Effect of Head Neck Position on the Reaching of Children with Spastic Cerebral Palsy

Amira M. EL-Tohamy, Ph D, Faten H. Abdel-Azeim, Ph D.
Department of Physical Therapy for Pediatrics and its Surgery, Faculty of Physical Therapy, Cairo University.

ABSTRACT

This study was to evaluate the effects of head neck position on the reaching of the children with cerebral palsy. Thirty spastic hemiparetic cerebral palsy, ranging in age from 4 to 7 years and the degree of spasticity was determined according to modified Ashowrth scale of 1, 1+ and 2 grades. The reaching was studied by examining the effects of different head neck positions on the distance, time and velocity of their performance through the use of modified single cut-out table and video camera. This work showed a significant difference between the neutral head neck position and other tested head neck positions for distance, time and velocity of reaching. There was a significant difference among and within the different head neck positions and also demonstrated that, for an efficient reaching with the affected upper extremities, the dorsiflexed position and the rotated head neck position toward the affected side. So that, the head neck position must be considered during the assessment and habilitation of such children.

INTRODUCTION

Cerebral palsy is one of the most common neurologic problems of the children refered to physical therapist, with the children with spastic cp constituting 60% of patient population[14,25]. Hemiplegin is the commonest form of cp, accounts for 30% to 40 % of the total, and is usually subdivided into congenital and acquired forms[24].

Reaching is a necessary component of many daily functional tasks and is representative of well learned, highly skilled movements. Children with spastic cerebral palsy might be expected to have a problem with the components of reaching. Faulty postural control mechanisms, abnormal muscle tone mechanisms, excessive cocontraction during attempted movement and abnormal reflex activity contribute to movement problems such as difficulty initiating movement, thus affecting the accuracy of reach[4,5,6,10].

The head neck position may affect the movement pattern of the affected upper extremity of the spastic hemiparetic cp children due to election of symmetrical and/or asymmetrical tonic neck reflexes which in turn may affect the motor performance through influencing muscle tone distribution of both upper and lower extremities.

The asymmetrical tonic neck reflex would seem to play an important role in visiomotor development. It presents during the time visual fixation upon near by objects is developing and it seems that nervous system is making sure that the appropriatearm stretch

out towards visualized object. As the hand touches the objects, the seeds are sown of awareness of distance and eye hand coordination[15].

In order to improve the motor competence of the patient with cp, we need to develop and test new assumption, focus on the attainment of functional motor outcomes, and utilize creative methods for measuring these functional outcomes[11].

Since cp is a developmental disorder, assessment need to be found on principles of development of movement and posture control[19]. Particularly with early brain damage, fundamental perceptlumotor skill such as looking, timing and maintaining balance are likely to be affected, Which could affect the development of more complex skills such as reaching, walking and writing. It is therefore necessary to gain insight into the basic principles of the development of movement[23].

The focus of this article will be whether head neck position affects the movement outcomes for the individuals with the movement problems such as cp. If functional movement is stressed, however, then measures of functional movement can be utilized for the assessment of the efficacy of therapy.

The purpose of this study was to document and evaluate the effects of head neck position on the reaching movement skills of the children with spastic cp, and which of the different head neck positions has the greatest facilitation effect on the affected upper extremity in spastic hemiparetic cp children.

Reaching time was defined as the time between the start to the farset point the patient can touch. Hopenfeld (I976) stated that the neutral head neck position is the midline position of the head, the ventroflexed head neck position is the flexed position of the head forward so that, the chin can touch the chest the dorsiflexed head neck position is the extended position of the head backward, so that, the eyes can look directly at the ceiling above the head and the rotated head neck position is the position in which the head is turned until the chin is almost in line with the shoulder[16].

SUBJECTS

The population of this study was thirty spastic hemiparetic cp children, 19 boys (11 right sided, 8 left sided) and 11 girls (1 right sided and 10 left sided), their age ranged from 4 to 7 years, the subjects were randomly selected from Pediatric Hospital, Cairo University. All participated children were suffering only from spastic hemiparetic cp with no any other associated disorders. The affected upper extremity was free from any limitation of the range of motion other than spasticity and the degree of spasticity was 1,I+ and 2 grades according to Ashworth scale[7].

