Effect of Bobath Axillary Roll in Posture Adjustment of Spastic Hemiplegic Cerebral Palsied Children

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ABSTRACT

The purpose of this study was to evaluate the effect of Bobath axillary roll in posture adjustment of spastic hemiplegic cerebral palsied children. The study was conducted on thirty spastic hemiplegic children ranging in age from 4 to 6 years from both sexes. They were classified randomly into two groups of equal numbers; control group (A) and study group (B). Both groups received physical therapy program, 3 times/week (every other day) in addition a specially designed posture correction exercise program was added to the program of the study group (B), this program was conducted while wearing Bobath axillary roll. The treatment program for both groups was conducted for 3 successive months. In all patients the posture was evaluated before and after the suggested treatment program by formetric instrument system. The post treatment trunk imbalance, lateral deviation, pelvic tilt, kyphotic angle, and lordotic angle results showed significant improvement of study group which confirm the important of using Bobath axillary roll in rehabilitation program of spastic hemiplegic children.

INTRODUCTION

Cerebral palsy (CP) is a term used to describe a group of disorders of posture, movement, muscle tone, or other features that reflect abnormal control over motor function by the central nervous system (CNS). It encompasses only those non-progressive or static lesions that affect the developing brain's control over motor abilities[16]. Hemiplegic CP is a common form of CP and usually results from damage to the sensorimotor cortex that controls one side of the body. It is used when one side of the body is affected, including the limbs, trunk and possibly the neck[2].

The upper limb is much more affected than the leg and the functional disturbance of the lower limb often becomes more apparent with ambulation[1]. Muscle weakness or abnormal tone in the trunk lead to atypical alignment patterns in the trunk, shoulder and pelvic girdles. The appearance of shortening on affected side comes from a number of compensatory adjustments to balance or as a result of the heavy weight of a weak arm which pulls the upper quadrant into excessive forward flexion[15]. As spasticity evolves, there is a failure of the antagonist muscles to relax when the agonist muscles contract, thus creating cocontraction. Spastic unilateral paraspinal muscles overwhelm those on the contralateral side, causing lateral flexion of the spine toward the affected side. Also, the spine begins to flex laterally toward the hemiparetic side because of the elimination of the righting reflex, further altering the scapulothoracic relationship[19]. Insecurity caused by poor stabilization and abnormal reaction to body weight bearing in an antigravity position might contribute to asymmetric posture. Asymmetrical posture during static stance has been identified as a common problem in persons with hemiplegia[10]. Correction of asymmetry of arms, flexion-adduction-internal rotation and other abnormal postures of the arms also corrects abnormal postures of the head and trunk[12]. The axillary roll/wedge is used for patient's with increased tone. It is placed in the axilla attached by means of a strap passing across the back and around the opposite shoulder in a figure of eight. The bulk afforded by the roll/wedge brings the arm away from the body. This places the arm in a position of slight abduction, thereby inhibiting the dominance of adduction, flexion and medial rotation, also placing the roll/wedge in the axilla and removing it ensures that the upper limb is moved away from the body on a regular basis and thus improves hygiene[4]. The videorasterstereography (VRS) (Formetric system) is capable of recognizing to a high degree of reliability the necessary topographical points for the evaluation and calculation of the spinal curve and it analysis all existing curvatures without manual invasion and provides measuring values for comparison[22]. It provides a quantification and documentation of the abnormality in back shape before and after treatment. The results can be controlled and documented objectively[8].

So the aim of this study was to evaluate the effect of Bobath axillary roll with postural correction exercises on improving posture in hemiplegic cerebral palsied children.

SUBJECTS, MATERIALS AND PROCEDURES

Subjects

This work was conducted on thirty spastic hemiplegic cerebral palsied children (16 right sided and 14 left sided), selected from both sexes (14 boys and 16 girls) with age ranged from 4 to 6 years with a mean age of 4.9 ± 0.79 years, from the out-patient clinic of the faculty of Physical Therapy, Cairo University.

