RESEARCH ARTICLE

Effect of Positioning on Tonic Labyrinthine Reflex in Cerebral Palsy: A Single-centre Study from Lahore

Samia Sarmad[1], Iqra Khan[2], Samreen Sadiq[3], Rabiya Noor[4]

Abstract

Objective: To evaluate the effect of positioning on tonic labyrinthine reflex in children with cerebral palsy.

Methods: The quasi-experimental study was conducted at the Institute of Psychological Services and Physical Rehabilitation, Lahore, from July 2016 to June 2017, and comprised children with spastic and athetoid cerebral palsy aged six months to three years. Gross Motor Functional Classification Scale level V was taken as baseline measure. Data was obtained and functional motor abilities were assessed by Motor Function Measure-20 Scale. Participants received intervention in the form of positioning in hammock for 10 hours, in-between sitting in cerebral palsy chair with harness along with sensory motor integration techniques. The readings were compared before the intervention and after the treatment strategies. SPSS 21 was used to analyse the data.

Results: Of the 30 subjects, 18(60%) were boys, and 7(23%) had athetoid cerebral palsy. The overall mean age was 18.13±7.33 months. Motor function variables significantly improved post-intervention ($p<0.05$).

Conclusion: Positioning provided significant improvement and positive effect in tonic labyrinthine reflex of spastic and athetoid cerebral palsy children.

Keywords: Abnormal reflex, Athetosis, Patient positioning, Spastic. (JPMA 69: 478; 2019)

Introduction

Cerebral palsy(CP) is an irreversible maldevelopment of brain in prenatal, perinatal or postnatal stage, which is demonstrated by prolonged retention of reflexes and abnormal muscular tone.[1] Most of the time this motor disability disorder leads to insufficient development of postural reflex mechanism.[2] The primitive and retained reflexes cause the abnormal movements, defective visual abilities, learning difficulties and emotional disturbances.[3] Brainstem reflexes comprise tonic labyrinthine reflexes (TLRs), asymmetric and symmetric tonic reflexes, and these usually appear throughout the first four months of a child's life.[4] These primitive reflexes are modified afterwards in righting reactions of neck and body that contribute toward the skeletal stabilisation. This skeletal steadiness and equilibrium is achieved by prolonged and static contractions.[5] Righting reflexes occur at mid-brain level that principally appear during the phases of six months to five years of age. After the period of six months of age, primitive TLR changes into labyrinthine righting reaction which facilitates the child in elevation of his head against the gravity.[6] TLR is basically stimulated when the child is in supine lying or when the position is made into flexion or extension. Retention of TLR restricts the side-lying, roll-over, creeping and lying to seated ability of the child.[7]

In developmentally-delayed child, like CP, TLR retention causes the increased flexor tone with the child in prone lying position.[8] While there is most likely increase in extensor tone in CP child with supine lying positioning, it leads to stereotypical movements as tonic reflexes are retained at brainstem level.[9] This retention of primitive reflex make the CP child uncomfortable in seated position and indirectly has a marked effect on the attention span and learning skills of the child.[9]

Earlier studies suggested that proper seated position is the main goal to normalise the muscular tone, improving the optimal function,[10] sustaining postural alignment, inhibiting deformities and promoting stability.[11] It was

[1]Pediatric Center, University of Lahore Teaching Hospital. [2,4]University Institute Of Physical Therapy, [3]University of Lahore. [3]Lahore College of Physical therapy, Lahore Medical and Dental College.

Correspondence: Samia Sarmad. e-mail: samia735@gmail.com

proposed that adaptive equipment which is provided to CP children should be customised individually according to the child's functional and contextual needs.[12] Some studies advocated making the child seated upright, while other studies advised to practice forward inclined position[13] and some researchers were in favour of reclined positions for postural control.[7] It is documented that appropriate positioning of CP children is essential to facilitate the functional activities, performance and environmental participation.

Intrauterine imitation by usage of hammock improves the motor experiences and enhancement of brain development. The positioning of CP child in hammock improves vestibular stimulation and reduces the extensor tone in CP child.[14] The positioning of CP child in the CP chair provides proprioceptive stimulation that improves normal muscular tone with the child having tonic labyrinthine reflex.[15] The child positioning in prone lying with neck righting reflex encourages sensory motor system.[16] Head control with rotational movement assists the development and improvement of equilibrium reactions. During the application of intervention whenever the child is positioned in prone lying it must be followed with the positioning in hammock.[17]

The flexor tone is needed to enhance the table top activities and the ability to reach and grasp, and then allowing the child to cross the midline by reaching further than midline. The position of reaching takes the limb far from body allowing the recognition of spatial orientation.[18] This positioning also improves the eye-hand coordination, attained by proper head positioning which is essential for appropriate arm function.[19] The extensor tone is increased in the athetoid and spastic CP child with retained tonic labyrinthine reflex.[20] This study aimed at inhibiting the extensor tone posture and retained TLR with the help of proper positioning in hammock and the CP chair. The current study was planned to enhance the flexed posture as all the functional activities of upper extremity cannot be performed with hypertonic extensor muscles of the body.

