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Thoracoscopic correction and placement of anterior instrumentation for scoliotic deformity

Case report

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Correction of rigid scoliotic deformities involving the thoracic spine has required that a thoracotomy be performed to obtain anterior release to mobilize the deformity, as well as placement of corrective spinal instrumentation either via a separate posterior or anterior thoracic approach. To the best of the author's knowledge, this is the first published report of a case in which anterior correction of a deformity was achieved endoscopically.

A 27-year-old man presented with a rigid 85° thoracic kyphoscoliotic deformity that had developed over several years. He had previously undergone a C7-T12 laminectomy to decompress the spinal cord from a lipoma. Using thoracoscopic techniques, the author performed an anterior release and interbody fusion. Endoscopically, an anterior screw/rod system applied from T-5 to T-9 corrected the deformity to 55°.

There were no surgery-related complications. At follow-up examination 1.5 years after surgery, the patient had developed a solid fusion and the correction was maintained at an angle of 58°.

It is feasible to use thoracoscopic techniques to perform an anterior release and to apply anterior corrective spinal instrumentation to treat thoracic scoliotic deformities, thereby avoiding the need for an open posterior approach in which instrumentation is placed.

Key Words * thoracoscopy * spinal surgery * scoliosis * thoracic spine * spinal fusion * spinal instrumentation

Traditionally, severe and rigid thoracic spine scoliotic or kyphotic deformities have been treated by thoracotomy in which an anterior release is performed to mobilize the spine and to correct the deformity and spinal instrumentation is then applied to reduce and fixate the deformity. In cases of scoliosis, instrumentation to fixate the spine can be applied anteriorly (a screw/rod or screw/cable system) or posteriorly (a hook or screw and rod system) by using open surgical techniques. In the past several years, several surgeons have performed anterior release of spinal kyphosis and scoliosis by using thoracoscopy instead of thoracotomy.^{1,2,5-7,15-17]} Procedures involving the thoracoscopic release, however, have

always been followed by open posterior surgery in which the corrective instrumentation is applied. We report a case in which anterior release of a thoracic scoliotic deformity and placement of instrumentation were achieved solely via an endoscopic approach. This novel approach differs significantly from other available techniques.

CASE REPORT

Presentation. This 27-year-old man presented with a progressive thoracic rigid scoliotic deformity of 85° as well as progressive myelopathy (Fig. 1). The deformity developed over several years. He had previously undergone a C7-T12 laminectomy to relieve the spinal cord from the compressive effects of an extensive intradural lipoma.

Fig. 1. Preoperative anteroposterior radiograph demonstrating the thoracic scoliotic deformity with a curve that measures 85° . The apex of the curve was at T-7.

Examination. Magnetic resonance imaging demonstrated no evidence of spinal cord compression from lipoma or tethering. Side-bending radiographs demonstrated that the curve was rigid and only reduced 10° with lateral bending. The patient was shown to have a rib hump deformity, spastic paraparesis with mild weakness in the legs (4/5), and a T-6 sensory level deficit. An anterior release and corrective instrumentation were recommended to prevent progression of neurological deficits, to stabilize the progressive spinal deformity, and to improve the appearance of his rib hump and spinal deformity.

Operation. The procedure was performed with the patient in a left lateral decubitus position. A right-sided thoracoscopic approach was used to access the convex surface of the scoliotic deformity. Four 15-mm flexible portals were placed in the posterior axillary line from T-4 to T-10, and two flexible portals were placed in the anterior axillary line for the endoscope. A double-lumen endotracheal tube was used for single-lung ventilation, providing atelectasis to allow the right lung to fall away from the surface of the spine. Direct visualization was provided by a 1-cm-diameter thoracoscope and monitored with adjunctive fluoroscopy and somatosensory evoked potentials.

An anterior release of the deformity was performed from T-5 to T-9. The pleura was incised longitudinally over the surface of the vertebral bodies. The segmental vessels from T-5 to T-9 were ligated with hemoclips and then divided, providing exposure of the entire lateral and anterior surfaces of the thoracic spine on the right side. At each disc level (T5/T6 to T8/T9), the exposed annulus and the entire anterior longitudinal ligament were incised, and disc material was thoroughly removed from the disc space by using curettes and disc rongeurs. The end plates were decorticated, and morcellized bone grafts were inserted into the interspaces.

