

# Tridimensional Analysis of Rotatory Subluxation and Sagittal Spinopelvic Alignment in the Setting of Adult Spinal Deformity

Emmanuelle Ferrero, MD<sup>a,b,\*</sup>, Renaud Lafage, MS<sup>a</sup>, Bassel G. Diebo, MD<sup>a</sup>,  
Vincent Challier, MD<sup>a</sup>, Brice Illharreborde, MD, PhD<sup>c</sup>, Frank Schwab, MD<sup>a</sup>, Wafa Skalli, PhD<sup>d</sup>,  
Pierre Guigui, MD<sup>b</sup>, Virginie Lafage, PhD<sup>a</sup>

<sup>a</sup>Orthopaedic Surgery, Hospital for Special Surgery, 535 E 70th St, New York, NY 10021, USA

<sup>b</sup>Orthopaedic Surgery, Hôpital Européen Georges Pompidou, 20 Rue Leblanc, 75015 Paris, France

<sup>c</sup>Orthopaedic Surgery, Robert Debré Hospital, 48 Bd Sérurier, 75019 Paris, France

<sup>d</sup>Laboratoire de Biomécanique, Arts et Métiers ParisTech, 151 Boulevard de l'Hôpital, 75013 Paris, France

Received 25 August 2016; revised 24 November 2016; accepted 7 January 2017

---

## Abstract

**Study Design:** Retrospective single-center.

**Objective:** To investigate rotatory subluxation (RS) in adult spinal deformity (ASD) with three-dimensional (3D) stereoradiographic images and analyze relationships between RS, transverse plane parameters, spinopelvic parameters, and clinical outcomes.

**Background:** Recent research has demonstrated that sagittal plane malalignment and listhesis correlate with ASD patient-reported outcomes. However, there is still a lack of knowledge regarding the clinical impact of 3D evaluation and rotatory subluxation. Recent developments in stereoradiography allow clinicians to obtain full-body standing radiographs with low-dose radiation and 3D reconstruction.

**Methods:** One hundred thirty lumbar ASD patients underwent full-spine biplanar radiographs (EOS Imaging, Paris, France). Clinical outcomes were recorded. Using sterEOS software, spinopelvic parameters and lateral listhesis were measured. 3D transverse plane parameters included apical axial vertebral rotation, axial intervertebral rotation (AIR), and torsion index (sum of AIR in the curve). ASD patients were divided in three groups: AIR < 5°, 5° < AIR < 10°, AIR > 10°. Groups were compared with respect to radiographic and clinical data. Correlations were performed between the transverse and sagittal plane parameters and clinical outcomes.

**Results:** Patients with AIR > 10° were significantly older, with larger Cobb angle (39.5°) and greater sagittal plane deformity (pelvic incidence–lumbar lordosis mismatch 11.7° and pelvic tilt 22.6°). The AIR > 10° group had significantly greater apical vertebra axial rotation apex (24.8°), torsion index (45°), and upper-level AIR (21.5°) than the two other groups. Overall, 27% of AIR patients did not have two-dimensional (2D) lateral listhesis. Patients with AIR > 10° had significantly worse Oswestry Disability Index and more low back pain.

**Conclusion:** For patients in which lateral listhesis was unreadable in 2D imaging, rotatory subluxation was revealed using stereoradiography and at an earlier disease stage. Moreover, different 3D transverse plane parameters are related to different patient-reported outcomes. Therefore, axial rotation can be considered in evaluation of lumbar degenerative scoliosis severity and prognosis.

**Level of Evidence:** Level III.

© 2017 Scoliosis Research Society. All rights reserved.

**Keywords:** Adult spinal deformity; Lumbar scoliosis; Rotatory subluxation; Transverse plane; 3D analysis

---

Author disclosures: EF (none); RL (none); BGD (none); VC (none); BI (personal fees from Zimmer Spine, other from Implanet, outside the submitted work); FS (personal fees from Nemaris Inc., grants and personal fees from MSD and DePuy, personal fees from K2M and Medicea, grants from AO, outside the submitted work); WS (none); PG (none); VL (personal fees from Nemaris Inc. and MSD; grants and personal fees from DePuy; grants from ISSG, SRS, and NIH; personal fees from K2M, NuVasive, and Medicea, outside the submitted work).

The authors acknowledge the French Orthopedic and Traumatologic Surgery Society (SoFCOT), without whose help this research would not have been possible.

\*Corresponding author. Hôpital Européen Georges-Pompidou, APHP, Paris V University, 20 rue Leblanc, 75908 Paris Cedex 15, France. Tel.: +331 56 09 32 72; fax: +331 56 09 23 95.

E-mail address: [Emmanuelle.ferrero@gmail.com](mailto:Emmanuelle.ferrero@gmail.com) (E. Ferrero).

