Research Article

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Posture Outcomes for Children Suffering from Obstetrical Injuries.

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This study was conducted at the lab of geometrical analysis of spine, Faculty of Physical Therapy, Cairo University, Egypt in 2006 to evaluate the geometrical analysis of spine of children suffering from brachial plexus injury at birth specially those of upper trunk lesion (Erb's type) and compare results with those of normal children to identify the differences between the two groups. Fifteen Erb's palsied children and fifteen normal children participated in this study. All children ranged in age from three to six years. Formetric (rastersterography) instrument was used for assessing the back geometry of both groups. The data of Erb's palsied children was compared with that of normal group through un-paired t-test with p-value at 0.05. The results of this study showed significant differences in the measured parameters including lateral deviation (rms), lateral deviation (max), kyphotic angle ICT-ITL (max) and kyphotic angle VP-T12 between the two groups. On the other hand, there was no significant difference when comparing kyphotic angle VP-ITL between both groups. From the obtained results, it can be concluded that, this study predicts the possible spinal deviations resulting from obstetrical brachial plexus injury.

Key words: Erb's Palsy, Spinal geometry, Rastersterography.

The brachial plexus is a network of nerves that conduct signals from the spine to the shoulder, arm, and hand. It is composed of the four lower cervical roots (C_5 – C_8) and the first thoracic root (T_1). The roots exit through the anterior vertebral foramen and divide first to the upper, middle and lower trunk, and then to the lateral, posterior and medial cord in the axilla. Then split into the final nerve branches (Hamill and Knutzen, 2003). Brachial plexus injuries may result from traction as the head is pulled away from the shoulder during delivery. Injury to C_5 – C_6 roots is most common and results in Erb-Duchenne paralysis. The arm is limp, adducted and internally rotated, extended and pronated at the elbow, and flexed at the wrist (so-called waiter's tip posture), grasp is present. If the lower nerve roots (C_8 – T_1) are involved, the hand is flaccid (Klumpke's). Isolated involvement of these roots is rare. If the entire plexus injured, the arm and hand are flaccid, with an associated sensory deficit (Thilo and Rosenbergs, 2003). Ideal posture is variously described as the posture that requires the least amount of muscular support, the posture that minimizes the stresses on the joints, or the posture that minimizes the loads in the supporting ligaments and muscles. In the absence of clear understanding of meaning of the ideal posture, careful measurements of the positions assumed by individuals without known musculoskeletal impairments or complaints provide a perspective on the typical, if not ideal , alignment of limb segments (Carol, 2004). Congenital spinal anomalies are a consequence of an embryological developmental problem, while scoliosis with neurological and muscular associations can occur secondary to neurological conditions such as cerebral palsy, muscular dystrophy or syringomyelia (Dangerfield, 2003). There is wide range in geometrical properties of the spine such as lordosis, kyphosis, and axial rotation and of the trunk including the angle of trunk inclination and other parameters. Furthermore, the terminology considers the underlying pathologies as well classifying the curve types based on their anatomical levels in the spine and the various curve patterns (Weiss et al., 2003). Many affected brachial plexus palsied children recover with no deficits or only minor residual ones; however, others never achieve sufficient limb function and go on to sustain functional limitations, bony deformities and joint contractures (Piatt, 2004). The brachial plexus palsied child should be re-evaluated on a regular basis to ensure that scoliosis does not develop from muscle imbalance and asymmetric motor patterns (Jennifer and Ann, 2001).

MATERIALS AND METHODS

Subjects:

Thirty subjects were selected in this study (15 Erb's palsied and 15 volunteers) and the study was conducted in the geometrical lab of the Faculty of Physical Therapy, Cairo University. Subjects were divided into two groups of equal numbers as follows:

A – Normal group:

Fifteen volunteers' children of both sexes were selected from the population. Their age ranged from three to six years. All selected children were right handed. They had no current or previous neurological or musculoskeletal disorders. Those children were volunteers and were selected from governmental School. These children were selected after taking the images of the Erb's palsy group to achieve matching between the two groups in age, sex, height and weight. Their average heights were one meter or more. They had grade 5 according to Mallet classification (Raymond and Stuart, 2006) as all children were able to do the functional activities of Mallet system for full range and in accurate manner.

B – Patients' group:

Fifteen patients with Erb's palsy were selected from the outpatient clinic of the Faculty of Physical Therapy, Cairo University. Children of both sexes participated in this study as they were receiving the traditional physical therapy program. Their age ranged from three to six years. All participant children were Erb's palsied type (C_5, C_6 and C_7 affected). All selected children were right handed. Their average height was not less than one meter or more. They had either grade 3 or grade 4 according to Mallet classification (Raymond and Stuart, 2006). They were able to understand orders and follow verbal commands and instructions given to them. They had neither visual nor auditory defects. They had no significant perceptual disorders. They had no significant tightness or fixed deformity of the affected upper limb.

