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Clinical Study

Thoracal flat back is a risk factor for lumbar disc degeneration after scoliosis surgery

Peter Bernstein, MD[a,*], Susanne Hentschel[a], Ivan Platzek, MD[b], Sebastian Hühne[a], Uwe Ettrich, MD[a], Albrecht Hartmann, MD[a], Jens Seifert, MD[a]

[a]*Department of Orthopaedic Surgery, University Hospital Carl Gustav Carus, Technical University Dresden, Fetscherstrasse 74, D-01307 Dresden, Germany*
[b]*Department of Radiology, University Hospital Carl Gustav Carus, Technical University Dresden, Fetscherstrasse 74, D-01307 Dresden, Germany*

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Abstract

BACKGROUND CONTEXT: Lumbar segments below fused scoliotic spines are thought to be exposed to extraordinary stress. Although positive sagittal imbalance has come into focus, reports about factors influencing the outcome of these segments remain inconclusive.

PURPOSE: Our study aimed at identifying spinal risk factors for the development of lumbar degenerative disc disease (DDD) in surgically treated patients with adolescent idiopathic scoliosis (AIS).

STUDY DESIGN/SETTING: Retrospective comparative prognostic study (Level III) was conducted. Thirty-three patients were seen at an average follow-up of 7.5 years after either isolated selective anterior (n=18) or long combined anterior-posterior fusion (n=15) for AIS.

OUTCOME MEASURES: Self-reported Scoliosis Research Society 22 questionnaire, physical examination including the detection of segmental pain and unspecific back pain, preoperative and postoperative whole-spine standing radiographs, and magnetic resonance imaging were obtained.

METHODS: Radiographic evaluation included the measurement of regional, coronal, and sagittal curve parameters and the assessment of spinal balance. Magnetic resonance imaging evaluation was done for preoperative and postoperative lumbar discs, according to the classification of Pfirrmann.

RESULTS: Patients with low DDD (Pfirrmann grading <3) had a significantly higher thoracal kyphosis angle (mean 28°) than patients with advanced DDD (mean 15°). There was a trend toward a more flat-type lumbar lordosis in patients with severe DDD. Positive sagittal imbalance was associated with advanced DDD. Follow-up coronal parameters, trunk imbalance, instrumentation length, and lowest instrumented vertebra selection had no influence on DDD. Specific segmental pain could be attributed to a significantly higher coronal trunk imbalance (21 vs. 11 mm).

CONCLUSIONS: This study establishes thoracal flat back as a risk factor for lumbar DDD after spinal fusion and supports the pathogenetic role of positive sagittal imbalance in this process.

Keywords: Scoliosis; Degenerative disc disease; Fusion; Adjacent segment; Sagittal balance

FDA device/drug status: Not applicable.

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* Corresponding author. Department of Orthopaedic Surgery, University Hospital Carl Gustav Carus, Technical University Dresden, Fetscherstrasse 74, D-01307 Dresden, Germany. Tel.: (49) 351-458-18174; fax: (49) 351-449-210413.

E-mail address: peter.bernstein@uniklinikum-dresden.de (P. Bernstein)

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EVIDENCE & METHODS

Context
Juxtafusional degeneration distal to fusion for AIS is a concern and the identification of risk factors might be helpful for prevention.

Contribution
In this retrospective series, the authors found that postoperative thoracic hypokyphosis was associated with DDD at levels below the fusion.

Implications
The interesting findings might serve as a nidus for futher investigation and reinforce the need for balanced correction. Unfortunately, not enough patients with pre-operative MRIs were included to determine whether the observed DDD represented a progression from the pre-op status; thus the findings regarding both association and causation are inconclusive.

