The location and type of vertebral anomaly can affect the severity and prognosis of congenital scoliosis. When a large deformity is present at an early age, surgical treatment is necessary. Surgical correction of congenital curves is generally more successful when high-risk curves of a smaller magnitude are treated early. In cases in which the curves manifest later in life, treatment is more challenging to the clinician.

There are a number of surgery-related options available for the management of congenital scoliosis. Historically these options have included posterior spinal fusion with or without instrumentation, anterior and posterior fusion in situ, hemiepiphysiodesis, and fusion following hemivertebra excision via combined anterior–posterior approach. Initially this was conducted via a combined anterior–posterior approach. Recently some authors have indicated that in the lumbar spine hemivertebra resection can safely and effectively be achieved via a single posterior transpedicular approach. The authors report two adult cases in which they performed posterior transpedicular lateral extracavitary excision of a thoracic, fully segmented hemivertebra. Essentially complete correction of the deformity was achieved. There were no neurological complications. The patients were spared a thoracotomy and no chest tubes were required.

KEY WORDS • hemivertebra • spinal deformity • spinal instrumentation

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CASE REPORTS

Treatment Overview
We report two cases of adults presenting de novo with fully segmented thoracic hemivertebrae in whom symptoms merited surgical treatment. Both patients underwent hemivertebra excision via a posterior-only, transpedicular lateral extracavitary approach at a single institution; the procedures were performed by a single surgical team. The spine was stabilized using pedicle screw fixation above and below the level of resection.

Surgical Technique
Both hemivertebrae were in the mid thoracic spine. Fluoroscopy was used to identify the level of each hemivertebra. The posterior hemilamina was excised. The...
corresponding medial 8 cm of rib was resected via a later-
al extracavitary approach. The suprajacent and subjacent
discs were resected. The hemivertebra body was then de-
cancellated and removed piecemeal. Compression on the
ipsilateral side was then applied to the pedicle screws
above and below the site of resection. If correction was
not achieved using minimal force application, additional
resection was undertaken until correction was obtained.
This required excision of the posterior concave facet joint,
which often is ankylosed. Bone graft material derived
from the resected body and rib was used to facilitate ante-
rior and posterior fusion. In both cases, motor evoked po-
tentials and somatosensory evoked potentials were used to
ensure no neurological compromise occurred.

Case Summaries

Case 1. This 42-year-old woman suffered constant
midthoracic back pain. Pain was worsened by activities
such as standing and sitting for prolonged periods of time.
Symptoms were alleviated minimally by physical ther-
apy and oral analgesic medication. Imaging revealed a T-6
hemivertebra with resulting kyphoscoliosis (Fig. 1). She
was taken to the operating room where she underwent lat-
eral extracavitary excision of the hemivertebra and place-
ment of posterior instrumentation. She required a delayed
placement of chest tube for pleural effusion. Serial radi-
ographs revealed good fusion and improvement in kypho-
scoliosis (Fig. 2). Although she continued to suffer back
pain, her preoperative symptoms nonetheless improved.

Case 2. This 24-year-old woman suffered constant
midthoracic back pain and myelopathy. Pain was made
worse with activity. She was unable to perform her mili-
tary duties. Conservative therapy proved ineffective. Neu-
roimaging revealed a T-5 hemivertebra with resulting ky-
phoscoliosis (Fig. 3). She underwent lateral extracavitary
excision of the hemivertebra and placement of posterior
instrumentation. Her postoperative course was complica-
ted by acute cholecystitis unrelated to the surgical pro-
dure. Serial radiographs revealed good fusion and im-
provement in kyphoscoliosis (Fig. 4). She remains on
active duty 30 months after surgery meeting the physical
requirements for duty.

![Fig. 1. Case 1. Preoperative studies. Left: Anteroposterior radiograph. Center and Right: Computerized tomogra-
phy scans.](image)

![Fig. 2. Case 1. Postoperative radiographs (anteroposterior [left] and [right]).](image)

DISCUSSION

Fully segmented hemivertebrae can have significant
unbalanced growth potential. Patients presenting
with a high-magnitude curve at a very young age are
at substantial risk for deformity progression. Although
the optimal treatment for “high-risk” congenital curves
is surgery, the required approach remains controversial.
Treatment options include posterior spinal fusion alone,
anterior–posterior fusion, hemiepiphysiodesis, or single-
or two-stage hemivertebra excision and fusion.

