International Journal of Health Sciences and Research
www.ijhsr.org ISSN: 2249-9571

*Original Research Article*

# Effect of Therapeutic Taping on Functional Sitting Control during an Exercise Session in Children with Hypotonic Cerebral Palsy

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## ABSTRACT

**Background:** Cerebral palsies are a heterogeneous group of non- progressive motor disorders of developing brain. It results from a lesion or developmental abnormality in fetal life or early infancy. Children with hypotonic cerebral palsy often exhibit problems with impaired trunk control and display poor sitting postures against gravity due to altered co- activation of muscles of trunk and hip. Therapeutic taping over the trunk helps in orientation of muscle forces along normal vectors and increasing proprioceptive and tactile facilitation. This study aims to, determine whether therapeutic taping helps in improving the functional sitting control during an exercise session in children with Hypotonic Cerebral Palsy, using the sitting domain of Gross Motor Function Measure-88 scale.
**Methodology:** Convenience samples of twenty subjects were taken and were screened for inclusion and exclusion criteria. Baseline scores of sitting domain of GMFM were taken and specific exercise to improve sitting balance was given. After the exercise session the scores for sitting domain of GMFM was taken again. All subjects were called after a gap of one day and baseline score for sitting domain of GMFM was recorded. Therapeutic taping was applied over the trunk and exercises were given along with it. After the session, scores of sitting domain of GMFM was recorded without removing the tape.
**Results:** Wilcoxon signed rank test was used for statistical analysis of the scores of sitting domain of GMFM-88 scale before and after treatment session. There was a significant change observed in the scores of exercise session with and without therapeutic taping ($p<0.001$).
**Conclusion:** On analyzing the results of this study, it is observed that addition of therapeutic taping to an exercise session is beneficial in improving the functional sitting control in children with hypotonic cerebral palsy.

***Key words:*** Cerebral palsy, Functional Sitting Control, Therapeutic Taping, Gross Motor Function Measure-88.

## INTRODUCTION

"Cerebral palsy (CP) is described as a group of permanent disorders in the development of movement and posture, causing activity limitations that are attributed to non progressive disturbances that occurred in the developing fetal or infant brain." [1] The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication and behavior. [2] The incidence of cerebral palsy is between 2 to 2.5 cases per 1000 live births. Approximately 25 lakh children and people in India are estimated to be affected with cerebral palsy. This makes cerebral palsy as

the commonest cause of disability in India. [3]

Etiology of cerebral palsy is very diverse and multifactorial. Injury to developing brain may be prenatal, perinatal or postnatal. [4] Cerebral palsy can be classified in two ways. One way to classify CP is to describe the predominant motor characteristics which include Spasticity, Hypotonia, Athetosis, Ataxia and Mixed. Another way classifies CP by, describing the topographical pattern of limb involvement which includes Monoplegia, Diplegia, Triplegia, Hemiplegia and Quadriplegia. Spastic CP accounts for nearly 70-80% of all cases of CP and non spastic CP which includes dyskinetic and ataxic forms account for 20-30% of all cases. [5] Children with spastic CP exhibit upper motor neuron signs, weakness, hypertonia, hyper-reflexia, clonus and positive Babinski sign. Hypotonic CP is characterized by extreme floppiness when infant is picked up and by the infant's inability to generate enough muscular force to move the body against gravity. [6]

One of the key gross motor functions to be achieved against gravity is sitting. It is also an essential activity to provide postural tone required for functional movements of upper extremity. Maintaining an erect sitting requires coordinated activation of flexors and extensors of trunk as well as hip. [7] Infants begin to sit independently by the age of 6-8 months of postnatal life. This skill develops from sitting with hands propped at 3-4 months of age to unsupported sitting in few months. By 9-10 months the child is able to move in and out of this position while playing. [8]

Children with developmental motor disorders often show deviant and delayed development of sitting. Thus, knowledge about the typical development of postural control is a prerequisite for understanding of deviant development of sitting. [9]

