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ORIGINAL ARTICLE

Effect of Wakeful Prone Position on Postural Reflexes in Spastic Quadriplegic Cerebral Palsy Children with Gross Motor Function Classification System (GMFCS) Level V

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ABSTRACT

Objective: To evaluate the effect of wakeful prone position as determinant of motor development in cerebral palsy

Study Design: A quasi-experimental study was conducted.

Place and Duration of Study: A sample of 180 children with spastic quadriplegic cerebral palsy was taken from two rehabilitation setups from December 2018 to October 2019 in infants with spastic quadriplegic cerebral palsy.

Material and Methods: The participants aged between 1-3 years with GMFCS level V and Modified Ashworth Scale 2 as baseline were recruited in the study. Wakeful prone position along with colorful, musical, visual and auditory toys was introduced to focus tracking and reaching and also to improve their intrinsic drive. The sessions were divided for 2-3 hours a day in different time intervals at clinical and home settings. Intervention time was 2 to 3 hours for six days a week for six months. Data was collected and assessed through Gross Motor Function Measure-88.

Results: The results of the study showed significant improvement in test scores in all dimensions lying, rolling, sitting position, crawl, kneeling, standing, walking and running. Paired t-test showed significant improvement after intervention ($p<0.05$).

Conclusion: The study revealed that wakeful prone positioning is effective in improving gross motor function in children with spastic quadriplegic cerebral palsy.

Key Words: Cerebral Palsy, Postural reflex, Prone position, Quadriplegia, Spasticity.

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INTRODUCTION

Cerebral Palsy is a heterogeneous neurodevelopmental syndrome resulting from injury to developing brain and it leads to effect the muscle tone, movements and sensory motor skills. Cerebral Palsy is a disorder in which the need for effective rehabilitation and management has been recognized globally.[1] Stimulation of motor and sensory systems in a precise and specific way helps to improve movements and develop motor skills. There is a close relationship in developing segmental head and trunk control and improving gross motor function that in turn leads to functional mobility of cerebral palsy population.[2] The triangular relationship of child, task and the environment is found to be effective way of designing intervention to achieve functional gross motor task.[3] Unstable head position most likely is the reason to the development of asymmetrical postural problems leading to disturbing musculoskeletal status that is usually normal at birth.

Proper positioning of the child in first year of life is of significant importance.[4] Head control in prone position facilitates achieving motor mile stones and also influence on developing cognition and in improving visual acuity of the child.[5] Prone sleepers in normal population have been found to be more advanced in achieving their motor development as compared to supine sleepers. Infants when lying prone, recruit muscles used for head control, reaching, crawling, pulling up and for developing other physical milestones leading to strengthening of arm and shoulder girdle muscles.[5] Preterm infants are found to have better physiological stability in prone position than in supine position. Prone positioning is found to have positive effect on heart rate, respiratory rate and in So_2.[6,7]

In Cerebral Palsy, limitations of poor head and trunk control affects negatively on the functionality of the child. Functions like oral feeding and proper breathing patterns all depend on head control.[8] Compromised chest expansion due to underdeveloped chest wall muscles can become a leading cause of pneumonia in cerebral palsy population. Intervention strategies that develop connection between internal frame of reference and sensory environment consisting of auditory and visual feedback is found to be effective. Prone position improves chest wall mechanics leading to balances stress-strain distribution and improved ventilation–perfusion matching.[9] There exists a strong interaction between musculoskeletal and neuromuscular systems with particular importance on perception of sensations especially visual sensations, as vision has significant effect on vestibular anti-gravity response. Coupling of sensory motor system helps in developing postural control and fulfilling the demands of tasks presented.[10]

Improvement in body structure and function is seen as a result of putting the child in challenging situation in which the child has to adapt his or her behavior.[11] Bio feedback through auditory and visual processing is found to be effective along with social reinforcement conditions.[12] It is a strategy in which biofeedback through precise auditory and visual stimulus is given to the child to improve his spatial position of head. It is a treatment strategy that produces significant effect in progressing from feedback trained to feedback learned.[13]

There is lack of evidence that suggested the wakeful prone positioning to achieve motor milestones in Cerebral Palsy. This study was conducted to assess the impact of wakeful prone position on gross motor functions in cerebral palsy and it was hypothesized that there exists a close relationship between prone position and Gross motor function.

