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Staged Anterior Release and Posterior Instrumentation in Correction of Severe Rigid Scoliosis (Cobb Angle >100 Degrees)

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Abstract

Purpose: Severe rigid curves present a big challenge to the treating spine surgeon. We evaluated the outcome of staged anterior release and posterior instrumentation for rigid scoliosis.

Methods: Twenty-one patients with an average age of 14.4 years (range 11–17) having a rounded severe rigid scoliosis (Cobb angle >100 degrees) underwent surgical correction. Six patients had congenital scoliosis, 13 idiopathic scoliosis, and 2 syndromic. All patients underwent anterior release in Stage I with one or more Ponte osteotomies and in Stage II with all pedicle screw instrumentation, and 13 of the patients underwent an asymmetric pedicle subtraction osteotomy at the apex. Patients were assessed for deformity correction, operative time, blood loss, and any complications.

Results: The preoperative Cobb angle of 116.6 degrees (range 101–124 degrees) improved to 74.0 degrees (range 54–86 degrees) after anterior release: 29.4% correction and the final postoperation Cobb angle after posterior instrumentation was 26.5 degrees (range 22–32 degrees), with final 76% correction. The average blood loss in anterior release was 585.95 mL (range 400–980 mL; % estimated blood volume = 19.5%), whereas the mean operative time was 223 minutes (165–315 minutes). One patient had prolonged chest drain and two, basal atelectasis following anterior release. The mean operative time for the posterior procedure was 340 minutes (range 280–420 minutes) and average blood loss was 2,066 mL (range 1,200–3,200 mL). The mean apical axial rotation of 56 degrees (range 26–79 degrees) improved to 28 degrees (range 9–42 degrees) ($p < .05$). There was loss of motor evoked potential signal in one and hook pullout, superficial infection, and local skin necrosis one case each.

Conclusion: The staged approach to the management of severe, rigid scoliosis helps get an excellent correction. Anterior release loosens up the rigid apex and provides with nearly 30% correction so that the extent of the osteotomies in the second stage from the back is substantially reduced, allowing for a final good correction.

Keywords: Severe rigid scoliosis; Anterior release; Ponte osteotomy; Asymmetric pedicle subtraction osteotomy

Introduction

The result of scoliosis correction is influenced by many factors, for example, the severity of deformity, spine flexibility, apical rotation, patient's age, type of deformity, and associated abnormalities. A curve is defined as large when the magnitude of curve is 70 degrees or greater and rigid when curve flexibility is 30% or lower [1]. Severe rigid scoliosis is more difficult to treat because the spine deformity is usually stiff, amenable only to radical release or osteotomy of the spine. The management of severe curves can potentially carry significant risk, especially with respect to blood loss, neurologic deficit, and pulmonary compromise. However, the benefit of this surgical treatment is potentially far reaching from a cosmetic, pulmonary, and general health viewpoint, which can prolong many of these patients' lives and give tremendous confidence and psychological boost to their personality [2].

In developing countries, a large majority of scoliosis patients present late. There is still no consensus in the management of these rigid curves. Combined anterior and

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posterior radical release with instrumentation is generally required for correction of these deformities. However, there has been a shift to a posterior-only approach with multiple osteotomies and vertebral column resections (VCRs) for correction of all rigid deformities with the advent of segmental pedicle screw-rod instrumentation [3,4]. We evaluated the outcome of staged anterior release and posterior instrumentation for rigid scoliosis.

Materials and Methods

This was a retrospective study of 21 patients from a single center, with severe rigid deformity of spine from October 2007 to May 2010 with an average follow-up of 32 months (range 24−55 months). Necessary approval from the institutional ethics committee was taken before the study.

Deformity was measured using the Cobb angle method in standing anteroposterior and lateral radiographs by one of the authors. Flexibility was assessed by comparing supine bending and standing x-rays. Similarly, flexion extension views were done to assess flexibility in the sagittal axis. All the patients underwent routine computed tomography and magnetic resonance imaging along with lung function test as part of the preoperative workup.

