Lateral retroperitoneal transpsoas interbody fusion in a patient with achondroplastic dwarfism

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The authors present the first reported use of the lateral retroperitoneal transpsoas approach for interbody arthrodesis in a patient with achondroplastic dwarfism. The inherent anatomical abnormalities of the spine present in achondroplastic dwarfism predispose these patients to an increased incidence of spinal deformity as well as neurogenic claudication and potential radicular symptoms. The risks associated with prolonged general anesthesia and intolerance of significant blood loss in these patients makes them ideal candidates for minimally invasive spinal surgery. The patient in this case was a 51-year-old man with achondroplastic dwarfism who had a history of progressive claudication and radicular pain despite previous extensive lumbar laminectomies. The lateral retroperitoneal transpsoas approach was used for placement of interbody cages at L1/2, L2/3, L3/4, and L4/5, followed by posterior decompression and pedicle screw instrumentation. The patient tolerated the procedure well with no complications. Postoperatively his claudicatory and radicular symptoms resolved and a CT scan revealed solid arthrodesis with no periimplant lucencies.

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Spinal abnormalities such as thoracolumbar kyphosis, spinal stenosis, shortened pedicles, and an underdeveloped sacrum are much more frequently seen in patients with achondroplastic dwarfism than in the normal adult population.12 Achondroplasia is a disease of endochondral bone formation that results in early fusion of the pedicles to the vertebral bodies.7,11,12 It is the most common skeletal dysplasia, with an incidence of 1 per 13,500 live births.7 Achondroplasia is an autosomal dominant point mutation that occurs at the 4p16.3 locus, which results in a defective fibroblast growth factor receptor.2,4,7

Despite early fusion of the pedicles to the vertebral bodies and an overall shorter spinal column, the spinal cord in patients with achondroplasia is typically the same size as in individuals without the disease.12 Secondary to their bony abnormalities, 35%–47% of people with achondroplasia report neurological problems.7 In one study by Farmer et al.,4 a large cohort of 437 adults with achondroplasia were sampled. More than 40% of the patients queried acknowledged chronic back pain. Thirty percent claimed to have a spinal deformity. Nearly half (205 patients) reported weakness in either their upper or lower limbs.3

Patients with achondroplasia are not spared from the degenerative cascade of the lumbar spine as originally described by Kirkaldy-Willis.8 Because of the higher risk associated with general anesthesia and lower tolerance for significant blood loss, patients with achondroplastic dwarfism appear to be ideal candidates to benefit from new, minimally invasive corrections of their spinal deformities. The lateral retroperitoneal approach is an anterior interbody arthrodesis performed via lateral access to the spine.6 This procedure has been shown to reduce recovery time, blood loss, and tissue damage.5 Results from lateral access interbody fusions have been proven to provide at least equivalent, if not better results than traditional posterolateral fusions in limited studies.3 More long-term efficacy studies need to be performed to prove superiority. Specifically, interbody grafts have been shown to increase the rate of fusion and to provide biomechanically important anterior column support.5 In patients with a spondylolisthesis, the radiographic and clinical outcomes after fusion surgery have been shown to trump simple conservative measures.1

We report a case of a 4-level anterior interbody arthrodesis for deformity correction and relief of radicular and claudicatory pain in a patient with achondroplastic dwarfism. This is the first reported case of the lateral access approach being used to correct a deformity in a patient with achondroplasia.

ABBREVIATION AP = anteroposterior.
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Case Report

History and Examination

This 51-year-old man had a history significant for achondroplastic dwarfism and recurrent lumbar stenosis, radiculopathy, and neurogenic claudication. Seventeen years prior to his current presentation he underwent an L3–5 laminectomy followed by an L1–2 laminectomy 1 year prior to this presentation. Both surgeries were performed for neurogenic claudication and were met with excellent clinical results. However, beginning approximately 6 months after his most recent surgery, the patient began to suffer from recurrent claudication and radicular symptoms. His symptoms were exacerbated when standing up and relieved by sitting and lying down. His radicular symptoms were in the classic L-4 and L-5 patterns bilaterally.

His motor and sensory examinations revealed no focal abnormalities. His initial Oswestry Disability Index score was 16/50. Plain anteroposterior (AP) and lateral radiographs were taken, which revealed diffuse degenerative changes in his lumbar spine as well as a Grade 1 spondylolisthesis at L4–5 (Fig. 1). A CT myelogram was performed, which revealed significant canal and lateral recess stenosis at L3–4 and L4–5 secondary to facet hypertrophy (Fig. 2). Lateral scoliosis films did not reveal any upward sagittal or coronal alignment.

After 6 months of conservative treatment (including steroids, physical therapy, rest, and time) failed, the patient presented for surgical decompression and fusion. Revision of his previous laminectomies alone was considered; however, given his congenitally narrow canal, an adequate revision facetectomy for decompression necessitated a fusion.

A posterior instrumented fusion with revision laminectomy was considered in this case. However, lateral interbody grafts were needed for foraminal height restoration given the patient’s marked foraminal stenosis and radicular symptoms. In addition, the placement of interbody grafts provides for increased fusion rates and improved anterior column support.

