MANAGEMENT OF TONE AND HAND FUNCTIONS IN CEREBRAL PALSY: INHIBITIVE WEIGHT BEARING SPLINT AS AN ADJUNCT MODALITYAtul Manoharrao Deshkar¹, Sujit Kumar Naik², Akshataa Atul Deshkar³**HOW TO CITE THIS ARTICLE:**

Atul Manoharrao Deshkar, Sujit Kumar Naik, Akshataa Atul Deshkar. "Management of Tone and Hand Functions in Cerebral Palsy: Inhibitive Weight Bearing Splint as an Adjunct Modality". Journal of Evolution of Medical and Dental Sciences 2014; Vol. 3, Issue 35, August 14; Page: 9173-9178, DOI: 10.14260/jemds/2014/3183

ABSTRACT: A CP child who manifests spasticity in upper extremity, interferes with hand function and hand development. Weight Bearing promotes the development of mature arm and development of hand skills. The present study was intended to evaluate the efficacy of the inhibitive weight bearing splint for cerebral palsy patients in management of tone and hand functions. The performance of the splint was observed using EDPA scale, hand tracing and functional activity of ball play on the cerebral palsy patients. This study shows the fact that there was not only significant improvement in hand, opening but also hand use was found to be improved during the intervention period. The inhibitive weight bearing splint was found to be low cost and easy to fabricate. The modality can be used as an adjunct with neurodevelopmental therapy.

KEYWORDS: inhibitive Weight bearing splint, cerebral palsy, spasticity.

INTRODUCTION: One of the most disabling aspects of cerebral palsy is the development of spasticity. Among around 7,50,000 individuals living with cerebral palsy, spasticity is estimated to be as high as 60%. Spasticity interferes with the functional use of hand.¹

Typical Flexion pattern of spasticity decreases ability to use the upper extremity so they may miss opportunities to experience normal weight bearing of arms and hands and thus increases likelihood of restricted joint mobility and decrease the possibility of normal proprioceptive and tactile inputs. Consequently, the development of task, such as eating, playing, writing, may be impeded.

Since the child who manifests spasticity in upper extremity, may not develop appropriate upper extremity weight bearing on hand during infant development. The proponents of both neurodevelopment treatment approach and developmental treatment approach promote the use of weight bearing as a treatment strategy to reduce tone.

Weight bearing or learning on upper extremity is a posture incorporated into motor development milestones of normal infant and children. Weight bearing promotes the development of mature stability and mobility patterns and provides basic sensory information that leads to development of arm hand skills.

Prehension involves the ability to approach and grasp an object, manipulate it with hands and release it,² Mature prehension pattern depends on development of muscular stability and smooth movement of scapular, humeral, forearm, wrist and finger joints.

Weight bearing on upper extremity is often used in occupational therapy to treat prehension problems³ of children with cerebral palsy. However, it is commonly observed that weight bearing on extended arm causes curling of fingers because of spasticity of distal muscle groups.

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Therefore, it was felt that an inhibitive weight bearing splint can be developed which will enhance weight bearing. The present study was intended to evaluate the efficacy of the low cost inhibitive weight bearing splint for cerebral palsy patients in management of tone and hand functions

MATERIALS & METHODS: The study was carried out in the Paediatric Unit of Occupational therapy department, of Occupational Therapy at KEM Medical College, Mumbai with institutional ethical clearance and it was further extended at Department of Physiology, Govt. Chhattisgarh Institute of Medical Sciences, Bilaspur.

A random sample of 10 patients with cerebral palsy and hemiplegia (n=2) or quadriplegia (n=8), in the age group of 6 months to 2 years, who had visual deficits, contracture and deformity in the upper extremity were included in the study.

Baseline evaluation of tone and hand functions were done using hand tracing, Erhardt's Development Prehension Assessment (EDPA) Scale, ⁴ Functional Activity. In hand tracing, tracing of hand while weight bearing inside sitting was used to measure presence of tone and a change in tone.

The hand of the subject was outlined on a graph paper to determine the hand contact with the surface. The assessment of hand tracing was done before weight bearing, after weight bearing, and at the end of hand therapy session. In Functional Activity, a 12" diameter ball was rolled to the subject 10 times and number of times hand used was noted for effort of touch and trapping.

