ORIGINAL ARTICLE

Effect of position on gross motor function and spasticity in spastic cerebral palsy children

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Abstract

Objective: To evaluate the effect of positioning on gross motor function and spasticity in spastic quadriplegic cerebral palsy children with Gross Motor Function Classification System level IV and V.

Methods: A quasi-experimental study was conducted at two Paediatric Physical Therapy Centres from November 2018 to July 2019. The study comprised of seventy four children with quadriplegic cerebral palsy aged between 3 to 8 years. Data was obtained and gross motor functional abilities and spasticity were assessed by GMFM-88 and Modified Ashworth Scale, respectively. Twenty four-hour positioning in specific seats, night positioning and standing frames for six months. The child was being positioned 24 hours according to his challenges for the period of six months. Semi reclined positioning was performed to manage aspiration, oral leak and to develop retention. Prone positioning was done to develop righting reactions, functional sitting position was used in the treatment regime to attain better upright position and neutral pelvic standing using standing frames. SPSS 24 was used to analyse the data.

Results: Paired t-test reported significant improvement in the test scores in lying position, rolling, sitting position, crawling, kneeling, standing, walking or running. Fifty-nine subjects exhibited improvement in spasticity before and after interventional procedures, while 15 showed no improvement ($p<0.05$).

Conclusion: Twenty-Four-hour proper body positioning and postural techniques improved gross motor functioning in all five dimensions of functioning. The overall spasticity in quadriplegic cerebral palsy children was also reduced due to appropriate positioning techniques.

Keywords: Cerebral palsy, Patient positioning, Quadriplegia, Spasticity. (JPMA 71: 801; 2021)

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Introduction

Cerebral Palsy (CP) is a disorder in which damage to brain occurs in prenatal, perinatal or postnatal stage leading to impairment of movements and postures. Spastic, Athetoid, Ataxic and mixed (unclassified) are the types of Cerebral Palsy, among which spastic type is most common.[1] Cerebral palsy is not merely defined as motor dysfunction, i.e., an abnormality of movements and posture, it also effects on developing sensory functions due to prolonged retention of reflexes and increased muscle tone. Poor visual , auditory processing and improper sensory motor integration adds on complications of CP child by creating emotional disturbances and also hinders on the learning process of the child.[2]

The prevalence statistics of CP has constantly been explained to be about 2-2.5 per 1000 live births that is almost 1 in every 400 children for past twenty years in the western world.[3] According to a hospital based survey, presentation of CP in Pakistan is mostly due to birth asphyxia, prematurity, meningocephalitis and kernicterus.[4]

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Poor prenatal care is also one of the most documented factor that increases the risk of Cerebral Palsy,[5] however, the epidemiology of CP in low and middle income countries on large population has not been documented as evidence based.[6]

Twenty four hours postural management using special seating, night positioning and standing frames play a very vital role not only in preventing musculoskeletal complications including contractures, muscular deformities, subluxations, dislocations and decreased bone density but also produces therapeutic effect on neurological system that is on muscle tone, spasticity, exaggerated reflexes and joint position sense.[7,8]

Posture management is actually individually selected interventional programme that not only produces positive impact on child's body structure and function but also facilitates in improving activity and participation level.[9] Whole day and night positioning is being focused in the study as spastic cerebral palsy cases have poor joint and kinesthetic sense.[10] Positioning in sitting, semi reclined and side lying improves oxygen saturation level (SaO_2) as compared to lying supine.[8] Proper seating helps to develop functionality in the child by facilitating upper extremity function. Feet rests, hip belts, cutout tables and seating

angle (that should be individual based) are important pre-requisites of functional sitting position.[1] Children positioned with flexed neck position combined with a 300 reclined sitting position exhibits decreased aspiration, diminish oral leak and improvement in retention. The most supported position for feeding in literature includes an upright seated position with back supported, head aligned with the trunk, chin slightly flexed in a chin-tuck position, and hips, knees, and ankles at 90^{o} flexion.[11]

