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Technical Report

A new extensile anterolateral retroperitoneal approach for lumbar interbody fusion from L1 to S1: a prospective series with clinical outcomes

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Abstract

BACKGROUND CONTEXT: A variety of surgical approaches have been used for cage insertion in lumbar interbody fusion surgery. The direct anterior approach requires mobilization of the great vessels to access the intervertebral disc spaces cranial to L5/S1. With the lateral retroperitoneal transpsoas approach, it is difficult to access the L4/L5 intervertebral disc space due to the lumbar plexus and iliac crest, and L5/S1 is inaccessible. We describe a new anterolateral retroperitoneal approach, which is safe and reproducible to access the disc spaces from L1 to S1 inclusive, obviating the need for a separate direct anterior approach to access L5/S1.

PURPOSE: This paper had the following objectives: first, to report a reproducible novel single-incision, muscle-splitting, anterolateral pre-psoas surgical approach to the lumbar spine from L1 to S1; second, to highlight the technical challenges of this approach and highlight approach-related complications; and third, to evaluate clinical outcomes using this surgical technique in a prospective series of L1 to S1 anterior lumbar interbody fusions (ALIFs) performed as part of a 360-degree fusion for adult spinal deformity correction.

STUDY DESIGN: This report used a prospective cohort study.

PATIENT SAMPLE: A prospective series of patients (n=64) having ALIF using porous tantalum cages as part of a two-stage complex spinal reconstruction from L1 to S1 were studied.

OUTCOME MEASURES: Data collected included blood loss, operative time, incision size, technical challenges, perioperative complications, and secondary procedures. Clinical outcome measures used included visual analogue scale (VAS) Back Pain, VAS Leg Pain, EuroQoL-5 Dimensions (EQ-5D), EQ-5D VAS, Oswestry Disability Index (ODI), and Scoliosis Research Society-22 (SRS-22).

METHODS: Pre- and postoperative radiographic parameters and clinical outcome measures were assessed. Mean follow-up time was 1.8 years.

RESULTS: Mean blood loss was 68±9.6 mL. The mean VAS Back Pain score improved from 7.5±1.25 preoperatively to 2.5±1.7 at 3 months (p=.02), 1.2±0.5 at 6 months (p=.01), and 1.4±0.6 at 1 year (p=.02). The mean ODI improved from 64.3±31.8 preoperatively to 16.6±14.7 at 3 months (p>.05), 10.7±6.0 at 6 months (p=.02), and 6.7±6.1 at 1 year (p=.01). There were no permanent neurologic, vascular, or visceral injuries. One revision anterior procedure was required on a patient with rheumatoid arthritis and advanced systemic disease that sustained a sacral fracture and required revision ALIF at L5/S1.

FDA device/drug status: Not applicable.

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CONCLUSIONS: The technique described is a safe, new, muscle-splitting, psoas-preserving, one-incision approach to provide access from L1 to S1 for multilevel anterior or oblique lumbar interbody fusion surgery.

Keywords: Adult spinal deformity; Anterior lumbar interbody fusion; Anterolateral approach; Lumbar interbody fusion; Retroperitoneal

Introduction

Surgeons have traditionally accessed the L3–S1 intervertebral disc spaces through a direct anterior approach (Fig. 1A). However, this is associated with complications, including vascular injury, retrograde ejaculation, postoperative colonic obstruction, lymphocele, and sympathetic chain injury [1–3], with access to the intervertebral disc spaces cranial to L5/S1 requiring mobilization of the great vessels. The lateral retroperitoneal transpsoas approach (Fig. 1B), used in extreme lateral interbody fusion and direct lateral interbody fusion, was developed to eliminate the need for an approach surgeon, but dissection through the iliopsoas muscle places the lumbosacral plexus at significant risk of injury. This approach is associated with a complication rate of up 20%, the most common being anterior thigh numbness, radiculopathy, iliopsoas, and quadriceps weakness [4–6]. However, the L4/L5 intervertebral disc space is difficult to access due to the lumbar plexus and iliac crest, and L5/S1 is inaccessible.

