

Clinical Study

Factors associated with long-term patient-reported outcomes after three-column osteotomies

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Received 18 January 2015; revised 20 April 2015; accepted 12 June 2015

Abstract

BACKGROUND CONTEXT: Studies have demonstrated sustained improvements in patient-reported outcomes (PROs) after three-column osteotomies (three-COs), but no study has evaluated what factors impact long-term outcomes.

PURPOSE: The aim was to investigate factors associated with PROs in patients who underwent three-CO at minimum 5 years postoperatively.

STUDY DESIGN/SAMPLE: This was a retrospective review of prospective database.

PATIENT SAMPLE: All patients who had a three-CO at a single institution and completed clinical evaluations after at least 5 years postoperative were included.

OUTCOME MEASURES: Oswestry Disability Index (ODI), Scoliosis Research Society (SRS) scores, and radiographic parameters were assessed at baseline and a minimum 5 years postoperatively.

METHODS: Analysis of 120 patients who underwent three-CO (96-pedicle subtraction osteotomy/24-vertebral column resection) was performed. The mean age was 48 years (range 8–79), and clinical follow-up was 7 years (range 5–14). Separate multivariable linear regression analyses were performed to determine factors associated with ODI, SRS average, and SRS satisfaction while controlling for time since surgery and baseline outcome scores.

RESULTS: Average PROs were significantly improved from baseline at a minimum 5-year follow-up (ODI: 48–28, $p < .01$; SRS: 2.8–3.5, $p < .01$). The average SRS satisfaction score was 4.0. Average sagittal alignment (C7 plumb) improved 74 mm, with 81% of patients' alignment less than 95 mm. Major surgical complications occurred in 32 patients (27%) with major reoperations in 30 patients (25%). Multivariable regression analysis found that prior surgery and major reoperations were risk factors for worse ODI scores. A diagnosis of adult idiopathic scoliosis and final sagittal

FDA device/drug status: Not applicable.

Author disclosures: **KRO'N:** Nothing to disclose. **LGL:** Royalties: Medtronic (I), Quality Medical Publishing (A); Consulting: DePuy Synthes Spine: (C, monies donated to a charitable foundation), K2M: (D, monies donated to a charitable foundation), Medtronic: (F, monies donated to a charitable foundation); Speaking and/or Teaching Arrangements: DePuy Synthes Spine, K2M, Medtronic (included in consulting agreement); Trips/Travel: AOSpine, BroadWater, DePuy Synthes Spine, K2M, Medtronic, Seattle Science Foundation, Scoliosis Research Society, Stryker Spine (E [reimbursement only]); Research Support (Investigator Salary, Staff/Materials): Setting Scoliosis Straight Foundation (D, Paid directly to institution), EOS Imaging (A, Paid directly to institution), Axial Biotech (A, Paid directly to institution), Fox Family Foundation (G, H; Paid directly to institution); Grants: AOSpine & Scoliosis Research Society (G, Paid directly to institution); Fellowship Support: AOSpine North America (D, Paid directly to institution). **KHB:** Royalties: Wolters Kluwer (B past 36 months for the Textbook of Spinal Surgery, 3rd ed); Endowments: J. Albert Key Distinguished Professor of Orthopaedic Surgery

Endowment (FY 15, E; FY 14, E; FY 13, D, Paid directly to institution); Grants: NIH (H over the course of 6 years (2010–2016), Paid directly to institution); Fellowship Support: AO Spine (E for each of the following academic years, 13/14 and 14/15, Paid directly to institution), OREF (D for 13/14, Paid directly to institution). **BJN:** Nothing to disclose. **HJK:** Consulting: Medtronic (B), Biomet (B), K2M (C); Speaking and/or Teaching Arrangements: Depuy (B), Stryker (C). **KRA:** Grants: PCORI (H), NIH (F), NIDRR (G, Paid directly to institution).

The disclosure key can be found on the Table of Contents and at www.TheSpineJournalOnline.com.

There are no funding sources for this study.

The IRB approval for this study was obtained from Washington University, Human Research Protection Office.