All the patients fulfilled the following criteria:

(1) Degree of spasticity according to modified Ashworth scale ≥1+[5].

(2) Their height was around one meter.

(3) No detectable perceptual deficits.

(4) Able to stand independently.

(5) Able to follow simple verbal commands or instructions included in both test and training.

(6) Neither visual nor auditory problems were demonstrated.

(7) No structural deformities in any joint or bone of the lower limbs.

They were classified randomly into two groups of equal numbers (control and study), each group composed of fifteen spastic hemiplegic cerebral palsied children.

Control group (A); received physical therapy program based on NDT approach, in addition a specially designed postural correction exercise program.

Study group (B); received the same physical therapy program based on NDT approach, in addition a specially designed postural correction exercise program while wearing Bobath axillary roll. Treatment program for both groups was conducted 3 times/week (every other day) for 3 successive months.

Materials

For evaluation: Formetric instrument system:

It was used to evaluate back geometry. It contains the following major subassemblies:

1- The scan system: optical column with base plate contains a raster projector and a video camera mounted into a profile tube.
2- The computer: consists of a standard PC for image processing, a printed circuit board for capturing images (frame grabber), a module for rotation of live

images and image presentation on a monitor. The stereo imager 800 is the basic component including VRS software (visual spine software) which provides 3D-reconstruction of the spine based on measurement data of the system Formetric.

3- The black background screen: suspended at the distance of about 3 m from the optical column.

4- The laser printer: provides high-quality result presentation. The results of shape analysis plot on the laser printer as graphic protocols. Each graphic protocol contains some anatomical parameters which are calculated from the anatomical landmarks, (i.e. VP: Vertebra prominence, DL: Left dimple, DR: Right dimple, and DM: Midpoint between both dimples).

For treatment: Bobath Axillary Roll:

The Bobath axillary roll contains the following components:

- Roll or wedge: It was adjusted individually to allow 15 degrees shoulder abduction by using goniometer.
- Strap: The strap length is about 130 cm. It was adjusted individually to allow both shoulder level position.
- Val Crum: It was used for locking and unlocking of the axillary roll. The axillary roll/wedge was placed in the axilla attached by means of a strap passing across the back and around the opposite shoulder in a figure of eight[6].

Other Materials

1- Weight scale: for measuring weight: valid and reliable weight (0 to 120 kilograms).

2- Meter: for measuring height of the subjects (0 to 200 centimeters) was used.

3- Goniometer: for measuring 15 degrees shoulder abduction, for Bobath axillary roll application.

4- Mat, medical ball, wedges, rolls, standing bar, tilting board and mirror were used.

Procedures

(A) For Evaluation:

Each child in both control and study groups was assessed before and after the treatment program which lasted 3 successive months by using:

Formetric Instrument System: The protocol of the work was explained to the children before conducting the study. The software program started, and then the child data was entered. The child was positioned in front of a black background screen in a distance of two meters from the measurement system. The child's back surface (including buttocks) was been completely bare in order to avoid disturbing image structures.

The child was asked to keep his/her neck in a slightly forward-bending posture, just as in normal walking in order to improve the presentation of the vertebral prominence. Also, he was asked to keep his both upper extremities extended beside his body.

When the child and the system were correctly positioned, the image was captured. The best moment for releasing image capture was the slightly breathed-out state. The child was asked to stop breathing for some seconds while image capture was released. Finally, The device analyzed the data and compared it to the values of the normal person and printed out for each patient. five main values produced by the Formetric system were evaluated: trunk imbalance, lateral deviation (RMS = root mean square), pelvic tilt, kyphotic angle (VP-T12), and lordotic angle (DM-T12).

(B) For Treatment:

Neurodevelopmental treatment (NDT) and the specially designed postural correction exercise program: included the following:

Approximation technique for the upper and lower limbs was applied in a slow, regular and rhythmic manner, Facilitation of righting and equilibrium reactions, Training of protective (saving) reaction, Training of pelvic stability and equal weight shift on both sides with concentration on the affected side. Strengthening exercises for upper and lower limbs and also for abdominal, hip and back extensors muscles from supine and prone positions.