INSTRUMENTATION

(A) A modified single cut-out table (fig.1) was used (modified from Preston equipment for rehabilitation center and special education, model No. PC 4514D, 1981).

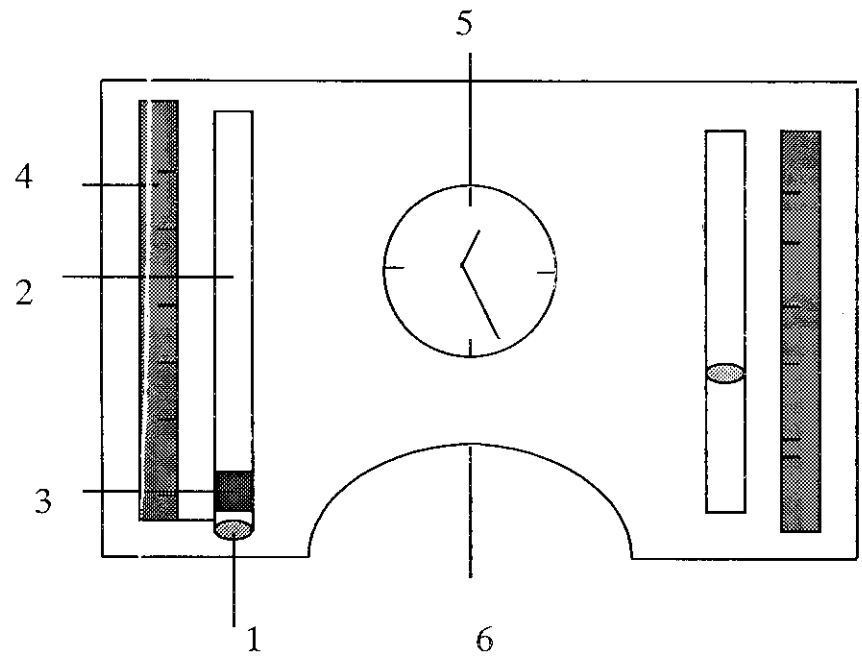

Figure (1): Upper surface of the modified single cut-out table.

1- The movable arms with pointers.
2- The forward-backward directional grooves.
3- Arm blocker.
4- Tape measurement.
5- A wall o'clock
6- The cut-out.

(B) A chair with suitable height (45cm) and a back support.
(C) The Straps.
(D) Video camera and flat screen TV.

PROCEDURE

The room was quite with the same environment attainment throughout the research. Among other factors, improper seating can exacerbate and aggreavate spasticity and can lead to early fatigue[14], therefore, each child was seated on the chair in front of the modified single cut-out table. The height of the table was then adjusted until the child forearms were rested on the table midway between supination and pronation with the elbow flexed 90 degrees and the shoulder in adduction beside the child's trunk. The patient was asked to grasp the table arms, one in each hand, the hand of the tested upper extremity was maintained in the grasping position passively while the child was performing the tested activities. At the same time, the untested upper extremity was maintained in its position by fixing the table's arm using the arm blocker. The patient was then asked to maintain the affected upper extremity in the previous mentioned position and not to do any movement by this extremity, and with the unaffected upper extremity, he/she was asked to reach the table arm forward as much as he/she could and as faster as possible. The same process was then repeated while the unaffected upper extremity was maintained in the starting position and the reaching activity was performed several times while the head and neck of the patient were in

the following positions; neutral, ventroflexed, dorsiflexed, rotation toward the affected side, and rotation away from affected side, All these previous steps were recorded on a video tape.

The distance and time of the three successful trials for reaching activity was measured in each of the previously mentioned head neck positions, the means of the distance and the time were calculated and the mean of velocity of reaching was then calculated for each head neck position.

To preclude practice that might mask the effect of tonic neck reflex and to reduce fatigue, each subject performed the trails with a minimum of one minute's rest between these trials.

RESULTS

The collected data were statistically treated using paired t-test to show the significant difference between the neutral head-neck position and the following head neck positions, ventroflexed, dorsiflexed, rotation toward the affected side and rotation away from the affected. This was conducted for the distance, time and velocity of reaching with the affected upper limp.

In regarding to distance of reaching with the affected upper limb as shown in table (1); the results represent a significant difference between the neutral position and the following head neck positions; ventroflexed, dorsiflexed, rotation toward the affected side and rotation away from the affected side.

