Diplegic Children with Cerebral Palsy.

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Abstract
Background:
Spasticity in the plantar flexors can contribute to pathological gait patterns in both stance and swing phase of gait. Spastic plantar flexors affect forward foot clearance during swing phase; the consequence is toe drag while walking. Spastic plantar flexors resist extension at the knee and dorsi flexion of the foot. The ratio of prevalence in males and females in India is 1:2 per 1000 live births.
Materials and Methods:
In this prospective comparative study, 30 subjects with children with diplegia were randomly divided into 2 groups i.e. group A and group B with 15 subjects in each group. Group A was given prolonged icing and group B was given passive stretching with weight bearing for the reduction of spasticity and the lasting effects of both the treatments were measured immediate, post 30minutes and post 60 minutes with the outcome measures of Modified Ashworth scale and Resting angle.
Results: *showed that up to 30 minutes of post application of both passive stretching with weight bearing and Prolonged icing seems to be effective but after 60 minutes there is a slight reduction in the efficiency of passive stretching with weight bearing compared to Prolong Icing. Group A treated with Prolong Icing showed better improvement with lasting efficacy in outcome measures compared to group B treated with passive stretching with weight bearing.*
Conclusion: *The present study concluded that Prolong Icing is a better technique than passive stretching with weight bearing in children with Spastic diplegic Cerebral palsy.*
Key Word: *Spastic diplegia, Prolonged Icing, Passive stretching with weight bearing, Modified Ashworth scale (MAS) and Resting angle (RA).*

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I. Introduction:

Cerebral palsy is a group of non progressive disorders that cause aberrant movement and posture resulting from Central Nervous system damage or insult in the early periods of brain development usually in the first 5 years of life [1]. Cerebral Palsy(CP) is one of the most common causes of gait deviation in children. Children with CP start walking later than typically developed children and about 30% never walk independently [2,3].

The damage caused to the immature brain, which often results in primary impairments, like increased muscle tone, loss of selective motor control and impaired balance mechanisms, causing secondary impairments, such as muscle shortening, muscle weakness and decreased joint range of motion (ROM) [2,3]. The primary and secondary impairments often influence both the ambulation quality and capacity during childhood [2,4,5]. Three-dimensional gait analysis (3DGA), including kinematics, kinetics, and gait parameters, shows that gait function in cerebral palsy deteriorates over the period of time [4,6].The majority of children with spastic cerebral palsy are eventually able to ambulate; the acquisition of this skill is delayed and differs qualitatively from normal. The ability to perform the Lower Limb function is a major concern of the parents of children with Cerebral Palsy improving and maintaining the is ability to ambulation is often considered to be the primary focus of most of the problem seen in children with spastic Cerebral Palsy.

Children with CP spend much of their childhood receiving physiotherapy focusing on optimal gait performance; hence choosing valid and effective treatment modalities is of great importance for the better progression in the treatment. Reduced muscle strength in CP is shown to be associated with impaired gait function and children with spastic CP, even the children who are mildly affected, have significantly lower limb muscle strength compared to typically developing (TD) children [2,8,9].

The severe impairments associated with spasticity have led Physiotherapists to search for clinical procedures to combat this problem Inhibitory techniques is one of the treatment which has been used in management of spasticity. Thus the purpose of this study focused on to show the comparative effects of two inhibitory techniques (prolonged Icing Vs Passive stretching with weight bearing) and the effects of duration of each techniques on lower limbs Plantar flexors there by reducing the spasticity in the spastic children with Cerebral palsy.

In addition to the muscle Spasticity, muscle weakness and muscle shortening contribute to the restricted gait function (2,6). Spasticity in the plantar flexors can contribute to pathological gait patterns in both stance and swing phase of gait spastic plantar flexors affect forward foot clearance during swing, the consequences. Short hamstrings tend to cause limitations at the knee extension in initial foot contact, and knee extension in mid-stance.

As a bi-articular muscle it also tends to rotate the pelvis posterior [2]. Some muscles are more affected and hamstring shortening is shown to be more common in children with lower functional levels [4,6,10], and with increasing age. In addition to muscle weakness, muscle spasticity and muscle shortening contribute to the restricted gait function [2,6].

Mc Nee et al. [11] study states that the lower limb extensor moment in combination with the muscles stabilising the knee joint contributes to stability and smooth progression over the stationary foot, which is essential for the swing of the opposite leg and an optimal step length. Stretching as one of the physiotherapy treatment modality in CP is scarcely documented and the effect size is small [12, 13, 14]. Muscle stretching is most commonly used [3], and it is mainly based on the assumption that stretching maintains or increases ROM [15]. To explore the effect of this practice, reviews conclude that the evidence is limited and more research with longer follow-up periods is needed [12, 13, 14]. Physiotherapy comprises different modalities, recognizing the fact that complex functional problems may need complex interventions [15].