Stretching exercises for achilles tendon, hamstrings, hip flexors and adductors in the lower limbs and the shoulder internal rotators, elbow and wrist flexors, pronators and ulnar deviators of the upper limbs and sternocleidomastoid and pectoralis muscles. Exercise to stretch tight structures on the affected hemiplegic side of the trunk was done from prone and side lying position on the unaffected side of the trunk.

Exercise to elongate the trunk was done from standing and reaching up a wall.

Gait training exercises and different exercises to facilitate hand function were applied. The child wore a white T-shirt with a vertical stripe down the centre and tried to match the stripe on the T-shirt to a vertical strip on the mirror, also, while perform a variety of tasks, such as reaching for an object[16].

Statistical analysis

The mean ± standard deviation (mean ± SD) were calculated for each variable (trunk imbalance, lateral deviation, pelvic tilt, kyphotic angle, and lordotic angle), for both study and control group before and after treatment.

- The pre and post training results within subjects were evaluated using paired t-test.
- The between group differences for the studied variables were carried out using Independent t-test.

The level of significance was set at $P < 0.05$.

RESULTS

The collected data were statistically analyzed using paired t-test and independent t-test. The results revealed a significant improvement ($P<0.05$) in all measuring postural variables including trunk imbalance, lateral deviation, pelvic tilt, kyphotic angle, and lordotic angle in both groups (A and B), when comparing their pre and post treatment results, also when comparing the post treatment results of both groups (A and B), there was a significant improvement ($P<0.05$) in study group (B) than control group (A).

Table (1) and figures (1 and 2) showed that the mean values ± SD of trunk imbalance, lateral deviation, pelvic tilt, kyphotic and lordotic angles before and after treatment for hemiplegic children and represented a significant improvement in all measured variables of both groups A and B after treatment ($P<0.05$) in relation to the pre and post treatment in each group.

Table (1): Pre and post treatment mean values of trunk imbalance, lateral deviation, pelvic tilt (millimeters), kyphotic and lordotic angles (degrees) for hemiplegic children of control group (A) (No.=15) and study group (B) (No.=15).

Variables	Pre & post treatment mean values of all measured variables			
	Group (A) (No.=15)		Group (B) (No.=15)	
	Pre	Post	Pre	Post
Trunk imbalance, Mean ± SD	16.33±2.74	10.60±2.47	15.20±3.02	6.00±1.41
t-value P-value	8.71 <0.05*		11.74 <0.05*	
Lateral deviation, Mean ± SD	6.13±2.16	3.40±1.50	5.13±1.92	1.70±0.70
t-value P-value	11.01 <0.05*		7.63 <0.05*	
Pelvic tilt, Mean ± SD	11.66±2.43	8.26±2.08	10.33±2.71	3.13±1.18
t-value P-value	10.60 <0.05*		10.51 <0.05*	
Kyphotic angle, Mean ± SD	39.40±6.81	35.33±6.25	38.33±6.66	30.53±6.33
t-value P-value	8.79 <0.05*		12.60 <0.05*	
lordotic angle, Mean ± SD	34.60±8.94	32.53±8.76	38.93±11.20	25.53±9.50
t-value P-value	13.48 <0.05*		16.80 <0.05*	

No.: Number SD: Standard deviation t-value: paired sample t-test value
P-value: Probability value *: significance

