Spine

SPINE Volume 40, Number 1, pp E36-E42

CLINICAL CASE SERIES

Feasibility and Patient-Reported Outcomes After Outpatient Single-Level Instrumented Posterior Lumbar Interbody Fusion in a Surgery Center

Preliminary Results in 16 Patients

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Study Design. Retrospective study.

Objective. To report surgical and patient-reported outcomes after outpatient lumbar fusions in an ambulatory setting.

Summary of Background Data. There is growing interest in the potential benefits of outpatient spine surgery such as reduced costs, consistent operative team, and decreased postoperative complications during in-hospital recovery. However, there are limited studies on outcomes after outpatient lumbar fusions, to guide patient selection, treatment techniques and postoperative expectations.

Methods. Medical records of 16 consecutive patients, who underwent outpatient direct open, single-level, posterior lumbar interbody fusions, were examined by a single surgeon. Outcome measures included visual analogue scale (VAS) scores for lower back and Oswestry Disability Indices (ODIs). Mean body mass indices (BMIs), estimated blood loss, surgical times and complications, and fusion rates were evaluated.

Results. Males represented 56% of patients. Mean age was 42.81 ± 3.05 years (mean ± standard error) and mean body mass index was 28.95 ± 1.04. History of smoking and narcotics use were statistically noncontributory. Mean final follow-up was 15 (range, 5.52–34.2 mo) months. Mean postoperative scores were determined by the final follow-up VAS and ODI. L5–S1 was the most common level of the 16 levels operated on (69%). Preoperative and postoperative VAS and ODI scores for lower back were obtained for 15 patients (93.75%). Mean lower back VAS score of 8.4 ± 0.37 preoperatively reduced to 4.96 ± 0.73 postoperatively, (P = 0.001). Mean ODI improved from 52.71 ± 0.04 preoperatively, to 37.43 ± 0.06 postoperatively, (P = 0.04). One patient experienced postoperative worsened back pain with clinical and radiological signs of possible aseptic discitis. Estimated blood loss was 161 ± 32 mL and average operating time was 124.85 ± 7.10 minutes. The overall fusion rate was 87.5%.

Conclusion. Direct open posterior lumbar interbody fusions were done safely with statistically significant reduction in average pain and ODI scores. Surgical times were approximately 2 hours with minimal blood loss, allowing patients to be comfortably discharged the same day without a drain.

Key words: lumbar fusion, outpatient surgery, outcomes, complications, ambulatory center, surgery center, decompression, low back pain, less-exposure surgery (LES), minimally invasive surgery.

Level of Evidence: 4

Spine 2015;40:E36–E42

With advances in less-invasive procedures and improved anesthesia techniques, there is a growing interest in outpatient surgical procedures.[1–3] Compared with standard hospital experiences, the potential benefits include improved patient satisfaction from a more personalized perioperative care plan, decreased health care costs, less exposure to nosocomial infections, less risks of iatrogenic complications from medical errors,[4–6] and increased safety for the surgeon who can choose a consistent surgical team.

The literature on outpatient lumbar spine surgery is sparse on discussing the appropriate techniques and technologies, patient selection, costs, outcomes, and complication rates.[7–11] The authors therefore provide herein, a preliminary report of the clinical experience and feasibility of performing instrumented single-level open posterior lumbar interbody fusion (PLIF) or transforaminal lumbar interbody fusion in an ambulatory surgery center (ASC) with same-day home discharge.

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Acknowledgment date: October 29, 2013. First revision date: April 1, 2014. Second revision date: June 1, 2014. Acceptance date: August 8, 2014.

The manuscript submitted does not contain information about medical device(s)/drug(s).

No funds were received in support of this work.

Relevant financial activities outside the submitted work: board membership, grants, patents, royalties, stocks, travel/accommodations/meeting expenses.