Standing position in a moveable platform develop postural orientation in response to visual information and active alignment of body segments with respect to gravity.[12,13] Standing position in early years of life improves abductor functioning.[14] Prolonged standing in erect posture improves the alignment of lower extremity joints and continuous stretching of lower limb muscle helps to improve their range of motion producing positive effect on weight bearing stamina. Prolonged standing improves muscle flexibility and proprioceptive feedback of sole of the feet that facilitates in developing gait in CP cases.[15] In non-ambulant patients with CP, continuous hamstring stretch resulting from prolonged standing makes transference and performance of Activity of Daily Livings slightly easier.[16] Consistent therapeutic management regarding positioning as an early interventional service in physically impaired cases needs family education and guidance. The caregivers are guided to altered care giving regime through proper positioning with the goal to improve functional potentials of the child.

Children with cerebral palsy need long-term therapy for gaining improved motor function. It seems to be a need for treatment and training at home. Handling training on caregivers in home is a well-controlled approach covering all activities and treatment strategies, which sequel an individual posture and function. The study was conducted to explore the effect of positioning techniques along with other conventional therapies (neuro-developmental, sensory motor integration), thus providing the opportunity of window for paediatric physical therapist to focus on functional levels of independence among cerebral palsy children. Incorporating positioning techniques are ignored in Pakistan that are very important for early achievement of motor function. There is yet no study on effect of 24 hours positioning in cerebral palsy children. Incorporating positioning techniques are ignored in Pakistan that are very important for early achievement of motor function.

Methodology

A quasi experimental study was conducted at Paediatric Physical Therapy Centre of University of Lahore Teaching Hospital and Institute of Psychological Services and Physical Rehabilitation. The study duration was 9 months from November 2018 to July 2019. As it is already proven that positioning reduces muscle tone and facilitating musculoskeletal alignment, so it was found unethical to conduct a study to evaluate the effects of positioning on Gross Motor Function with a control group. These Cerebral Palsy children need a long term therapeutic interventions and not giving a therapy with previously proven effects in reducing muscle tone, would have been unethical.

Seventy four children with cerebral palsy were recruited in the study calculated through the sample size determination in health studies by WHO[17].

$$n = \frac{Z^2_{1-\frac{\alpha}{2}} P\sigma^2}{\varepsilon^2 \mu^2}$$

In the mentioned formula Z=1.96, μ being the anticipated mean improvement in gross motor function after intervention to be 7.97,[18] σ being the standard deviation to be -0.77, ε^2 is the margin of error being taken as 2%, sample size came out to be 84 and with 20% dropout rate expected sample size was 67. Non-purposive convenience sampling technique was utilised. Subjects included in the study were spastic quadriplegic type of cerebral palsy children, aged 3 to 8 years with Gross Motor Function Classification System (GMFCS) level IV and V. Level IV of the scale characterises with children having self mobility but with limitations and Level V signifies requirement of the child to move from one place to another in manual wheelchair.[19] The children with athetoid and ataxic type of cerebral palsy, with recent joint dislocation or surgeries, with contractures or joint deformity, who are unable to comprehend or cooperate for the anticipated tasks and those receiving botulinum toxin injections were excluded from the study. The parents of included children were educated and informed about the study and written consent was obtained to involve their children voluntarily. The study permission was taken from the Institutional Review Board of University of Lahore.

The data was collected and the outcome measures used were Gross Motor Function Measure-88 (GMFM-88) for assessment of gross motor functioning in different positions and Modified Ashworth Scale (MAS) for measurement of spasticity. The Gross Motor Function Measure is a standardized tool that is used to evaluate gross motor functioning over a span of time in basically five dimensions, that is, lying and also rolling, sitting position, crawling and kneeling also, standing and finally walking plus running. The scoring of the tool involves 0, 1, 2, 3 and

not tested usually scored as 9. The items of the score, which a child is not willing to attempt even though that can be performed atleast partially is measured as 'not tested'. Scoring for each of the five dimensions was measured in percentages against the maximum score. Then finally the total scoring was attained by taking average score of all the five dimensions. Modified Ashworth Scale is a validated tool to measure spasticity with scoring from 0 to 4 with six choices, 0 being no increase in muscular tone and 4 being effected part rigid or fixed in flexed or extended position.[20]

