

Changes in Trunk Appearance After Scoliosis Spinal Surgery and Their Relation to Changes in Spinal Measurements

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Received 2 April 2014; revised 18 April 2015; accepted 4 May 2015

Abstract

Study Design: Retrospective study of surgical outcome.

Objectives: To evaluate quantitatively the changes in trunk surface deformities after scoliosis spinal surgery in Lenke 1A adolescent idiopathic scoliosis (AIS) patients and to compare it with changes in spinal measurements.

Summary of Background Data: Most studies documenting scoliosis surgical outcome used either radiographs to evaluate changes in the spinal curve or questionnaires to assess patients health-related quality of life. Because improving trunk appearance is a major reason for patients and their parents to seek treatment, this study focuses on postoperative changes in trunk surface deformities. Recently, a novel approach to quantify trunk deformities in a reliable, automatic, and noninvasive way has been proposed.

Methods: Forty-nine adolescents with Lenke 1A idiopathic scoliosis treated surgically were included. The back surface rotation and trunk lateral shift were computed on trunk surface acquisitions before and at least 6 months after surgery. We analyzed the effect of age, height, weight, curve severity, and flexibility before surgery, length of follow-up, and the surgical technique. For 25 patients with available three-dimensional (3D) spinal reconstructions, we compared changes in trunk deformities with changes in two-dimensional (2D) and 3D spinal measurements.

Results: The mean correction rates for the back surface rotation and the trunk lateral shift are 18% and 50%, respectively. Only the surgical technique had a significant effect on the correction rate of the back surface rotation. Direct vertebral derotation and reduction by spine translation provide a better correction of the rib hump (22% and 31% respectively) than the classic rod rotation technique (8%). The reductions of the lumbar Cobb angle and the apical vertebrae transverse rotation explain, respectively, up to 17% and 16% the reduction of the back surface rotation.

Conclusions: Current surgical techniques perform well in realigning the trunk; however, the correction of the deformity in the transverse plane proves to be more challenging. More analysis on the positive effect of vertebral derotation on the rib hump correction is needed.

Level of evidence: III.

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Keywords: Scoliosis; Trunk surface measurement; Surgical outcome

Introduction

Improving trunk appearance is a major reason for adolescent patients with scoliosis and their parents to seek

treatment [1]. They are concerned about the deformity and imbalance of their trunk as much as, if not more than, the curvature of their spine as assessed on radiographs [2]. For patients undergoing scoliosis surgical correction, the degree of satisfaction with surgery highly depends on their post-operative self-image [3]. Therefore, addressing trunk deformities should be of great importance in the surgical treatment of adolescent idiopathic scoliosis (AIS).

Usually, the surgical outcome of AIS is mainly reported in terms of reduction of the spinal curvature, by means of the Cobb angle. This radiologic measurement quantifies adequately how well the surgeon realigned the spine in the frontal plane. However, the Cobb angle being a

Author disclosures: LS (none); FC (none); HL (none); SP (none).

This work was supported by the Natural Sciences and Engineering Research Council of Canada (Grant # 222860-2012RGPIN) and MENTOR, a strategic training program of the Canadian Institutes of Health Research.

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bidimensional measurement is not sufficient to assess how well the surgery improved the general trunk appearance. However, because there is no clear evidence of a direct relationship between the spinal curvature and the trunk deformity, the radiologic outcome cannot assess by itself how well the surgery improved the trunk appearance.

Most studies attempting to document the changes in trunk shape before and after scoliosis spinal surgery involved questionnaires for patients [3] and nonmedical [4] and medical raters [5] to complete. The high subjectivity of most of these assessment forms has highlighted the need for an objective and quantifiable measurement of clinical trunk deformity [6].

In a previous paper, we introduced a novel and reliable approach to quantify trunk surface deformities, using a noninvasive three-dimensional (3D) reconstruction of the full torso [7]. The objectives of the current study are 1) to use this new index to document AIS surgical outcome in terms of changes in trunk deformities in AIS patients with Lenke 1A curve type and 2) to compare these changes with the changes in two-dimensional (2D) and 3D spinal measurements.