Muscle shortening is associated with joint stiffness and pain (9)Short hamstrings tend to cause restrictions on the knee extension at initial foot contact and knee extension in mid-stance. As a bi articular muscle it also tends to rotate the pelvis posterior. Some muscles are more affected and hamstring shortening is shown to be more pronounced in children with lower functional level (4, 6,10).

II. Materials and Methods

2.1. Study Design

The study design is a quasi experimental study and the population is spastic cerebral palsy children with sample selection of mild to moderate spasticity age between 7 to 12 years . Purposive sampling technique was used to select the 30 Diplegic children and on inclusion and exclusion criteria with the consent of the parents and child. The study were conducted in Outpatient department in Vel's college, Pallavaram , Chennai and Mithra Hospital,Chennai.

2.2. Procedure

Method of Prolonged Icing

Children were allowed to feel the ice pack prior to the application following the Measurement & Grading, the subject were given 15 minutes of ice packs to their calf muscles is the supine lying. The ice pack was wrapped in turkey towel and applied over the area. The part applied with ice pack was wiped with the towel checked for any skin reaction due to the ice pack application.

Method of Passive stretching with weight bearing.

Passive stretching with weight bearing to the plantar flexors was given 15 minutes to each child by placing a towel roll under the metatarsal heads in standing position each stretch was maintained for 60 seconds with a gap of 10 seconds. During passive stretching the knee joint of the stretching side was maintained in extension following this stretching that weight bearing regimen then subjects was asked to repeat.

III. Data Analysis and Results

Table I : Modified Ashworth Scale (MAS)

Variables	Prolonged Icing (Group-I)		Passive Stretching with weight bearing (Group-II)	
	Mean	S.D.	Mean	S.D.
Pre	2.93	0.80	3.13	0.64
Post (Immediate)	1.93	0.80	2.13	0.64
Post (30minutes)	1.93	0.80	2.13	0.64
Post (60 Minutes)	1.93	0.80	2.4	0.99

The above table shows the mean and standard deviation of modified Ashworth scale before and after application of prolonged Icing and passive stretching with weight bearing.

Table II : Resting Angle (RA)

Variables	Prolonged Icing (Group-I)		Passive Stretching with weight bearing (Group-II)	
	Mean	S.D.	Mean	S.D.
Pre	36.8	11.89	39.47	8.38
Post (immediate)	32.0	12.21	35.53	8.3
Post (30 minutes)	32.93	12.23	36.47	8.41
Post (60 minutes)	34.40	12.25	37.53	8.48

The above table shows the mean and standard deviation of resting angle before and after application of prolonged Icing and passive stretching with weight bearing.

Table –III Modified Ashworth Scale (MAS)

Comparison	Prolonged Icing (Group-I)		Paired t-value	Passive Stretching with weight bearing (Group-II)		Paired t-value
	Mean	S.D		Mean	S.D	
Pre Vs post (immediate)	1.0	0.0	8.38***	1.0	0.0	8.38***
Pre Vs post (30 minutes)	1.0	0.0	8.38***	1.0	0.0	8.38***
Pre Vs post (60 minutes)	1.0	0.0	8.38***	0.73	0.45	6.2***

*P<0.05 **P<0.01 ***P<0.001 level of significance NS-not significant

The above table shows the changes in MAS values after application of prolonged Icing and passive stretching.

Table- IV

Comparison	Prolonged icing(Group-I)		Paired t-value	Stretching with weight Bearing(Group-II)		Paired t-value
	Mean	S.D.		Mean	S.D.	
Pre Vs Post (immediate)	4.8	0.77	24.0***	3.93	2.6	5.85***
Pre Vs Post (30 minutes)	3.87	0.64	23.4***	3.0	2.85	4.07***
Pre Vs Post (60 minutes)	2.4	0.83	11.22***	1.93	2.84	2.64*

*P<0.05, **P<0.01, ***P<0.001, Level of significance. NS- not significant

The above table shows the changes is Resting Angle values after application of prolonged Icing and Passive stretching with weight bearing.

TableV: Modified Ashworth Scale

Comparison	Prolonged Icing (Group -I)		Stretching with weight Bearing(Group-II)		Student t-value
	Mean	S.D.	Mean	S.D.	
Pre Vs Post (immediate)	1.0	0.0	1.0	0.0	O.ON.S.
Pre Vs Post (30 minutes)	1.0	0.0	1.0	0.0	O.ON.S.
Pre Vs Post (60 minutes)	1.0	0.0	0.73	0.45	1.96*

*P<0.05,**P<0.01,***P,<0.001LevelofSignificance,NS-not Significant

The above table shows the comparison of changes in mean values and standard deviation between prolonged Icing and passive stretching with weight bearing.