Two measurements were taken; first baseline measurement before start of intervention, and second after 6-months of intervention. The 24-hour positioning in specific seats, night positioning and standing frames were utilised for six months. Level appropriate positioning was done, that is, positioning in hammock to reduce extensor thrust. Semi reclined positioning was performed to manage aspiration, oral leak and to develop retention. Prone positioning was done to develop righting reactions, functional sitting position was introduced in treatment regime to attain better upright position and neutral pelvic standing using standing frames. The specific intervention activities were different for each participant based on individual goals, but, in general, these activities involved placing the child in various developmental positions and encouraging antigravity movements and greater independence maintaining these positions using toys or other motivators. The therapist provided minimal amount of support and cueing during these activities and then decreased the support throughout intervention. Visual and verbal stimulation was provided during positioning to emphasise responsiveness from the children. The equipment used during intervention session were mat, benches, toys, CP chair and standing frame.[10] The parents were guided by our department to make these basic things available for the disabling condition. The structure of CP chair was guided and made through a carpenter or other help at home. Other equipment was also made available. The subjects included in our study were personally monitored if they had these things at home or not.

Furthermore, the parents of children were attending session thrice a week and instructions were being given in writing and through pictures after comprehensive execution of whole positioning regime during clinical sessions.

IBM SPSS 24 version was used for the analysis. Every calculated value was depicted in form of mean and standard deviation and also through paired t-test. Before and after intervention results of spasticity were compared using Wilcoxon signed rank test. The data collected for MAS did not turn out to be normally distributed; therefore, non -parametric test was applied, while the data for GMFM came out to be normally distributed on the scale; that is why parametric test was applied. The alpha level was set at less than 0.05 for significant results.

Results

Total of seventy-four cerebral palsy children were enrolled in the current study. The characteristics of sample such as age, gender and level of Gross Motor Functional Classification Scale are described in Table 1. Mean age was 5.36±1.53.

Pre and post intervention scores of motor functions were evaluated in five of the dimensions of Gross Motor Function Measure-88. Baseline and follow up measurements were taken after 6 months. Paired t- test

Table-1: Characteristics of the Sample (n=74).

Characteristics	Mean±S.D
Mean age (Years)	5.36±1.53
Characteristics	**Frequency**
Gender (M/F)	38/36
GMFCS level IV	40
GMFCS level V	34

GMFCS= Gross Motor Function Scale, M/F= Male/Female, S.D= Standard Deviation

Table-2: GMFM-88 pre and post intervention results after 6 month follow up (Paired-T test).

Dimensions	Baseline Mean ± S.D	Follow up Mean ± S.D	Sig.	Mean Difference
Lying & Rolling	50.23 ±35.76	85.08 ±14.39	0.000	-34.84
Sitting	22.12 ±22.65	43.49 ±19.50	0.000	-21.37
Crawling & Kneeling	9.83 ±12.04	24.91 ±23.87	0.000	-15.08
Standing	4.97 ±9.90	13.07 ±20.49	0.000	-8.09
Walking, Running and jumping	2.19 ±3.86	5.81 ±9.87	0.000	-3.61
Total score	17.88 ± 15.52	34.49 ± 15.99	.000	-16.61

GMFM-88= Gross Motor Function Measure-88, S.D= Standard Deviation, Sig.= Significance Level.

Table-3: MAS pre and post results after 6 months follow up (Wilcoxon Signed Rank Test).

Ranks	n	Mean Rank	Sum of Ranks[4]
Negative Rank	59[1]	30.0	1770.0
Positive Rank	0[2]	0.0	0.0
Ties	15[3]		
Total	74		

[1]Follow up MAS < MAS baseline; [2]Follow up MAS > MAS baseline;
[3]Follow up MAS = MAS baseline;
[4]the sum of Mean rank for positive and negative ranks; MAS= Modified Ashworth Scale

Statistics

	Follow up-Baseline
Z	-7.280
Sig. (2 tailed)	0.000

was utilised to compare before and post intervention recorded values of motor functions that revealed significant improvement in lying, rolling over, sitting position, crawling, kneeling, standing positions and also during running or walking (Table 2).

