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19 The Anterior Approach to Treating Scheuermann's Disease: Short Segment Fusion

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Introduction

Holger Scheuermann described a condition in 15 to 17 year-old farm boys as activity-related thoracic pain and a progressive kyphotic deformity with a wedging of at least three apical vertebrae.[4,5,7] The spectrum of this disease has been elucidated by longitudinal natural history studies.[2] On one hand we have the classical Scheuermann's disease which represents a patient with a hyper-kyphotic deformity that is a result of a multi-level pathology with vertebral body wedging, narrowed disks, Schmorls nodes[6] and irregular endplates (group I, Table 19.3). On the other hand is a group of patients with a predominance of pain (group II, Table 19.3). Murray identified this group as those with a moderate deformity and apical thoracic pain.[2] These patients also have the classical vertebral body wedging, end plate irregularity, Schmorls nodes and disk space narrowing, though with fewer levels involved hence the deformity is not a predominant clinical feature. The hyperkyphosis in group 1 is a striking clinical feature though very frequently not a problem with regards to function (group IA, Table 19.3). The progression is slow and an unrestricted lifestyle can be pursued any occupations and recreational activities. However there is a subset of this group (group IB, Table 19.3) that present with a progressive and symptomatic deformity. The progressive deformity may cause pain over the thoracic spine, in the hyperlordotic lumbar spine, cause cosmetic problems due to the hyperkyphosis and lead to psychosocial issues. These patients may be appropriate candidates for the surgical treatment of the deformity.

The majority of the patients of group II report having pain that can be controlled with one or more nonsurgical treatment modalities such as stretching, strengthening, swimming and bracing, nonsteroidal medications. They do not require the use of narcotics. They will be able to lead a normal unrestricted lifestyle (group IIA). Some patients will have pain that cannot be controlled despite narcotics and leads to severe limitations in the lifestyle (group IIB). These patients may be appropriate for surgical intervention such as a short segment anterior fusion of the affected disks. It is conceivable that some of these patients, if untreated, may progress to category IB with an increase in the magnitude of the deformity (Table 19.1). It should be appreciated that these groups are not mutually exclusive and some overlap between the 2 groups is common in clinical practice.

The presence of Schmorls nodes,[6] irregular end plates, disk space narrowing and vertebral body wedging is commonly noted, Bradford[10] suggested that the underlying pathology might be a discopathy. The development and application of MRI has expanded

Table 19.1: Indications for short segment anterior fusion

1. Skeletally mature adolescents or adults
2. Scheuermann's disease confirmed on radiographs and MRI
3. Failure to respond to nonsurgical measures, including narcotics, resulting in lifestyle-limiting pain and/or chronic narcotics
4. Examination findings:
   a. Disturbed range and rhythm
   b. Apical kyphosis
   c. Tenderness on percussion over the apex
   d. Normal neurological assessment

our knowledge of the problem.[3] MRI-based observations have demonstrated early disk degeneration, end plate irregularity and vertebral wedging, even before the kyphosis is clinically evident. The painful disks at the apex of the diseased levels can be identified on provocative discography.[8,9]

Historically the treatment has been essentially posterior with anterior surgery being limited to releasing the 'bow-strung' anterior longitudinal ligament and excising the apical disks. This may have been in part due to the late presentation of the patients with a progressive hyperkyphosis and partly due to the understanding of the natural history of this condition. Although pain has not been recognized as a primary indication for surgery for this condition the pain at the apex of the kyphosis can be severe enough to interfere with life even when the kyphotic deformity was moderate (group IB). This understanding that pain can be a problem relatively independent of the magnitude of the deformity, has led to a different treatment approach. It seemed to the senior author (RWG) that the surgical approach for these patients could be focused strictly on the treatment of the diseased disks and vertebral bodies which were the source of their complaints. The most straightforward approach for this is an anterior correction procedure including a thorough disectomy and placement of a structural interbody cage to achieve arthodesis of the involved segments and to remove the source of the patient's pain. This approach eliminates the 'diseased' segments and corrects the deformity without fusing any normal levels. We recommend this surgical approach for moderate deformity when pain—not just the deformity—is the principal surgical indication.