The results also represent that the highest mean value of the distance (0,1867m) was obtained when the head and neck were in the rotation toward the affected side indicating that this position is the best head neck position for acheiving reaching activity (fig.2).

Table (I): Distance of reaching with the affected upper limb in the neutral and the other tested head-neck positions.

Head-Neck Positions	Min (m.)	Max (m.)	$\overline{X}$ (m.)	SD (m.)	D	t	P
Neutral	0.15	0.19	0.17	±0.014			
Ventroflexion	0.10	0.20	0.16	±0.019	0.011±0.017	3.70	0.001*
Dorsiflexion	0.14	0.22	0.17	±0.016	-0.008±0.021	-2.13	0.042*
Rotation toward affected side	0.15	0.22	0.19	±0.015	-0.02±0.019	-5.85	0.0001*
Rotation away affected side	0.12	0.17	0.15	±0.013	0.019±0.011	9.00	0.0001*

(*) : Significance Min : minimum m. : meter

Max : maximum $\overline{X}$: mean SD : standard deviation

D : meandifference t : paricd samples t-test value.

P : probability value.

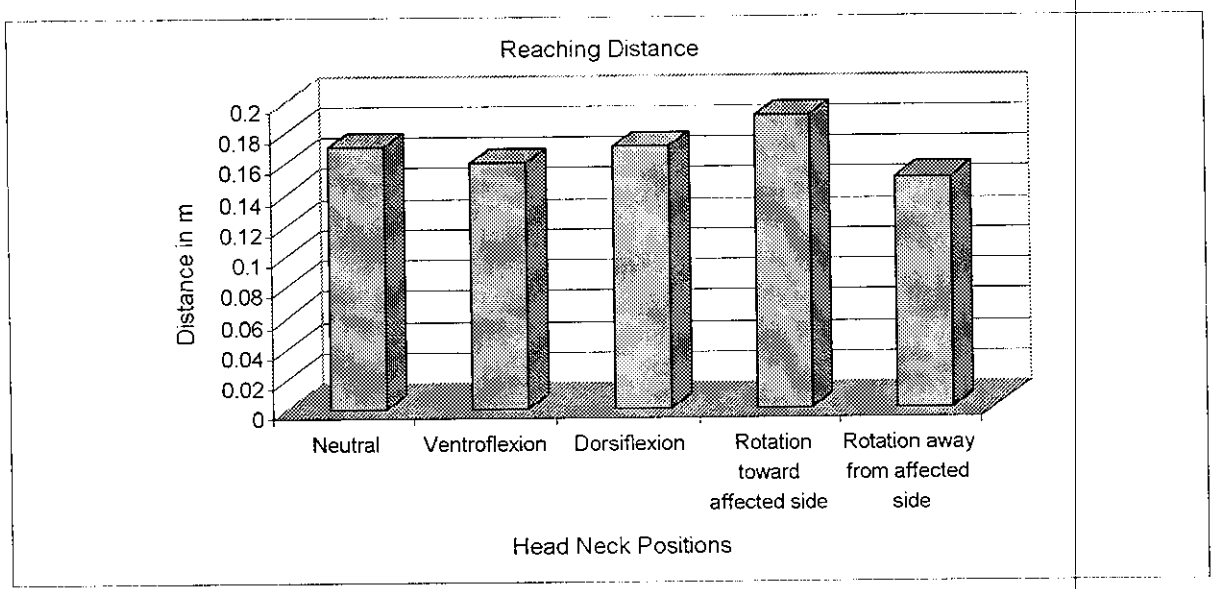

Figure (2): Shows the mean and standard deviation of the reaching distance with the affected upper limb in the neutral and other tested head neck positions.

Table (2): Time of reaching with the affected upper limb in the neutral and the other tested head-neck positions.

Head-Neck Positions	Min. (sec.)	Max. (sec.)	X (sec.)	SD (sec.)	D	t	P
Neutral	1.00	6.70	3.87	±1.143			
Ventroflexion	1.30	8.30	4.51	±1.426	-0.643±0.766	-4.60	0.0001*
Dorsiflexion	1.10	5.30	3.37	±0.942	0.497±0.470	5.79	0.0001*
Rotation toward affected side	1.00	4.70	2.74	±0.985	1.130±0.764	8.10	0.0001*
Rotation away affected side	1.30	8.30	5.18	±1.526	-1.307±1.103	-6.49	0.0001*

As shown in table (2), there was significant difference between the time of reaching in the neutral position and the following head neck positions; ventroflexed, dorsiflexed, rotation toward the affected side and rotation away from the affected side.

