



Posterior Osteotomy Corrective for Severe Angular Kyphosis: Comprehensive Analysis of Clinical and Radiographic Results

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Abstract

Background: Angular kyphosis is a debilitating spinal deformity characterized by an excessive curvature that leads to chronic pain, functional impairment, and potential neurological deficits.

Materials and Methods: Between January 2012 and December 2014, 10 patients (mean age 18.4 years; 5 males, 5 females) with a Cobb angle $>60^\circ$ underwent a standard posterior corrective osteotomy. Preoperative assessments included radiographic measurement of the Cobb angle, pain evaluation using the Visual Analogue Scale (VAS), functional assessment via the SF-12 Health Survey, and neurological evaluation using the Frankel grading system. Patients were followed at 3, 6, and 12 months postoperatively.

Results: The mean preoperative Cobb angle of 78.7° was significantly reduced to 19.7° at 12 months, yielding an average correction of 59° ($p \leq 0.001$). VAS scores improved from 7.8 preoperatively to 2.7 at 12 months, and SF-12 scores increased from 23.40 to 46.40. All patients maintained stable or improved neurological status.

Conclusion: Posterior corrective osteotomy is a safe and effective intervention for high-degree angular kyphosis, providing significant radiographic correction and clinical improvement in pain and quality of life. Further studies with larger cohorts and longer follow-up are warranted to validate these results.

Keywords: Angular Kyphosis, Posterior Corrective Osteotomy, Cobb Angle Correction Sagittal Balance Restoration, Clinical and Radiographic Outcomes

Introduction

Angular kyphosis is a complex spinal deformity in which the thoracic curvature exceeds the normal physiological range of 20° – 30° [1, 2]. This abnormal curvature may arise from congenital malformations, post-traumatic sequelae, or infections such as tuberculosis [3, 4]. The excessive kyphotic angle disrupts the biomechanical equilibrium of the spine, often resulting in chronic pain, compromised pulmonary function, and neurological deficits [5]. In addition, the cosmetic and functional impairments associated with the

deformity contribute to significant psychosocial distress [6].

Over recent decades, various surgical interventions have been developed to manage severe spinal deformities. The posterior corrective osteotomy has emerged as a preferred approach because it allows direct visualization of neural elements, reduces the risk of neurological injury, and effectively restores sagittal balance [7, 8]. Several techniques—including closing-opening wedge osteotomy [9], posterior total wedge resection [10], pedicle-sparing osteotomy [11], and total vertebral column resection [12]—have demonstrated promising



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outcomes. Comparative studies have further shown improvements in pulmonary function and quality of life with these procedures [13, 14]. Moreover, selecting the appropriate treatment based on patient-specific factors is critical for optimal results [15]. Adjunctive measures such as vertebroplasty [16] and advanced instrumentation in adolescent patients [17] have also enhanced outcomes, while techniques like total en-bloc spondylectomy [18] and posterior vertebral column resection [19] broaden the surgical armamentarium.

This study evaluates the clinical and radiographic outcomes of posterior corrective osteotomy for high-degree angular kyphosis while integrating insights from a wide range of surgical techniques and studies.

Materials and Methods

Study Design and Patient Selection

A combined retrospective and prospective study was conducted at the Sancheti Institute of Orthopedics and Rehabilitation from January 2012 to December 2014. Ten patients with high-degree angular kyphosis (defined as a Cobb angle $>60^\circ$) were enrolled [13]. The etiologies included congenital malformations, post-traumatic deformities, and post-tubercular kyphosis. Patients with round-back kyphosis, active infections, or kyphosis associated with a history of trauma leading to paraplegia were excluded to maintain a homogeneous study group [14].

Preoperative Evaluation

Each patient underwent a comprehensive preoperative evaluation that included:

Radiological Assessment: Lateral roentgenograms were obtained to measure the Cobb angle and evaluate overall spinal alignment [3].