Posterior spinal fusion with or without anterior spinal
fusion will arrest progression of the curve and may, with
the use of instrumentation, obtain curve correction. Using
this method, Winter and Moe together and with Lon-
stein reported their extensive experience in young chil-
dren and adolescents. They found that in some children
undergoing posterior spinal fusion alone “bending of the
fusion mass” occurred (or what is now called crankshaft
phenomenon) in up to 14% of cases. Bending of the fusion
mass was associated with some loss of spinal alignment
correction. In both studies, however, they did not correlate
the eventual bending of the fusion mass with posteriorly
tethered anterior growth. They believed that an associated anterior fusion was not necessary. In a similar population, Hall and coworkers reported that with the use of Harrington instrumentation a greater degree of correction was maintained.

Hemiepiphysiodeses was originally described in 1963. Bradford reported on hemiepiphysiodeses in 1982. This procedure was an attempt to arrest curve progression through partial convex anterior hemiarthrosis while achieving a slow curvature correction with further spinal growth. Hemiepiphysiodeses was also an attempt to limit the restriction of growth that occurs after posterior spinal fusion. When used in congenital scoliosis, results of this procedure were mixed.

In the past hemivertebra excision was considered to be an aggressive treatment. Leatherman and Dickson expressed concern about the neurological risk associated with the single-stage hemivertebra excision. Despite their concern, they suggested that two-stage hemivertebra excision might pose less danger of neurological injury than instrumentation-augmented posterior spinal fusion because hemivertebra excision shortens the spine while correcting the deformity. Subsequently Bradford and Boachie-Adje reported that this procedure could be conducted safely in a single stage. The results of a number of other studies of heterogeneous groups of children and adolescents have supported their results. It is unclear whether this decrease in complications is due to an improvement in surgical or anesthetic technique or neurological monitoring. It is likely that the combination of these advances has contributed to a safer procedure than that originally reported by Leatherman and Dickson.

A one-stage hemivertebra resection via the posterior approach has been previously described. Ruf and Harms reported on 21 cases (age range 15–167 months) with a 2-year follow-up period. In all cases a posterior-only approach was used for the placement of transpedicular instrumentation and hemivertebra resection. The mean preoperative Cobb angle of the main curve was 41°; postoperatively it was 14° and at the latest follow-up assessment it was 15°. The angle of kyphosis was 24° before surgery but improved to 11° after surgery. There was one infection, one pedicle fracture, and two failures of the initially used wire instrumentation. Shono, et al., reported on 12 patients (age range 8–24 years) in whom hemivertebra resection was performed via a one-stage posterior approach; the minimum follow-up period was 2 years. All patients harbored a single nonincarcerated hemivertebra at T-9 (one patient), T-10 (two patients), T-11 (two patients), T-12 (four patients), and L-1 (three patients). The mean preoperative scoliosis was 49° and was corrected to 18°, and preoperative kyphosis of 40° was corrected to 17°. A trunk shift of 23 mm was improved to 3 mm. No intraoperative complications were noted, and a solid fusion was achieved in all patients.

To date there has been very little written on congenital spinal deformity presenting in adulthood. In the two previous reports the authors concentrated on the adolescent population and little was noted on single-stage resection in the adult population. In our experience, with patients presenting in this fashion there are significant sagittal-plane issues. In both of these patients, there was an acute kyphotic angulation at the site of the hemivertebra. With the aging process the spine becomes progressively more kyphotic, primarily through loss of disc height. Because the discs can no longer compensate for the structural osseous anomalies, degenerative spurring can occur. When this happens in the thoracic spine, cord compression or thoracic nerve root compression can occur. Treatment then is directed at decompressing the neural elements and achieving appropriate spinal realignment while trying to minimize surgery-related morbidity. In our two cases, correcting the scoliosis is helpful, but restoring appropriate segmental sagittal alignment is paramount.

CONCLUSIONS
Fully segmented thoracic hemivertebrae that require surgical treatment can be resected via a posterior-only approach in not only pediatric patients but also adult pa-
tients. The combined use of transpedicular decancellation and a lateral extracavitary approach makes the resection safe at the spinal cord level. Rigid internal fixation involving placement of thoracic pedicle screws makes stabilization and rapid postoperative mobilization possible.

Disclosure

The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the US Army, US Navy, or the Department of Defense. The authors are employees of the US government. This work was prepared as part of their official duties and as such, there is no copyright to be transferred.

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Manuscript received December 16, 2002. Accepted in final form January 10, 2003. Address reprint requests to: Ross R. Moquin, M.D., Walter Reed Army Medical Center, 6900 Georgia Avenue NW, Neurosurgery Service, Building 2, Room 6444, Washington, DC, 20307. email: RossMoquin@aol.com.