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DOI: 10.1097/BRS.0000000000000604

MATERIALS AND METHODS

We reviewed the medical records of 16 consecutive adult patients treated by a single surgeon in an ASC. Patients underwent single-level posterior spinal decompression with PLIF or transforaminal lumbar interbody fusion. Supplemental posterior fixation was performed using transfacet pedicle screws bilaterally, or unilaterally combined with standard pedicle screw fixation and an interspinous fixation device, based on surgeon preference. Indications for surgery included chronic, disabling low back pain with or without leg pain secondary to degenerative disc and facet disease and/or grade I spondylolisthesis with foraminal stenosis as evidenced on clinical examination, provocative injections, and/or discography and radiological findings. All patients had failed a minimum of 6 months of conservative therapy, which included anti-inflammatory medications, physical therapy, therapeutic steroid injections, and radio-frequency rhizotomies for patients with suspected facet-mediated axial back pain. Chronic but stable medical conditions included asthma, hypertension, diabetes mellitus, arthritis, hypercholesterolemia and heart disease. All patients were medically cleared by their family practitioner and/or cardiologist where applicable and deemed fit for surgery by the anesthesiologists as ASA 1, 2, or 3. ASA 4 patients were excluded from outpatient surgery.[12]

The operating surgeon had extensive experience, performing the procedure in academic and private hospitals, as if the patients were in an outpatient setting, until reproducible in the hospital, prior to commencing in an ambulatory setting.

Patients were discharged directly to their homes after surgery. As such, the eligibility criteria for lumbar fusion in an ambulatory center included the following:

1. Must be living or staying within 30 minutes from a hospital.
2. Body mass index less than 42.
3. Cardiologist evaluation including echocardiogram and/or stress test for patients with a history of cardiac problems.
4. Must have a responsible adult living with, or staying with the patient who is available to care for them for at least 24 hours after surgery.
5. Low-to-moderate anesthesia risks according to ASA criteria 1 to 3.

All patients received 30 to 60 mg of ketorolac intravenously approximately 10 minutes before waking up from anesthesia. Additional medications included diazepam 10 mg orally for spasms and anxiety, short and long acting oral narcotics such as oxycodone and acetaminophen (Percocet) 5 mg/325 mg and oxycodone HCL (OxyContin) 10 to 20 mg orally twice per day for patients to take at home. Patients were given an intravenous bolus of cefazolin of 1 g prior to discharge and a prescription of cefalexin for 5 days.

Patients were discharged from the recovery room with a responsible adult to drive them home only after they were deemed to be fully alert by an experienced registered nurse and the attending anesthesiologists and were neurologically intact by the attending spine surgeon.

Transfer agreements are in place between the ASC and with neighboring hospitals within 30 minutes, for hospital admission, if patients develop any serious problems.

Follow-up

1. Patients were instructed on postoperative protocol (Figure 1).
2. Patients were called the night of surgery after being discharged and again the morning after surgery.
3. The first clinic follow-up visit was at 1 to 2 weeks postoperatively, and physical therapy was started. Follow-up continued at 6 weeks, 3 and 6 months, and at the final recorded outpatient follow-up thereafter.

Functional outcomes included a patient numeric rating scale/visual analogue scale (VAS) for lower back pain and the Oswestry Disability Index (ODI). Preoperative and postoperative VAS and ODI scores for lower back were obtained for 15 patients (93.75%). Mean final follow-up was 15 (range, 5.52–34.2 mo) months, at which time VAS and ODI results were used to calculate the mean postoperative scores.

Complications, estimated blood loss, fluoroscopic times, length of surgery, and fusion rates were also evaluated. Fusion was attained with interbody polyetheretherketone cages and supplemental fixation, demineralized bone matrix, allograft cancellous chips and/or autograph laminectomized bone. Fusion was assessed on the basis of clinical absence of axial back pain or movement between the spinous processes on flexion and extension lateral radiographs. We also evaluated plain radiographs and computed tomographic (CT) scans looking for bridging bone across the facets and interbody space (Figure 2A–C).