Formetric instrumentation system:

(AESCULAP-MEDITEC GMBH, Holland)

It serves for the determination of the geometry of the back surface of human beings based on non contact three dimensions scan and, derived from it, a spatial reconstruction of the spine by means of a specific mathematical model. The device is a reliable, valid and non-invasive method in assessing any spinal or pelvic deviation. It uses the three dimensional analysis so it can detect any deviations in any planes. Also it take few time for Full Back analysis, that will be recorded, and printed out without sophisticated mathematical calculations in x-ray method or using many devices to get the results (Drerup and Hierholzer, 1996).

The preparatory procedure:

The procedure was explained to the subject and his/her attending relatives. Child was taught to take and hold deep breathing. Care was taken not to interrupt the recording procedure to maintain the child in relaxed position. Child had to be bare feet before standing to avoid any spinal deviation.

The evaluative procedure:

The software program was started before positioning the child. Data was entered in his/her file on the computer including date of birth, name, sex, height, weight, any previous radiological findings and any comments on the case. Child was asked to stand facing the black ground screen at a distance of two meters away from the measurement system (scan system). A freestanding posture was preferable. Each child was asked to take normal breathing. The subject was asked to stop breathing for few seconds while image capture was released. Forced breathing in and out should be avoided, as it will affect his/her balance causing trunk imbalance. The scanner was elevated for different subjects' heights as there is a green horizontal line appears on the computer screen when the camera is ready for recording. Full back shape three-dimensional analysis was done, recorded, and printed out.

Statistical analysis

The collected data of demographic and other baseline characteristics was statistically treated to show mean, range and standard deviation of mean for back geometrical parameters. The collected data for both groups were statistically analyzed using Graph pad instate software version 3.05. Un-paired t-test was conducted for back geometrical parameters to determine any statistically significant differences between data collected from both groups. P-value (<0.05) was considered significant.

RESULTS

General characteristics:

Table (1) presents a summary of children general characteristics at entry as age, frequency distribution of gender and frequency distribution of Mallet system grading.

Back geometrical variables: It was observed statistical differences in back geometrical parameters including lateral deviation (rms), lateral deviation (max) kyphotic angle ICT-ITL (max) and kyphotic angle VP-T12 ($p<0.05$) but it is observed no statistical difference in kyphotic angle VP-ITL ($p>0.05$) when comparing mean values of both groups as shown in table (2) and demonstrated in figure (1).

DISCUSSION

Including the study group sample to be from Erb's palsied children agrees with Wilson and Kenyon (2002) who stated that, Duchenne-Erb type constitutes a major form among brachial plexus palsied children as, it accounts about 80 – 90% of all brachial plexus palsied cases as a result of unilateral upper trunk lesion.

Choosing age from three to six years was based on being sure that spontaneous recovery that occurs between three to six months after injury and it will become irreversible after two years of age was supported by Rust (2000) who reported that, muscle atrophy being from lower motor neuron lesions begins three to six months after injury and by one and half to two years is irreversible. Also, this agrees with Raymond and Stuart (2006) who stated that, prognosis has been defined by the spontaneous rate of recovery of muscle strength in the first three to six months of infancy. Regain of function is the predictor of recovery. The infants who did not show complete regain of function by three months, will not be normal after two years of life. Ranging in age from three to six years is supported by Wilson and Kenyon (2002), who revealed that, most plexus injuries would recover spontaneously by three to four months of age. But, recovery can occur up to two years of age.

All clinical measuring parameters are liable to high margins of error. Measuring the surface with the video rastersterography (Formetric instrumentation system) has shown high reliability in previous studies, this system has been used to evaluate the results of rehabilitation in the patients with Scheuermann's disease (Weiss et al., 2003).

Regarding the obtained results from this study, some values of trunk imbalance, lateral deviation (rms) and lateral deviation (max) for normal group exceeded the normal values. These obtained results may be attributed to immaturity of the spine or bad practiced habits. This agrees with Nof and Rebecca (2005) who stated that, in the early stages of development, the infant props him/herself on arms, in a position that permits the elevation of the chest from a surface. Spinal extension strengthens in the antigravity prone position and proceeds in a cephalic to caudal direction from the cervical to the thoracic spine promoting stability in the upper quadrant.

The stability of the vertebral column depends upon a number of factors. One of these is the relationship to a vertical line representing the center of gravity, the line of gravity, is among the most important. When weight is properly balanced on the vertebral column, minimal muscular activity is necessary. A constantly maintained position in which the weight is not reasonably well balanced is resulting in structural changes and a permanent deformity in the growing child (Jenkins, 2002).

