

# Minimally Invasive Anterior Spinal Exposure and Release in Children with Scoliosis

Evan R. Kokoska, MD<sup>1</sup>, Keith R. Gabriel, MD<sup>2</sup>, Mark L. Silen, MD, MBA<sup>1</sup>

## ABSTRACT

**Background:** The early experience with thoracoscopy in children has involved the diagnosis and treatment of pleural and pulmonary diseases. Recent advances have allowed surgeons to perform more complex procedures through video-assisted thoracoscopic surgery (VATS), potentially decreasing the pain and pulmonary impairment associated with an open thoracotomy. The authors report their initial experience with thoracoscopic assisted anterior spinal exposure and release as part of the treatment for children with spinal deformities.

**Methods:** A retrospective chart review of five children who underwent VATS for anterior spinal surgery between June 1995 and January 1997 was performed.

**Results:** The ages of the patients ranged from 11 to 16 years with a mean of 13.4 years. All patients had an anterior spinal release with or without fusion and same-day posterior spinal fusion with instrumentation. VATS was successfully completed in all patients without major morbidity and no mortality. The average operative time for the anterior portion of the procedure was 305 minutes, and a mean of 7 disc levels were released. Mean length of chest tube drainage and hospitalization were 6.8 and 8.6 days, respectively.

**Conclusions:** The objectives of anterior exposure for spinal surgery in children can safely and effectively be accomplished using minimally invasive surgery.

**Key Words:** Thoracoscopy, Scoliosis, Thoracic spine, Video-assisted thoracoscopic surgery.

## INTRODUCTION

The first major clinical contribution to laparoscopy was in 1910 and is credited to Hans Christian Jacobaeus. He explored the pleural, pericardial, and peritoneal cavities using a cystoscope and termed his procedure "laparothorakoskopie." His initial interest was in the performance of laparoscopy for the diagnosis of cirrhosis, malignancy, syphilis, and tuberculosis (TB). However, after 1913, he focused his attention on thoracoscopy because "the most interesting use of the endoscope is for the examination of the pleural cavity" and it "is such a simple method that it can be performed without inconvenience."<sup>1</sup>

Jacobaeus subsequently expanded the indications for thoracoscopy, utilizing it not only for diagnostic but also for therapeutic purposes. He demonstrated in a large series of patients that the technique could be used to lyse pulmonary adhesions and allow for complete lung collapse as a treatment for TB. This therapy was widely adopted in Europe and North America and was performed at the bedside.<sup>1,2</sup>

A wide variety of thoracoscopic procedures have been achieved since the development of charged coupling devices (CCD) or "chips" and video technology. The early experience with thoracoscopy in children was directed toward pleural and pulmonary biopsies.<sup>3,4</sup> Video-assisted thoracoscopic surgery (VATS) has recently been described for exposure of the anterior spine.<sup>5-7</sup> The present report describes an experience in five children with the use of VATS in the anterior exposure and treatment of spinal deformities.

## PATIENTS AND METHODS

Between June 1995 and January 1997, five children with significant spinal deformities of various etiologies (**Table 1**) underwent VATS for anterior spinal release and/or fusion as part of their spinal stabilization procedure. All patients and guardians were informed of the risks and potential benefits of thoracoscopy, including the need for a standard thoracotomy if VATS was not possible.

<sup>1</sup>Department of Surgery

<sup>2</sup>Department of Orthopedic Surgery

Saint Louis University Health Sciences Center and Cardinal Glennon Children's Hospital, St. Louis, MO 63104.

Address reprint request to: Mark L. Silen, MD, MBA, Division of Pediatric Surgery, Cardinal Glennon Children's Hospital, 1465 South Grand Boulevard, St. Louis, MO 63104 USA. Telephone: (314) 577-5629, Fax: (314) 268-6454

**Table 1.**  
Patient Characteristics and Outcome.

Patient	Age (years)	Gender	Past Medical History	Diagnosis	Procedure	Operative Time (minutes)		Patient Controlled Analgesia (days)	Chest Tube (days)	Hospital (days)
						Anterior	Posterior			
A	16	Male	None	Scheuermann's kyphosis (T3-T9)	ASR/PSF	310	425	3	5	8
B	12	Male	Neurofibromatosis	Dystrophic scoliosis (T2-T11)	ASR/PSF	285	410	2	7	9
C	11	Female	None	Idiopathic scoliosis (T5-T11)	ASR/PSF	315	385	3	7	8
D	15	Male	Neurofibromatosis	Dystrophic scoliosis (T5-L3)	ASR/ASF and PSF	340	420	3	7	9
E	13	Male	Neurofibromatosis	Dystrophic scoliosis (T6-T10)	ASR/PSF	275	390	4	8	9
Mean	13.4					305	406	3	6.8	8.6

ASR=anterior spinal release    ASF=anterior spinal fusion    PSF=posterior spinal fusion

### Operative Technique

Following the induction of general anesthesia, the patient is intubated with a dual lumen endotracheal tube. Central venous and arterial access, a nasogastric tube, and a Foley urinary catheter are used routinely. The patient is placed in a lateral decubitus position with the apex of the spinal deformity up.<sup>8,9</sup> For release of kyphosis, the left lateral decubitus position is preferred.