All the surgeries were carried out by a single senior chief surgeon with his team under neurophysiological monitoring, and all the patients received tranexamic acid perioperatively (loading: 10−20 mg/kg; infusion 1−2 mg/kg/hour) [5].

Twenty-four patients with severe rigid rounded thoracic scoliosis (Cobb angle >100 degrees) underwent a two-staged procedure involving anterior release in Stage I and posterior osteotomies in Stage II (asymmetric posterior pedicle subtraction osteotomy [PSO] and/or Ponte osteotomies) with all pedicle screw instrumentation and fusion during the study period. Three patients did not complete 2-year follow-up, and hence 21 patients (7 males and 14 females) were included in the study.

The anterior release comprised radical discectomy of apical four or five discs, resection of adjacent convex rib head at the apex, up to the costo-transverse joint. The release included a complete clearance of the disc space all around the bony endplates and up to the posterior longitudinal ligament (PLL) in depth. In very rigid cases, even the PLL was released. The cleared disc space is packed loosely later on with the autologous graft obtained from the resected rib and rib heads. Chest tube is left in for 48−72 hours and chest physiotherapy is initiated as soon as possible. Mobilization in bed and sitting up was allowed on postoperative days 3−4 as tolerated by the patient. The posterior procedure was carried out 10−14 days after the anterior release. Posterior release included release of posterior ligaments, facetectomies, and multilevel posterior column osteotomies (Ponte) followed by instrumented fusion. Occasionally, asymmetric pedicle subtraction osteotomy (APSO) at the apex was done if the curve was very severe. The correction technique used was a combination of rod rotation, derotation, and a judicious permutation of compression and distraction.

Results

The average age was 14.4 years (range 11−17 years) and the diagnoses were congenital scoliosis in six patients and neglected idiopathic scoliosis in 13, and 2 were syndromic children. The mean preoperative Cobb angle of the primary curve was 116.6 ± 7.2 degrees (range 101−124 degrees) and the bending Cobb angle 98 ± 11.20 degrees (range 78−116 degrees), with an average 16% flexibility. The mean preoperative thoracic kyphosis was 50.1 ± 21.9 degrees (range 18−98 degrees).

Anterior release

The average blood loss in anterior release was 585.9 mL (range 400−980 mL; % estimated blood volume = 19.5%), whereas the mean operative time was 223 minutes (range 165−315 minutes). On an average, 4.19 discs (range 3−5) per patient were removed during the procedure. Preoperative Cobb angle (coronal) of 116.6 ± 7.2 degrees (range 101−124 degrees) improved to 74.0 ± 8.2 (range 54−86 degrees) after anterior release ($p = .00$) with correction of 42.6 degrees (29.4%) (Fig. 1). Similarly, the thoracic kyphosis improved from 50.1 ± 21.9 degrees (range 18−98 degrees) to 39.4 ± 9.6 degrees (range 24−60 degrees), with 10.7 degrees (21.3%) of correction (Fig. 2). One patient had prolonged serous drainage from the chest tube, and the tube was removed after 4 days. Two had mild basal atelectasis, which was managed by antibiotics and physiotherapy. No major complications such as vascular injury were encountered following anterior release.

Second-stage surgery was planned after 10−14 days of anterior release.

Posterior Instrumentation with osteotomies

The average blood loss in posterior procedure was 2,066 mL (range 1,200−3,200 mL; % estimated blood volume = 68.8%), whereas the mean duration of the procedure was 313 minutes (280−420 minutes). All the patients underwent posterior column osteotomies: Ponte osteotomy [6] either above or below the apex or both. On an average, 1.90 (range 1−3) Ponte osteotomies were required per patient. APSO at the apex was done in 13 patients. Further, APSO was reserved for curves close to 120 degrees and where wedging of the vertebra was seen at the apex. On an average, 11.5 (range 10−15) vertebral segments were included in instrumented fusion. The coronal Cobb angle improved from 116.2 ± 7.2 degrees (range 101−124 degrees) to 26.5 ± 3.7 degrees (range 22−32 degrees), with an overall improvement of 89.7 degrees (77.2% correction) ($p < .05$) (Fig. 1). The average thoracic kyphosis was