This approach does not replace the techniques such as anterior and posterior corrections and osteotomies for the advanced hyperkyphotic deformity. The essential components for success with this method is the identification of patients with intractable pain from the diseased segments, a moderate and a flexible kyphotic deformity, a meticulous discectomy and careful placement of custom-contoured and anterior interbody spacers.

Surgical indications

- Skeletally mature with a diagnosis of Scheuermann's disease based on the classical disk and vertebral changes seen on radiographs and MRI scans.
- The patients that are suitable for this form of surgical treatment are the ones with a moderate kyphotic deformity (68-85 degrees).
- The main indication of surgery was the presence of pain that is not well controlled despite the use of narcotics. The pain resulted in functional limitations which mandated narcotic analgesics.
- These patients consistently demonstrated a disturbed spinal flexion and extension rhythm, pain and tenderness on percussion over the apex of the kyphotic deformity.

Table 19.2: Key elements of the surgical procedure

1. Rib head excision
2. Complete excision of the diseased intervertebral disk
3. Correction of the kyphosis with structural interbody grafts
4. Stabilization of the reconstructed segments with anterior instrumentation (dual screw rod construct)

Selection of Operative Levels

- Based on imaging assessment that comprises of:
  - standing anteroposterior and lateral radiographs.
  - MRI of the entire spinal column.
  - hyperextension radiographs confirmed the flexibility of the kyphosis and demonstrated the apex of the curve and the vertebral wedging.
- The operated levels included each dehydrated disk and each wedged vertebra.
- The instrumentation and fusion spanned only the pathological levels and spared all normal levels.

Operative Technique

POSITIONING

Patients were positioned in the lateral decubitus position on a peg-board and gelpad (Fig. 19.1). They were firmly positioned by the pegs so that they would not slide or roll during the procedure.

ANESTHESIA AND NEURO-MONITORING

General anesthesia is employed. A dual lumen endotracheal tube is optional. Neurophysiological monitoring of spinal cord function is recommended.

ACCESS

An open thoracotomy is performed by removing the rib which is attached to the level below the top one which would be instrumented during the procedure (e.g. If T6 is the

Figure 19.1: Positioning the patient in the right lateral decubitus position on a peg board. This secures the position throughout the procedure

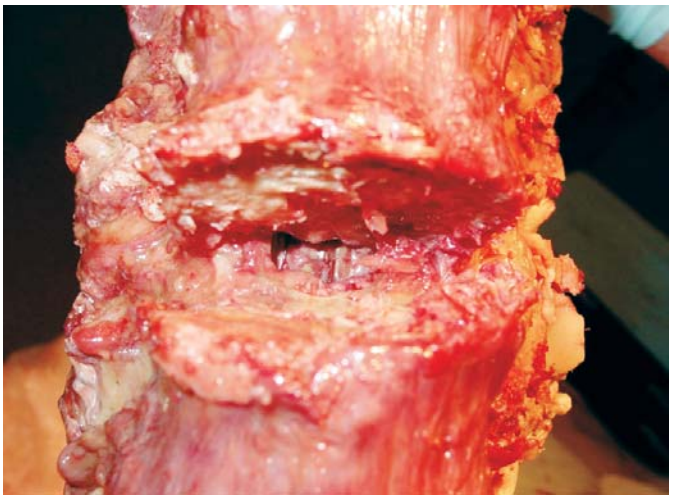


Figure 19.2: A thorough discectomy involves the excision of the disk to include the posterior annulus and the PLL and ensuring that the far lateral corner is clear, as seen in this cadaveric dissection

upper instrumented level, the 7th rib is removed for the exposure). The segmental vessels are clipped, divided and retracted to expose the diseased segment of the spine. The vertebral body and the disks are identified, and the levels are confirmed on the image intensifier. Retractors are placed to prevent injury to the thoracic viscera.