The patients were divided into two groups on the basis of being subjected to weight bearing with or without the splint. The Experimental group received weight bearing with splint and the Control group received weight bearing without the splint.

The splint had two components – Ventral component made up of low cost moldable plastic, polyvinyl chloride (PVC) which was cut after taking actual measurement by tracing the weight bearing hand with the thumb in abduction and the Dorsal component made from polythene which was cut in similar manner except that a part was trimmed by 1" to ensure for the wrist extension, padded with foam and harnessed with 1/2" Velcro in loops and hoops.

Photograph of the Splint:

Inhibitive Weight Bearing Splint

The treatment session, neurodevelopment therapy was 75 min of hand therapy which was divided into two phases - Phase I consisting of weight bearing activity, Phase II consisting of prehension activity.

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Photograph of the Splint with weight bearing activity:

Patient with inhibitive Weight bearing splint

In the Phase I, subjects were placed in each of weight bearing postures i) prone in wedge, ii) four point over therapist lap or bolster, iii) side sitting for a few min for a total duration of 10min. Phase II followed Phase I, when prehensile activities like reach, grasp, carry and release were given for next 10 min. For reach, initially general arm movement, then hand/ arm placement, and finally finger extension was emphasized.

Once the children were able to reach the object with some control, a toy was presented below the shoulder level and gradually increased the height in a graded manner. Lateral reaching was then incorporated with shoulder abduction and neutral or external rotation during reach. Then humeral hyperextension with controlled internal rotation is given by presenting a toy behind the body. For grasp, the toy was presented by therapist directly in his fingers.

Once the child retrieved the object successfully, the object was placed near to child's hand in different places. For carry, the subjects were asked to lift objects from one place to another which were of different sizes to increase voluntary finger extension and place them in larger to smaller containers in graded manner. Mothers were asked to follow similar therapy program at home.

Hand tracing and Functional Activity were done during every therapy session after which hand function was assessed with EDPA after every month. All the patients were treated for a period of 3 months and followed up during this period.

RESULTS & ANALYSIS: The data collected was analyzed with Mean, Standard Deviation, Standard Error. The mean and standard deviation of pre and post intervention scores of Primary involuntary arm, hand pattern [positional reflexive] of EDPA of left and right hand in controls and the experimental group, showed improvement of hand function over the period of intervention.

Erhardt cluster 1 of EDPA the arm on approach (supine) component exhibited significant improvement for left hand ($t = 1.98$, $p < 0.05$) and for right hand ($t = 1.80$, $p < 0.05$). There was improvement in arms at rest and during play in supine, which resulted in a gradual increase in hand opening and keeping the patient's thumb out during prehensile activities.

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The mean and standard deviation of pre and post intervention scores of control and experimental groups of right and left hand in the Primary voluntary movement (cognitively directed) of EDPA showed improvement in the release of Dowel in the experimental group for left hand ($t = 1.10$, $p < 0.05$) and in the right hand ($t = 1.78$, $p < 0.05$).

The scores of the mean and standard deviation of pre and post intervention hand tracing, before weight bearing, after weight bearing and post prehensile activity indicate that there was an increase in the surface area after weight bearing. The hand surface area was found to be more increased immediately after weight bearing.

Table showing comparison between scores of mean and SD of pre and post intervention of control and experimental group of right and left hand during hand tracing activity.

		Change in Mean		Change in SD		t value		p value	
		Left	Right	Left	Right	Left	Right	Left	Right
Before Weight Bearing	EXPTL	1510.8	1515.4	608.9	609.0	2.278	2.229	0.027	0.028
	CTRL	744.8	765.4	440.9	441.4				
After Weight bearing	EXPTL	1459.7	1461.4	560.5	552.5	2.151	2.339	0.024	0.024
	CTRL	722.8	733.0	521.5	520.9				
Post prehension	EXPTL	548.7	1508.6	538.3	535.2	2.610	2.450	0.020	0.020
	CTRL	736.0	748.8	440.8	441.0				

Even though there was a decrease in the mean value of surface area after prehension activity, surface area did not return to pre-weight bearing status. It was also observed that during the intervention phase despite of decreasing hand surface area after weight bearing, there was an overall increase in hand surface area.

On comparing both the groups, weight bearing surface area was found to be increased more significantly in the experimental group over the control group.

