Quantitative Postural Analysis of Children With Congenital Visual Impairment

Michelle de Pádua, MS, Juliana F. Sauer, MS, and Silvia M.A. João, PhD

Abstract

Objectives: The aim of this study was to compare the postural alignment of children with visual impairment with that of children without visual impairment.

Methods: The sample studied was 74 children of both sexes ages 5 to 12 years. Of these, 34 had visual impairment and 40 were control children. Digital photos from the standing position were used to analyze posture. Postural variables, such as tilt of the head, shoulder position, scapula position, lateral deviation of the spine, ankle position in the frontal plane and head posture, angle of thoracic kyphosis, angle of lumbar lordosis, pelvis position, and knee position in the frontal and sagittal planes, were measured with the Postural Assessment Software 0.63, version 36 (SAPO, São Paulo, Brazil), with markers placed in predetermined bony landmarks.

Results: The main results of this study showed that children with visual impairment have increased head tilt ($P < .001$), shoulder deviation in frontal plane ($P = .004$), lateral deviation of the spine ($P < .001$), changes in scapula position ($P = .012$), higher thoracic kyphosis ($P = .004$), and lower lumbar lordosis ($P < .001$).

Conclusions: Visual impairment influences postural alignment. Children with visual impairment had increased head tilt, uneven shoulders, greater lateral deviation of the spine, thoracic kyphosis, lower lumbar lordosis, and more severe valgus deformities on knees. (J Manipulative Physiol Ther 2017;xx:1-9)

Key Indexing Terms: *Posture; Child; Visual Impairment*

Introduction

Vision plays a fundamental role in body development because it is a primary source of stimulus that enables direct interaction with the external environment. The ability to move and explore the environment enables the acquisition of key experiences that allow the global development and adaptation of the child to the environment.[1-5]

Although the body needs information from various sensory and proprioceptive organs, vision plays the most important role because it encodes and processes information from all other senses. Thus, in the early years of life, the child is more dependent on visual information than on somatosensory and vestibular information.[6]

Some variations in posture in children are associated with growth stages, and changes in body proportions can lead to problems with balance. The deviations in postural alignment could be considered normal at the developmental phase of the musculoskeletal system, but the same deviations may be considered inappropriate at a subsequent developmental phase.[7]

Evaluation and postural education are important aspects of rehabilitation for diagnosis and treatment planning, as well as for monitoring the progress and results of physical therapy treatment.[7]

According to Lafond et al, in clinical practice, assessment of the standing posture of children and adolescents can be very useful for early detection of developmental musculoskeletal changes. This early detection helps plan interventions to prevent or delay the establishment of postural abnormalities.[8]

In children with visual impairments, temporal as well as spatial information is processed with lower speed, and motor development is less understood than in children with normal vision.[2]

The literature demonstrates that children with visual impairments may undergo more changes in posture than only in the alignment of the head and the cervical spine. There is no standard approach to assessing posture. However, the use of photographs as a tool for postural assessment has been supported by many researchers.[9-13] This technique has a quantitative character that allows the measurement of angles and distances between bone references, joints, planes, and axes.[11]

Considering that children with normal vision usually exhibit postural changes during growth, that children with visual impairment may have postural changes related to

Department of Physical Therapy, Speech and Occupational Therapy, University of São Paulo, São Paulo, SP, Brazil.

Corresponding author: Juliana F. Sauer, MS, Department of Physical Therapy, Speech and Occupational Therapy, University of São Paulo, 51 Cipotânea St, São Paulo, SP 05360-000, Brazil. Tel.: +55 11 97043 0977. (e-mail: *Juliana.sauer@usp.br*).

Paper submitted August 2, 2016; in revised form November 7, 2016; accepted July 28, 2017.

0161-4754

https://doi.org/10.1016/j.jmpt.2017.07.016

lack of information, and that the knowledge of most frequent postural changes in children with visual impairment can be critical to diagnosing and treating musculoskeletal disorders and to monitoring patient progress in physiotherapy treatment, it is necessary to investigate the postural pattern in children with visual impairments.

Therefore, the objective of the present study was to quantitatively characterize the posture of children with congenital visual impairment. Our hypothesis was that children with congenital visual impairment would have more postural changes compared with children with normal vision.