PROCEDURE (TABLE 19.2)

Rib Head Resection and a Complete Discectomy

Performing a complete disectomy is central to the success of this procedure. The entire disk is removed along with the cartilaginous end plate with due care to avoid damage to the cortical end plate. The key to a complete discectomy is to identify the posterior margin of the disk. This is facilitated by identifying and excising the head of the rib (Fig. 19.3). This leads the surgeon directly to the costovertebral joint that lies over the intervertebral foramen. The neural foramen is identified and opened to allow the passage of a Penfield no. 4 dissector along the posterior extent of the posterior longitudinal

Table 19.3: Spectrum of the disease

Scheuermann's disease

Group I: Predominant kyphotic deformity
- Multilevel pathology
- Classical wedging, disk and end plate changes
- Hyperkyphosis

Group II: Predominant pain
- Fewer levels involved
- Classical wedging, end plate and disk changes
- Mild or moderate kyphosis

A: No symptoms
- Nonprogressive or slow progression
- Normal lifestyle despite deformity
- Observation/No treatment

B: Symptomatic
- Pain and cosmetic issues related to the deformity
- Associated psychological problems
- Consider deformity correction (anterior/posterior/osteotomies)

A: Minimal pain
- Respond to conservative measures
- Can lead unrestricted lifestyle with appropriate measures
- No narcotics required
- Observe/reassure

B: Moderate to severe pain
- Requires conservative measures to lead a restricted lifestyle
- Narcotics required if pain severe
- Short-segment anterior fusion
- May lead to **IB** if untreated

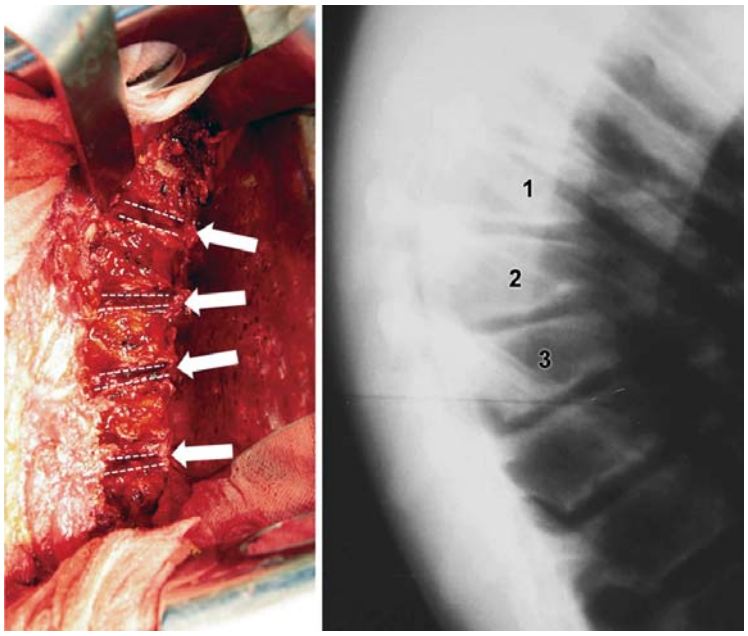


Figure 19.3: Left, an intra-operative picture from our series showing a complete discectomy at 4 contiguous levels after excision of the rib heads. The broken white lines mark the end plates and the bold arrow points to the disk space that is 'opened' by an anteriorly directed force with a fist over the apex of the kyphosis. Right, a preoperative hyper-extension radiograph shows the 'opening' of the disk spaces.

ligament. This facilitates a thorough discectomy including the posterior annulus and the posterior longitudinal ligament.[2] Care is taken to ensure that the far corner of the disk is removed completely. The apical disk is operated first, and then other adjacent diseased disks are similarly excised. An anteriorly directed force with a closed fist demonstrates the opening up of the disks and confirms a thorough discectomy (Fig. 19.4). This maneuver also permits insertion of the interbody cages to correct the kyphotic deformity at the involved interspaces.

Spacers

After the entire disk is removed, a spacer is placed to correct the deformity. This may be either a uniquely shaped femoral ring allograft or an appropriately shaped carbon-fiber interbody cage. These structural grafts are filled with morselized rib grafts obtained