The findings of this study come in agreement with Case-Smith (2005) who stated that; scoliosis is the most common and serious of spinal curvature disorders. Lateral curvature of the spine is often accompanied by rotation of the vertebral bodies. Functional scoliosis is flexible and can be caused by poor

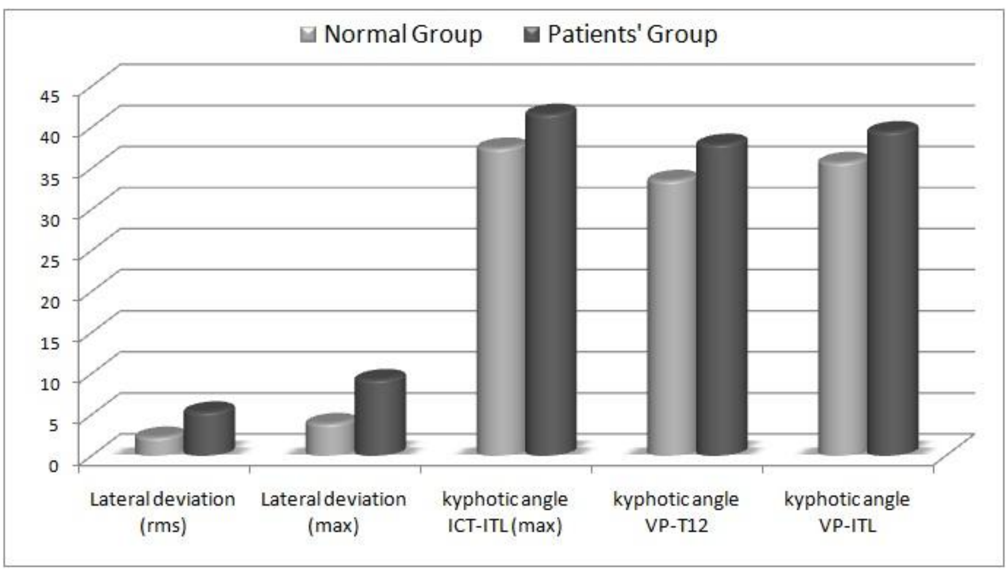
Table 1: General characteristics of all subjects.

Item		Normal group	Patients' group
Age (year)	Mean±SD	4.69 ± 0.79	4.68 ± 0.81
	Range	3.75 – 6	3.58 – 6
Frequency distribution of gender	Male	8	6
	Female	7	9
Frequency distribution of Mallet system grading	Grade 3	0	9
	Grade 4	0	6
	Grade 5	15	0

Table 2: Comparison of mean values for measured variables between both groups.

Variable	Mean ± SD		t-value	p-value
	Normal group	Patients' group		
Lateral deviation (rms)	2.27±1.87	5.33±3.04	3.33	<0.05
Lateral deviation (max)	3.93±2.43	9.27±5.05	3.69	<0.05
kyphotic angle ICT-ITL (max)	37.47±5.97	41.6±4.76	2.13	<0.05
kyphotic angle VP-T12	33.53±4.22	37.93±5.54	2.45	<0.05
kyphotic angle VP-ITL	35.73±5.34	39.47±5.32	1.92	>0.05

Figure 1: Mean values of all measured variables between both groups.



posture, leg length discrepancy, poor postural tone, or pain. Diseases of the nervous system or spine also may create scoliosis. It also come in agreement with Chen et al. (2005) who demonstrated that, whatever the initial trigger that induces a spinal curvature, asymmetric loading of the spinal axis produces biomechanical forces that can account for most if not all progression of the spinal deformity.

The obtained results may be attributed to the weight differences between both upper limbs as the affected one suffer from atrophy which represent differences in force or load bearded by the spinal column. Also, the findings of the present study may be attributed to the limitation in functional level as there is relation between stability and mobility. Any limitation in mobility around the spine will in turn affect the stability of the spine which will lead to un-expected deformities through altering the loads around the spine. Differences occurred between both groups may be attributed to defects in the work of one factor or more of the infra structures in which spinal alignment depends on such as bones, joints, ligaments and muscles. Also, the findings of the present study may be attributed to the effect of proximal affection through involving the muscles around either scapula or glenohumeral joint (shoulder complex). It may also be attributed from the biomechanical point of view to the idea that, the applied stresses on a structure should be equal in all direction in which to maintain the alignment of this structure. This idea may not be achieved in brachial plexus palsied children in which the stresses the spine are not equal due to muscle imbalance.

Conclusions:

From the previous discussion of the results of this study and according to the reports of the investigators in the fields related to the present study, it can be stated that, brachial plexus palsy is considered as one of the predisposing factors that may lead to different geometrical changes of the spine which may develop scoliosis and kyphosis in the future.

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