Summary of Operative Technique

Patients were placed prone on a Wilson frame, which was then cranked up into maximum kyphosis to open the interlaminar spaces for decompression. Patients were given 2 g of cefazolin intravenously. A 22-gauge spinal needle was placed just lateral to the spinous processes, docking against the lamina of the intended spinal level under anteroposterior fluoroscopic guidance. Five to 10 mL of 0.5% bupivacaine with epinephrine was injected into the paraspinal muscles. A Midline incision was then made and the spine exposed (Figure 3). The exposure was limited laterally to the facets because the facets were the intended fusion surfaces and not the transverse processes. The supraspinous and interspinous ligaments were removed and the ligamentum flavum was elevated from the inferior lamina's surface and the underside of the cephalad lamina using a curette. A burr and Kerrison rongeurs were used to create a hemilaminotomy/hemilaminectomy window to the disc. Partial facetectomies were performed. The ligamentum flavum was released laterally from the facets, cephalad and caudad from the laminas, and a medially based flap retracted medially

1. Most spine incisions are closed with subcuticular sutures that will dissolve on their own.
2. Do not shower until 2-3 days after surgery unless you can avoid getting the incision wet. No still sitting water (bath or pool) until incision is completely closed. This usually takes 14 days or further advised by Dr. ().
3. While showering avoid allowing water to hit incision directly, apply water resistant bandage.
4. Cover the incision with dry sterile gauze dressing daily and cover with paper tape, until further advised at your 1st postoperative appointment.
5. Call if concerned with wound. If reddened incision, increased drainage, or irritation apply antibiotic ointment (Neosporin, Bacitracin, Triple A Cream).
6. Steri-strips will fall off on their own, usually by 10-12 days.
7. Monitor temperature daily. Fever may arise. Call if fever is greater than 101.5, chills, nausea over 48 hours in duration and not related to a cold/flu.
8. Pain is expected after surgery. If pain is not relieved by pain medications and is getting progressively worse, call our office to let us know. Weakness and/or numbness/tingling in extremities can be part of the healing process especially if present immediately after surgery.

Medications: Patients may take over-the-counter (OTC) laxatives and stool softeners for constipation. Follow the administration instructions on the product package.

Stool softeners such as: Colace, Pericolace, Surkfak, Senokot-S

Laxatives such as: Milk of Magnesia, Dulcolax, Senokot, and Herbal teas

Suppositories such as: Dulcolax and Glycerine

IF THERE ARE ANY ISSUES DO NOT HESITATE TO CALL

DR. (): xxx-xxx-xxxx

Figure 1. Outpatient lumbar fusion post-operative instructions.

against the dura that protected the traversing nerve root (Figure 4). The exiting nerve root was rarely visualized during this approach as it is migrated cephalad in kyphosis away from the disc space. The traversing nerve root was protected underneath the ligamentum flavum flap. An annulotomy defect was created using a size 15 blade. Pituitaries, curettes, and shavers were used to dislodge and remove disc material and exposed bleeding endplate. A custom bone funnel was placed into the disc space. Cancellous bone graft followed by microparticulate demineralized bone matrix and autograft laminectomized bone were packed tightly against the anterior longitudinal ligament (Figure 5A–B). A PLIF/transforaminal lumbar interbody fusion polyetheretherketone cage was placed straight through the annular window while preserving the facets, until it impacted the graft. The final position was confirmed fluoroscopically. At this point, complete decompression was achieved with removal of any remaining compressive ligamentum flavum or facets. The spinous processes were retained along with the facets. Then, the Wilson frame was taken out of kyphosis and the patient's lumbar spine would visibly settle into lordosis. Pedicle screw fixation was then placed either through the facets[13] or using standard pedicle screws. The facets were decorticated with a burr and bone graft packed over the facets. Then, the wound was closed in interrupted layers. No drain was used in any of the surgical procedures.

Statistical Analysis

Statistical analysis was performed using Microsoft Excel version 14.1.3 (Microsoft Corp., Redmond, WA) and Stata statistical software version 12 (StataCorp, College Station, TX). Comparisons were expressed as counts or means with standard error. The Fisher exact test was used for analysis of contingency. Tests were considered significant if $P < 0.05$.