Materials and Methods

Study design and patient data

We performed a retrospective analysis of the medical records, the spine radiographs and the trunk acquisitions of AIS patients surgically treated at Sainte Justine Hospital (SJH) in Montreal. We analyzed all the AIS cases that had a spinal surgery between May 2004 and August 2011, by one of three fellowship-trained orthopaedic surgeons. Our inclusion criteria were the following: a Lenke 1A [8] main thoracic curve type, a posterior spinal fusion as surgical approach, preoperative standard posterior–anterior and

lateral radiographs, and full trunk acquisition taken at most 6 months before surgery and postoperative posterior–anterior and lateral and full trunk acquisition taken at least 6 months after surgery. Forty-nine cases did meet those inclusion criteria and were included in this study. We did not reject any patient that met our inclusion criteria. For comparison sake between the radiographic and trunk surface measurements, we tolerated a maximum of 6 months between the radiographic and trunk surface acquisitions as long as both postoperative acquisitions were done at least 6 months after the surgery. A total of 25 patients of the 49 satisfied this latter criterion and were thus included in the correlation analysis.

Surgical procedures

Each of the three orthopaedic surgeons who performed the surgeries of the 49 patients included in this study has a different surgical technique. The first surgeon (O1) performs mostly a 90° rod rotation procedure only for the concave rod with differential sagittal rod contouring on the convex side and compression at the apex on the convex side. The second surgeon (O2) adds to the rod rotation a direct vertebral derotation at all the instrument levels. The third one (O3) performs a reduction by spine translation. Because all the curves are Lenke 1A, the lumbar spine was not instrumented, except for the L1 vertebra, which was the last vertebra instrumented in some cases.

Trunk measurements

Preoperative and postoperative trunk acquisitions and reconstructions were obtained using a noninvasive optical system made of four Inspeck (Creaform, Levis, Canada) digitizers, which provides a mesh of the whole trunk

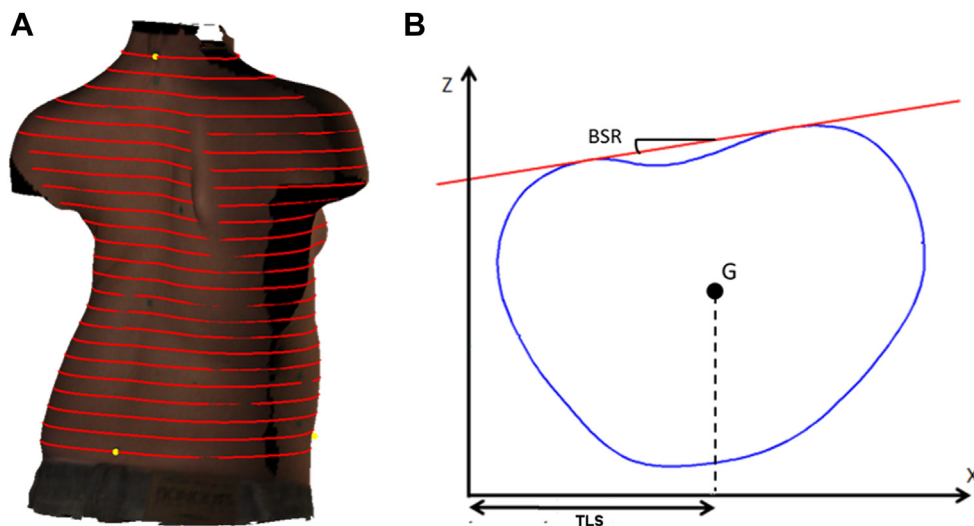


Fig. 1. Cross-sections extraction (A) and cross-sectional measurements (B). Horizontal sections are extracted along the trunk height (A). The BSR and TLS are measured on each cross section (B). BSR, back surface rotation; TLS, trunk lateral shift.

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