



EFFECTS OF SEAT SURFACE INCLINATION ON RESPIRATION IN CHILDREN WITH SPASTIC CEREBRAL PALSY

Physiotherapy

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ABSTRACT

BACKGROUND: Respiratory problems are commonly observed in children with cerebral palsy. They frequently show abnormal muscle tone, impaired muscle contraction, and altered postural control. These abnormal muscle tones and movements not only adversely affect development of trunk muscles that are the foundation of respiration, but also cause thoracic deformity, which leads to respiratory problems. Ergonomic approach can be recognized as a simple intervention to improve respiratory function in children with CP. The modification of sitting posture changes the structure of respiratory muscles in resting position. A sitting device such as a wheelchair can be modified accordingly.

METHODOLOGY: Spastic cerebral palsy patients aging 6-15 years, ability to maintain sitting position independently and follow commands, (GMFCS level I-IV) were selected. Subjects were asked to sit on chair with its seat surface inclined anterior 15°, horizontal 0°, and posterior 15°. Inclination was given by wedge. Instructions and demonstrations were provided prior to the manoeuvre. Using pulmonary function testing device, Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 second (FEV1), Peak Expiratory flow rate (PEFR) and Maximum voluntary ventilation (MVV) were measured.

RESULT: Friedman test indicated that FVC at anterior 15° inclination of seat surface (1.50 ± 0.80 L) was significantly greater than at posterior 15° inclination of seat surface (1.38 ± 0.73 L) and horizontal inclination (1.44 ± 0.74 L) ($P < 0.05$). FEV1 at anterior 15° inclination of seat surface (1.47 ± 0.77 L) was significantly greater than at posterior 15° inclination of seat surface (1.35 ± 0.68 L) and horizontal inclination (1.39 ± 0.74 L) ($P < 0.05$). PEFR at anterior 15° inclination of seat surface (3.07 ± 1.71 L), at posterior 15° inclination of seat surface (2.90 ± 1.69 L) and horizontal inclination (3.08 ± 1.72 L), ($P = 0.05$) shows no significant difference. MVV at anterior 15° inclination of seat surface (34.82 ± 13.21), at posterior 15° inclination of seat surface (34.00 ± 13.09) and horizontal inclination (34.82 ± 10.82) ($P > 0.05$) shows no significant difference.

CONCLUSION: The present study concludes that significant difference is observed in FVC and FEV1, while there is no significant difference in PEFR and MVV across three seat inclinations. It shows that adjustment of seat inclination can be an effective intervention to improve the respiratory function of children with spastic cerebral palsy.

KEYWORDS

Cerebral palsy, Ergonomics, Respiration, Seat inclination

INTRODUCTION

Children with spastic cerebral palsy (CP) account for about 80% of all children with CP. They frequently show abnormal muscle tone, impaired muscle contraction, and altered postural control [1]. The disorder presents a group of neurological symptoms caused by nonprogressive brain lesions. The symptoms causing the most concern is motor dysfunction characterized by abnormality of muscle tone and movement pattern, poor postural control, motor developmental delay [2,3]. Currently, the Gross Motor Functional Classification System (GMFCS) has been widely adopted in clinical settings for diagnosis of functional motor level in CP. [4,5] Thus, movement disorders as a function of diversified types of children with cerebral palsy induce secondary complications and functional activity limitations related to skeletal muscles system, and also affect respiratory function. [6,7].

Approximately 40% of children with spastic CP experience the impairments of respiratory function [8]. The level of respiratory impairment is significantly greater in children with spastic diplegic CP than in those with spastic Hemiplegic CP [9]. Along with motor disability, children with CP can have abnormality of respiratory function, such as poor airway clearance, respiratory muscle weakness, and lung distensibility [10,11]. Pulmonary functions are reduced as abnormal respiration methods such as shallow breathing, reverse breathing pattern of children with cerebral palsy over a long period shorten respiratory muscles, and induce stiffness in costovertebral joint to limit thoracic cage mobility. [12]

An ergonomic approach that adjusts the orientation of sitting to support physical function has been studied in children with CP. [13,14]. Evidence shows that the orientation of sitting position influences functions in children with CP. [14] especially those who depend on a wheelchair for most of their daily activities. [15] The anterior-inclined seat may provide a positive effect to the function of the upper limbs and postural control [16]. Studies have also reported that the inclination of sitting position affects the respiratory function and speech in children with CP. [17].

The purpose of the study is to identify if inclination of seat surface could influence respiratory ability in children with spastic cerebral palsy. Aim of the study is to compare the pulmonary functions in three different seat inclinations in children with spastic cerebral palsy and find out the best effective position for the children with cerebral palsy.

METHODS

STUDY DESIGN

This study used a purposive sample and included individuals of Pediatric Neurophysiotherapy Department, Ahmedabad with a diagnosis of cerebral palsy.

MATERIALS

Wedge, Goniometer, Pulmonary function test machine, disposable mouthpiece, nose clip, paper, pen.

PARTICIPANTS

Total 17 participants were included in the study. Participants were Spastic cerebral palsy (Hemiplegic, diplegic, triplegic and quadriplegic) with Age: 6-15 years and GMFCS level: I-IV with good Cognition that is Child should be able to follow commands. Child should be able to maintain sitting posture independently. Those with Other pediatric neurological condition like ASD, ADHD and hydrocephalus etc., Orthopaedic problem limiting sitting balance and Respiratory illness were excluded from the study.