MATERIAL AND METHODS

A quasi-experimental study was conducted from December 2018 to October 2019 in infants with cerebral palsy. Two rehabilitation setups from where data was collected were Pediatric Physical Therapy and Rehabilitation Centre, University of Lahore Teaching Hospital and Institute of Psychological and Physical Rehabilitation. Study duration was 10 months from December 2018 to October 2019. 180 infants of both gender between the ages of 1-3 years with Modified Ashworth Scale 2 as baseline and GMFCS level V with head control deficit were being recruited. Sample size was determined through WHO calculator using the following formula $n = \frac{Z^2_{1-\frac{\alpha}{2}} P\sigma^2}{\varepsilon^2 \mu^2}$. The parameters chosen for the equation were Z equals 1.96, mean (μ) equals 12.5 with the standard deviation (σ) 2.2.[13] Margin of error was set to 2% and the sample size calculated was 220. When dropout rate of 20% was added, the expected size came out to be 176. Sampling technique used was non-purposive convenience sampling. Infants with contractures, deformities tested with passive range of motion test in supine position and with history of seizures were excluded from the study. Consent was being taken from the parents to follow the instructions given for home management. The study permission was taken from the Ethical Review Committee of Dimensions.

Segmental head control training was being given for up to half an hour three times a day, 6 days a week for a period of 6 months along with applying sensory motor integration and neuro-developmental techniques. Training was carried out both by parents at home and by the therapist at clinical set up along with treatment strategies to improve visual and auditory processing of the child. Graded prone position exposure starting from using heavy pillow to facilitate neck raise and in cases with zero head control, ball or cushion of small height was being introduced to the child initially leading to prone lying on flat surface with good neck righting reflex in prone. Supervision was being provided by trained physiotherapist to avoid any hyperextension at neck that can cause obstruction of airways such as nose and mouth. Colorful musical toys were being introduced in child's visual field to make him accept the position. Time frame for the position was being monitored considering the comfort level of the child. Data was collected at baseline and after six months of intervention. Treatment instruments included were different sizes of wedge, heavy pillows, rolls, mats along with colorful, moving, rattling toys to motivate the child for position acceptance and to focus and track the objects presented at different heights and directions. Tactile stimulation to para spinals were also being given to facilitate head and trunk extension.

Outcome measures were selected to determine the effect of the intervention on body structure and function level and activities level of the International Classification of Functioning, Disability and Health for Children and Youth (ICF-CY). The data was assessed through a validated and reliable questionnaire named Gross Motor Function Measure-88,[14] which assessed the gross motor function in various positions. It measures the dimensions: lying and rolling (Dimension A), sitting (Dimension B), kneeling and crawling (Dimension C), standing (Dimension D) and walking, running and jumping (Dimension E). Each item is scored on a 0-3-point scale with a lower score indicating greater impairment in gross motor function. The Modified Ashworth Scale[15] was used as a baseline measure to assess the degree of spasticity. The Modified Ashworth scale MAS uses a 6-point scale (0, 1, 1+, 2, 3, and 4) with "0" signifying no tone and “4” signifying a rigid limb.

SPSS 24 version was utilized for the data analysis. The demographic data was summarized using descriptive statistics. The variables were described through mean and standard deviation and motor function values through paired t-test. The normality of variables was checked through Kolmogorov-Smirnov test, and the values followed the normality assumptions. Therefore, a parametric test, paired-t test was used to determine the gross motor function before and after intervention. The finding of p value to be 0.05 or less were considered significant.

RESULTS

One hundred and eighty cerebral palsy children were recruited in the study. Demographic characteristics and the level of gross motor function are described in table 1. Pre and post treatment scoring was done with 6-month duration. Paired t-test was applied for the comparison of motor activities at the baseline and after 6 months of intervention (table 2). The mean pre-test values and post values were calculated to find out the significant difference in a variety of dimensions of GMFM-88 tool. P value came out to be 0.000.