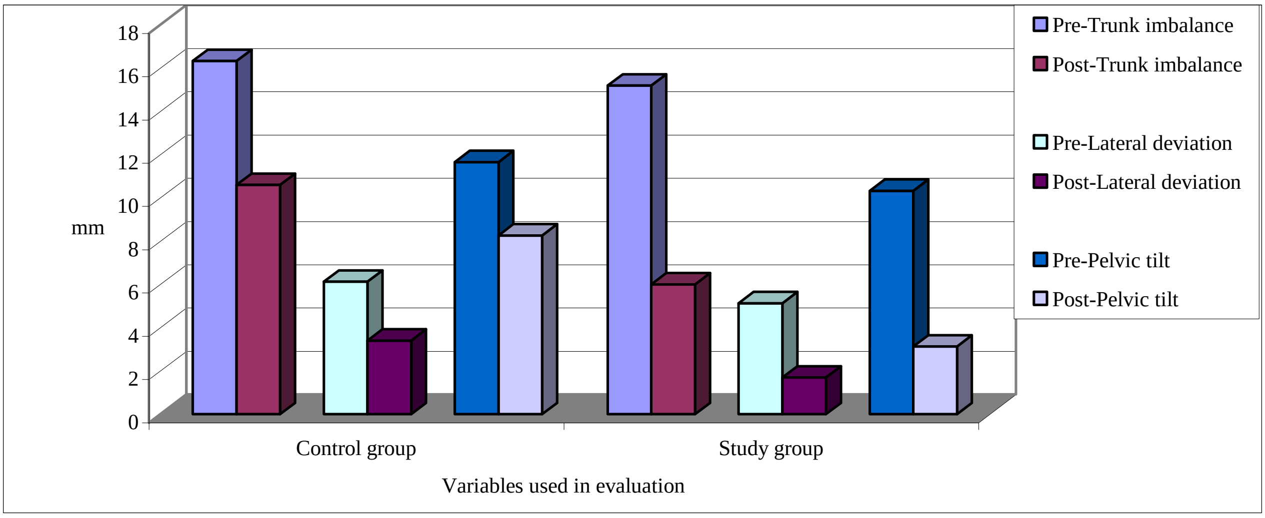

Fig. (1): Pre and post treatment mean values of trunk imbalance, lateral deviation, pelvic tilt (millimeters), for hemiplegic children of control group (A) and study group (B).

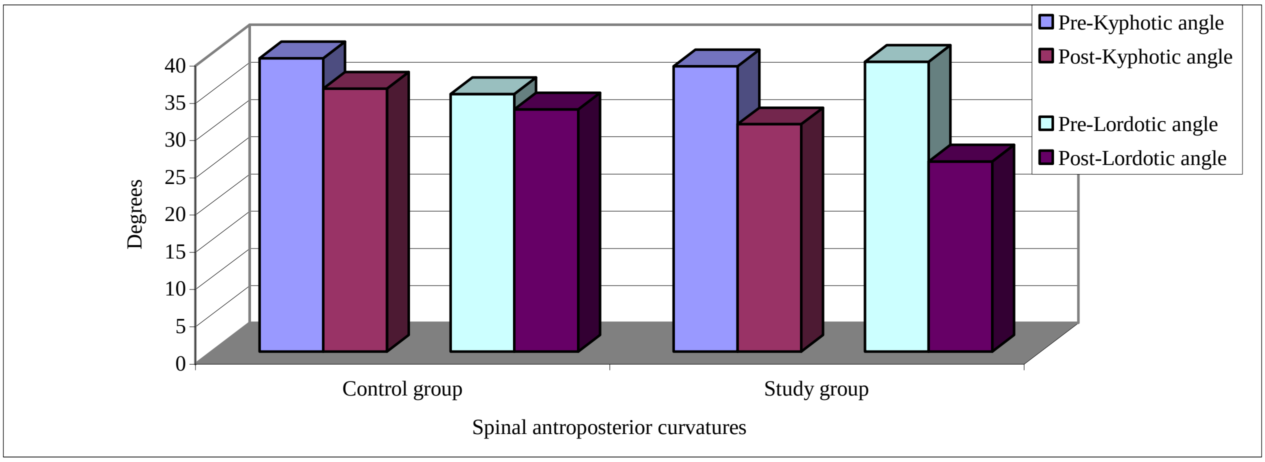

Fig. (2): Pre and post treatment mean values of kyphotic and lordotic angles (degrees) for hemiplegic children of control group (A) and study group (B).