The result also represent that the lowest mean value of the time (2.7400) was obtained when the head and neck were in the rotation toward the affected side indicating that this position is the best head neck position for acheiving reaching activity (fig.3).

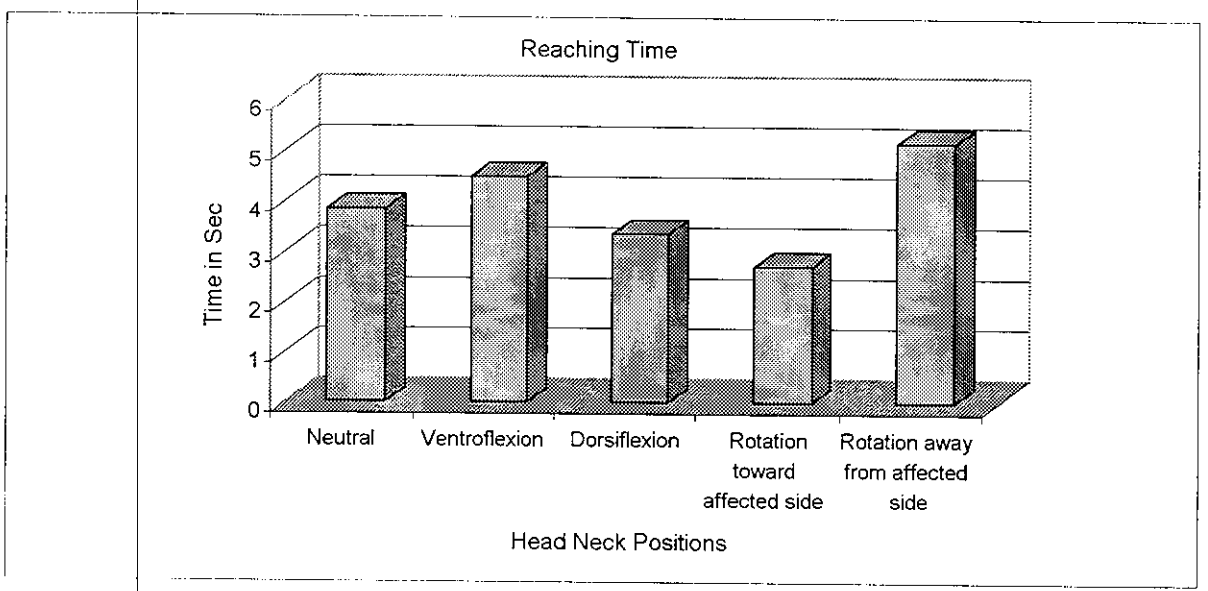

Figure (3): Shows the mean and standard deviation of the reaching time with the affected upper limb in the neutral and other tested head neck positions.

As shown in table (3), there was significant difference between the velocity of reaching in the neutral position and the other head neck positions: ventroflexed, dorsiflexed, rotation toward the affected side and rotation away from the affected side.

Table (3): Velocity of reaching with the affected upper limb in the neutral and other tested head- neck positions.

Head-neck Positions	Min. (m/sec.)	Max. (m/sec.)	X (m/sec.)	SD (m/sec.)	D	T	P
Neutral	0.03	0.15	0.05	±0.022			
Ventroflexion	0.01	0.10	0.04	±0.017	0.011±0.011	5.61	0.0001*
Dorsiflexion	0.03	0.18	0.06	±0.029	-0.010±0.013	-4.16	0.0001*
Rotation toward affected side	0.04	0.19	0.08	±0.037	-0.030±0.027	-6.05	0.0001*
Rotation away affected side	0.02	0.12	0.03	±0.021	0.015±0.011	7.59	0.001*

The results also represent that the highest mean value of the velocity (0.0793 m/sec) was obtained when the head and neck were rotated toward the affected side indicating that this position is the best head-neck position for acheiving reaching activity (fig. 4).

