

Recoup From Home? Comparison of Relative Cost Savings for ACDF, Lumbar Discectomy, and Short Segment Fusion Performed in the Inpatient Versus Outpatient Setting

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Abstract

Study Design: Broad narrative review.

Objective: To review and summarize the current literature on the cost efficacy of performing ACDF, lumbar discectomy and short segment fusions of the lumbar spine performed in the outpatient setting.

Methods: A thorough review of peer-reviewed literature was performed on the relative cost-savings, as well as guidelines, outcomes, and indications for successfully implementing outpatient protocols for routine spine procedures.

Results: Primary elective 1-2 level ACDF can be safely performed in most patient populations with a higher patient satisfaction rate and no significant difference in 90-day reoperations and readmission rates, and a savings of 4000 to 41 305 USD per case. Lumbar discectomy performed through minimally invasive techniques has decreased recovery times with similar patient outcomes to open procedures. Performing lumbar microdiscectomy in the outpatient setting is safe, cheaper by as much as 12 934 USD per case and has better or equivalent outcomes to their inpatient counterparts. Unlike ACDF and lumbar microdiscectomy, short segment fusions are rarely performed in ASCs. However, with the advent of minimally invasive techniques paired with improved pain control, same-day discharge after lumbar fusion has limited clinical data but appears to have potential cost-savings up to 65-70% by reducing admissions.

Conclusion: Performing ACDF, lumbar discectomy and short segment fusions in the outpatient setting is a safe and effective way of reducing cost in select patient populations.

Keywords

ACDF, microdiscectomy, short segment fusion, outpatient surgery, cost analysis

Introduction

As the United States healthcare system has proven to be the most expensive of all developed countries,¹ changes that aim to increase cost efficiency of diagnosis and management of common medical conditions are being implemented. Outpatient surgery has become increasingly popular in specific fields including eye surgery, soft tissue cases, arthroscopy and now arthroplasty. Sweden, being a prime example of a cost-effective healthcare system, is now performing more than half of their surgeries in the outpatient setting, and the US is following suit.² As the demand for surgery outweighs many hospitals capacity to supply operative time, ambulatory surgery centers (ASCs) have

increased by 60%, followed by an increased in outpatient surgeries in the Medicare population 40%.^{3,4} Additionally, ASCs are able to perform the same procedure as a hospital at a lower cost by accepting a lower facility reimbursement fee.^{5,6}

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Spine surgery is a high expenditure of the current US health-care system with nearly 90 billion dollars per year spent on the diagnosis and management of back and neck pain.⁷ As such, spine surgery is a major target of the healthcare system to reduce overall cost. A primary method for reducing this cost has been shifting operations from the inpatient to the outpatient setting, which may reduce the cost by 43%.⁸ Routine spine procedures safely performed in an outpatient setting are being increasingly reported.^{9,10} As spine surgeons in the United States aim to reduce costs of procedures through outpatient surgery in carefully selected patients, understanding of the current literature is essential. Thus, the purpose of this article is to discuss the cost efficacy of performing anterior cervical discectomy and fusions (ACDFs), lumbar microdiscectomy, and short segment fusions of the lumbar spine in the outpatient setting.

Results

Anterior Cervical Discectomy and Fusion (ACDF)

Although ACDFs are relatively safe procedures, the complications of these procedures can be potentially devastating.^{11,12} Ranging from the rare but dreaded esophageal perforation with a 0.1% mortality rate, to the less severe postoperative dysphagia of up to 9%. However, the most concerning is postoperative hematoma which can threaten the airway occurring in up to 6% of cases.¹³ Given this complication profile, the safety of performing an ACDF in an outpatient setting requires careful assessment.