TABLE 1: Demographic Characteristics of Sample (n=180)

Characteristics	**Mean ± S.D**
Age (Months)	12.17 ± 3.93
Characteristics	**Frequency**
Sex	
Male	96 (46.7%)
Female	84 (53.3%)
GMFCS	Level V
MAS	Level 2

This table shows the descriptive statistics of age with mean ± S.D in months and the frequency of male and female children that participated in the study.

TABLE 2: GMFM-88 baseline and follow up at the end of 24th week results n=180. (Paired-t test)

Dimensions	**Baseline Mean ± S.D**	**After Intervention Mean ± S.D**	**Sig. (p-value)**
Lying and rolling	44.57 ±32.59	83.78 ± 14.02	0.000
Sitting	20.70 ± 22.19	42.30 ± 20.02	0.000
Crawling & Kneeling	11.21 ± 15.30	23.97 ± 23.54	0.000
Standing	5.53 ± 11.17	10.38 ± 18.58	0.000
Walking, Running& Jumping	1.38 ± 3.21	3.59 ± 7.96	0.000

DISCUSSION

The current study was focused on promoting triangular relationship of child, task and environment. Exposing the child with age appropriate auditory and visual stimuli, develops intrinsic drive in the child to do movements. Enriched environmental exposure in wakeful prone position in early infancy facilitates in achieving prone specific physical mile stones like rolling, pivoting on abdomen, quadruped and in sitting leading to the acquisition of age appropriate walking and in functional table top activities. A study conducted by Yu-ling kuo et al[16] also concluded the importance of wakeful prone position in early infancy.

This study focused on the fact that there exists a close relationship between wakeful prone position and gross motor functions, specifically on guiding parents regarding positioning the child in prone at regular intervals along with providing sensory feedback to enhance gross motor development. The results concluded were in accordance with a study[17] which recommended that proper communication with families and collaborative goal setting leads to positive outcome. It was seen that not only cerebral palsy children but it also contributes towards relieving stress and anxiety of parents as well, but it needs proper facilitation of parents through clinical based execution and coaching along with consultant appreciation.

Current study highlighted the fact that graded wakeful prone position facilitates in achieving all developmental mile stones especially cognition and improving visual acuity. A randomized control trial[18] proposed different positional supports to develop tolerance towards wakeful prone positions due to the fact as it promotes motor milestones. According to the study, pillow and rolled blanket leading to flat blanket are three graded positions to develop tolerance of wakeful prone position to those infants with poor prone position acceptance.

A study conducted by Derek et al[2] contradicts the findings of the current study. The RCT stated that segmental training is not superior to usual care in improving Gross Motor Function. Segmental training improves head control at primary endpoint that is of six months but no appreciable effect was found at follow-up of 12 months.

Implications of a systemic review done by Alexander MacIntosh et al[19] are that consistent, concurrent and child oriented bio feedback can improve motor outcome in cerebral palsy that is in accordance to the current study mentioning that precise and targeted biofeedback influence the child in progressing from feedback trained to feedback learned.

Wakeful prone position encourages developing head/trunk righting reflex that in turn improves functionality of the child. These finding are in concurrence with a study[20] stating that positioning a child leads to head and trunk alignment and control. This is a pre-requisite to improve swallowing and to overcome the risk of aspiration, the stability of head improves fine movements of jaw and tongue that is needed for feeding.

The current study provided significant insights in the rehabilitation of cerebral palsy children, but still there are certain limitations that has left many questions for future research and exploration. Further investigation is required to evaluate the results in different contexts and populations. Additionally, future studies with larger and diverse sample along with proper grouping of subjects is needed. Lastly, there is need to understand the exact timing and the effects of dosage required in early rehabilitation and advancing development**.**

CONCLUSION

The study concluded that keeping the child in wakeful prone position along with level appropriate sensory feedback helps in stabilizing head in midline, rolling, crawling on abdomen and in achieving sitting with both hands support, high kneeling and walking. Activity focused functional therapy approach is found to be effective in achieving gross motor function that exercise regime focused on facilitation and normalization of normal movement patterns.

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