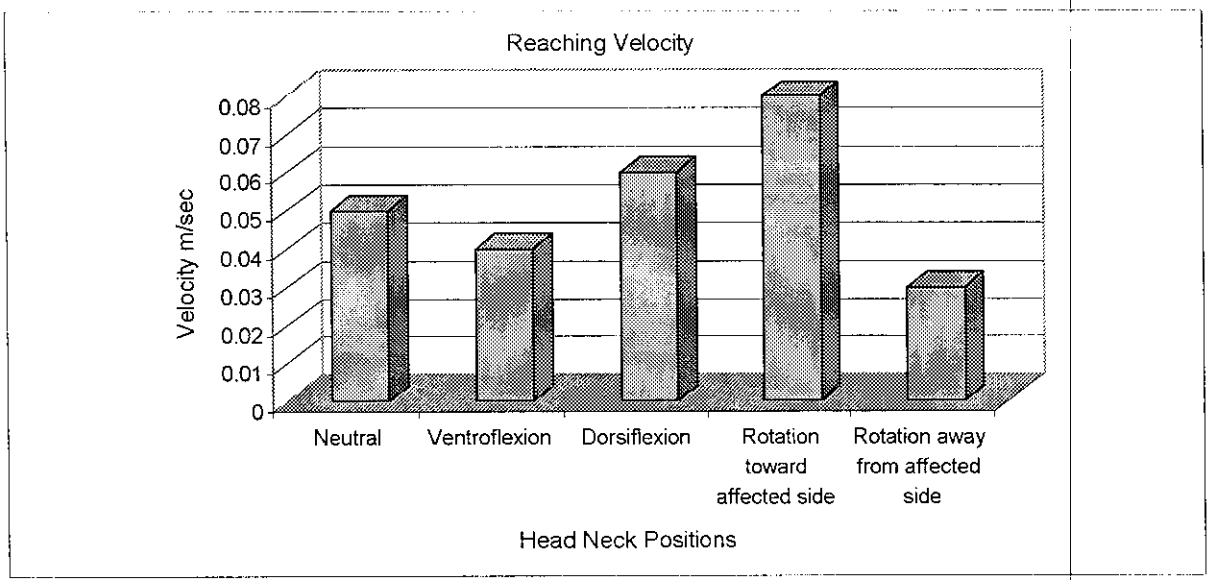

Figure (4): Shows the mean and standard deviation of the reaching velocity with the affected upper limb in the neutral and other tested headneck positions.

Comparative studies were then conducted between the mean difference in the five previously mentioned head-neck positions for the distance, time and velocity of reaching with the affected upper limb by using the ANOVA test to show the statistical significance at the 0.05 level among and within the tested head-neck positions. In case of significance. A Duncan s multiple range test was conducted to detect the most preferable head neck position for the performance of the reachg activity with the affected tipper limb.

ANOVA result of the reaching distance, time and velocity were significant at the 0.050 level (table 4a).. Duncan s new multiple range test was then conducted for the reaching distance, time and velocity at the 0.050 level as shown in (table 4b).

Table (4a): ANOVA among head- neck positions for the distance, time and velocity of reaching with the affected upper limb.

Source	D.F.	S.S.	M.S.	F. ratio	P. value
Among positions					
Distance	4	0.0286	0.0072	28.9838	0.0000
Time	4	108.7177	271794	18.0531	10.000
Velocity	4	0.0402	0.0101	15.0040	10.0001
Within positions					
Distance	145	0.0358	0.0002		
Time	145	218.3020	1.5055		
Velocity	145	0.0972	0.0007		
Total					
Distance	149	0.0644			
Time	149	327.0197			
Velocity	149	0.1375			

S.S. : sum of square M.S. : mean of squares

Table (4b): Duncan,s new multiple range test for the distance, time and velocityof reaching with the affected upper limb.

Head-Neck Positions	Mean	I	II	III	IV	V
Neutral (I)						
distance	0.1663		*			*
time	3.8700				*	
velocity	0.0490					
Ventroflexion (II)						
distance	0.1550					
time	4.5133	*		*	*	
velocity	0.0377					
Dorsiflexion (III)						
distance	0.1743		*			*
time	3.3733				*	
velocity	0.0587		*			*
Rotation toward affected side (IV) distance						
time	0.1867	*	*	*		*
velocity	2.7422					
	0.0793	*	*	*		*
Rotation away from affected side (V)						
distance	0.1477					
time	5.1767	*	*	*	*	
velocity	0.0337					

(*)Significant at the 0.05 level.

