



Operative Technique

Feasibility of the mini-open vertebral column resection for severe thoracic kyphosis

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ABSTRACT

Severe thoracic kyphosis caused by pathologic fractures often needs to be corrected by resection of the collapsed vertebral body, reconstruction of the anterior spinal column, and correction of the kyphosis with long-segment fixation. The resection of this pathologic bone functions essentially as a vertebral column resection. With the advent of minimally invasive technology, the powerful corrective forces afforded in open cases can be applied using a less invasive approach. In this article, we describe a mini-open posterior technique for thoracic kyphosis via a vertebrectomy and cantilever technique. Two patients underwent kyphosis correction via mini-open vertebrectomy. One patient was corrected from 92 degrees to 65 degrees, and the second patient was corrected from 70 degrees to 53 degrees. Both patients underwent a mini-open approach. Cantilever correction was accomplished over an expandable cage with a minimally invasive pedicle screw system. We describe our technique of mini-open vertebral column resection and kyphosis correction in the thoracic spine.

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1. Background and importance

The surgical correction of severe thoracic kyphosis usually requires an osteotomy to mobilize the spine and long segment fixation for correction and stabilization. Options include multiple Ponte/Smith-Peterson osteotomies, pedicle subtraction osteotomy (PSO), or vertebral column resection (VCR) [1–3]. Although Ponte/Smith-Peterson osteotomies may be advantageous for smooth-gradual kyphoses such as Scheurmann's kyphosis, this may not be the case for sharp-angular kyphoses in the thoracic spine with vertebral body compromise. The VCR is a good option for many reasons. First, the correction gained can be significant, as much as 60 degrees. Second, there is less posterior column spinal shortening compared to a PSO, which can be limited because of the spinal cord's inability to withstand severe deformation and kinking. Third, the thoracic VCR is commonly performed for many other pathologies such as tumor or infection, and thus, it may be a much more comfortable operation for many surgeons who perform posterior vertebrectomies (costo-transversectomies, transpedicular corpectomies, or extracavitary approaches). A vertebrectomy with circumferential bone removal in the face of a severe deformity functions essentially as a VCR.

Until recently, the standard posterior thoracic vertebrectomy has been performed through large, open exposures, with muscle and fascial dissection of seven levels or more [1–4]. However, with

more recent advances in minimally invasive (MI) techniques, vertebrectomies are now being performed in a MI fashion or in a mini-open fashion [5,6]. We have previously described the mini-open transpedicular corpectomy as a novel technique to perform posteriorly-based corpectomies [6]. As an extension of this previously described technique, we describe how we utilized this approach to correct kyphosis via a mini-open vertebrectomy (which functions essentially as a VCR) and long segment fixation.

2. Clinical presentation

We describe the clinical presentation of case examples of severe kyphosis, indications for surgery, and description of our technique.

2.1. Patient 1

A 61-year-old woman with metastatic breast cancer to T6 presented with difficulty walking and gait imbalance. Neurological examination was significant for 4/5 strength and ankle clonus in bilateral lower extremities. Standing lateral radiograph demonstrated 70 degrees of kyphosis in the thoracic region (measured from T2 to T12) (Fig. 1A). MRI revealed a T6 pathological fracture and draping of the spinal cord over the T6 apical kyphosis/deformity (Fig. 1B). The patient underwent a mini-open T6 vertebrectomy with long segment posterior fusion for kyphosis correction (Supp. Video 1).

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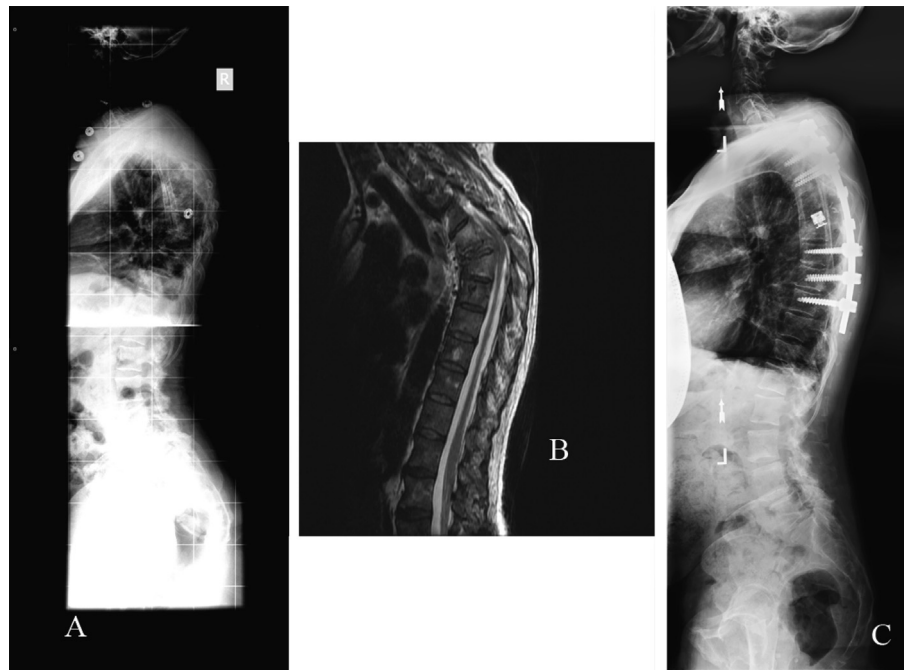


