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Presacral retroperitoneal approach to axial lumbar interbody fusion: a new, minimally invasive technique at L5-S1: Clinical outcomes, complications, and fusion rates in 50 patients at 1-year follow-up

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Abstract

Background: The presacral retroperitoneal approach to an axial lumbar interbody fusion (ALIF) is a percutaneous, minimally invasive technique for interbody fusion at L5-S1 that has not been extensively studied, particularly with respect to long-term outcomes.

Objective: The authors describe clinical and radiographic outcomes at 1-year follow-up for 50 consecutive patients who underwent the presacral ALIF.

Methods: Our patients included 24 males and 26 females who underwent the presacral ALIF procedure for interbody fusion at L5-S1. Indications included mechanical back pain and radiculopathy. Thirty-seven patients had disc degeneration at L5-S1, 7 had previously undergone a discectomy, and 6 had spondylolisthesis. A 2-level L4-S1 fusion was performed with a transforaminal lumbar interbody fusion at L4-5 in 15 patients. AxiaLIF was performed as a stand-alone procedure in 5 patients and supplemented with pedicle screws in 45 patients. Pre- and postoperative visual analog scale (VAS) and Oswestry Disability Index (ODI) scores were evaluated and complications were tracked. Fusion was evaluated by an independent neuro-radiologist.

Results: At 1-year follow-up, VAS and ODI scores had significantly improved by 49% and 50%, respectively, versus preoperative scores. By high-resolution computer tomography (CT) scans, fusion was achieved in 44 (88%) patients, developing bone occurred in 5 (10%), and 1 (2%) patient had pseudoarthrosis. One patient suffered a major operative complication–a bowel perforation with a pre-sacral abscess that resolved with treatment.

Conclusion: Our initial 50 patients who underwent presacral ALIF showed clinical improvement and fusion rates comparable with other interbody fusion techniques; its safety was reflected by low complication rates. Its efficacy in future patients will continue to be monitored, and will be reported in a 2-year follow-up study of fusion.

Keywords: AxiaLIF; Percutaneous fusion; Minimally invasive fusion; Interbody fusion

Lumbar interbody fusion is indicated for a variety of clinical conditions, including degenerative disc disease, spinal trauma, infection, and spinal deformity. Interbody fusion accomplishes the goal of achieving stability of the spine, and maintenance of coronal and sagittal balance by placing the graft near the central axis of rotation.[1,2] The four major access corridors for lumbar interbody fusion include the posterior lumbar interbody fusion (PLIF), transforaminal lumbar interbody fusion (TLIF), anterior lumbar interbody fusion (ALIF), and extreme lateral trans-psoas lumbar interbody fusion (XLIF).

The PLIF technique described by Cloward et al[3,4] permits dorsal access to the spine for both decompression and fusion. Its potential drawbacks include exposure and retraction of the dural sac and exiting nerve roots bilaterally that can lead to nerve root injury and spinal fluid leakage.[5,6] The PLIF can be performed as an open or minimally invasive technique.[5,7–9] The TLIF was described by Harms in the 1980s as an open procedure[6,10–12] and later became more popular as a minimally invasive procedure with the introduction of percutaneous pedicle screw systems.[13–17] In comparison with PLIF, the TLIF provides unilateral exposure with less retraction of the dural sac and nerve roots.

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Table 1
Fusion criteria on 3-mm high-resolution CT scan reconstructions in coronal and sagittal planes (with permission from Mayfield Clinic)

Grade	Time period	Definition
I	Applicable at any follow-up	Bridging bone, advanced fusion. Presence of continuous bridging bone extending from the L5 to the S1 endplate on the reconstructed images, occupying >50% of available space for fusion.
II	Applicable at any follow-up	Bridging bone, fusion. Bridging bone filling <50% of available space between vertebral bodies.
III	Early: 6 months Late: 12,18, 24 months	Early: Presence of developing bone connected to either end plate without bridging. Late: Presence of developing bone connected to either endplate without bridging with fusion mass greater than previous scan.
IV	6 months	No bridging or developing bone connected to either endplate.
V	Applicable at 12, 18, 24 months	No bridging or developing bone. Decrease or nonprogression of developing bone since previous visit.