Normal Postural control involves controlling the body's position in space for dual purposes of stability and orientation. [10] Postural adjustments are organized into two functional levels of control. First level involves the generation of basic, direction-specific adjustments. Perturbations that induce a forward sway of body, such as reaching movements are accompanied by activity of muscles on dorsal side of body and perturbations that induce backward body sway are accompanied by postural activity in ventral muscles. Second level of control is involved in fine tuning of basic postural patterns on basis of multisensorial afferent inputs from somatosensory, visual and vestibular systems. The modulation of postural adjustments can be achieved in various ways for instance by changing the number of direction specific muscles recruited and by modifying the order in which the direction specific muscles are recruited (e.g. In caudal- cranial sequence or in reverse order). [11,12]

Children with hypotonic cerebral palsy show difficulty in achieving static and dynamic trunk control in sitting due to faulty feedback mechanisms. As a result of this the postural control system is unable to generate appropriate muscular forces and integrate sensory information received from receptors present throughout the body. Thus leading to "Postural Dyscontrol". [13]

Therapeutic interventions to address seated postural dyscontrol in children with CP should emphasize on improving postural alignment and gravitational forces about the body. Thereby, allowing normalization of recruitment and timing patterns of muscles. [13] One of the most widely used therapy approach for treatment of children with cerebral palsy is Neurodevelopmental Therapy, developed by Berta Bobath in 1940,s. It aims at normalizing the muscle tone and improving postural alignment by specific handling techniques. The therapist controls proximal "key points of control" (i.e. head, shoulder, trunk and pelvis) which helps in controlling the abnormal patterns of movement while at the same time normal patterns of movement can be facilitated. [14] Other techniques of facilitation used in rehabilitation of children with cerebral palsy include The Sensory Integration therapy,

Roods Approach, Conductive education, Patterning Therapy, Constraint induced movement therapy and Vojta method. [15]

New adjuncts for therapy and management of children with cerebral palsy have been emphasized in past two decades. Some of these interventions like Lycra pressure garments and Adeli suits have shown to improve abnormal muscle tone and proximal stability especially in children with hypotonia and ataxia. However they are associated with significant practical problems like difficulty to put on and off, cost noncompliance to heat and need for replacement with growth. [16,17] other adjuncts like electrical stimulation over the abdomen and posterior back muscles have shown to improve trunk control in children with spastic diplegia. [7]

Therapeutic taping over the trunk may employ similar advantages. Taping employs the principle of applying prolonged low load corrective forces to the musculoskeletal system and provides a foundation for normal firing and recruitment patterns of muscles. It also helps in orientation of muscle forces along normal vectors and increasing proprioceptive and tactile facilitation. [18] Thus addition of Therapeutic taping during an exercise session may be beneficial in facilitating correct posture and movement patterns.

Accurate measurement of motor change in children with cerebral palsy is necessary for monitoring their motor development and evaluating the outcome of treatment intervention. Gross Motor Function Measure (GMFM) a criterion referenced assessment tool has been developed especially for evaluating changes in gross motor function over time in children with cerebral palsy. It consists of 88 items grouped into 5 functional dimensions i.e. lying and rolling, sitting, crawling and kneeling, standing and walking. Scores of each dimension are expressed as percentage of maximum scores for that dimension. Total score is obtained by averaging percentage scores across the 5 dimensions. Individual dimensions of GMFM can be administered depending on the client's current level of function. This selective use of GMFM allows fewer items to be administered and increases the measures responsiveness to change by eliminating items that are not relevant to the therapeutic intervention or are unlikely to change the result of intervention. GMFM is a valid, reliable and widely used outcome measure used to detect changes motor function for children with cerebral palsy. [19]

There are a few studies done on incorporating therapeutic taping to a physical therapy intervention in children with cerebral palsy. However, the evidence on effects of incorporating therapeutic taping over the trunk with exercises in children with hypotonic cerebral palsy is very scarce. Therefore, this study has been undertaken to determine whether therapeutic taping helps in improving the functional sitting control during an exercise session using the sitting domain of GMFM-88 scale, in children with Hypotonic Cerebral Palsy.