Table-VI Resting Angle (RA)

*P<0.05,**P<0.01,***P,<0.001 Level of Significance, NS –Not Significant

Comparison	Prolonged Icing(Group-I)		Passive stretching with weight bearing changes (Group-II)		Student t-value
	Mean	S.D.	Mean	S.D.	
Pre Vs Post (Immediate)	4.8	0.77	3.93	2.6	1.24NS
Pre Vs Post (30 minutes)	3.87	0.64	3.0	2.85	1.59NS
Pre Vs Post (60 minutes)	2.4	0.83	1.93	2.84	0.61NS

The above table shows the comparison of mean values and standard deviation between prolonged Icing and passive stretching with weight bearing

Statistical Methods:

A comparative effectiveness of two inhibitory techniques prolonged Icing and Passive stretching with weight bearing and their lasting efficacy was identified through modified Ashworth scale and Resting angle and the combined standard deviation was taken.

The mean and standard deviation for all the parametric values were calculated by the inferential statistics.

The parametric values of modified Ashworth Scale and Resting Angle of Pre Vs Post (immediate) for Prolonged Icing, passive stretching with weight bearing were analysed using paired 't' test.

Unpaired ’t’ test was used to compare the changes in mean value between prolonged Icing and passive stretching with weight bearing.

IV. Discussion

In this study, Group**–**I, underwent prolonged Icing and Group-II on the other hand underwent Passive stretching with weight bearing for the reduction of spasticity. Table V shows Group-I patients who underwent prolonged Icing program showed a mean change of 1.0±0.0 in the value of modified Ashworth scale for Pre Vs Post (Immediate), Pre Vs Post 30minutes & Pre Vs Post 60minutes of treatment session. This shows that there is no change in lasting efficiency for prolonged Icing after one hour of treatment session. Table V shows Group-II patients who underwent passive stretching with weight bearing showed a mean value of 1.0±_0.0 according to modified Ashworth scale for Pre Vs Post (immediate), Pre Vs Post 30minutes of treatment Session.

But Pre Vs Post60 minutes mean value is deceased to 0.73±0.45, when comparing the 2 groups the 't' value for 60 minutes post application shows a significant difference (P<0.05). This shows that up to 30minutes of post application, both passive stretching with weight bearing and prolonged Icing seems to be effective but after 60 minutes there is a slight reduction in the efficiency of passive stretching with weight bearing.

Table VI shows the mean values of Group I & Group II gradually as the time decreases according to Resting Angle value. This table shows that there is no statistical immediately after the treatment, after 30 minutes and after 60 minutes of treatment.

The main aim of the study is to find the effects of two inhibitory techniques and their lasting efficacy over the reduction of spasticity in calf muscles.

Fahre [16]1991 also stated that, A number of studies comparing cold with other therapies have supported the superiority of cryo therapy. The study results seem to prove that both the inhibitory techniques ie., prolonged Icing and passive stretching with weight bearing are useful for the reduction of spasticity.

But prolonged Icing shows better lasting efficacy when compared to passive stretching. The physiological mechanism by which prolonged Icing & Passive stretching with weight bearing reduces spasticity has been explained by various authors.

The probable cause of effect of prolonged Icing could be; Lee and Warren, 1978 and Lehmann and Delateur, [16] 1982 suggested that the differential effect of cooling on the small myelinated fusimotor efferents and secondary afferents on the one hand, and the large thickly myelinated motor nerves to the extra fusal fibers on the so ther. Cooling the muscle decreases the muscle temperature and decreases the sensitivity of muscle spindle and stretch.

Probable causes of Passive stretch with weight bearing to decrease spasticity could be;

1 James E.Zachazewski stated that, the advantage s are quite reasonable because connective tissue has a very high tensile resistance to a suddenly applied tension of short duration, while demonstrating visco elastic and plastic elongation when placed under prolonged mild tension. Static stretching may minimize any impact on the Ia & II spindle afferent fibres and maximize the impact on the Golgi tendon organ.

2. Kim Jones and Karen Barken stated that, along slow passive stretch is used to reduce hyper tonicity in the patient with other neurological disorders. The relaxation effect on the spastic muscle is achieved Via Golgi tendon organ inhibition.

V. Conclusion

In this study prolonged Icing shows a marked lasting efficiency than passive stretching with weight bearing when MAS scale was used as a measurement parameter. When resting angle is considered as an indicative parameter, prolonged Icing shows better lasting efficacy than passive stretching with weight bearing. Thus it can be concluded that prolonged Icing is a better form of treatment for its lasting efficacy when compared to passive stretching with weight bearing for the reduction of spasticity.

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