METHOD

Oral Consent of the parents of the child was taken. Inclination of the wedge was measured with the help of goniometer. The order of sitting was randomly selected for assessments of respiratory function. Wedge was placed on chair and at each sitting, their feet touched the floor maintaining 90° of their knee joint angle, and when needed, a footrest was used to secure their feet to the floor. Instructions and demonstrations were provided prior to the manoeuvre. Using pulmonary function testing device, subject was asked to perform the manoeuvre by placing the mouthpiece in his/her mouth, firmly held by the lips. Nose was blocked by noseclip to prevent air leakage.

In Three different positions,

- 1) Anterior inclination:Subjects will be asked to sit on chair with its seat surface inclined anterior 15° with the use of wedge.
- 2) Posterior inclination:Subjects will be asked to sit on chair with its seat surface inclined posterior 15° with the use of wedge.
- 3) Neutral position:Subjects will be asked to sit on chair with normal seat surface.

OUTCOME MEASURES

FVC was determined by measuring the amount of a quick and strong expiration after a maximal inspiration.FEV1 was defined as the amount of air expired in 1s following maximal inspiration.PEFR was determined by calculating amount of air emitted maximally.For MVV, subject was asked to breathe as deeply and quickly as possible.



STATISTICAL ANALYSIS

Result was calculated by using SPSS 16.0.
Level of significance=95%(0.05)

Various statistical measures such as mean,standard deviation(SD) ,test of significance were utilized to analyse the data.Non parametric data were analysed using Friedmann test.

RESULTS

	ANTERIOR INCLINATION(15°)	POSTERIOR INCLINATION(15°)	HORIZONTAL(0°)
FORCED VITAL CAPACITY(FVC)	1.50 ± 0.80 L	1.38 ± 0.73 L	1.44 ± 0.74 L
FORCED EXPIRATORY VOLUME IN 1 SECOND(FEV1)	1.47 ± 0.77 L	1.35 ± 0.68 L	1.39 ± 0.74 L
PEAK EXPIRATORY FLOW RATE(PEFR)	3.07 ± 1.71 L	2.90 ± 1.69 L	3.08±1.72 L
MAXIMUM VOLUNTARY VENTILATION(MVV)	34.82 ± 13.21	34.00 ± 13.09	34.82 ± 10.82

FVC at anterior 15° inclination of seat surface (1.50 ± 0.80 L) was significantly greater than at posterior 15°inclination of seat surface (1.38 ± 0.73 L)and horizontal inclination(1.44 ± 0.74 L)($P < 0.05$)

FEV1 at anterior 15° inclination of seat surface(1.47 ± 0.77 L)was significantly greater than at posterior 15° inclination of seat surface(1.35 ± 0.68 L)and horizontal inclination(1.39 ± 0.74 L)($P < 0.05$).

PEFR at anterior 15° inclination of seat surface(3.07 ± 1.71 L),at posterior 15° inclination of seat surface(2.90 ± 1.69 L)and horizontal inclination(3.08±1.72 L),($P = 0.05$) shows no significant difference.

MVV at anterior 15° inclination of seat surface(34.82 ± 13.21),at posterior 15° inclination of seat surface (34.00 ± 13.09)and horizontal inclination(34.82 ± 10.82)($P > 0.05$)shows no significant difference.

DISCUSSION

Children with CP experience various pulmonary problems [19] In particular, respiratory function is markedly diminished in children with spastic diplegic CP, which may be due to the inefficient functions of respiratory muscles.[9] Altered breathing patterns, such as unsynchronized movements between the diaphragm and respiratory muscles, may result in shallow and rapid respiration in children with spastic CP.[20]

This study shows that the FVC and FEV1 of children with spastic CP is greater with 15° of anterior seat inclination than with neutral and 15° of posterior seat inclination. So,The result suggests that sitting in an anterior-inclined seat can help children with CP maintain or improve their respiratory function. Children with spastic CP, because of their abnormal muscle tone and unstable posture, often display a particular way of sitting. To compensate for their unstable posture, their sitting position involves upper trunk flexion and posterior pelvic tilt.[21]

Previous Studies have shown results which suggests that the vital capacity varies depending on posture and this variation was significant in children with spastic diplegic CP while in this study significant variation of vital capacity is seen in all the children with spastic CP(hemiplegic,diplegic,triplegic and Quadriplegic) .The results of this study does not show any significant difference in PEFR and MVV. It proves that both of these parameters are not affected by the inclination in seat.

So,the results suggests that an ergonomic approach can be done in order to improve or maintain the respiratory function of the children with spastic cerebral palsy who are using wheelchairs for their daily activities. It would show beneficial results if the seat of the wheelchair is modified with 15° anterior inclination.

LIMITATION OF THE STUDY

Limitation of this study is that the subjects fell within a wide range (from levels I to IV) of the GMFCS level and it can limit positive outcomes. Thus, the effect of a seat inclination approach on respiratory function in children with different levels of GMFCS should be done in future studies.

CONCLUSION

The present study concludes that significant difference is observed in FVC and FEV1,while there is no significant difference in PEFR and MVV across three seat inclinations. It suggest that adjustment of seat inclination can be an effective intervention to improve the respiratory function of children with spastic cerebral palsy.

Conflict of interest: NIL

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