## Introduction

In the setting of orthopedic practice, low back pain (LBP) represents roughly 2.5% of all physician visits [1]. Causes of LBP include but are not limited to scoliosis, adult spinal deformity (ASD), and degenerative spine diseases. With regard to ASD, several authors have investigated the impact of radiographic parameters on health-related quality of life (HRQOL) parameters [2-6]. Radiographic parameters that most highly correlate with patient-reported outcomes are focal (ie, rotatory subluxation [RS]), regional (ie, loss of lordosis), and global (ie, sagittal malalignment) [7]. These complex deformities are often associated with spinal degenerative diseases, such as arthrosis and central or foraminal stenosis, and can lead to pain and radiculopathy [2]. Recently, the literature has also confirmed the impact of spinopelvic alignment on patient reported outcomes [7-9].

Although these studies define the path to an evidence-based approach through the identification of radiographic parameters by correlating them with patient-reported outcomes, they also present certain limitations such as lack of analysis regarding rotatory subluxation and three-dimensional (3D) radiographic measurements. In 1981, Perdriolle described scoliosis as a 3D deformity and investigated the transverse plane of this pathology [10]. Although uncommon in the setting of adult pathology, the analysis of the transverse plane in adolescent idiopathic scoliosis revealed that transverse plane parameters are associated with more progressive and severe deformity [10-13]. With the help of numerical models of the spine, some authors also demonstrated that the rotation measured in two-dimensional (2D) on standard radiographs differed from the real 3D rotation [10,14]. Taken together, these findings highlight the notion that radiographic measurements only represent a projection of the “true” shape and position of the vertebrae, thus masking a complete understanding of the pathology. In an effort to better understand the spinal deformity and to evaluate the transverse plane, radiograph analyses are often combined with the use of magnetic resonance images or computed tomographic scanner. However, these exams are not performed on patients in a weight bearing position and therefore can lead to failure in identifying patterns of deformity that cause pain. Additionally, use of the computed tomographic scanner is associated with high levels of radiation exposure for patients.

Stereoradiography, which was recently introduced into the clinical practice, allows clinicians to obtain full-body standing biplanar radiographs with low-dose radiation and 3D reconstructions of the spine with transverse plane analysis [12,13,15]. The validity of stereoradiography in routine preoperative and postoperative use has been reported [15,16]. However, to our knowledge, few studies, with only small sample sizes, have performed 3D analyses of the spine in ASD with these low-dose biplanar images [11,17].

The purpose of this study is to investigate rotatory subluxation in ASD with low-dose biplanar 3D images and to analyze the relationships between RS, transverse plane parameters, spinopelvic parameters, and patient-reported outcomes. The hypothesis was that stereoradiography could allow the physicians to better describe concealed conditions such as RS and understand potential pain generators that can only be visualized with 3D imaging.

## Material and Methods

### Patient selection

This study is a single-site retrospective chart review of ASD patients who underwent stereoradiography between November 2012 and July 2014. The study was approved by the institutional review board (IRB) committee. Inclusion criteria were any adult patients older than 18 years with lumbar spinal deformity defined by a coronal Cobb angle greater than 10° [18]. Exclusion criteria were diagnoses of scoliosis other than degenerative or idiopathic, previous spinal surgery, patients without stereoradiographic images, or images without visible femoral heads or C7.

### Data collection

Standard demographic information was recorded for each patient (age, sex, body mass index [BMI]). HRQOL scores were assessed with a visual analog scale (VAS) and

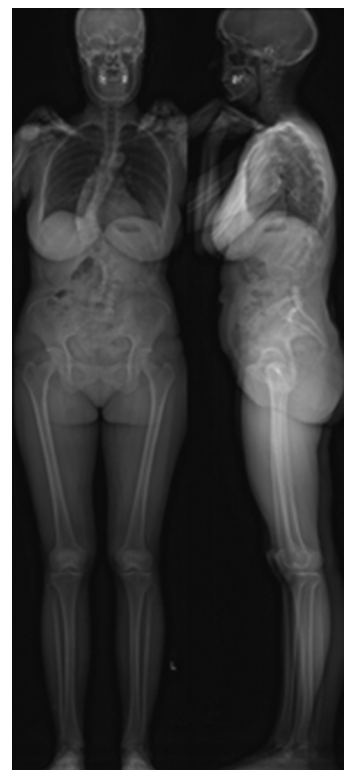


Fig. 1. Stereoradiography imaging coronal and sagittal images.

Download English Version:

<https://daneshyari.com/en/article/5712617>

Download Persian Version:

<https://daneshyari.com/article/5712617>

[Daneshyari.com](https://daneshyari.com)