SECTION I: Case discussion: Minimally Invasive Surgery for Adolescent Spinal Deformity

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Dr. Samdani is a pediatric spine surgeon at the Shriner's Hospital for Children in Philadelphia, PA. He is treating many of his patients using a minimally invasive surgical approach. The following is a case study featuring the use of minimally invasive surgery to treat a severe spinal deformity.

History and Examination
WC is a 12-year-old girl who presented to our institution with a Lenke 1AN 72 degree curve. She had originally presented with a 35 degree curve at age 9. MRI revealed no intraspinal anomalies. She progressed despite being braced in a TLSO for 16 hours/day. On physical examination her right shoulder was elevated, and on Adams forward bending test the inclinometer read 17 degrees. Neurological examination was within normal limits.

Radiographic Studies
Full length standing PA/lateral and bending films were obtained (Figure 1a-c). These demonstrated a right convex 72 degree curve from T5-L1, which bend down to 29 degrees.

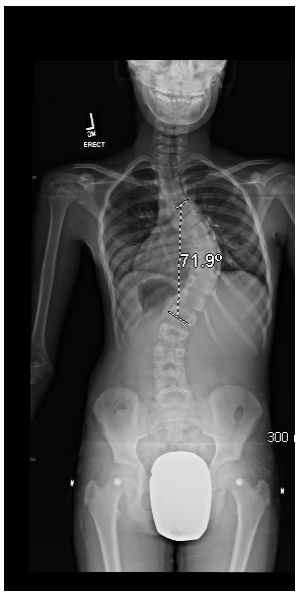

Figure 1a

Figure 1b

Figure 1c

Operative Treatment
The patient was brought to the operating room for a posterior spine fusion (PSF) utilizing a muscle sparing approach (Figure 2). After standard prep and drape, the fluoroscopy machine was used to plan a midline incision from T2-L2. The skin was opened sharply and undermined laterally maintaining fascial integrity. Under fluoroscopic guidance the Jamshidi needles were placed into the pedicle to a depth of 20 mm. This was done sequentially from L2-T2 bilaterally, skipping T4 on the right (Figure 3). Subsequently, guide wires were advanced with removal of the Jamshidi needles. At this point, the fluoroscopy machine was positioned for a lateral projection and a muscle protective sleeve passed over the guide wires. A cannulated awl was used to start the pedicle hole, followed by the appropriate size tap. At this point, each facet was visualized with a hand held retractor and the facets drilled with a high

speed burr. Care was taken to ensure adequate decortication and the grafting material was placed. This consisted of a mixture of corticancellous chips, aspirated blood from the pedicle, and HEALOS®. Subsequently, the appropriate size pedicle screw was inserted and the guide wire removed.

Figure 2

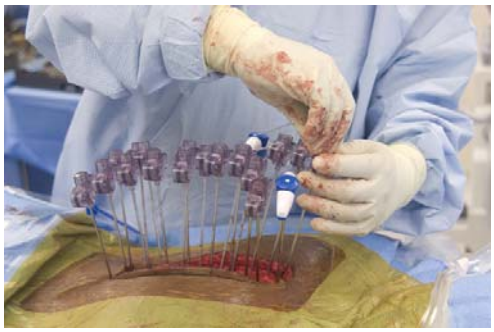

Figure 3

Curve correction and derotation was performed by the 'rod second' technique as described by Vallespir et al.[1] In this technique, vertebral coplanar alignment is attained by first placing two rods through the tubes on the convexity. Controlled, forceful separation of the rods results in coronal and axial correction. Once, the correction was attained an appropriately sized cobalt chrome rod bent into the appropriate sagittal contour was introduced on the concavity. The rod was inserted through L2 and sequentially up. Tactile and visual feedback guides the passing of the rod through the tubes. Once all tubes were engaged, set screws were placed and the rod reduced using reduction instruments. The concave rod was turned into the appropriate sagittal plane, and the set screws tightened. In a similar manner the rod on the convexity of the curve was placed. Prior to placement of the convex rod, an en bloc derotation maneuver was performed. Intraoperative x-rays confirmed good correction and the wound was closed in a standard manner. Intraoperative blood loss was 250 cc. The patient was discharged home on postoperative day 5. Her two month standing PA/lateral x-rays demonstrate her correction (Figure 4a,b).

Figure 4a

Figure 4b

Discussion

In this report we present a patient who was treated with a MIS versus standard open PSF. Standard open posterior approaches to the spine are associated with significant muscle morbidity including atrophy, denervation, and scarring.[2-5] These issues can increase postoperative pain and hospital stays, with the possibility of chronic long term pain.[6-8]

To overcome these limitations, minimally invasive approaches to the posterior spine have been utilized to treat a variety of pathologies. In the lumbar spine, several authors have documented similar outcomes with decreased blood loss and hospital stay utilizing MIS versus open approaches. [9] [10] [11] Similar results have been reported for trauma patients.[12] Currently there is only one report in the literature on the use of MIS in deformity.[13] Some concerns with using MIS in deformity include attaining fusion, rod passage, and the ability to perform corrective maneuvers such as derotation. Attaining a solid fusion is a viable concern particularly in older patients. In younger patients this is less of a concern, particularly with use of modern instrumentation.[14] For this patient the facets were aggressively decorticated and the fusion bed prepared and graft placed prior to insertion of pedicle screws.

Dr.'s Asghar and Cahill performed the first percutaneous posterior spine fusion at our institution in October 2007. That patient was concerned about loss and for personal reasons could not accept a blood transfusion. She underwent a T4-L1 fusion with approximately 200 ccs of blood loss. A CT scan obtained 6 months postop demonstrated good bony fusion. Since that time we have operated on 8 patients utilizing an entirely MIS approach, in addition to 6 patients in whom a 'hybrid' approach consisting of a mini open area across the apex of the curve was used. The 'hybrid' technique allows for aggressive osteotomies across the apex to improve coronal and sagittal correction, particularly in hypolordotic patients. We are currently planning a prospective study to compare MIS versus traditional open in patients with adolescent idiopathic scoliosis.

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