An anterolateral pre-psoas retroperitoneal approach has been recently described in six patients [7], but it has been used for many years for anterior lumbar interbody fusions (ALIFs) from L1 to L5 (Fig. 1C). This provides a slightly oblique trajectory to the intervertebral disc spaces of L1 to L5, with a separate Pfannenstiel approach required for access to the L5/S1 intervertebral disc space. A modified version of this approach (Fig. 1D) has in fact been used for ALIF surgery by the senior author (SM) for the past 10 years in over 250 patients.

A cadaveric study (n=20) for the first time reported a minimally invasive retroperitoneal oblique corridor providing access from L2 to S1 [8]. The access corridor from L2 to L5 was defined as the left lateral border of the aorta (or iliac artery) and the anterior medial border of the psoas. The L5/S1 corridor of access was defined transversely from the midsagittal line of the inferior end plate of L5 to the medial border of the left common iliac vessel and vertically to the first vascular structure crossing the midline. Cadavers were placed in the lateral decubitus position. The L5/S1 disc space was accessed from an oblique angle with gentle retraction of the iliac vessels. We have used a similar surgical approach to extend access to the L5/S1 intervertebral disc, but the patient is in a semi-lateral position. Furthermore our surgical technique enables direct anterior, rather than oblique access, for interbody fusion of L5/S1 (Fig. 1E).

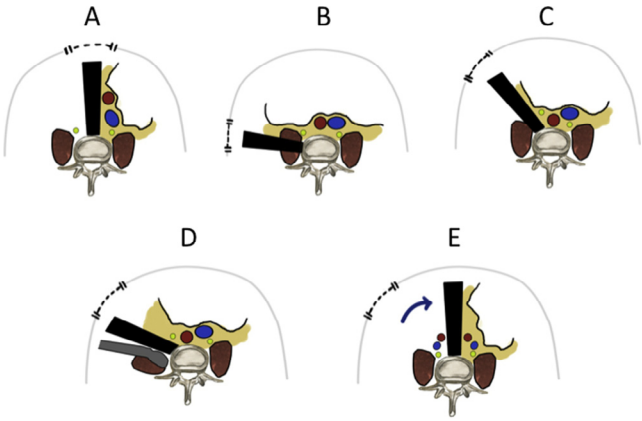

Fig. 1. Existing approaches to the lumbar spine, with relationship to psoas and major vessels: (A) direct anterior, (B) direct lateral/transpsoas, (C) traditional anterolateral, (D) new anterolateral approach for L1–L5, and (E) new anterolateral approach for L5/S1.

Consequently, the objectives of this study were firstly to report a reproducible novel single-incision, muscle splitting, anterolateral pre-psoas surgical approach to the lumbar spine from L1 to S1; secondly, to highlight the technical challenges of this approach and highlight approach-related complications; and thirdly, to evaluate clinical outcomes using this surgical technique in a prospective series of L1 to S1 ALIFs performed as part of a 360-degree fusion for adult spinal deformity correction.

Materials and methods

Patient population

This was a prospective cohort study of a consecutive series of patients (n=64) having multilevel ALIF using porous tantalum cages as part of a two-stage 360-degree complex spinal reconstruction for degenerative spine pathology. The inclusion criteria were patients having multilevel ALIFs that included the L5/S1 level. This study was performed at a national tertiary and quaternary referral center for spinal surgery. The study period was between January 1, 2011 and December 31, 2014. Institutional Review Board approval was attained for this study. The mean age of our patient cohort was 63.5±11.4 years. There was a strong female preponderance with a female-to-male ratio of 8.2:1. The mean American Society of Anesthesiologists grade of the cohort was 2±1.1. The proportion of cases performed that were revision complex spinal fusions was 42%.

Surgical technique

The patient is placed in a semi-lateral decubitus position, on a beanbag positioner, and tilted 30° posteriorly (Fig. 2A). The table is broken to increase the space between