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Clinical Study

Nerve injury after lateral lumbar interbody fusion: a review of 919 treated levels with identification of risk factors

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Abstract

BACKGROUND CONTEXT: Lateral lumbar interbody fusion (LLIF) has become an increasingly common minimally invasive procedure for selective degenerative deformity correction, reduction of low-grade spondylolisthesis, and indirect foraminal decompression. Concerns remain about the safety of the transpsoas approach to the spine due to proximity of the lumbosacral plexus.

PURPOSE: To address risk factors for iatrogenic nerve injury in a large cohort of patients undergoing LLIF.

STUDY DESIGN: Retrospective analysis of 919 LLIF procedures to identify risk factors for lumbosacral plexus injuries.

METHODS: The medical charts of patients who underwent transpsoas interbody fusion with or without supplemental posterior fusion for degenerative spinal conditions over a 6-year period were retrospectively reviewed. Patients with prior lumbar spine surgery or follow-up of less than 6 months were excluded. Factors that may affect the neurologic outcome were investigated in a subset of patients who underwent stand-alone LLIF.

RESULTS: Four hundred fifty-one patients (males/females: 179/272) met the inclusion criteria and were followed for a mean of 15 months (range, 6–53 months). Average age at the time of surgery was 63 years (range, 24–90 years). Average body mass index was 29 kg/m^2 (range, 17–65 kg/m^2). A total of 919 levels were treated (mean, 2 levels per patient). Immediately after surgery, 38.5% of the patients reported anterior thigh/groin pain, whereas sensory and motor deficits were recorded in 38% and 23.9% of the patients, respectively. At the last follow-up, 4.8% of the patients reported anterior thigh/groin pain, whereas sensory and motor deficits were recorded in 24.1% and 17.3% of the patients, respectively. When patients with neural deficits present before surgery were excluded, persistent surgery-related sensory and motor deficits were identified in 9.3% and 3.2% of

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the patients, respectively. Among 87 patients with minimum follow-up of 18 months, persistent surgery-related sensory and motor deficits were recorded in 9.6% and 2.3% of the patients, respectively. Among patients with stand-alone LLIF, the level treated was identified as a risk factor for postoperative lumbosacral plexus injury. The use of recombinant human bone morphogenetic protein 2 was associated with persistent motor deficits.

CONCLUSIONS: Although LLIF is associated with an increased prevalence of anterior thigh/groin pain as well as motor and sensory deficits immediately after surgery, our results support that pain and neurologic deficits decrease over time. The level treated appears to be a risk factor for lumbosacral plexus injury.

Keywords: Complications; Nerve injury; LLIF; Risk factors; Transpsoas approach

Introduction

The minimally invasive direct lateral retroperitoneal transpsoas approach for lumbar interbody fusion has been developed as an alternative to the well-established anterior lumbar interbody fusion (ALIF). The lateral lumbar interbody fusion (LLIF) technique combines the biomechanical and biologic benefits of ALIF compared with dorsally based interbody procedures with the advantages of any minimally disruptive procedure. More specifically, LLIF is thought to be associated with improved graft-host interface, higher fusion rates, improved restoration of spinal alignment, better indirect foraminal decompression by achieving greater correction of intervertebral and foraminal height, decreased blood loss, early patient mobilization, and decreased hospital stay [1]. The advantages of LLIF over ALIF include reduced complications and invasiveness because LLIF does not require vascular or visceral retraction, better spine alignment correction and postoperative stabilization through the intact anterior and posterior longitudinal ligament (ligamentotaxis), and insertion of wider implants that span the dense ring apophysis and provide excellent mechanical support to maintain interbody height and resist subsidence [1–5].

Although LLIF has been effectively used in the setting of many adult degenerative disorders, such as scoliosis, degenerative disc disease, and degenerative or low-grade isthmic spondylolisthesis, concerns remain about its safety regarding injury of the lumbosacral plexus as it travels within the psoas muscle. The reported incidence of nerve injury following LLIF ranges widely from 0.7% to 23% with the largest series limiting their follow-up to 1 year after surgery [6–11]. Nevertheless, all clinical studies except one focus on multiple variables apart from neurologic impairment [6], and all fail to distinguish transient muscle weakness secondary to iliopsoas direct muscle trauma from true iatrogenic injury to lumbosacral plexus due to intraoperative traction and compression during retractor dilation.

The purpose of this study was to specifically address factors associated with neural complications in a large cohort of patients undergoing LLIF. Additionally, by reviewing a subset of patients with a minimum follow-up of 18 months, we tested the hypothesis that most of the neurologic deficits secondary to LLIF continue to decrease over time.

Methods

Study population

After obtaining institutional review board approval, the medical records of patients who underwent LLIF with or without supplemental posterior fusion for degenerative spinal conditions between March 2006 and April 2012 were retrospectively reviewed. Patients with prior lumbar spine fusion surgery or follow-up of less than 6 months were excluded. The indications for surgery included axial back pain due to degenerative deformity of the lumbar spine (scoliosis and/or kyphosis), degenerative spondylolisthesis, adjacent segment degeneration, and/or neurogenic claudication due to central or foraminal stenosis. All patients underwent minimally invasive lateral transpsoas approach and lumbar interbody fusion at one or more levels using either the extreme lateral interbody fusion system (XLIF-Nuvasive, Inc., San Diego, CA, USA) or the COUGAR system (COUGAR-Depuy Spine Inc., Raynham, MA, USA). Both traditional in-house neuromonitoring for electromyographic activity and dynamically evoked electromyography were used in every patient. Perioperative data collection included patient demographics, preoperative diagnosis, side of approach, operative time, use of recombinant human bone morphogenetic protein-2 (rhBMP-2), and levels treated.

Detailed neurologic assessment was performed by the treating surgeon immediately before and immediately after surgery as well as at 3 months, 6 months, 1 year, and every 6 months thereafter if a neurologic deficit was present. Neurologic examination included tactile sensory detection, 2-point discrimination, and motor strength testing using the manual muscle test scale for each muscle group of the lower extremities. The presence of anterior thigh and/or groin pain was also recorded at each postoperative visit. To distinguish lumbosacral plexus injury secondary to intraoperative traction or compression from proximal muscle weakness due to iliopsoas muscle injury or transient denervation, we defined as nerve injury a muscle weakness of Grade 4 if persisted for more than 6 months or less than or equal to Grade 3 at any point in time.

Patients who met the inclusion criteria were divided into three subsets: subset of surgery-related neurologic deficits after exclusion of patients with neurologic deficit present