Spasticity was measured through Wilcoxon Signed Rank test, which showed n=59 subjects exhibited improvement in spasticity before and after interventional procedures, while n=15 showed no improvement (Table 3). The decreased spasticity measured on Ashworth Scale was the measurement of improvement. The Wilcoxon signed rank test table clearly shows that there have been negative ranks, mean follow up values taken had decreased scoring Ashworth scale.

Discussion

The progression in gross motor functioning is an essential goal of rehabilitation protocol of cerebral palsy children. The objective of current study was to promote Gross motor function in cerebral palsy children through proper positioning techniques. In the current study, one-hour intervention was applied thrice a week for a total of six months' period in quadriplegic spastic cerebral palsy children. The results described appreciable improvement in gross motor function of cerebral palsy children with GMFCS level IV and V. Multiple occupational and physical therapy methods target abnormal postural tones, sensory abnormalities, motor dysfunctions and functional incapacities of such children.

An earlier study reported significant improvement in rolling and sitting positions after the developmental techniques applied, which is in line with results of the current study.[21] According to present study, marked improvement was noted in gross motor functions in lying position, sitting, rolling from one to other direction, kneeling position and standing with and without support. Another study results are also consistent with results of current study, depicting significant improvement in gross motor functions of rolling and sitting position after neuro-developmental techniques.[22] A study on neuro-developmental approach also suggested improvement in motor functions of cerebral palsy child.[23]

A Randomized Controlled Trial reported that 2 hours session of Sensory Integration Techniques for total six weeks ensues a marked improvement in gross motor functioning in terms of sitting and crawling ability.[24] The treatment period of mentioned study is similar to current study time period for intervention, with a significant improvement in motor function.

Most of the studies constantly emphasise the positive role of neutral positioning of entire body of a CP child in promoting the functional capabilities.[1,25] These findings are in line with the results of current study, highlighting progressive effect of proper positioning of upper and lower extremity in quadriplegic cerebral palsy children with baseline abilities at GMFCS level IV and V. Whereas another study contradicts the results of current study, revealing insignificant differences between neutral standing in the frame and posterior pelvic tilt sitting for reach and grasp abilities of CP children. The results of the study were mixed, for instance neutral pelvis position showed improvement in feeding time, while it had a negative effect in early grasping of minor objects. It was seen that these findings could be the result of inappropriate outcome measure being unequal spacing between top of table from sitting and standing positions. The results might have been in favour of posterior pelvic tilting, as during sitting position, subjects were able to support their elbow and rest their forearm on top of the table to reach and grasp various objects. Whereas, feeding maneuver did not need external support of forearm and elbow; thus this outcome was achieved with neutral positioning of pelvis.[26]

A longitudinal study was conducted without any intervention or a true control group for the effects of positioning in CP child. This literature supported the current study, which emphasised positive effectiveness of functional positioning for sitting and neutral standing in the frame in CP children.

A study reported that altered trunk movements due to compensatory motions or basic inefficient trunk abilities cause abnormal gait patterns in cerebral palsy children. The outcomes measured on Trunk Control Measurement Scale showed poor performance while sitting, due to abnormal trunk motions.[27] These findings are similar to current study results, depicting low scoring on Gross Motor Function Measure-88 Scale with altered trunk movements. However, current study did not mention the exact angles and degrees of trunk motions or deviations while assessing Cerebral Palsy child gait patterns. Both the studies clearly described that abnormal trunk movements emphasise low performance in sitting on various tools measuring motor functional abilities. Minimal literatures have targeted the effects of positioning in a cerebral palsy child to improve overall gross motor functioning in cerebral palsy child.

Conclusion

The study concluded that 24-hour proper body positioning and postural techniques improve gross motor functioning in all of the five dimensions of functioning. It had also been suggested that hammock positioning reduces extensor thrusts, sitting increases postural stability, positioning in

standing frame facilitates musculoskeletal alignment. Thus focusing on twenty four hour positioning minimizes costing of health care system. The overall spasticity in quadriplegic cerebral palsy children was also reduced due to appropriate positioning techniques.

Major limitations of the current study were that the data was taken from merely two setups with less sample size. There was no control group and there have been no demarcation in mild, moderate or severe type of cerebral palsy.

Disclaimer: Article retrieved from thesis.

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