DISCUSSION

A review of the literature has revealed the existence of the tonic neck reflex in young children and in persons who are under stress or neurologically impaired. As this reflex is elicited in healthy children, it can be used in habilitation of recovery in neurologically impaired children[8].

The results obtained from this piece of work clearly demonstrated the evidence of the effect of different head-neck positions on the performance of reaching activities using the affected upper extremity of the spastic hemiparetic cerebral palsied children.

When then data from the individual subjects were pooled, three of the variables distance, time, and velocity were chosen for the study changed following the different head-neck positions on reaching with the affected upper limb.

All motor activity is based on inherent reflexes and on modification of those reflexes by higher centers[12]. The evaluation of reflexes and reactions is one of many methods used for the analysis of posture and movement in infants, children and adolescents[9]. The supra spinal reflexs have more extensive ramification of their synaptic connections on the spinal reflex and therefore produce more generalized response than do spinal reflexes, Their action can produce postural and semipurposful appearing motor pattern[3].

In respect to the results of the study considering the neutral head- neck position as the position that does not stimulate the tonic neck reflex and in regard to the reaching activity, there were a significant increase in the

mean values of the distance and velocity of reaching and a significant decrease in the mean values of time of reaching when the head and neck were in the dorsiflexed position and the rotated position toward the affected side, in which the maximum mean values of the distance and velocity and the minimum mean value of time of reaching were recorded in the rotated head-neck position toward the affected side. However, there were a significant decrease in the mean values of the distance and velocity of reaching with a significant increase in the mean values of time of reaching when the head and neck were in ventroflexed position and the rotated position away from the affected side, in which the minimum mean values of the distance and the velocity and the maximum mean value of the time were recorded in the latter head - neck position.

The increase in the mean values of the distance and the velocity with the decrease in the mean values of the time of reaching with the affected upper extremity while the head and neck were in the dorsiflexed position and in the rotated position toward the affected side can be explained by the slipraspinal effect of the symmetrical and asymmetrical tonic neck reflexes respectively on the tone of the musculature of the affected upper ings in the cervical inlervertebral joints extremity, in which the sensory end mainly between the occiput, the atlas and the axis in addition to the proprioceptors in the ligaments around these joints, were stimulated and the impulses entered the central nervous system through the first, second and third posterior cervical roots of the spinal cord to enters in the upper two cervical segemnents and the lower medullary reticultun, then the tonic neck reflex activity was initiated through the gamma neurons to increase spindle activity in the stimulated muscles. So that, with dorsiflexed position (STNR stimulus) and the rotated head- neck position toward the position affected side (STNR stimulus) there were an increase in the extensor tone of the affected upper extremity and as the elbow extensors were mainly required to perform the tested reaching activity, so this activity was performed with the longest distance, lowest time and highest velocity in the previously mentioned head-neck positions when compared with those in the other tested head- neck positions.

The results of our study clearly demonstrated a highest variations in the mean values of time of performance of reaching activities among all of the participated children when compared with the variations in the mean values of the distance of their performance, this might be occurred because the forward - backward directional grooves of modified single cutout table was of a limit length (45cm) which was very clear for each patient, so that the patients tried to reach the maximal limit as much as possible and to return to the starting without regarding the time of their performance. As a result, the time of performance rather than the distance of performance clearly demonstrated the different effects of the tested head neck positions on the reaching activity. This explanation can be supported by LeVeau (20) who stated that the analysis of temporal factors (such as time) is the first approach to the study of human movement and knowledge of time factor is essential in kinematic analysis of motion.

The cortical influence through the use of vision (eye-hand coordination) may be behind the maximal increase in the mean values of the distance and the velocity and the maximal decrease in the mean value of the time of reaching in the rotated head-neck position toward the affected side when compared with those in the dorsiflexed head-neck position. This explanation can be supported by patla[22] who stated that the visual information can

modulate the locomotion patterns effectively using several strategies including avoidance of obstacles and change of the velocity of locomotion.