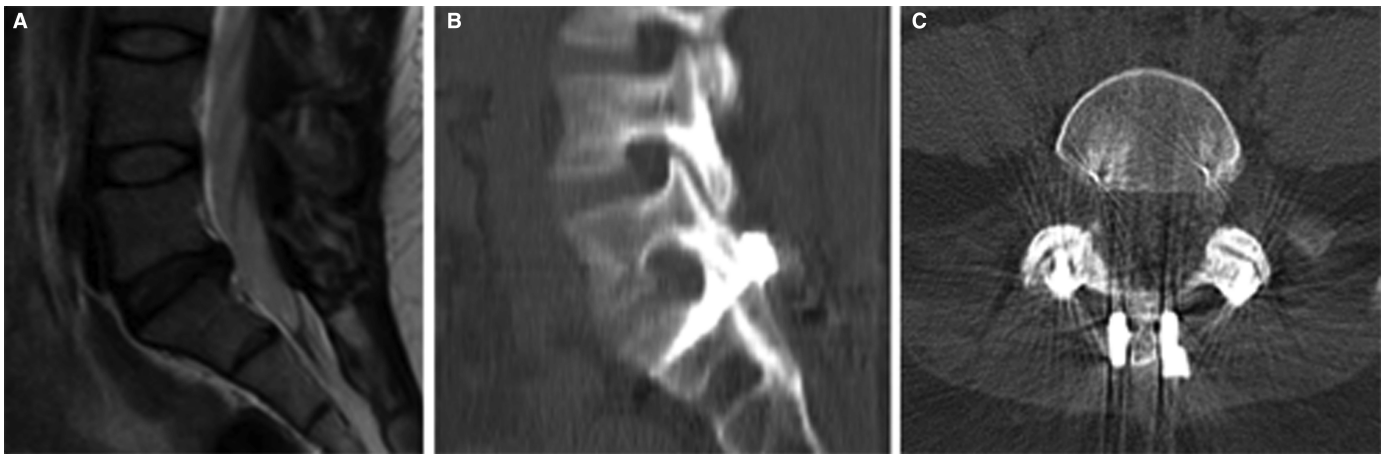

Figure 2. A, Sagittal view of a preoperative MRI showing lumbar disc herniation at L5–S1. **B**, Sagittal view of a computed tomogram 11 months postoperatively showing bridging bone across the L5–S1 interbody space. **C**, Bilateral facet joint fusion seen on axial cut of the same postoperative CT. MRI indicates magnetic resonance imaging.

RESULTS

Males represented 56% of patients. Mean age was 42.81 ± 3.05 years (mean ± standard error) and mean body mass index was 28.95 ± 1.04. Smoking history and narcotics use were statistically noncontributory. Total number of levels performed during the study period was 16 with L5–S1 being the most common level operated on (69%). Mean estimated blood loss was 161 ± 32 mL and mean operating time was 124.85 ± 7.10 minutes. Fluoroscopic times averaged 43 ± 8 seconds.

There was a reduction in VAS pain scores by 2 or more points in 81.25% of patients at their final follow-up. Mean lower back VAS score of 8.4 ± 0.37 preoperatively reduced to 4.96 ± 0.73 postoperatively, (P = 0.001). Mean ODI improved from 52.71 ± 0.04 preoperatively, to 37.43 ± 0.06 postoperatively, (P = 0.04).

The overall fusion rate for the primary surgery was 87.5% (14/16). Two male patients (39 and 46 yr, respectively) developed pseudarthrosis of L5–S1, diagnosed clinically after a history of persistent back pain and nonunion on CT. They both admitted to have been heavy smokers (>1 pack/d) and were active in the early postoperative period due to improved symptoms. They subsequently underwent revision surgery after 6 months of failed improvement.