Table (2) and figures (3 and 4) showed that, the post treatment mean values ± SD of trunk imbalance, lateral deviation, pelvic tilt, kyphotic and lordotic angles for hemiplegic children of control group (A) and study group (B) and represented a significant improvement of study group (B) after treatment (P<0.05) in favour of control group.

Table (2): Post treatment mean values of trunk imbalance, lateral deviation, pelvic tilt (millimeters), kyphotic and lordotic angles (degrees) for hemiplegic children of control group (A) (No.=15) and study group (B) (No.=15).

Variables	post treatment mean values of all measured variables	
	Group (A) (No.=15)	Group (B) (No.=15)
Trunk imbalance, Mean ± SD	10.60±2.47	6.00±1.41
t-value	6.25	
P-value	< 0.05*	
Lateral deviation, Mean ± SD	3.40±1.50	1.70±0.70
t-value	3.89	
P-value	<0.05*	
Pelvic tilt, Mean ± SD	8.26±2.08	3.13±1.18
t-value	8.28	
P-value	<0.05*	
Kyphotic angle, Mean ± SD	35.33±6.25	30.53±6.33
t-value	2.08	
P-value	<0.05*	
lordotic angle, Mean ± SD	32.53±8.76	25.53±9.50
t-value	2.09	
P-value	<0.05*	

No.: Number SD: Standard deviation t-value: paired sample t-test value
P-value: Probability value *: significance

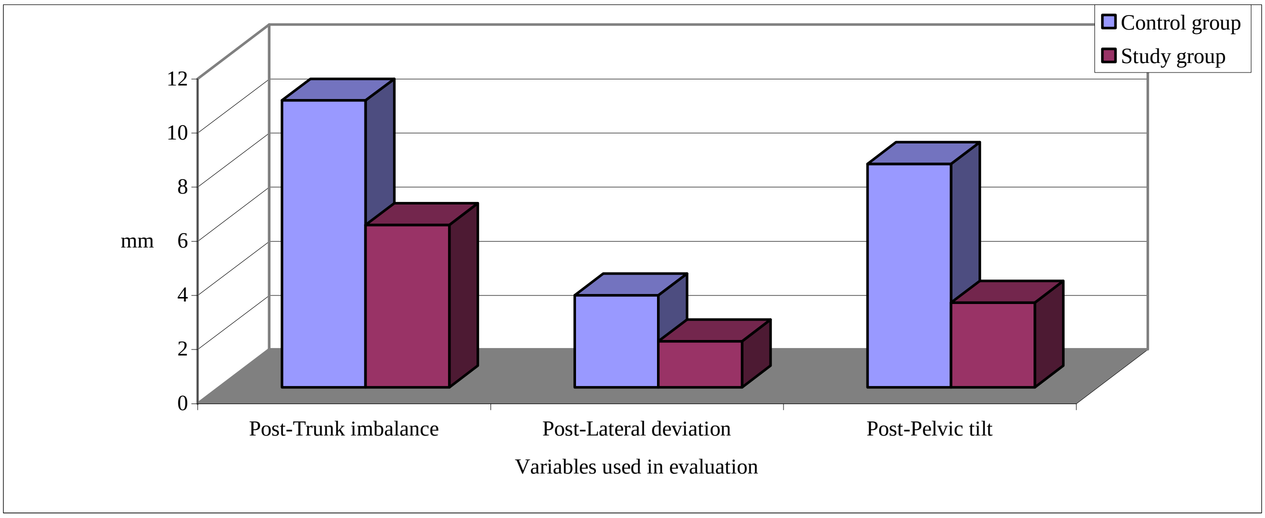

Fig. (3): Post treatment mean values of trunk imbalance, lateral deviation, pelvic tilt (millimeters), for hemiplegic children of control group (A) and study group (B).