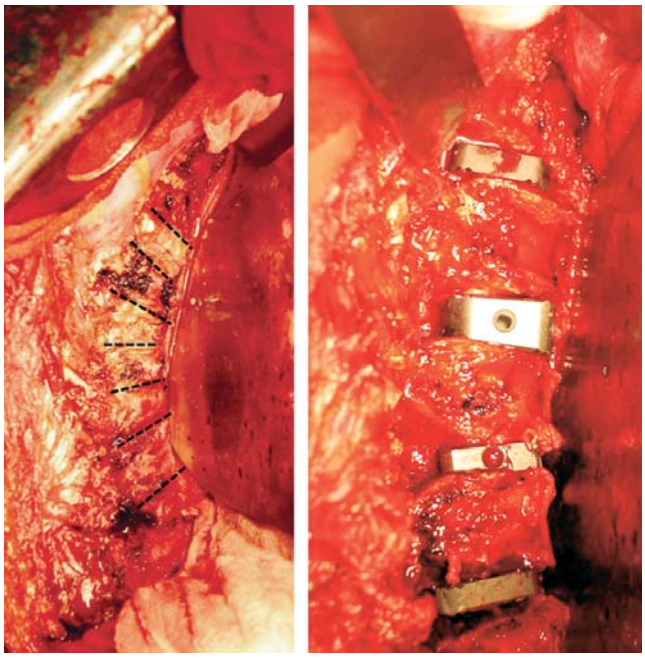


Figure 19.4: Before discectomy (left) and after insertion of spacers (right). The spacers correct the deformity and provide a large foot print for the fusion of the anterior column

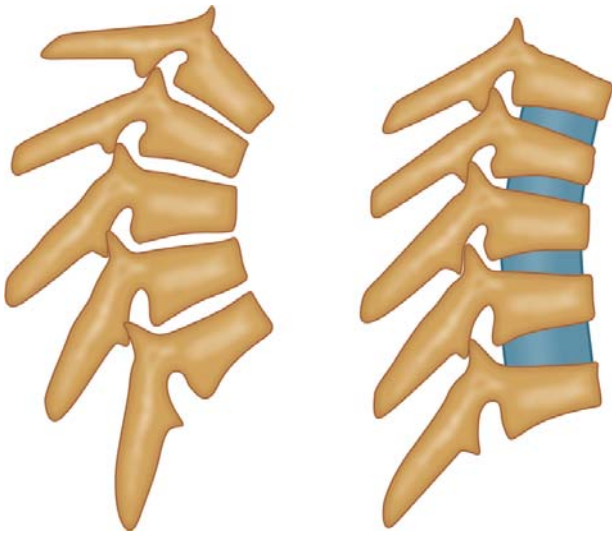


Figure 19.5: A diagrammatic representation of the 'closed' disks at the involved levels preoperatively (left) and after the discectomy and placement of the cages, showing correction of the deformity (right)

from the rib removed during the exposure. Maximum correction is achieved by selecting an appropriately sized interbody graft that is tapped into place. We usually place the apical spacers and work in both the directions. The interbody spacer achieves all of the correction (Figs 19.4 and 19.5).

Instrumentation

The screws and rods do not serve to obtain any further correction. All of the correction is achieved by the placement of the spacers. The screws and rods merely stabilize the operated segments to permit healing of the reconstruction. Excision of the rib head allows positioning of implants in a more suitable posterior location that allows safe positioning of the screws. The author has used KASS implants, a dual screw, dual rod system, (Depuy, Raynham, MA) for all his cases (Fig. 19.5).

Prior to closure of the chest the prominent implants are covered either by way of a parietal pleural flap or a Gore-Tex pericardial membrane. An epidural catheter is placed for optimizing postoperative analgesia.[6]