Postoperative complications occurred in 1 female patient (6.25%) who called our office to complain of pain, deep to the incision site with midline tenderness and opening of the incision edges. She was seen the same day and was afebrile. The wound seemed clean with only trace erythema around the incision edges and slight opening. A magnetic resonance imaging (MRI) was performed, and we made a diagnosis of possible aseptic/low-grade discitis on the basis of the radiological appearance of endplate changes, her initial worsened back pain and lack of a fluid collection. The surgeon also based his diagnosis on experience with this postoperative

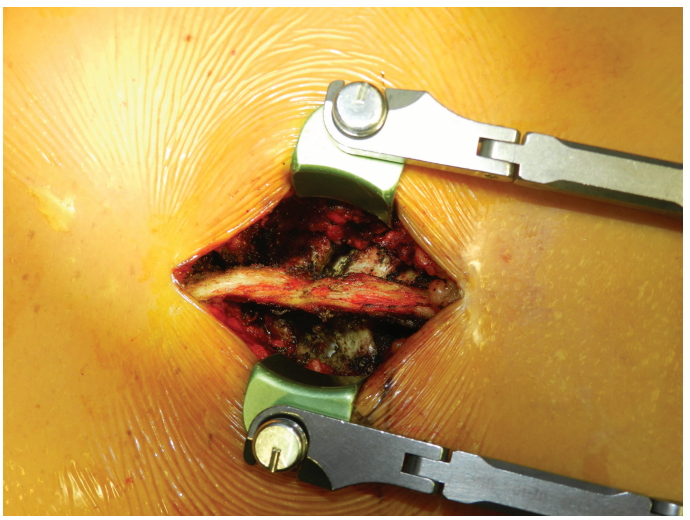

Figure 3. Exposure of the spinous processes, lamina, and facets.

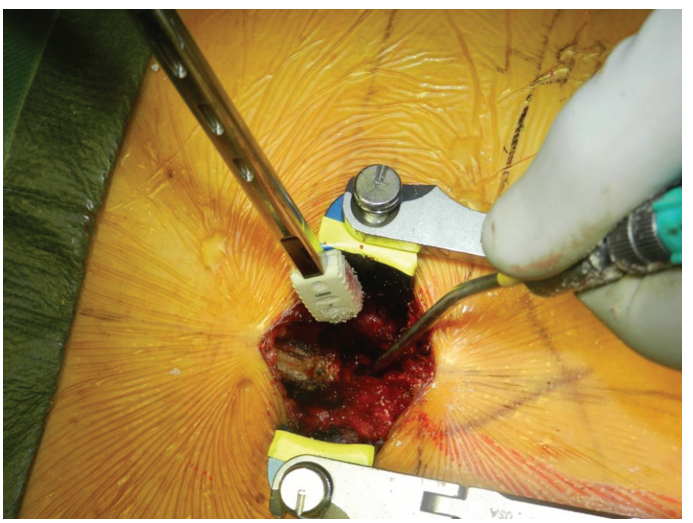

Figure 4. Exposed ligamentum flavum being used as a medially based flap for dura and nerve root protection during cage insertion. PLIF PEEK cage is also seen being inserted at L4–L5. PLIF indicates posterior lumbar interbody fusion; PEEK, polyetheretherketone.