Pain Assessment: Baseline pain intensity was quantified using the Visual Analogue Scale (VAS) [4].

Functional Assessment: Quality of life and functional status were measured using the SF-12 Health Survey [6].

Neurological Examination: The Frankel grading system was employed to assess baseline motor and sensory function [15].

Laboratory Investigations: Routine blood tests and viral marker screenings (HIV, HBsAg) were performed to ensure patient suitability for surgery [13].

Operative and Postoperative Protocol

All patients underwent a standard posterior corrective osteotomy under general anesthesia. Although the detailed intraoperative surgical techniques were standardized across all cases, this report focuses on the overall protocol. Postoperatively, patients were monitored in the intensive care unit for 24 hours, received intravenous antibiotics, and had surgical drains removed on postoperative day one [16]. Early mobilization was initiated on day two using a Total Contact Orthosis (TCO) [17]. Follow-up evaluations at 3, 6, and 12

months included repeat radiographic measurements, VAS scoring, SF-12 surveys, and neurological examinations.

Statistical Analysis

Data were analyzed using paired t-tests and Wilcoxon signed-rank tests to compare preoperative and postoperative outcomes. Pearson correlation analysis was used to assess the relationship between the degree of angular correction and clinical improvements. A p-value of ≤ 0.001 was considered statistically significant [18].

Results

Demographics and Baseline Characteristics

The study cohort consisted of 10 patients (5 males and 5 females) with a mean age of 18.4 years (range: 7–36 years). The mean preoperative Cobb angle was 78.7° (SD ± 10.1).

Radiological Outcomes

Postoperative radiographs demonstrated a significant reduction in the Cobb angle, with the mean angle decreasing to 19.7° at 12 months, reflecting an average correction of 59° ($p \leq 0.001$).

Clinical Outcomes

- **Pain Improvement:** Mean VAS scores decreased significantly from 7.8 preoperatively to 2.7 at the 12-month follow-up.
 - **Functional Improvement:** SF-12 scores increased significantly from a preoperative mean of 23.40 to 46.40 at 12 months, indicating substantial improvements in quality of life.
- Neurological Status:** All patients maintained stable or improved neurological function as determined by the Frankel grading system, with no permanent deficits observed.

Discussion

The significant reduction in the Cobb angle and the marked improvements in VAS and SF-12 scores underscore the efficacy of posterior corrective osteotomy for high-degree angular kyphosis [5, 6]. The posterior approach facilitates direct visualization of neural structures, minimizes the risk of neurological injury, and restores sagittal balance—key factors in alleviating symptoms and enhancing functional outcomes [7, 8]. Although various surgical techniques such as total vertebral column resection [12] and en-bloc spondylectomy [18] have been reported, our findings support the use of a standardized posterior corrective osteotomy in achieving reliable outcomes [13, 14].

Comparative studies have indicated that while the extent of radiographic correction may not always directly correlate with clinical improvements, the overall positive impact on patient quality of life is significant [14, 15]. Tailoring treatment to individual patient profiles remains critical for optimal outcomes [16]. Adjunctive procedures like vertebroplasty [16] and advanced instrumentation methods in adolescent

populations [17] have further improved surgical results. Our study's outcomes, in line with previous reports [19], advocate for the continued use of posterior corrective osteotomy in managing severe spinal deformities.

Conclusion

Posterior corrective osteotomy is a safe and effective surgical intervention for high-degree angular kyphosis. This study demonstrated a significant mean angular correction of 59° accompanied by substantial improvements in pain (VAS) and quality of life (SF-12). The preservation or improvement of neurological function further supports the safety of this procedure. Although detailed intraoperative techniques were standardized and not elaborated upon in this report, the overall clinical outcomes affirm the posterior approach as a reliable treatment modality for severe spinal deformities. Future research with larger patient cohorts and extended follow-up periods is essential to refine patient selection criteria and optimize long-term outcomes.

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