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alignment less than 95 mm were associated with improved SRS scores. Improvement in major coronal Cobb and final pelvic tilt less than 30° were associated with increased SRS satisfaction.

CONCLUSIONS: With a minimum 5-year follow-up, PROs in patients undergoing three-CO were associated with improvements in radiographic alignment but negatively affected by prior surgery and complications necessitating revision surgery. © 2015 Elsevier Inc. All rights reserved.

Keywords: Adult spine deformity; Spine osteotomies; Patient-reported outcomes; Three-column osteotomies; Surgical complications; Kyphosis; Scoliosis

Introduction

Three-column osteotomies (three-COs) in the form of either pedicle subtraction osteotomy (PSO) or vertebral column resection (VCR) are the most powerful corrective maneuvers available in the spine surgeon's armamentarium for the treatment of severe rigid spinal deformity. The PSO involves destabilization of all three columns with retention of a portion of the anterior column, whereas the entire vertebral body is removed in the VCR. These osteotomies can result in dramatic improvements in spinal alignment [1–5], and studies have demonstrated durable improvement in patient-reported outcomes (PROs) [6–11]. However, because no study to date has comprehensively assessed factors associated with PROs in patients undergoing three-CO, it remains unclear what patient, surgical, or radiographic qualities are predictive of outcomes.

Numerous studies have shown significant and sustained improvements in PROs after three-CO, but none have adequately considered factors associated with PROs. Many studies did not investigate these factors [10,12–14], whereas others considered only individual factors. For instance, studies have found no impact on PROs by the occurrence of a neurologic deficit [7], pseudarthrosis [15], major surgical complication [11], or major reoperation [11]. Diminished outcomes have been associated with positive sagittal imbalance (>8.0 cm) [15], and improved outcomes were demonstrated in those with ankylosing spondylitis [16]. However, these studies are limited in that they rely on subgroup analyses without controlling for potential confounding variables. A comprehensive analysis is required to more robustly determine factors that are associated with PROs.

Therefore, the purpose of this study was to identify patient, surgical, and/or radiographic factors that were associated with either better or worse long-term PROs after three-CO. Given the known relatively high complication rates after these complex procedures [4,7,8,10,17,18], it is important to identify these factors to risk-stratify patients and determine expected outcomes for individual patients. To that end, a multivariable analysis of factors potentially associated with PROs was performed using prospectively collected radiographs, clinical data, and PROs from a large cohort of patients who underwent three-CO at a single academic institution with 5-year follow-up.

Materials and methods

After IRB approval was obtained, a retrospective review was performed at a single academic medical center. All patients who had a three-CO and had completed clinical evaluations 5 years postoperatively were included for analysis.

Patient data

Patient age at time of surgery, gender, and body mass index were determined. History of tobacco use was noted. All patient comorbidities were prospectively assessed and entered into a database at the time of surgery. This was reviewed to determine the number of comorbidities for each patient. Any history of anxiety or depression was separately noted, along with any history of previous spine surgery.

Surgical data

Surgery was performed by one of the two senior authors in all cases. The diagnoses prompting the three-CO were determined by chart review. The final number of fused levels, type of osteotomy (PSO vs. VCR), and whether fusion was extended to the sacrum were recorded. The total operative time and estimated blood loss were then determined. Combined totals were used for operations that were staged.

Outcomes and complications

Patient-reported outcomes were assessed preoperatively and at the 5-year follow-up period. Scoliosis Research Society (SRS)-24 and Oswestry Disability Index (ODI) scores were prospectively entered in a database and reviewed for this study. All clinical notes were reviewed for each patient, and the presence and type of any complication or reoperation was recorded. Complications were classified as major surgical, major medical, minor surgical, and minor medical according to previously published guidelines [19]. Instrumentation failure below S1 and partial instrumentation failure (at least one intact rod) were considered minor, but complete instrumentation failure was considered a pseudarthrosis and therefore a major complication. Elective surgery for removal of iliac screws was not considered a major reoperation. Finally, the occurrence of any major surgical

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