ELSEVIER

CrossMark

The Spine Journal 14 (2014) 2094–2101

THE SPINE JOURNAL

Clinical Study

Extended costotransversectomy to achieve circumferential fusion for pathologies causing thoracic instability

Sarat Poodipedi Chandra, MCh[a,*], Shashank Ravindra Ramdurg, MCh[a], Nilesh Kurwale, MCh[a], Avnish Chauhan, MPhil[a], Abuzer Ansari, MPhil[a], Ajay Garg, MD[b], Chitra Sarkar, MD[c], Bhawani Shankar Sharma, MCh[a]

[a]*Department of Neurosurgery, CN Center, Ansari Nagar, All India Institute of Medical Sciences (AIIMS), New Delhi, India*
[b]*Department of Neuroradiology, CN Center, Ansari Nagar, All India Institute of Medical Sciences (AIIMS), New Delhi, India*
[c]*Department of Neuropathology, CN Center, Ansari Nagar, All India Institute of Medical Sciences (AIIMS), New Delhi, India*

Received 16 July 2013; revised 21 October 2013; accepted 30 December 2013

Abstract

BACKGROUND CONTEXT: Conventional circumferential stabilization for pathologies causing instability of the thoracic spine requires a two or even a three-staged procedure. The authors present their tertiary care center experience of single-staged procedure to establish a circumferential fusion through an extended costotransversectomy approach.

OBJECTIVE: To demonstrate neural canal decompression, removal of the pathology, achieve circumferential fusion, and correcting the deformity through a single procedure.

STUDY DESIGN: Prospective and observational.

PATIENT SAMPLE: Forty-six patients with pan thoracic column instability due to various pathologies.

OUTCOME MEASURES: Neurologic condition was evaluated using American Spinal Injury Association and Eastern Cooperative Oncology Group grading systems. Outcome was evaluated with regard to the decompression of neural canal, correction of deformity, and neurologic improvement. All patients were evaluated for neural canal compromise and degree of kyphosis preoperatively, early, and late postoperatively.

METHODS: All patients had severe spinal canal compromise (mean, 59%±9%) and loss of vertebral body height (mean, 55%±10%). A single-stage circumferential fusion was performed (four-level pedicle screw fixation along with a ventral cage fixation after a vertebrectomy or corpectomy) through an extended costotransversectomy approach.

RESULTS: The pathologies included trauma (21), tuberculosis (18), hemangioma (2), aneurysmal bone cyst (1), recurrent hemangioendothelioma (1), solitary metastasis (1) and plasmacytoma (1), and neurofibromatosis (1). Thirty-five of 46 patients (76%) demonstrated improvement in the performance status. The major complications included pneumonitis (3), pneumothorax (3) and neurologic deterioration (3; improved in two), deep venous thrombosis (2), and recurrent hemoptysis (1). No implant failures were noted on last radiology follow-up. There were two mortalities; one because of myocardial infarction and another because of respiratory complications.

CONCLUSIONS: The following study demonstrated that extended costotrasversectomy approach is a good option for achieving single-staged circumferential fusion for correcting unstable thoracic spine due to both traumatic and nontraumatic pathologies.

Keywords: Spinal compression; Spinal instrumentation; Circumferential fusion; Thoracic spine; Tuberculosis; Trauma; Hemangioma

FDA device/drug status: Not applicable.

Author disclosures: ***SPC:*** Grant: Ministry of Science and Technology as part of another project (D (approx), Paid directly to institution); Research Support (Investigator Salary): salary for research fellow and data entry operator (About B per year for both, Paid directly to institution); Research Support (Staff/Materials): salary for research fellow and data entry operator (About B per year for both, Paid directly to institution). ***SRR:*** Nothing to disclose. ***NK:*** Nothing to disclose. ***AC:*** Nothing to disclose. ***AA:*** Nothing to disclose. ***AG:*** Nothing to disclose. ***CS:*** Nothing to disclose. ***BSS:*** Nothing to disclose.

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

Disclosure of funding: Nil.