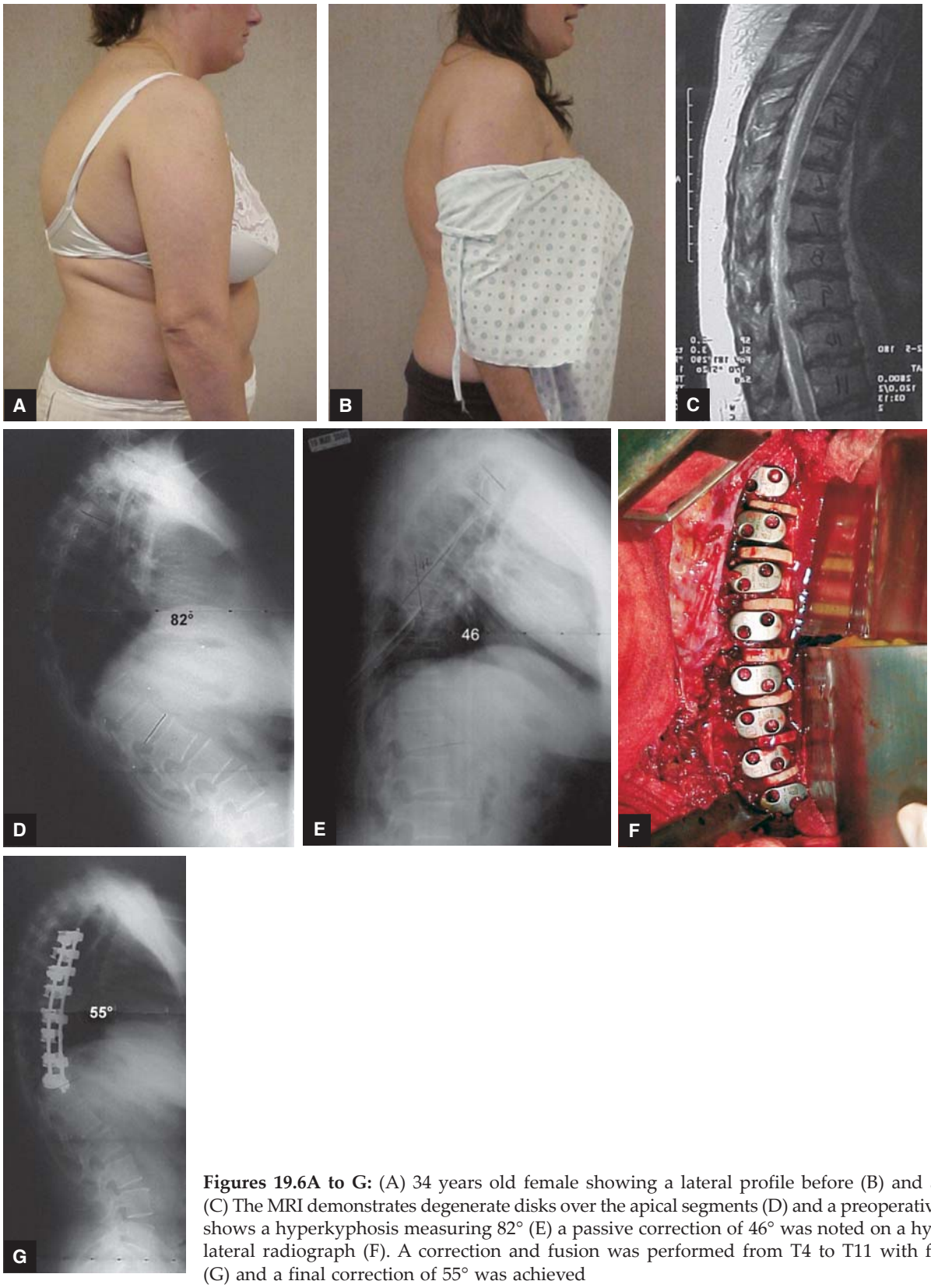
Complications

Spinal cord injury is a rare complication. It is avoided by a good understanding of the pathoanatomy and a complete discectomy. The use of spinal cord monitoring has emerged as a useful adjunct to correcting spinal deformities (MEP, SSEP). A good surgical technique avoids any injury to the visceral structures. A careful closure should be performed to avoid an injury to the intercostal nerve that could result in scar dysesthesia. Careful selection of levels, as outlined earlier, is vital for a successful outcome with regards to pain and deformity. Proximal or distal junctional kyphosis virtually never occur by this approach.

After-care

The patients are allowed up when comfortable. We brace the patients for a period of 8 weeks after the procedure. They are encouraged to limit themselves to nonexertional activities (any activity that does not lead to breaking a sweat) for 6 weeks. They are allowed to return to normal activities by 2-3 months. Recreational sports are allowed at that time, and contact sports are permitted when they are comfortable for the patient.

Illustrative Case (Figs 19.6A to G)



Figures 19.6A to G: (A) 34 years old female showing a lateral profile before (B) and after surgery (C) The MRI demonstrates degenerate disks over the apical segments (D) and a preoperative radiograph shows a hyperkyphosis measuring 82° (E) a passive correction of 46° was noted on a hyperextension lateral radiograph (F). A correction and fusion was performed from T4 to T11 with femoral rings (G) and a final correction of 55° was achieved

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