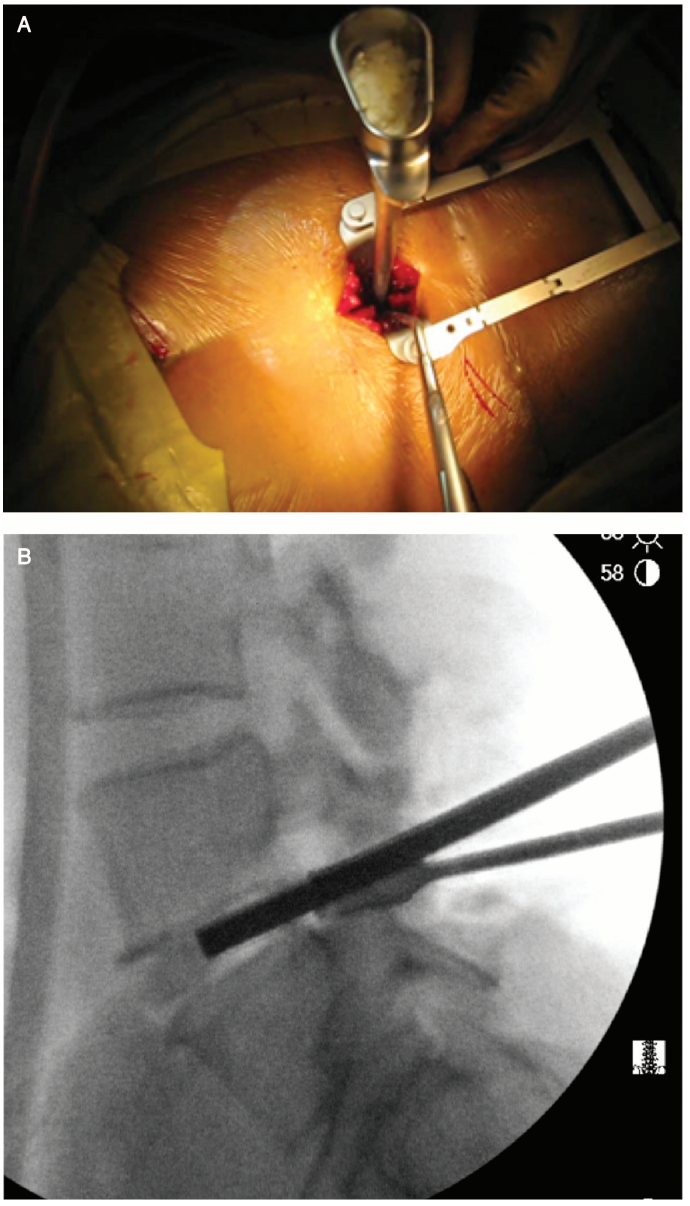

Figure 5. A, A custom bone funnel and tamp being placed into the disc space to allow easy insertion of bone graft material anteriorly against the anterior longitudinal ligament. **B**, Lateral fluoroscopic image showing cancellous bone graft, microparticulate DBM and autograft laminectomized bone being packed tightly against the anterior longitudinal ligament. DBM indicates demineralized bone matrix.

MRI endplate finding after interbody fusion in the early postoperative period in noninfected patients.

Further investigation revealed that this patient did not take the usual postoperative oral antibiotics and this raised our concern that there might be a low-grade infection. We therefore commenced treatment with oral 500 mg of cefalexin every 6 hours. After completing 10 days of antibiotics and reducing her activities, at 2 weeks postoperatively, her symptoms were fully resolved.

DISCUSSION

The rate of lumbar fusion surgical procedures has increased by 220% in 2001 from 1990 (spiking after 1996, after interbody cages were approved).[14] Contributing factors range from an expanding elderly population, the introduction of safer, quicker, and more cost-effective lumbar fusion techniques and the desire for the patients to remain physically active and productive well into their senior years.

Long-term clinical outcome and patient satisfaction is good when performed in a hospital setting although fusion rates do not always correlate with outcome.[15,16] Complications and hospital errors however, serve as the major disadvantages of inpatient hospital-based surgery.[17,18]

The mortality rates of inpatient lumbar fusion techniques has been quoted between 0.14% and 0.2% according to nationwide inpatient sample data.[19,20] Goz *et al*[19] found overall morbidity across all spinal levels (cervical, thoracic, and lumbar) to be trending upward between 2001 and 2010. The most common spinal procedure performed is discectomy with more than 300,000 performed annually.[3,21]

With this track record and the burgeoning health care costs, there is a growing body of literature supporting the benefits of outpatient lumbar surgery.[22–24] Pugely *et al*[22] compared inpatient *versus* outpatient morbidity and mortality specifically in patients who underwent single-level posterior lumbar decompression. Data collected from the American College of Surgeons National Surgical Quality Improvement Program, for 4310 patients undergoing either inpatient (61.7%) or outpatient (38.3%) lumbar decompression found the overall complication rate to be 5.4% in the inpatient group *versus* 3.5% in the outpatient group ($P = 0.068$). Propensity score matching and multivariate logistic regression analysis were used to adjust for confounders and they found several independent risk factors of short-term complications after lumbar discectomy including, age, diabetes, presence of preoperative wound infection, blood transfusion, operative time, and an inpatient hospital stay.