* Corresponding author. Room 7, 6th floor, CN Center, AIIMS, Ansari Nagar, New Delhi 110029, India. Tel.: 91-11-26594494, 91-11-26234446.
E-mail address: saratpchandra3@gmail.com (S.P. Chandra)

1529-9430/$ - see front matter
http://dx.doi.org/10.1016/j.spinee.2013.12.028

Introduction

A three-column disruption of thoracic spine with severe canal compression requires a '*360°*' circumferential to optimize stabilization. Conventionally, a thoracic circumferential fusion is established by undertaking at least two separate approaches; a dorsal approach to achieve pedicle fixation, followed by a ventral transthoracic approach to place a ventral instrumentation like a cage or any other ventral fixation device. Often a dorsal re-exploration (third procedure) is required to secure the cage firmly by compressing the rod/screw construct posteriorly. Development of expandable cages does not require the latter procedure now. However, the major shortcoming of expandable cages as compared with mesh may be higher rates of subsidence and lower rates of bone fusion because of smaller contact area and absence of adequate space to place bone grafts [1,2]. Additionally, some patients who require circumferential fusion may be poor candidates for an anterior transthoracic approach because of poor pulmonary function, previous surgery, or radiation therapy. It would be of advantage to use a single approach that can access both ventral and dorsal regions of the thoracic spine simultaneously. The authors propose a single-stage extended costotransversectomy as an alternate surgical approach to achieve a circumferential fusion for three-column pathologies. This is quite similar to single-stage posterolateral transpedicular approach (PTA) reported earlier but with some modifications. Unlike the earlier reports [3–6], where it has been used mostly for metastatic tumors, in the present series it has been used in a wide variety of pathologies [3–8].

EVIDENCE & METHODS

Context
Thoracic spinal instability often necessitates extensive surgical reconstruction, often requiring a combined anterior-posterior approach. As conventional anterior-posterior techniques are associated with substantial perioperative morbidity, many surgeons are exploring the use of single approaches that provide simultaneous access to the ventral and dorsal spine. The authors present their experience addressing thoracic spinal conditions using single-stage extended costo-transversectomy.

Contribution
The authors performed a retrospective review of a series of 46 cases treated using the single-stage extended costo-transversectomy technique. At minimum two-year follow-up 76% of the cohort demonstrated neurologic improvement and no implant failures were recorded.

Implications
As a retrospective case series, this investigation is subject to selection bias among other confounding factors and suffers from lack of a comparison group. Nonetheless, it is one of the larger series presenting results following the use of single-stage posterior approaches for the performance of circumferential fusion and thus adds to our understanding of the utility, as well as complication profile, associated with surgeries of this magnitude. It should be emphasized that the multidisciplinary medical team necessary to successfully carry out these types of surgeries may not be available at every facility and thus results many not be translatable to other centers.

—The Editors

Clinical materials and methods

Between 2004 and 2011, a total of 194 instrumented fusions of the thoracic spine were performed, of which 46 cases underwent circumferential fusion of the thoracic spine using the extended costotransvectomy approach (Fig. 1). The age of the patients ranged from 11 to 62 years with a mean of 32.5 years; 28 patients were males.

Inclusion criteria

1. Presence of three-column instability: This was assessed according to the three-column scheme of Denis [9]. This was determined by performing both plain roentgenograms and computed tomography (CT) scan with bone windows. Although a significant number of patients were of nontraumatic etiology (25 patients); the same principle was used to determine the columns involved. Only patients with three-column disruption were considered for extended costotransversectomy and circumferential fusion.
2. Absence of severe osteoporosis: This was ruled out by examining the plain roentgenograms and CT scans. In suspected cases with presence of risk factors, a bone densitometry was performed. Only those patients with T-scores higher than −2.0 were considered for surgical intervention.
3. Absence of any contraindications like severe medical, cardiac illness or severe restrictive chest disease.
4. Patients with American Spinal Injury Association (ASIA) score of A suggesting poor prognosis.

Clinical assessment

Functional outcome was assessed using the [10] ASIA impairment score, and performance status was assessed using the Eastern Cooperative Oncology Group (ECOG) grading system [11]. Overall, ASIA scores were A (n=0), B (n=20), C (n=18), and D (n=8). Correspondingly, ECOG scores were 1 (5 patients), 2 (11 patients), 3 (19 patients), and 4 (11 patients) (Table).

Pain self-assessment was based on a visual analog scale from 0 to 10. As described by Serlin et al. [12], 0 to 4 represents mild pain; 5 to 6, moderate pain; and 7 to 10, severe