Operation

Close examination of the preoperative AP and lateral radiographs revealed that the L4–5 interspace was to some extent blocked by the iliac crests on both sides. It was determined, however, that with proper patient positioning and taping, the crest could be moved caudally to allow for lateral access surgery at this level. Free running electromyography was used for the duration of the procedure. The patient underwent a standard lateral access interbody fusion at L1/2, L2/3, L3/4, and L4/5. Between L-4 and L-5 the NuVasive angled instruments were used to ensure that the instruments were always parallel to the endplate at each level. This was followed by a thorough central and lateral recess decompression at L3–4 and L4–5. A near-complete facetectomy was performed bilaterally at both levels to truly decompress the descending roots. The restoration of the disc height via the anterior grafts provided an indirect decompression of the neural foramina, allowing for a more straightforward posterior decompression of the exiting roots. The patient tolerated the procedure well, with no complications. Motor and sensory function remained at baseline after the procedure.

Postoperative Course

Postoperatively the patient progressed quickly. He had minimal (4/5) weakness of the left iliopectoas immediately after surgery, and no apparent anterior thigh paresthesias. No other motor abnormalities were appreciated. His hospital stay was uneventful and he was discharged home on postoperative Day 5. On discharge he was able to ambulate on his own for short periods with minimal assistance. Three weeks postoperatively he had normal motor strength in both lower extremities and no detectable sensory deficit. Three months after surgery he reported that all of his previous radicular and claudicatory pains were no longer present.

FIG. 1. Plain AP (left) and lateral (right) radiographs revealing previous laminectomy changes and diffuse degenerative disc disease throughout the lumbar spine, as well as a Grade 1 spondylolisthesis at L4–5.

FIG. 2. Axial CT myelograms showing severe lateral recess stenosis at L3–4 (left) and severe central and lateral recess stenosis at L4–5 (right).
present. His 6-month postoperative Oswestry Disability Index score was 4/50, a 12-point improvement from the preoperative score. Radiographs obtained 6 months after the procedure revealed good placement of all instrumentation and a healing fusion mass (Fig. 3A and B). A CT scan performed 9 months postoperatively revealed obvious progression of both anterior and posterolateral fusion with no evidence of hardware malfunction or periimplant lucencies (Fig. 3C). The interbody fusion at L4–5 was not yet completely solid, but bridging bone exists in the left intertransverse space at this level (Fig. 3D). The axial CT reconstructions demonstrated restoration of the L3–4 foramen bilaterally (Fig. 3E).

**Discussion**

In the normal spinal canal the interpedicular distance increases from L-1 to L-5. However, in the patient with achondroplasia this distance progressively decreases.\(^7\)\(^,\)\(^12\) This leads to a much greater incidence of spinal stenosis.

![Fig. 3. Follow-up lateral (A) and AP (B) radiographs obtained at 6 months showing excellent placement of hardware and appropriate interbody and posterolateral fusion progression. Postoperative sagittal CT scan (C) obtained at 9 months demonstrating solid interbody arthrodesis at L1–2, L2–3, and L3–4. There was no evidence of periimplant lucencies or hardware malfunction on a coronal view (D). Axial CT scan (E) at L3–4 showing marked resolution of foraminal stenosis seen preoperatively in Fig. 2 left.](image-url)
in this population. The laminae in this population are so narrow that an adequate decompressive laminectomy requires marked resection of the medial facets, potentially leading to instability. Revision decompression surgery obviates more facet resection, and at this point fusion should be considered to avoid iatrogenically created instability.

In the patient with achondroplasia, canal and foraminal stenosis is not necessarily idiopathic. In one study, all patients with achondroplasia in the symptomatic group had stenosis at the level of the disc rather than the vertebral body, implying that degenerative changes were the nidus for the symptoms as opposed to congenital forces. In fact, in the achondroplastic population the discs are congenitally hyperplastic. This leads to a greater tendency for posterolateral bulging and resulting degenerative disc disease.

Foraminal size has been shown to be significantly smaller in the achondroplastic population. This, however, is not generally the cause of the increased incidence of radiculopathy in these patients because, in addition to smaller foramina, patients with achondroplasia have also been shown to have smaller nerve roots at each lumbar level than those without achondroplasia. The achondroplastic lumbar plexus has not been specifically studied, but given the decreased diameter of each nerve root, one can surmise that nerves of the plexus would themselves be slightly smaller than in the normal adult population. Hypothetically, a smaller plexus would potentially widen the safe working corridors as described by Uribe et al. In this specific case, no nerve roots were encountered during dissection and no monitoring abnormalities were observed.

Standard lumbar decompressive surgery has been proven to be more difficult in patients with achondroplasia. These patients generally have much thicker and shorter laminae, which makes removal with standard hand tools much more difficult. In addition, the shape of the laminae makes posterior interbody arthrodesis much more difficult and dangerous. The lateral access interbody fusion has been shown to restore foraminal height, disc angle, and overall lumbar lordosis better than a standard transforaminal lumbar interbody fusion in the normal adult population. This approach also appears to be a viable option for the achondroplastic population.

Conclusions

Achondroplastic dwarfism leads to markedly increased incidence of neurological symptoms secondary to abnormal bony fusion during development and the subsequent degenerative cascade of the spine. New minimally invasive approaches have been proven safe and effective in the normal adult population. This is the first published case in which the minimally invasive lateral access approach was used for interbody arthrodesis in a patient with achondroplasia. Although the anatomy of the lumbar plexus in patients with achondroplasia has yet to be defined in comparison with normal adult anatomy, this approach appears to be safe and should be in the armamentarium of a spine surgeon when operating on patients with achondroplastic dwarfism.

References


Author Contributions
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