## MATERIALS & METHODS

20 children of age group 1-3 years diagnosed as having Hypotonic CP were included in the study. A cross over study design was chosen to assess the effect of therapeutic taping. The subjects were recruited based on convenience sampling.

The exclusion criteria were:

1. Children having other types of Cerebral Palsy other than Hypotonia
2. Children diagnosed as having Myopathies
3. Children diagnosed as having Down's syndrome and other genetic disorders
4. Presence of structural scoliosis
5. Children with Surgically implanted spinal instrumentation

### Procedure

Twenty subjects both males and females diagnosed as having hypotonic cerebral palsy were selected. All subjects acted as self controls. The purpose of the study was explained to the parents of

subjects and an informed consent was taken. The subjects who satisfied the inclusion criteria were taken for the study. On Day 1, Baseline score for the sitting domain of GMFM-88 was taken. After recording the baseline data, specific exercises to improve the sitting balance was given according to the protocol. The score for sitting domain of GMFM-88 was recorded after the exercise session again.

After a gap of one day the subjects were called again and their scores for the sitting domain of GMFM-88 were taken. After recording the baseline score, skin was prepared by applying Milk of Magnesia over the trunk and cover roll stretch tape was applied bilaterally with the patient sitting in supported upright position on a stool in the following manner:

Strips 1 and 2 were applied over the paraspinal region in caudo-cephalic direction from $L_4$ to $T_1$. Strips 3 and 4 were applied along the course of lower portion of trapezius with a medially directed force from acromion process to T 12 obliquely. The rigid therapeutic tape was applied directly over the cover roll stretch tape. Exercises were given along with the tape according to the protocol. After the therapy session, the scores for sitting domain of GMFM-88 were recorded without removing the therapeutic tape (Picture 1-6).

**Picture 1: Posture without Taping**

**Picture 2: Posture with Taping**

**Picture 3: Pectoral Elongation with Vertebral Compression without Tape**

**Picture 4: Pectoral Elongation with Vertebral Compression with Tape**

**Picture 5: Reach Outs in Side Sitting without Tape**

**Picture 6: Reach Outs in Side Sitting with Tape**

**Statistical analysis:**

Descriptive statistics was used to analyze gender and age. Normality of the data was checked using Shapiro- Wilk test. All the data were not distributed under normal distribution curve, therefore, Wilcoxon Signed Rank Test was used to determine the difference between the total scores of GMFM-88 with and without therapeutic taping. The statistical software for Social Science (SPSS) version 20 package was used for the computation and analysis of data and Microsoft Word and Excel were used to generate graphs and tables.

## RESULTS

An interventional study, consisting of 20 children with hypotonic cerebral palsy is taken up to assess the Effects of Therapeutic Taping on functional sitting control during an exercise session, using the sitting domain of GMFM-88 scale. The demographic data of the study sample in terms of age, gender are shown in table 1.

**Table-1: Age and sex distribution of subjects**

| Age (months) | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | Number | Percentage | Number | Percentage | Number | Percentage |
| 11-20 | 8 | 57.1 | 1 | 16.7 | 9 | 45 |
| 21-30 | 4 | 28.6 | 2 | 33.3 | 6 | 30 |
| 31-40 | 2 | 14.3 | 3 | 50.0 | 5 | 25 |
| Total | 14 | 100.0 | 6 | 100.0 | 20 | 100 |

The above table 1 shows that, of the 20 subjects, 8 males (57.1%) and 1 female (16.7%) were from 11-20 months of age, 4 males (28.6%) and 2 females (33.33%) were from 21-30 months of age and 2 males (14.3%) and 3 females (50%) were from 31-40 months of age.

The exercise session without therapeutic taping, the mean ± SD of pretest and posttest is 17.55±6.86 and 19.20±7.35 respectively. The difference in the mean

from pre test to post test is found statistically significant (Z= 3.347, P<0.001) as seen in table 2.