Clinical and radiological evidence of fusion was observed in 87.5% of our patients except for 2 males. Both patients were chronic, heavy smokers who each underwent a trial of smoking cessation preoperatively. Both underwent facet fixation at L5–S1, and persisted to smoke postoperatively. We now recommend preoperative urine tests for confirmation of smoking cessation and in young active patients, we avoid bilateral facet fixation at the L5–S1 level and instead offer pedicle screw and rod fixation.

In our series of patients, we noted 1 patient with aseptic discitis on the basis of clinical suspicion and the radiological appearance of endplate changes on the MRI. However, these changes could have been mechanical from the endplate preparation during surgery and the presence of the interbody cage, or a normal MRI finding in the immediate postoperative period.[25,26] Our patient had no constitutional symptoms and a normal white blood cell count. We decided against anti-inflammatory use to avoid compromising the lumbar fusion.[27] The rationale for antibiotic use in this case was 2-fold; (1) prophylactically, in case it was a simple wound dehiscence and (2) empirically, in case we were wrong and the infection was just not yet established.

Figure 6. Bulleted PLIF cage used that facilitates less retraction and greater preservation of the facets. PLIF indicates posterior lumbar interbody fusion.

There were no subsequent hospital admissions for pain control, which is a common reason for prolonged hospital stay after lumbar fusion.[28,29] We think that our patients remained comfortable perioperatively, due to the combination of intraoperative and postoperative analgesia used, in conjunction with the less-exposure surgical technique performed.

The advantages of the author's preferred surgical technique include the following: (1) Only a hemilaminotomy is used. (2) The PLIF is only 8-mm wide with extreme bulleting and slightly rounded edges make it easier to insert with much less retraction and allows one to preserve more of the facet (Figure 6). (3) The ligamentum flavum is preserved during the discectomy and placement of the cage, and acts as a medially based flap. (4) The Wilson frame, results in a more taut ligamentum flavum, which makes it easier to be resected. Traditionally, lumbar fusions are done on a Jackson table to accentuate lumbar lordosis, but this causes an almost shingling effect of the laminas. We use the Wilson frame *versus* the Jackson spinal table to make decompression easier and to preserve the lamina while removing ligamentum flavum and the medial border of the superior facets. We are able to recreate the patients lordosis when the Wilson frame is lowered and with compression of the facets during screw placement.

None of our patients' incisions were closed with a lumbar drain *in situ*. This decision was based on research that showed that the risk of hematoma development is not influenced by the use of drains in single-level lumbar decompressions and should be based on surgeon discretion.[30,31] The selection criteria of low-risk patients, including those without any bleeding diathesis, our meticulous attention to hemostasis and no dead space also contributed to this decision. Patients exhibited high satisfaction and 100% of them said that they preferred an ASC if they had to undergo the surgery again.

CONCLUSION

We demonstrated that single-level posterior lumbar fusions were done safely with strict patient selection to allow for medical clearance in patients with body mass index less than or equal to 42 and using a direct midline approach staying medial to the facets and retaining the posterior elements. This less-exposure technique reduced blood loss, kept surgical time from incision to closure to approximately 2 hours, fluoroscopic time less than 45 seconds, and allowed patients to be comfortably discharged home the same day with only oral pain medications and without a drain.

Cumulatively these preoperative and postoperative recommendations, medications, and surgical technique aided in a comfortable recovery immediately postoperatively, to allow for easier transfer to a waiting car and the drive home with no incidence of unplanned hospital admission.

➢ Key Points

- ❑ We described patient selection, outpatient lumbar fusion protocol, and surgical technique used in 16 consecutive patients undergoing single-level posterior lumbar decompression and interbody fusion in an ASC.
- ❑ Patient-reported and radiological outcomes as well as complications were evaluated.
- ❑ Outpatient single-level posterior lumbar fusion is feasible and safe when comprehensive patient education is routine, and strict patient selection criteria are followed.

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