

Clinical Study

Analysis of hip dysplasia and spinopelvic alignment in cerebral palsy

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Abstract

BACKGROUND CONTEXT: Knowledge of sagittal spinopelvic parameters and hip dysplasia is important in cerebral palsy (CP) patients because these parameters differ from those found in the general population and can be related to symptoms.

PURPOSE: The purpose of this study was to analyze sagittal spinopelvic alignment and determine its relation to hip dysplasia in CP patients.

STUDY DESIGN: Radiological analysis was conducted on patients with CP.

PATIENT SAMPLE: Fifty-four patients with CP and 24 normal controls were included in this study.

OUTCOME MEASURES: Participants underwent radiographs of the whole spine.

METHODS: The patient and control groups comprised 54 CP patients and 24 volunteers, respectively. All underwent lateral radiography of the whole spine and hip joint anteroposterior radiography. The radiographic parameters examined were sacral slope, pelvic tilt, pelvic incidence, S1 overhang, thoracic kyphosis, thoracolumbar kyphosis, lumbar lordosis, sagittal balance, center edge angle, acetabular angle, and migration index. Statistical analysis was performed to identify significant differences and correlations between the two groups.

RESULTS: Sacral slope, thoracolumbar kyphosis, lumbar lordosis, sagittal balance, acetabular angle, and migration index were significantly higher in CP patients, whereas pelvic tilt, S1 overhang, and center edge angle were significantly lower ($p < .05$). Correlation analysis revealed that pelvic incidence, sacral slope, pelvic tilt, and S1 overhang were related to each other and that thoracolumbar kyphosis was related to the thoracic kyphosis and lumbar lordosis ($p < .05$). For spinal and pelvic parameters, lumbar lordosis was related to sacral slope, pelvic incidence, pelvic tilt, and S1 overhang; for hip dysplasia parameters, center edge angle and acetabular angle were found to be inter-related ($p < .05$). Regarding symptoms, pelvic tilt, S1 overhang, and thoracolumbar kyphosis were found to be correlated with symptom severity in patients. However, no hip dysplasia parameters were found to be related to hip or spinal symptoms.

CONCLUSIONS: This study found significant differences between CP patients and normal controls in terms of spinopelvic alignment and hip dysplasia. Furthermore, relationships were found between the sagittal spinopelvic parameters and hip dysplasia, and correlations were found between sagittal spinopelvic parameters and pain. © 2014 Elsevier Inc. All rights reserved.

Keywords:

Cerebral palsy; Sagittal spinal alignment; Pelvic orientation; Hip dysplasia; Lumbar lordosis; Pelvic incidence

Introduction

Cerebral palsy (CP) is an encephalopathy caused by a brain dysfunction that occurs during the perinatal or postnatal phase of development, and the overall incidence of CP has been estimated to range from 1 to 5 children per 1,000 live births [1–5]. Cerebral palsy can be characterized by a lack of muscle control with increased spasticity or decreased muscle tone and variable levels of spinal and pelvic deformities, which include sagittal misalignment

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and hip dysplasia. These characteristics of CP are associated with considerable debility and reduced quality of life.

Recently, orthopedic surgeons have highlighted the importance of the shape of the human spine and pelvis in terms of understanding the physiology and pathophysiology of disease [6–9]. In addition, a chain of strong correlations between sagittal spinal and pelvic parameters have been described in specific subjects. Analyses of spinopelvic parameters can be important because CP commonly manifests with sagittal abnormality and hip dysplasia, which differs from that observed in the general population. Therefore, a more comprehensive understanding of spine and hip deformities is required in CP patients.

The aim of this study was to determine differences between sagittal spinopelvic alignment and hip dysplasia in CP patients and normal controls and to determine the relationship among associated parameters and symptoms in CP patients.

Materials and methods

Study subjects

All CP patients who visited hospital between 2008 and 2011 were taken radiographs of hip and spine as a routine examination. In addition, patients' self-reported pain scores were addressed. To evaluate the relation of spinopelvic parameters and hip dysplasia in CP, we selected the subjects with our inclusion criteria. Patients with nonambulatory CP who could not maintain a standing position, patients with complete hip dislocation (hips with migration index >100%) or severe scoliosis (Cobb >80°) who interfered with the accuracy of angular measurements, or patients unable to communicate their severity of pain were excluded. Consequently, the subjects in this study consisted of 54 CP patients (22 males and 32 females) with no history of a spine or hip operation on examination. All patients were diagnosed as having spastic CP (32 diplegic and 22 quadriplegic cases). In addition, 24 healthy subjects (11 males and 13 females) with no history of spinal or hip disease were

included as a control group according to the power analysis ($\alpha=0.05$, $1-\beta=0.95$). Subjects with an abnormal radiograph because of hip dysplasia, disc space narrowing, or other abnormalities or with spine or hip originating symptoms were excluded. All study subjects were consented to participate in the study.

Patients' disability analysis

All patients completed a questionnaire that gathered general information (sex, age, name, medical history [surgery, medication, intervention], and so forth) and information on concurrent diseases (cardiovascular disease, pulmonary disease, scoliosis, and other extremity deformity). We measured the pain score using 10-cm visual analog scale (VAS 0–10) score. Pain originating from the spine (including back pain, radiating pain, and sciatica) was scored as VAS L, pain originating from the hip was scored as VAS H, but pain originating from another part of the body, such the ankles or knees, was excluded.

Radiographic analysis

Lateral radiographs of the entire spine and anteroposterior hip radiographs were obtained at a standard tube-film distance of 180 cm, with the central ray targeting at the T6–T7 area. All radiographs were taken in the standing position, and we excluded the subjects who could not stand because of hip flexion deformity or severe scoliosis. The subjects held onto a vertical pole with their hands to prevent the upper extremities from duplicating over the spine. We measured 11 parameters in radiographs, defined as follows (Fig. 1):

1. Sacral slope: angle between the sacral end plate and the horizontal line.
2. Pelvic tilt: angle between the vertical line and a line joining the middle of the sacral end plate and hip axis.
3. Pelvic incidence: angle between a line perpendicular to the sacral end plate and a line joining the middle of the sacral plate and hip axis.

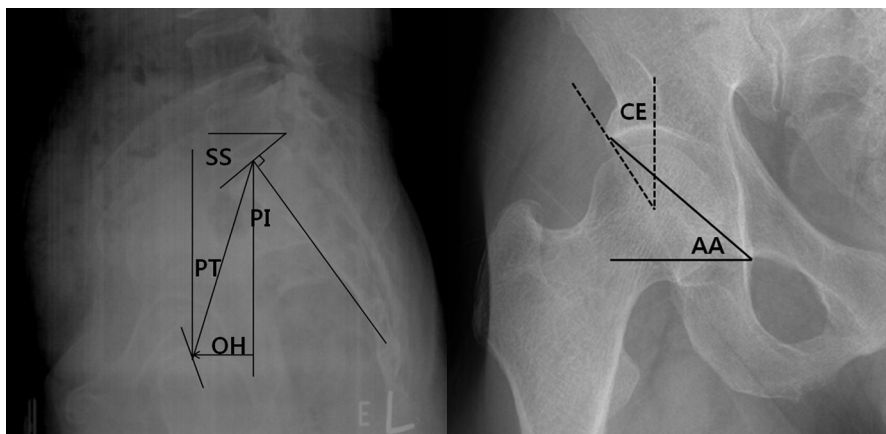


Fig. 1. Plain radiographs showing (Left) sagittal pelvic and (Right) coronal hip parameters.

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