**Table-2: Comparison of GMFM scores before and after exercise session without taping**

| GMFM (sitting domain) | Pre-test | | Post-test | | Z-value[@] | P-value*** (2 tailed) | Effect size |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | | |
| Exercise session without taping | 17.55 | 6.86 | 19.20 | 7.35 | -3.347 | 0.001 | 0.23 (S) |

[@] Z-value obtained by applying the Wilcoxon signed rank test, as the data is non-normal.
*** Highly significant at 0.1% level

**Table 3: Comparison of scores of GMFM before and after exercise session with Taping**

| GMFM (sitting domain) | Pre-test | | Post-test | | Z-value[@] | P-value*** (2 tailed) | Effect size |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | | |
| Exercise session with Taping | 18.90 | 7.61 | 24.00 | 9.10 | -3.934 | 0.000 | 0.61 (M) |

[@] Z-value obtained by applying the Wilcoxon signed rank test, as the data is non-normal.
*** Highly significant at 0.1% level

The exercise session with therapeutic taping, the mean±SD of pretest and posttest is 18.90±7.61 and 24±9.10 respectively. The difference in means is found to be statistically significant as seen in table 3.

**Table-4: Comparison between the exercise session alone and exercise session with taping**

| GMFM (sitting domain) | | Pre test | Post test |
|---|---|---|---|
| Exercise session without taping | Mean | 17.55 | 19.20 |
| | SD | 6.86 | 7.35 |
| Exercise session with taping | Mean | 18.90 | 24.00 |
| | SD | 7.61 | 9.10 |
| Z-value[@] | | 3.342 | 3.392 |
| P-value (2-tailed) | | < 0.001*** | < 0.001*** |
| Effect size | | 0.19 (S) | 0.58 (M) |
| Percentage change | | 7.7% | 25% |

[@] Z-value obtained by applying the Wilcoxon signed rank test, as the data is non-normal.
*** Highly significant at 0.1% level

The comparison between the exercise session without taping and exercise session with taping in the pre test reveals that, the mean ± SD of exercise session without taping is 17.55±6.86 and in the exercise session with taping it is 18.90±7.61 as seen in table 4 and Figure 1. There is a statistically significant difference noted between the two sessions (p < 0.001), showing the carry over effect of the exercise session. Effect size of the intervention is 0.19 and the percentage change pre and post treatment is 7.7%. In the post treatment, it is noticed that mean±SD for exercise session without taping is 19.20±7.35 and for exercise session with taping it is 24±9.10. There is a statistically significant difference noted between the mean of the two sessions (p<0.001), showing the effect of therapeutic taping incorporated with exercise session. The effect size of intervention is 0.58 and the percentage change pre and post treatment is 25%.

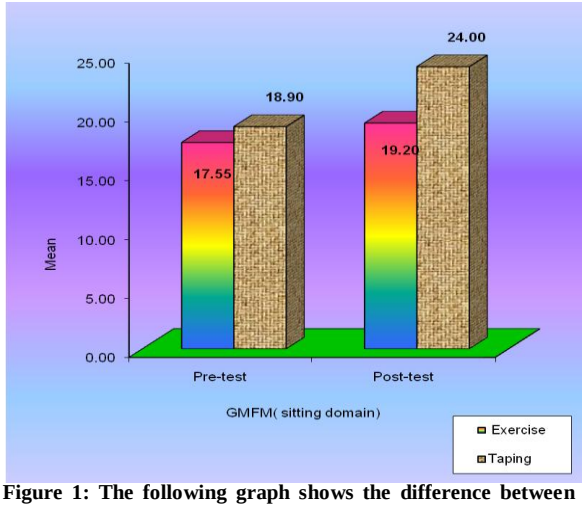


**Figure 1: The following graph shows the difference between the pre and post treatment scores of exercise alone and exercise session with Taping**