Patients and Methods

The quasi-experimental study was conducted at the Institute of Psychological Services and Physical Rehabilitation, Lahore, Pakistan, from July 2016 to June 2017, and comprised CP children aged six months to three years. The sample size was calculated using World Health Organisation (WHO) calculator[21] with the level of significance 5%, standard deviation 4.32 and power of study 90%. Non-probability convenience sampling was utilised for raising the sample which comprised spastic and athetoid CP children. Gross Motor Function Classification System level V[22] (GMFCS-V) was taken as the baseline measure. Children having congenital infections, fixed contractures and deformities at spinal level or upper and lower extremity were excluded. Children having visual impairments and respiratory disorders were also excluded.

Participants received intervention in the form of positioning in hammock for 10 hours, in-between sitting in CP chair with harness along with sensory motor integration techniques, like swinging, rolling or crawling on different texture objects, targeting proprioception, touching soft/hard surfaces, textures and different pressures for a period of five months. Sitting position was progressed according to the child condition from semi-reclined to straight-back sitting, and the forward inclination whenever needed for facilitation of functional activities.

Tool used to assess functional motor abilities was Motor Function Measure (MFM) questionnaire.[23] Scoring was done on a four-point scale, where 0 indicated that the child cannot initiate movement, and 3 indicated that the child performed the task normally and the movement was controlled. Informed consent was obtained from the parents of the participants, while permission was obtained from the institutional ethics board. Pre-intervention readings were compared with post-intervention readings. SPSS 21 was used to analyse the data. Mean and standard deviation (SD) were evaluated for age and the pre- and post-treatment scores of MFM-20. Wilcoxon signed rank test was used to evaluate median comparisons of MFM-20 scores. $P<0.05$ was taken as significant.

Results

Of the 30 subjects, 18(60%) were boys, and 7(23%) had athetoid CP. The overall mean age was 18.13±7.33 months. Baseline GMFCS-V readings suggested that physical impairments limited voluntary control of movement and the ability to sustain antigravity head, neck and trunk postures. All areas of motor function were restricted. Functional limitations in sitting and standing position were not fully compensated despite the use of adaptive equipment and assistive technology. At Level V, children

Table-1: Characteristics of Cerebral palsy children(n=30).

Characteristics	Frequency/Mean±S.D
Patients (n)	30
Age (months)	18.13±7.33
Gender (M/F)	18/12
Type of Cerebral Palsy (Athetoid/Spastic)	07/23
GMFCS	Level V

M/F: Male/Female, GMFCS: Gross Motor Functional Classification Scale, SD: Standard deviation.

had no means of independent movement. Some children attained self-mobility using a powered wheelchair with extensive adaptations. (Table1).

Of the 20 motor function variables, 19(95%)showed significant post-treatment improvement ($p<0.05$). The change in terms of standing without upper limb support and sitting down on the chair was non-significant ($p=0.71$) (Table2).

Besides, 4(13.3%) children had negative effect of interventions while 26(86.6%) children showed improvement ($p=0.001$) (Table3).

Discussion

The current study was conducted to evaluate the effect of positioning on TLR in CP rehabilitation at a child disability centre in Lahore. The position that was intervened was hammock positioning, along with in-between sittings in CP chair with harness.

In a study it was evaluated that to inhibit the spastic posture of CP child, there is an intense need to find out the appropriate angles of hip joint and knee joint flexion.[24] In our study hammock positioning promoted hip joint and spinal flexion that helped to overcome extensor tone. According to another study, the position of a child that eliminates the effect of gravity on the trunk is the anteriorly tipped pelvis and straight back having line of gravity forward to ischial tuberosity. This position is usually difficult to maintain for the child with retained extensor tone, so the intervention in the form of positioning is typically started with the child in the CP chair reclined backward. An important factor for the proper functional sitting position is symmetrical and equal weight distribution on ischial tuberosity.[25] This balanced weight distribution is achieved by fixing the child with a hip-belt on the CP chair and with the help of abduction orthosis. In our study, 10 hours' hammock positioning was added along with sitting in CP chair with harness to maximise the positioning effect for early rehabilitation.