Fig. 1. (A) Preoperative 3 foot lateral scoliosis radiograph showing thoracic kyphosis of 70°. (B) Preoperative sagittal T2-weighted MRI demonstrating draping of the spinal cord over the kyphotic apex, with T6 pathological fracture. (C) Postoperative 3 foot lateral scoliosis radiograph showing thoracic kyphosis correction to 53°.

2.2. Patient 2

An 82-year-old woman who had undergone two prior kyphoplasties for kyphoscoliosis presented with progressively worsening pain. The patient had been relegated to sitting in a lounge chair for most of the day. Standing radiographs demonstrated 92 degrees of kyphosis (measured from T2 to T12), and compression fractures (two treated with kyphoplasty at T10 and T12) with an apex of her kyphosis at T11 (Fig. 2A). The patient underwent kyphosis correction via a mini-open vertebrectomy at T11 with polymethylmethacrylate (PMMA)-augmented posterior instrumentation from T5 to L3 (Supp. Video 1).

3. Operative techniques

3.1. Pedicle screw fixation

The patient is positioned prone on a radiolucent operating room table. The skin is opened midline, but the fascia is preserved. The MI screws are placed transfascially in the same manner that they are placed percutaneously. We first placed Jamshidi needles (CareFusion, San Diego, CA, USA) into the pedicles using anterior-posterior and lateral fluoroscopy. Kirschner wires (K-wires) are then placed into the pedicles. The fascia is then opened over each K-wire with a #15 blade to accommodate the screws. A tap is then placed over the K-wires, the tap is removed, and then the screws are placed under fluoroscopic guidance. The K-wires are subsequently removed.

3.2. Mini-open transpedicular vertebrectomy

This technique is described in detail elsewhere [6], but we will briefly mention our technique here. The fascia over the vertebral body, superior lamina, and inferior lamina, is opened to facilitate the corpectomy. The fascia is held open using a self-retaining retractor, and the laminectomy is performed. A temporary rod is placed, the transpedicular corpectomy is performed, and the discs and posterior longitudinal ligament are removed. We then perform

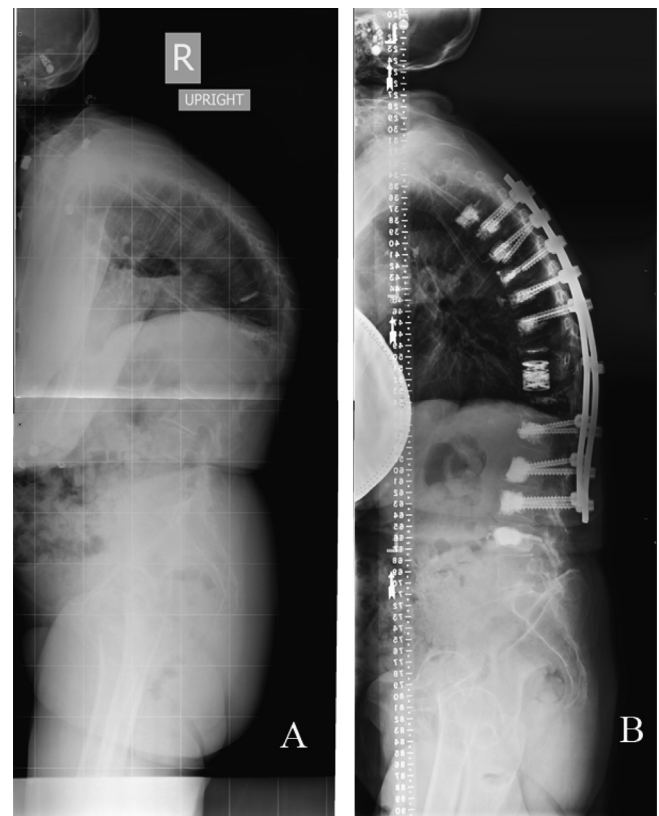


Fig. 2. (A) Preoperative lateral 3 foot scoliosis radiograph showing thoracic kyphosis of 92°. (B) Postoperative lateral 3 foot scoliosis radiograph showing thoracic kyphosis corrected to 65°.

a trap-door rib head osteotomy to mobilize the rib, and the rib is separated from the vertebral body [7,8]. An appropriate sized expandable cage is placed into the defect. For kyphosis correction, a cage with the largest footplate possible is used, but we do not

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