The ALIF, especially the retroperitoneal mini-open version, is one of the most often performed interbody fusion procedures.[18–21] It offers a wide exposure of the disc yet allows complete avoidance of the dural sac and neural elements. Disadvantages of the ALIF include higher rates of exposure complications, potential need for a vascular surgeon, and pain caused by muscular disruption of the abdominal wall.[2,13,15,22–26] Although the laparoscopic transperitoneal ALIF enjoyed brief popularity,[27–29] high complication rates and technical difficulties led to its decline.[25,27,30] The XLIF, a recently introduced mini-open approach, uses a lateral corridor that requires partial mobilization of the psoas muscle.[31,32] The roots of the lumbar plexus, especially at L4-5, are at risk in this approach and the L5-S1 interspace is inaccessible with the XLIF.

The presacral retroperitoneal approach to axial lumbar interbody fusion ALIF is a minimally invasive technique that uses a new access corridor for interbody fusion at L5-S1.[33,34] In this procedure, the L5-S1 interspace and disc is accessed percutaneously by development of the fatty plane of the presacral space. Yet, little has been reported about the clinical effectiveness of this approach, especially in long-term follow-up. In this retrospective review, we report our clinical and radiographic results at 1-year follow-up in a cohort of 50 patients who underwent axial ALIF using AxiaLIF (TranS1, Wilmington, NC) for L5-S1 interbody fusion.

Materials and methods

A retrospective medical chart and radiographic review was performed for 55 patients who underwent the presacral ALIF procedure between June 2005 and May 2006 at The Christ Hospital, Cincinnati, OH with approval by the Institutional Review Board. Five patients with incomplete data at 1-year follow-up were excluded from the study. Mean patient age was 45 years (range, 16-78), including 24 males (average, 46; range, 26-78 years) and 26 females (average, 44; range, 16-68 years). Patients included 15 smokers, 29 nonsmokers, and 6 patients with an unknown smoking history. Among the 50 patients, 37 suffered from degenerative disc disease, 6 had spondylolisthesis, and 7 had undergone previous discectomy. Conservative therapy had failed in all patients. Patients were operated on by 2 surgeons: first (40) and second (10).

Data obtained from the medical charts included patient age, sex, and history of smoking, and dates of service. Office charts and operative reports were reviewed for indications for surgery, operative time, estimated blood loss, levels of fusion and instrumentation, type of instrumentation, type of bone graft used, additional procedures performed, and any intra- and postoperative complications. We defined major complications as any condition that required unscheduled return to the operating room or prolonged hospital stay and considered all other complications minor.

On plain x-rays, we defined fusion as <1.5-mm translation and <3° of motion on flexion-extension films at L5-S1 level. All x-rays were digitalized and measured by using eFILM version 2.01 software (Merge Healthcare, Milwaukee, WI). We devised a classification of fusion status using thin-section, high-resolution, multi-planar CT scans (Table 1). Fusion status was assessed by an independent neuroradiologist using x-ray and CT scans performed 1 year postoperatively.

Clinical outcomes were derived from the VAS and ODI questionnaires that patients completed during their office visits at the preoperative evaluation and at 3-, 6-, and 12-month follow-up visits. The t test was used for continuous data and χ^2 test was used for noncontinuous data ($P \leq .05$ statistical significance).

Presacral ALIF: operative technique

Preoperative evaluation: In addition to routine preoperative studies to determine the indications for L5-S1 fusion, midsagittal T1- and T2-weighted MRI images of the sacrum and coccyx were performed to rule out a vascular anomaly or tumor.[25,26,35] Evaluation of the sagittal curve of the sacrum is necessary to confirm the feasibility of the approach (Fig. 1). The presacral ALIF is contraindicated in certain situations. First, in the occasional patient with an exaggerated sacral curve or C-shaped sacrum, the trajectory of the intended interbody screw may project posteriorly into the spinal canal behind the L5 vertebral body. Second, deformed anatomy from healed