Table-3: Wilcoxon Signed Rank Test for the pre- and post-intervention score of MFM-20.

	n	Mean Rank	Sum of Ranks	*z*-value	*p*-value
Negative ranks	4[a]	2.88	11.50	-4.55	<0.001
Positive ranks	26[b]	17.44	453.50		

a=post intervention score < pre intervention score,
b=post intervention score > pre intervention score.

A systematic review supported the evidences on the proper seating angles in the CP chair. The seating angles were evaluated to maximise upper extremity function.[26] In our study, to conserve the energy expenditure of a young CP child, hammock positioning was introduced in the intervention procedure to overcome TLR. Hammock usage and in-between sitting in the CP chair will in turn improve the flexor tone needed for upper extremity functional activities with less energy consumption.[27,28]

Another study was conducted on the correct postural alignment for the normal feeding or swallowing process in neuro-disabilities. According to this study, pelvic stability improved the trunk and head control which is the utmost requirement for safe feeding and oral functioning.[29] Our study emphasised the hammock use for extensor tone

Table-2: Mean and Standard Deviation of Motor Function Measure (MFM-20) measured pre and post treatment (n=30).

Variables	Pre intervention score Mean± S.D	Post intervention score Mean± S.D	*z*-value	*p*-value
supine,flexes hip and knee more than 90 degree	0.67± 0.80	1.87± 0.57	-4.34	<0.001*
supine,raises hand and move it to opposite shoulder	1.10± 0.76	2.47± 0.63	-4.65	<0.001*
seated on mat with tennis ball,without upper limb support, touches the ball and sits back again	0.53± 0.73	1.17± 1.20	-3.10	0.002*
standing,withoutupperlimb support, sits down on chair	0.27± 0.58	0.50± 0.73	-1.80	0.071
seated on chair or in wheelchair, the pencil on table,picks up pencil and draws a continuous series of loops inside the frame	0.43± 0.73	1.13± 0.86	-3.42	0.001*
seated on chair or in wheelchair, holding the sheet of paper, tears the sheet in four	0.60± 0.67	1.17± 0.83	-3.15	0.002*

*Statistically significant ($p<0.05$), SD: Standard devition.

disintegration that improves head and trunk stability, facilitating the feeding process. The CP chair with harness also inhibits uncontrolled movements in athetoid cases, improving postural alignment and reducing risk of aspiration pneumonia while feeding.

Positioning in hammock along with sitting in the CP chair and sensory integration techniques incorporated should be encouraged in CP children. Flexor tone development by proper positioning enhances bimanual functional activities. Weak evidences have been found in the placement of CP child in hammock to disintegrate the primitive reflex. The current study aimed at developing awareness among professionals about the appropriate positioning techniques in CP children.

The current study had certain limitations, like bias may have been unintentionally introduced while taking interviews from the parents of the children because the researchers were well aware of the study aims and objectives. Parents were unaware of study's aim but they may have manipulated or moulded the results by describing their own assumptions. A single setting was targeted which makes this study limited in terms of generalisation of its findings. Future researche is need to be done on multi-centre basis and other primitive reflexes should also be studied along with TLR to ensure early rehabilitation of CP children.

Conclusion

Positioning provided significant improvement and positive effect in TLR of spastic and athetoid CP children. Parents of the children reported more engagement of them in self-care and playful activities during the treatment phase. Gross motor function was enhanced with the help of proper positioning in the CP chair with harness along with the hammock positioning.

Disclaimer: None.
Conflict of Interest: None.
Source of Funding: None.