## DISCUSSION

The baseline parameters (table 1) in the study show that, maximum males were in the age group of 11-20 months and maximum females were in the age group of 31-40 months. This could be due to convenience sampling chosen for this study. On analyzing the results of table 2, it is observed that, there is a statistically significant improvement in the scores of sitting domain of GMFM-88 scale after exercise session without taping. This change

could be attributed to the ability of the exercises in specifically targeting the dynamic co-activation of trunk musculature, which is an important pre requisite to attaining an independent sitting control. [21] Exercise sessions for children with cerebral palsy are directed towards eliciting and establishing normal patterns of movement by providing controlled sensorimotor input and by using specific handling techniques which guides the movement in a functional way. [22] The exercise session in the present study was directed at improving the functional sitting control by, facilitation of active weight shifting in the frontal plane to produce elongation on weight bearing side while maintaining the appropriate dynamic co-activation of trunk flexors and extensors and facilitation of functional trunk rotation in the transverse plane. [21] Therefore, improvement in motor performance of the children can be attributed to the facilitation of co-activation of trunk muscles that could have helped the children in gaining better scores post exercise session.

On analyzing the results of table 3, it is observed that there is a statistically significant improvement in the scores of sitting domain of GMFM after exercise session with taping. It has been proved that children with hypotonic cerebral palsy exhibit reduced strength in trunk musculature and present with an inability to generate enough muscle forces to move the body segments against gravity. [2] Taping can be applied over weak muscles to facilitate muscle contractions. The tape is applied from origin to insertion of muscle and as the muscle fibers contract, the tape acts as a support by pulling and stimulating the muscle back to point of origin. [23] In addition to this, therapeutic taping provides the foundation for improved functional sitting abilities by controlling trunk movements in frontal and sagittal planes, orienting muscle forces along normal vectors thereby, assisting in static and dynamic balance. This in turn optimizes gravitational forces about the column of segments by improving body alignment. [14]

On comparison of exercise session without taping to exercise session with taping (table 4), it is observed that there is a significant improvement in the scores of sitting domain of GMFM on addition of therapeutic taping to an exercise session. This immediate change seen after the application of tape can be attributed to the proprioceptive input provided by the tape. [24] Therapeutic taping causes an increase in proprioception through increase in stimulation to cutaneous mechanoreceptors. When tape is applied, it causes stretching of skin which is thought to provide the central nervous system with feedback concerning joint movement and position sense, thereby improving the proprioception. [25] In addition to the above mentioned effects, taping applies corrective forces to the musculoskeletal system which helps in restoring optimal muscle length by providing foundation for normal firing and recruitment pattern of muscles. [19] The above findings are consistent with the findings of Greig et al, who observed an immediate reduction in thoracic kyphosis following the application of postural taping over the trunk in women. [20]

The tape acts as a passive stabilizing mechanism and promotes desired symmetrical movement pattern. It also helps in maximizing use of the affected muscles by incorporating it with functional activities. [26] In the present study, therapeutic taping was incorporated along with an exercise protocol which was specifically directed at improving the functional sitting control in children with hypotonic cerebral palsy. Therefore, the improvement in functional sitting control following the exercise session incorporated with therapeutic taping can be attributed to the above mentioned fact. The present study also shows that there is a carryover effect of the exercise session to the taping session.

Therefore, from the present study it can be inferred that, Therapeutic Taping incorporated with exercise is beneficial in improving the functional sitting control in children with Hypotonic Cerebral Palsy.

## CONCLUSION

From the present study we can conclude that therapeutic taping incorporated with exercise is beneficial in improving the functional sitting control in children with hypotonic cerebral palsy. Though the study was conducted on a small population and treatment was of a short duration, it showed statistical significance in the scores of sitting domain of GMFM after the exercise session incorporated with taping. Therefore, it can be inferred from the present study, that therapeutic taping can be used as an effective adjunct along with exercises to improve the functional sitting control in children with hypotonic cerebral palsy. Further studies should be done to evaluate the long term effects of therapeutic taping in improving functional sitting control in children with hypotonic cerebral palsy.

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How to cite this article: Dureja K, Verma S. Effect of therapeutic taping on functional sitting control during an exercise session in children with hypotonic cerebral palsy. Int J Health Sci Res. 2018; 8(9):71-79.

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