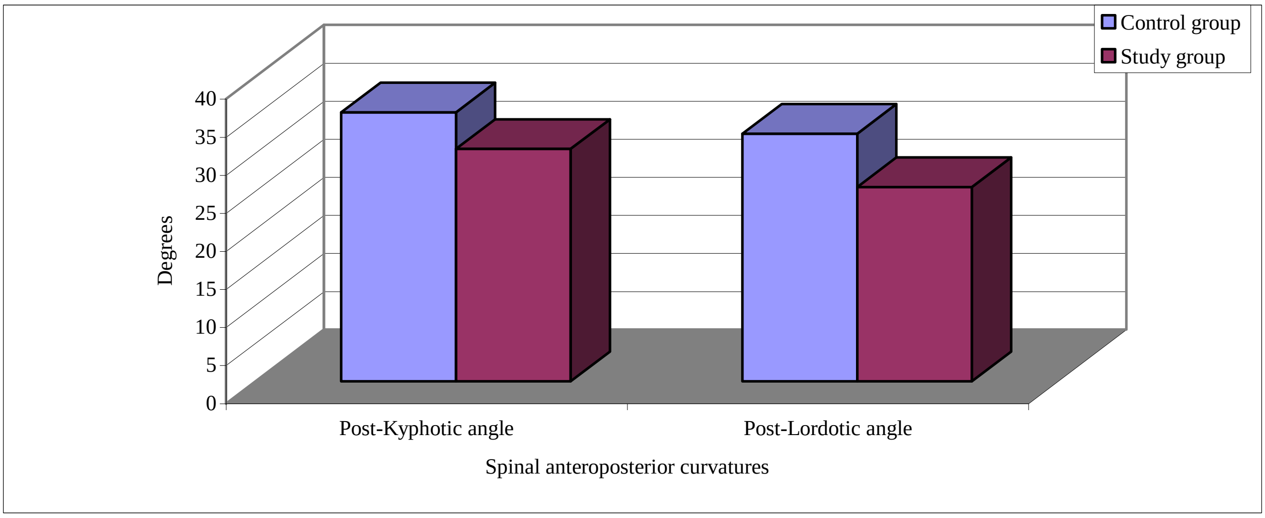

Fig. (4): Post treatment mean values of kyphotic and lordotic angles (degrees) for hemiplegic children of control group (A) and study group (B).

DISCUSSION

Children with cerebral palsy typically tend to have decreased active balance of trunk flexors and extensors in an upright position with difficulty sustaining muscle activation[18]. The aim of this work is supported by McKinnis, 1994[14] who emphasized that; any alteration in the standard postural position of the glenohumeral joint is a potentially serious postural problem. Choosing 15 degrees shoulder abduction for positioning the Bobath axillary roll agrees with Hall, 2003[9] who reported that; because of the effect of the arm position on shoulder loading, ergonomists recommended that seated at a desk or a table attempt to position the arms with 20 degrees or less of abduction. Also, it comes in agreement with Yahara, 1994[23] who found that; in the first 30 degrees of humeral abduction, the scapula moves only slightly compared to the humerus.

Concerning the pre treatment mean values of all measuring postural variables (trunk imbalance, lateral deviation, pelvic tilt, kyphotic angle, and lordotic angle) of hemiplegic children of both groups (A and B), showed a significant increase in their values which indicated that those children had a significant posture problems. This finding comes in agreement with Berker and Yalcin, 2005[3] who emphasized that; spinal deformity associated with CP might be postural or structural, and include scoliosis, hyperkyphosis, and hyperlordosis.

Also, this explanation is in agreement with Levitt, 2004[12] who reported that; the development of skeletal deformities in cerebral palsied children may be due to poor posture control. Also, inadequate control of the trunk and proximal musculature may contribute to inefficient control of the upper extremities. In hemiplegic cerebral palsied children lack of counterpoise of one arm (hemiplegic side) may lead to the child leaning abnormally to one side, this creates asymmetrical postures. Also, presence of tilt reactions to one side only may be associated with scoliosis.

Concerning the pre and post treatment results of all measuring postural variables the significant improvement in the post treatment mean values in both groups after treatment might be attributed to the effect of exercise program (based on NDT) which emphasized on the inhibition of abnormal muscle tone and abnormal postural reflexes, facilitation of normal patterns of postural control (righting and equilibrium reactions), developing weight shift, providing postural adaptations and alignment to improve equilibrium in all positions, developing a greater variety of normal movement patterns particularly in the trunk and lower extremities and finally reinforcement of function.