A customized titanium cannulated screw and rod instrumentation system (Sofamor-Danek, Memphis, TN) was applied using endoscopic and fluoroscopic guidance. Screws were inserted into the T-5 through T-9 vertebral bodies with their trajectory oriented parallel to the end plates of each vertebrae. First a K-wire was drilled into each vertebra, the pilot hole was tapped, and the cannulated screw was inserted and guided over the K-wire (Fig. 2).

Fig. 2. Intraoperative anteroposterior fluoroscopic images. Left: A K-wire is drilled into the bone. Right: Using a cannulated bone tap, the thread profile is cut into the bone, and a cannulated screw is inserted into the vertebral body. The K-wire is then removed, leaving the screw in the bone.

The K-wire was then removed. Each portal site was positioned coaxial to the intended screw trajectory. After all screws were inserted, a 3/16-inch-diameter titanium rod was measured and inserted into the chest via a portal. The straight rod was connected to the screws by using top-loading locking nuts. A customized endoscopic screw compressor was used to reduce the spinal deformity before each screw was locked to the rod (Fig. 3). The deformity was corrected to 55° (that is, a 30° reduction). At the completion of surgery, chest tubes were inserted and remained in place for 3 days after surgery. The closure procedure was routine. The operative time was 5 hours, and the estimated blood loss was 400 ml. No perioperative complications occurred.

Fig. 3. Intraoperative anteroposterior fluoroscopic images. Left: A rod connected to the screws partially corrects the deformity. Right: A compressor is placed over the screw heads to complete the correction of the deformity.

At follow-up examination 18 months after surgery, the patient experienced no new neurological deficits, and his posture and chest wall deformity had improved. Radiographic studies demonstrated a well-formed bone fusion and correction of the curve to 58° (Fig. 4).

Fig. 4. Anteroposterior radiograph obtained 1 and a half years after surgery revealing the position of the hardware and reduction of the curve to 58°.

DISCUSSION

This new thoracoscopic technique for the placement of anterior spinal instrumentation to correct thoracic

spinal deformities may preclude the need for open surgical procedures in selected patients with thoracic scoliotic and kyphotic deformities. In the past, thoracoscopic approaches have been used to perform anterior releases to mobilize spinal deformities. However, they have always required an open posterior surgical procedure in which to apply the instrumentation for reducing and maintaining correction of the spinal deformity.[1,2,5-7,15-17,19] In avoiding posterior approaches we may be able to reduce morbidity by decreasing both blood loss and the extent of muscular dissection, and cosmesis can be improved by reducing the number and length of surgical scars.[4,18,20]

Indications for Surgery

This endoscopic technique is limited to correcting deformities confined to the thoracic spine. If a deformity extends significantly into the lumbar spine, the thoracoscopic technique cannot provide sufficient access.[7-9,19,22] This technique can be used to correct progressive thoracic spinal deformities such as kyphosis (for example, traumatic or Scheurmann's kyphosis), idiopathic or neuromuscular scoliosis, nonunion of fractures, and hemivertebrae resection. It can also be used to prevent disparity between growth of the anterior and posterior spine in skeletally immature patients with scoliosis (crankshaft phenomena).[10]

Anterior Fixation of Scoliosis

For more than 20 years, anterior fixation of thoracic spinal deformities has been performed extensively with screw/rod or screw/cable systems.[3,11-14,20,21] Although well-established and associated with satisfactory results, this technique has previously been performed only in open thoracotomy. The screw/rod anterior instrumentation system used in thoracoscopic applications was developed by Drs. Ronald Blackman and Eduardo Luque.[2]

Thoracoscopic Correction of Scoliosis

The endoscopic attainment of anterior release and application of spinal fixation devices have the potential to reduce surgery-related morbidity. Thoracoscopy has several potential advantages: it may eliminate the need for open thoracotomy or posterior fixation procedures; reduce pulmonary morbidity, blood loss, and recovery time; enhance cosmetic outcomes; and decrease postthoracotomy pain and the length of hospitalization. However, the mechanical and clinical performances of this endoscopically placed spinal instrumentation need to be evaluated and compared with those of open procedures in large, long-term clinical studies that examine its efficacy in correcting deformities, maintaining long-term reduction, achieving fusion, and minimizing hardware-related complications.

CONCLUSIONS

The results in this case demonstrate the feasibility of using thoracoscopic techniques to apply fixation devices and to correct thoracic spinal deformities. Although this new technique appears promising, it requires practice and skill in thoracoscopic dissection techniques. Large-scale clinical trials are needed to compare the results of this technique with open surgical procedures for correction of thoracic spinal deformities.

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