The initial trocar (Thoracoport; Auto Suture Company, Division of U.S. Surgical Corp., Norwalk, CT) is inserted into the pleural cavity at the intercostal space associated with the superior aspect of the spinal deformity at the anterior axillary line. The pleural cavity is briefly inspected and the ribs are counted by palpation from inside the chest for orientation. An intervertebral disc is then marked with a K-wire and a radiograph is obtained for confirmation of level. Other trocars (2 or more) are then inserted as needed.

The pleura is incised and segmental vessels ligated with endoscopic clips. The posterior pleura is dissected free

from the vertebral bodies and their respective inner spaces. The anterior longitudinal ligament and annulus fibrosis are divided at each of the levels to be released using electrocautery. Rongeurs and sharp curettes are then used to remove the nucleus pulposus and as much as possible of the annular fibers. The most posterior fibers of the annulus fibrosis, however, are not completely divided. The disc spaces are then irrigated with saline. If anterior fusion is deemed necessary, bone chips are utilized either from a portion of resected rib or iliac crest.

The trocars are then removed and hemostasis is verified in all the chest wall incisions. A chest tube is placed through one of the port sites under direct visualization. Dual ventilation is then initiated and proper lung expansion is directly verified. The fascia and skin are closed with interrupted and subcuticular, respectively, absorbable suture, and the trocar sites are dressed with Steri-strips. The patient is then turned to a supine position, re-intubated with a single lumen endotracheal tube, and placed prone for the posterior spinal procedure.

Patients were generally observed in the intensive care unit

for the first postoperative evening. Pain control was achieved initially in all patients with patient-controlled analgesia consisting of intravenous morphine or meperidine. Chest tubes were maintained by suction (-20 cm water) for two to three days, subsequently placed to water seal if no air leak was evident, and removed when the output was less than 50 cc over 24 hours.

## RESULTS

Thoracoscopic assisted anterior spinal release was performed in five children. The indications, procedures, and results are shown in **Table 1**. All VATS procedures were successfully completed. There were no complications or mortalities. Although follow-up is short, the postoperative course of these patients has been similar to previous patients undergoing conventional surgery.

## DISCUSSION

Surgical treatment of spinal deformity may involve a combined anterior and posterior procedure. The traditional means of anterior exposure necessitated a posterolateral thoracotomy, which is associated with significant postoperative pain and impairment of respiratory function. These may be minimized with VATS.

Early VATS procedures were technically difficult in large part due to awkward instrumentation. Recent advances, such as the conversion to using open ports in place of sealed trocars and the development of longer orthopedic instruments, have made more complex procedures possible.<sup>10</sup> Experience with VATS assisted spinal procedures is now being reported in both adults<sup>10</sup> and children.<sup>6,11</sup>

The advantages of minimally invasive thoracic procedures are decreased pain, improved postoperative respiratory function, and improved shoulder function and mobility. Landreneau et al. compared 138 adult patients undergoing either VATS or a muscle-sparing thoracotomy for peripheral lung lesions. Following minimally invasive surgery, patients had less postoperative pain, improved shoulder girdle strength at three week follow-up, decreased early pulmonary impairment, and an overall shorter hospitalization.<sup>12</sup> This was the first study to objectively assess the benefits of VATS. Long-term follow-up is needed to investigate the effect of VATS on chronic post-thoracotomy pain.<sup>13</sup>

Thoracoscopy is a surgical approach, and may be consid-

ered whenever thoracotomy for anterior spinal surgery is indicated. Absolute contraindications to VATS include previous ipsilateral thoracotomy or empyema and relative contraindications relate to the inability to perform selective intubation for either anatomic (age) or metabolic reasons.<sup>5</sup> Small children may not have sufficient space between the ribs to permit VATS. Complications specific to thoracoscopy involve trocar or instrument injuries to the lung, diaphragm, heart, segmental vessels, dura, spinal cord or lymphatic vessels.

The current study summarizes a preliminary experience with minimally invasive anterior exposure and release of the spine in children with congenital deformities. As experience with this technique increases, thoracoscopic spinal surgery will likely be part of the technical armamentarium for both pediatric thoracic and orthopedic surgeons. While the benefits of VATS appear to be many, the surgical objectives must be identical to conventional procedures and should not be compromised.

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