The results of this study clearly demonstrated the effect of the different head-neck positions on the performance of reaching activities with the affected upper extremity in spastic hemiparetic cerebral palsied children in which the dorsiflexed head-neck position (STNR stimulus) and the rotated head-neck position toward the the affected side (STNR stimulus) facilitated the reaching with the most facilitatory effect while the head and neck were in the rotated position toward the affected side.

There is general agreement that movement must practice in order to become a part of a movement repertoire, yet the neurological approaches to treatment of children with cp. have not emphasized this critical feature of movement acquisition (12).

All motor activity is based on inherent reflexes and on modification of those reflexes by higher centers (I 8). The evaluation of reflexes and reactions is one of many methods used for the analysis of posture and movement infants, children and adolescents (9).

The influence of instructions of the coordination of prehensile movement has so far received only scant attention (1, 1 3,2 1). Change in control of movement may result in shorter reaction time and over all duration of reach. As the movement becomes smoother with improved muscle coordination, it may be reflected in the velocity and acceleration (I 2). As the effects of these reflexes on the upper extremities is more evident, the child with spastic hemiparetic cerebral palsy could be habilitated to use his/her affected upper extremities in the performance of many functions while considering the head-neck position.

CONCLUSIONS

The results obtained from this piece of work revealed a significant effect of the different head-neck positions on the reaching activity of perforrnancce of the affected upper extremity in children with spastic hemiparetic cerebral palsy aging from four to seven years. So that, it is recommended that the head-neck positions should be considered during the reaching activity in assessment and habilitation of such children.

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الملخص العربي

تأثير وضع الرأس والرقبة على طريقة الوصول في حالات الأطفال المصابين بالشلل المخي النصفي التصلبي

دراسة تأثير وضع الرأس والرقبة على حركة الوصول في حالات الأطفال المصابين بالشلل المخي النصفي التصلبي وأيضا معرفة أي من أوضاع الرأس والرقبة المختلفة (الوضع المعتدل ، وضع الثني للأمام ، وضع الثني للخلف ، ووضع الدوران في اتجاه الجانب المصاب ووضع الدوران في اتجاه الجانب الغير مصاب) له أكبر تأثير محفز على الأداء الوظيفي في حالات الأطفال المصابين بالشلل المخي النصفي التصلبي .

تم إجراء هذا البحث على ثلاثين طفلا من المصابين بالشلل المخي النصفي التصلبي من الجنسين (١٩ولدا و ١١ بنتا) تتراوح أعمارهم من أربع إلى سبع سنوات وقد تراوحت درجة الشلل التصلبي على أساس مقياس أشوارس المعدل ما بين ١ ، +١ ، ٢ درجة أستخدم لهذا البحث منضدة بمواصفات ومقاييس خاصة لكي تستعمل في الأداء الحركي للوصول وتم تصوير هذه الحركات باستخدام كاميرة فيديو. وقد كلف كل طفل بأداء حركة الوصول أثناء وضع الرأس والرقبة في الأوضاع التالية:

الوضع المعتدل (١) وضع الثني للأمام (٢) ، وضع الثني للخلف (٣) ، وضع الدوران في اتجاه الجانب المصاب(٤) ، ووضع الدوران في اتجاه الجانب الغير مصاب (٥) .

وقد تم أداء ما سبق باستخدام الطرف العلوي الغير مصاب أولا ثم باستخدام الطرف العلوي المصاب وهذا حتى يتسنى للطفل معرفة الحركات المطلوبة بالإضافة إلى حثه على أدائها. وقد قيمت حركتي الوصول عن طريق تحديد المسافة والزمن والسرعة الخاصة بكل حركة في كل وضع من أوضاع الرأس والرقبة تحت الاختبار .

أظهرت النتائج وجود فروق ذات دلالة إحصائية عالية بالنسبة لجميع أوضاع الرأس والرقبة بمقارنتها بنتائج وضع الرأس والرقبة المعتدل في حركة الوصول وهذه النتائج تؤكد وجود تحسن واضح في حركة الوصول في كل من وضع الثني للخلف ووضع الدوران في اتجاه الجانب المصاب مع أفضلية الوضع الأخير . على ضوء هذه النتائج نرى ضرورة الأخذ في الاعتبار وضع الرأس والرقبة أثناء تقييم وتأهيل الطرف العلوي المصاب في حالات الأطفال المصابين بالشلل المخي النصفي التصلبي .