References

1. Rosenbaum P, Paneth N, Leviton A, Goldstein M, Bax M, Damiano D, et al. A report: the definition and classification of cerebral palsy April 2006. Dev Med Child Neurol Suppl 2007; 109: 8-14.
2. Panteliadis CP, Hagel C, Karch D, Heinemann K. Cerebral palsy: a lifelong challenge asks for early intervention. Open Neurol J 2015; 9: 45-52.
3. Bilbilaj S. The Important of Babies' Movement in the First Year of Life. J Educ Soc Res 2014; 4: 381.
4. Berne SA. The Primitive Reflexes: Considerations in the Infant. Optometry Vision Develop 2006; 37: 139
5. Gerber RJ, Wilks T, Erdie-Lalena C. Developmental milestones: motor development. Pediatr Rev 2010; 31: 267-76.
6. Krog S, Kruger D. Movement programmes as a means to learning readiness. South Afr J Res Sport Phys Edu Recreation 2011; 33: 73-87.
7. Neville L. The Fundamental Principles of Seating and Positioning in Children and Young People with Physical Disabilities. James Leckey Design Limited 2005; 1: 3-5.
8. Schott J, Rossor M. The grasp and other primitive reflexes. J Neurol Neurosurg Psychiatry 2003; 74: 558-60.
9. Zafeiriou DI. Primitive reflexes and postural reactions in the neurodevelopmental examination. Pediatr Neurol 2004; 31: 1-8.
10. El Shemy SA, El-Fattah HMA. Effect of Vestibular Stimulation from Selected Head Positions on Fine Motor Skills and Pinch Strength in Children with Hemiparesis. Int J Ther Rehab Res 2017; 6: 60-9.
11. McDonald R, Surtees R, Wirz S. The International Classification of Functioning, Disability and Health provides a model for adaptive seating interventions for children with cerebral palsy. Br J Occup Ther 2004; 67: 293-302.
12. Hong S. Assessment for and provision of positioning equipment for children with motor impairments. Int J Ther Rehab 2005; 12: 126-31
13. van der Heide JC, Otten B, van Eykern LA, Hadders-Algra M. Development of postural adjustments during reaching in sitting children. Exp Brain Res 2003; 151: 32-45.
14. Midha D, Uttam M, Neb M. Journey of a child with spastic diplegic cerebral palsy from doldrums to hope. Indian J Cerebral Palsy 2015; 1: 127-30.
15. Kanagasabai PS, Mohan D, Lewis LE, Kamath A, Rao BK. Effect of multisensory stimulation on neuromotor development in preterm infants. Indian J Pediatr 2013; 80: 460-4.
16. Fujino Y, Amimoto K, Sugimoto S, Fukata K, Inoue M, Takahashi H, et al. Prone positioning reduces severe pushing behavior: three case studies. J Phys Ther Sci 2016; 28: 2690-3.
17. Shamsoddini A, Hollisaz M. Effect of sensory integration therapy on gross motor function in children with cerebral palsy. Iranian J Child Neurol 2009; 3: 43-8.
18. Azzam AM. Effect of hand function training on improvement of hand grip strength in hemiplegic cerebral palsy in children. J Nov Physiother 2012; 2: 116.
19. Sidaway B, Bonenfant D, Jandreau J, Longley A, Osborne K, Anderson D. The role of head position and prior contraction in manual aiming. Acta Psychol 2015; 154: 10-3.
20. Sterba JA, Rogers BT, France AP, Vokes DA. Horseback riding in children with cerebral palsy: effect on gross motor function. Dev Med Child Neurol 2002; 44: 301-8.
21. Lwanga SK, Lemeshow S, Organization WH. Sample size determination in health studies: a practical manual; 1991.
22. Palisano R, Rosenbaum P, Walter S, Russell D, Wood E, Galuppi B. Development and reliability of a system to classify gross motor function in children with cerebral palsy. Dev Med Child Neurol 1997; 39: 214-23.
23. de Lattre C, Payan C, Vuillerot C, Rippert P, de Castro D, Bérard C, et al. Motor function measure: validation of a short form for young children with neuromuscular diseases. Arch Phys Med Rehab 2013; 94: 2218-26.
24. Nwaobi OM. Seating orientations and upper extremity function in children with cerebral palsy. Phys Ther 1987; 67: 1209-12.
25. Fowler EG, Kolobe TH, Damiano DL, Thorpe DE, Morgan DW, Brunstrom JE, et al. Promotion of physical fitness and prevention of secondary conditions for children with cerebral palsy: section on pediatrics research summit proceedings. Phys Ther 2007; 87: 1495-510.

26. Stavness C. The effect of positioning for children with cerebral palsy on upper-extremity function: a review of the evidence. Phys Occup Ther Pediatr 2006; 26: 39-53.
27. Sahino?lu D, Coskun G, Bek N. Effects of different seating equipment on postural control and upper extremity function in children with cerebral palsy. Prosthetics Orthotics Int 2017; 41: 85-94.
28. Rigby PJ, Ryan SE, Campbell KA. Effect of adaptive seating devices on the activity performance of children with cerebral palsy. Arch Physical Med Rehab 2009; 90: 1389-95.
29. Redstone F, West JF. The importance of postural control for feeding. Pediatr Nurs 2004; 30: 97-100.