DISCUSSION: The present study consisting of cerebral palsy children was conducted to observe the effectiveness of inhibitive weight bearing splint on tone and hand functions as an adjunct to Neurodevelopmental therapy. These children were initially assessed using EDPA, hand tracing and then on a functional activity (Ball Play).

These children were then randomly divided into two groups basing on weight bearing with or without the splint. Both the groups of patients received one hour of neurodevelopmental therapy out of which 20 minutes were devoted to hand therapy. Weight bearing was given for 10 minutes, followed by prehensile activities.

The design of the splint was carefully planned, during the fabrication, keeping in view constraints of the hand surface area, neuromuscular factor, age of the patient, cost effectiveness, ease of application. The performance of the splint was observed using Erhardt Developmental Prehension Assessment Scale, hand tracing, functional activity. Therapy was provided for a period of three months and the patients were followed up at the end of each month. However, data analysis was done with the scores taken pre intervention and post intervention.

The mean and standard deviation of pre and post intervention scores in EDPA in the study showed more improvement in the experimental group than controls.

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The mean and standard deviation of pre and post intervention hand tracing before and after weight bearing in the study showed increased hand surface area, whereas there was a decrease in the mean surface area after prehensile activity which was still more than status before weight bearing. This indicates that weight bearing increases hand opening.

A neurophysiological explanation is that weight bearing inhibits motor neuron excitability most likely through prolonged stretch and possibly through effect on Golgi tendon organs, muscle spindle and cutaneous receptors⁵. Although there was increase in the hand surface area after weight bearing, it was also found that after prehensile activity the surface area was decreased. This finding may suggest that the effort of the prehension activity might interfere in hand opening.

This may indicate that weight bearing allows hand opening, but it was prehensile activity which may also contribute to carry over the hand opening. A study by Chakerian and Larson⁶ also shows similar results and quoted that this may be related to a long standing concept that active movements must occur in order to progress.⁷ A study also stated that weight bearing improves antigravity muscle strength.⁸

On comparing both the groups, weight bearing surface area was found to be increased more significantly in the experimental group over the control group. This indicates a positive aspect of weight bearing splint.

The effect of weight bearing was also observed through the functional activity of ball play. In some patients actually trapping of the ball was not possible, so responses were recorded as an effort to touch or trap the ball. Mean and standard deviation scores show increase in response of trapping of the ball in the experimental group, but no significant difference was found in effort of touching the ball. This shows hand use was increased after the intervention.

Most encouraging result was observed in one of the hemiplegic patient in the experiment group with the treatment given. Initially the baby was not at all using his hand to play or any other activity. With the treatment the patient started using his hand and exhibited next milestone i.e. creeping.

Gradual improvement was also observed in the weight bearing arm-hand pattern. This may be a reflection of reduction in tone and increase in voluntary movement in the extremity. Interaction with the mothers revealed improvement in arm-hand weight bearing (mother's assistance was less required while giving weight bearing postures with the splint), hand opening in the patients. Mothers felt encouraged since the children were motivated to use the hand, which otherwise was not the case and therefore, their cooperation was readily observed in the follow up treatment at home and in the department.

This study shows the inhibitive weight bearing splint has a positive effect on tone and hand functions. The design of the splint was found to be low cost and easy to fabricate. It also enhanced weight bearing surface area and has a positive effect on the spontaneous hand use, also to a certain extent prehension function.

CONCLUSION: The Occupational therapists strive for effective treatments and ways using devices, aids, splints and innovative techniques. The present pilot study was an effort to design an appropriate weight bearing splint of children with cerebral palsy. The patients in the study exhibited a delay in the development of hand functions. Also, the parents of these children indicated major concern about the hand use in those children.

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The inhibitive weight bearing splint was found to be low cost and easy to fabricate. The performance of the splint was observed using EDPA scale, hand tracing and functional activity of ball play on the cerebral palsy patients. This study shows the fact that there was not only significant improvement noted in hand, opening but also hand use was found to be improved during the intervention period.

Further, improvement was noted in grasp, release and arm approach. it can be concluded that inhibitive weight bearing splint has a definite and positive effect on tone and hand functions and can be used as an adjunct with neurodevelopmental therapy. A study on a larger sample population over a over a longer period of time is suggested.

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Date of Submission: 28/07/2014.
Date of Peer Review: 30/07/2014.
Date of Acceptance: 06/08/2014.
Date of Publishing: 12/08/2014.