Also, due to the effect of postural correction exercises which emphasized on providing balance between the opposite muscles (agonist and antagonist) to regain symmetry through stretching and strengthening exercises. This finding comes in agreement with Waddington, 1999[20] who reported that; in patients with CNS damage it may be necessary to facilitate protective extension reaction (saving reaction), either in infants and children who have never developed it or in adults where it has been disturbed, and stated that; balance reactions can be used to facilitate the contraction of selected muscle groups and as part of a muscle strengthening program, and with Wang et al., 1999[21] who found that; stretching exercises for the pectoral muscles and strengthening exercises for the scapular retractors and elevators and the glenohumeral abductors and external rotators improved muscle strength, produced a more erect upper trunk posture, increased scapular stability, and altered scapulohumeral rhythm.

Regarding the post treatment results of all measuring postural variables of hemiplegic children of control group (A) and study group (B), there was an improvement in the study group (B) more than in the control group (A), which could be attributed to the wearing of Bobath axillary roll, as it provided vertical support to the shoulder, allowed elevation and slight abduction of the glenohumeral joint, and retraction of the scapule which in turn adjust the scapulohumeral attitude in relation to the spine (trunk). Positioning the scapulohumeral joint in the corrected position in relation to the trunk, will help in the adjustment of posture to regain symmetry.

This finding comes in agreement with Galley and Forster, 1997[7] who stated that; the basic positions of posture requires adjusting the position of head and limbs in relation to the trunk. Also Luttgens and Hamilton, 1997[13] who reported that; good posture is a state of muscular and skeletal balance, which protects the supporting structures of the body against injury and progressive deformity, it can be maintained by adjusting the position of the head and limbs in relation to the trunk.

But This finding disagrees with Ikai et al., 1998[11] who compared a small group of hemiplegic patients using a Bobath sling with a control group and found no significant difference between the two groups as related to pain, ROM and subluxation. They conclude that, the Bobath sling need not be uniformly applied at all patients.

From the obtained results, it can be concluded that, wearing Bobath axillary roll in addition to postural correction exercise program can be added as an adjunct to physical therapy program (based on NDT) to adjust and correct posture of hemiplegic children.

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الملخص العربي

تأثير طية بوباث الأبطية على تعديل القوام في أطفال الشلل المخى المصابين بالشلل النصفي التصلبى

يهدف البحث إلى تقيم تأثير طية بوباث الأبطية على تعديل القوام في أطفال الشلل المخى المصابين بالشلل النصفي التصلبى. تم أجراء هذا البحث على ثلاثون طفلا من الجنسين تتراوح أعمارهم من 4 إلى 6 سنوات . تم تقسيمهم إلى مجموعتين متساويتين في العدد المجموعة الضابطة (أ) ومجموعة الدراسة (ب) . تلقت المجموعة (أ) مجموعة من التمرينات العلاجية المختارة مع تمرينات أصلاح القوام بينما تلقت المجموعة (ب) نفس التمرينات ولكن أثناء ارتداء طية بوباث الأبطية . تم تحديد قياسات القوام قبل وبعد ثلاثة أشهر من تطبيق العلاج باستخدام جهاز قياس تشوهات العمود الفقري . وقد أثبت التحليل ا لإحصائي وجود فروق ذات دلالة إحصائية في قياسات القوام الخمسة للمجموعتين (أ) و (ب) عند مقارنة نتائج ما قبل و بعد العلاج لكل مجموعة ، بينما كانت نسبة التحسن أعلى في صالح المجموعة (ب) عند مقارنة نتائج ما بعد العلاج للمجموعتين (أ) و (ب) مما يعكس أهمية استخدام طية بوباث الأبطية مع تمرينات أصلاح القوام والتمرينات العلاجية المختارة لتعديل القوام عند الأطفال المصابين بالشلل النصفي التصلبى .