Methods

Sample

The study included 74 children, 34 with visual impairments and 40 with normal vision. The sample size calculation of the 34 children with congenital visual impairment, based on head tilt, was carried out using G-Power 3.0 software (available at: http://www.gpower.hhu.de/en.html), considering a moderate effect size (F = 0.25), a statistical power of 80%, and a significance level of 5%.

Children with visual impairments were selected from the Low Vision sector of Hospital das Clínicas, Universidade de São Paulo, Institute of Blind Padre Chico, and the Brazilian Association of Assistance to the Visually Impaired. Sixteen girls (47%) and 18 boys (53%), ages 5 to 12 years, were included in the study. With regard to the group with visual impairments, the participants were blind (visual acuity lower than 3/60 gift or visual field lower than 10th), had severe visual impairment (visual acuity <6/60 present and ≥3/60), or had moderate visual impairment (visual acuity <6/18 present and ≥6/60).[6]

The children in the control group were selected from the network of municipal public schools of São Paulo, Brazil, and 17 girls and 23 boys, ages 5 to 12 years, were included in the study. For both groups, the exclusion criteria were the presence of neuromuscular, musculoskeletal, and cardiorespiratory diseases, and body mass index greater than the 85th percentile. Children involved in sports at a frequency greater than twice a week and/or up to 3 hours weekly were also excluded.

Procedure

Initially, parents or legal guardians signed a free and informed consent form. The study was approved by the Ethics Committee for Research Development Review, CAPPesq Clinical Hospital of the board of the Faculty of Medicine, University of São Paulo (São Paulo, Brazil).

An initial evaluation form containing information about weight, height, age, eye pathology, body mass index, race, dominance, and institution or school, was filled out.

Postural evaluation was performed with the use of digital photographs of the individual in the orthostatic position, in the sagittal and frontal planes. In the sagittal plane, each individual was photographed twice, first with arms positioned along the body and then with shoulder adduction and internal rotation and elbow flexion, resting hands on the thorax contralaterally, to facilitate measurement of the thoracic and lumbar curvatures, pelvic tilt, and knees.[7]

Children were dressed in bathing suits and positioned on a wooden base, with feet equidistant from the middle line of the wooden base.

A digital camera (Cyber-shot W-55; Sony, Tokyo, Japan) was placed on a tripod with at 1 m height, at a distance of 2.5 m from the wooden base. Reference points on the head, trunk, and limbs were marked with self-adhesive labels of 13 mm and 9 mm Styrofoam balls, as previously described by Penha et al.[7]

The following points were marked: external acoustic meatus, acromion, inferior angle of the shoulder blades; anterosuperior iliac and posterosuperior spine; spinous cervical region (C5 and C7); thoracic (T1, T3, T6, T9, and T12) lumbar (L3 and L5), sacral (S2) spine; lateral malleolus; the midpoint between the malleoli (Achilles tendon); the midpoint of the calcaneus; midpoint of the lower third of the leg; head of the fibula; and the greater trochanter of the femur.

Two previously trained evaluators performed the photographic procedures, and then the photos were imported into the Postural Assessment Software 0.63, version 36 (SAPO, São Paulo, Brazil). The Postural Assessment Software was developed to assist with posture assessment from digitalized pictures and determined coordinates of the anatomical points on the photographs. The measurements used for posture analysis included distances (in centimeters) and angles (in degrees), taken from a combination of anatomical points. The photo alignment was held from markers located on the plumb line. For each participant, 4 photos were analyzed (anterior, posterior, left, and right views). The analysis was conducted as follows: opening the photo, 40% zoom, calibrating image using the plumb line, marking anatomical points, and producing a report on the placement of the points in terms of x (horizontal) and y (vertical) coordinates.

Postural Data Analysis

Tilt of the Head in the Frontal Plane. Pictures were taken in the frontal plane. A line passing through the ear canal perpendicular to the plumb line and another line between the right and left ear canals were traced. The angle between the 2 lines was measured.

Head Posture. Pictures in the left and right sagittal planes, with arms placed along the body, were considered independent. A horizontal line going through C7 perpendicular to the plumb line and another line diagonal to C7 in