—The Editors

Introduction

Long-term outcome studies of patients with adolescent idiopathic scoliosis (AIS) have yielded interest in relation to the surgical technique, achieved correction, and the appearance of degenerative changes. The fate of segments below fused spines has been addressed by several studies, suggesting an overload mechanism to result in early disc degeneration, especially in the adjacent level [1,2]. Degeneration of those segments is frequently found in patients treated with posterior instrumentation systems that could not restore an optimal sagittal balance (eg, Cotrel-Dubousset, Harrington instrumentation). This suggests an important role of sagittal parameters in the pathogenesis of lumbar degenerative disc disease (DDD) [3–5]. A recent long-term follow-up (FU) of more than 10 years after scoliosis surgery showed that disc degeneration occurred most likely far distal from the fusion site in the L5/S1 segment and could not be attributed to coronal curve patterns or lumbar and pelvic sagittal parameters [6]. A positive sagittal balance has been shown to adversely influence DDD [5] and clinical outcome [7].

The aim of this work was to identify risk factors for the development of lumbar DDD after scoliosis surgery. Our hypothesis was that DDD would develop in correlation to fusion length, selection of the lowest instrumented vertebra (LIV), coronal and sagittal balancing, and curve parameters. In addition, we believed that disc changes seen in magnetic resonance imaging (MRI) would not correlate with discomfort or pain, as initial DDD is a common finding in surgically treated AIS patients [8] and young adults [9] but remains silent [5] or reaches clinical significance only later in life [10,11].

Materials and methods

The study was approved by the institutional review board (#EK 144062008). Each participating patient gave a written consent. Inclusion criteria were at least 5 years after ventral fusion using the Halm-Zielke device (group ''ventral derotating spondylodesis'' [VDS]) or combined dorsoventral fusion (pedicle screw–based Cotrel-Dubousset instrumentation, group ''dorsoventral''). Patients were identified for this study after a review of all scoliosis fusion procedures done for AIS between the years 1999 and 2004 by the senior scoliosis surgeon (JS). Patients with an underlying neurologic or myopathic disease were excluded. Patients were contacted by phone and mail. At the time of the FU visit, a history and physical examination by two independent physicians was performed (SH, PB). Particular attention was paid to the distinction between painful segments (segmental pain that could be provoked during examination by axial loading or spinal percussion) and unspecific back pain originating from painful paravertebral structures (unspecific pain). Only concordant results were used for further analysis.

Each patient completed the Scoliosis Research Society (SRS) 22 questionnaire. For analysis, the SRS22 subscores ''function'' (questions 5, 9, 12, 15, 18), ''pain'' (1, 2, 8, 11, 17), ''body'' (4, 6, 10, 14, 19), ''soul'' (3, 7, 13, 16, 20), and ''satisfaction'' (21, 22) were extracted. Lateral and anteroposterior standing whole-spine radiographs and FU whole-spine MRI were performed as described earlier [12].

Preoperative, immediate postoperative, early postoperative (1-year), and FU a.p. whole-spine standing radiographs were assessed for the Cobb angle of major and minor curves (SH). FU coronal balance deviation was measured by the center sacral vertical line (CSVL) distance to the LIV and the C7-CSVL distance (JS). Follow-up sagittal balance (according to the method of Jackson et al. [13]), sagittal angles for thoracic kyphosis (Th3–Th11), and lumbar lordosis (L1–S1) were either measured on MRI (thoracic kyphosis) or standing radiographs (thoracic kyphosis, sagittal balance, lumbar lordosis, pelvic parameters; SH, PB, AH, UE), according to an optimized measuring protocol as described earlier [12].

Degenerative disc disease was evaluated by a trained spine surgeon (UE) from sagittal plane T2-weighted preoperative MRI and from T2-SPACE–weighted FU MRI sequences (for MRI details, see Bernstein et al. [12]) according to the Pfirrmann classification system [14]. A disc degeneration index (DDD index) was averaged for the six caudal-most mobile lumbar segments (eg, Th12–S1). Fused segments were not graded. Degenerative disc disease–like alterations of caudal adjacent and subadjacent (the segment below the adjacent segment on the distal fusion site) were analyzed in particular. Also, patients were grouped into having mild disc alterations (low DDD index, meaning a Pfirrmann grading <3) or moderate to high alterations (high DDD index, meaning a Pfirrmann grading