ACDFs have been increasingly performed on an outpatient basis since 1996, when it was first introduced as a feasible option by Silvers et al.¹⁴ Further early studies confirmed the safety of performing 1-2 level ACDFs on a carefully selected patient population.¹⁵⁻¹⁸ These studies identified a very low rate of complications of up to 2% and only 1 patient converted to inpatient status for monitoring. However, as the largest sample size in these studies was 99 patients treated on an outpatient basis, they lacked power to demonstrate any statistical difference between the outpatient and inpatient cohorts. Following this, National Surgeon Quality Improvement Program (NSQIP) data was utilized to assess the safety of this new trend. After performing propensity score matching and multivariate regression analysis of 7288 cases, McGirt et al. reported that the outpatient cohort had 58% less major morbidity events and 80% lower rate of reoperation within 30 days.¹⁹ Adamson et al. followed this with a cohort study of 1000 consecutive patients classified as American Society of Anesthesia (ASA) I or II undergoing 1-2 level ACDFs prior to noon in an ACS and 484 patients undergoing ACDF in an academic hospital center. With only 8 patients requiring admission after a 4-hour observation period, and no differences in 30- and 90- day reoperation and readmission rates between the 2 groups.²⁰

Given the safety profile of outpatient ACDF in carefully selected patient populations, the promise of cost savings seems possible.²¹ In analyzing statewide databases of New York,

California and Florida, Purger et al. found that overall charges of outpatient ACDF was significantly lower than that of inpatient ACDF (\$33 362.51 vs. \$74 667.04).²² This was further supported by a meta-analysis of 16 studies including multiple outpatient spine surgeries that reported a mean cost savings of \$121 392.72.²³

Notably, outpatient ACDF is often selectively performed in healthier patients. Mundell et al. found that patient selection may bias outpatient surgery to have superior results to inpatient surgery.²³ They reported that younger patients undergoing outpatient ACDF had significantly less cost savings compared to those older than 65 years old. The cost savings for the outpatient surgery in an older population is likely due to fewer comorbidities than their inpatient counterparts that may necessitate surveillance. Although age plays a major role, medical comorbidities seem to be the most important factors in complications. Purger et al. studied these differences by stratifying the outpatient and inpatient ACDF groups by Charlson comorbidity index (CCI). Even when matched, the outpatient group resulted in lower ED visits, readmissions and reoperations within 30 days. Similarly, patients undergoing ACDF in the outpatient setting had higher satisfaction than their inpatient counterparts.²²

As stated, in the appropriately screened and selected patients, the authors feel primary single, and possibly 2-level ACDFs can be performed safely and effectively in the outpatient setting. There is recent literature to guide appropriate patient selection, suggesting patient's should be under 65 years old, BMI less than 35, ASA 2 or lower and no history of coagulopathies, bleeding disorders, TIAs or CVAs. There are also day of post-operative protocols and goals outlined which selected patient's must meet in order to be considered for same day discharge including no operative complications, hemodynamic stability in the recovery room, no respiratory alarm symptoms, and so on (Shenoy et al)19?. Patient's who fail to meet ALL of these criteria should not be considered to undergo ACDF in the outpatient setting. Descriptive information regarding studies examining outpatient ACDF are listed in Table 1.

Lumbar Discectomy

Lumbar discectomy is the most commonly performed spine surgery in the United States with over a quarter million cases a year.²⁴⁻²⁶ There is an overwhelming body of evidence supporting the efficacy of lumbar discectomy in relieving pain and improving function, with a reported 75-90 percent success rate.²⁷ Additionally, lumbar discectomy can be performed in a number of different ways. These range from the classic open procedure to microscopically assisted discectomy to the novel endoscopic microdiscectomy approach. Minimizing the invasiveness of the open procedure has assisted in performing lumbar microdiscectomy in an outpatient setting for over 20 years.²⁸

However, lumbar microdiscectomy has the potential for costly complications. Durotomy, deep infection, and

Table 1. Summary of Studies on Outpatient ACDF.

Author & Year	Study Information	Type of Surgery	Clinical Outcomes	Complications and readmissions	Cost-Effectiveness
Silvers 1996	Single institution, 1994, 50 prospectively analyzed outpatients, 53 retrospectively analyzed Inpatient controls	1- to 2-level ACDF	No statistically significant difference between inpatient & outpatient groups for any parameter, ambulatory surgery does not compromise safety or efficacy of ACDF.	Mortality: 0%, complication rate: 2% in both groups, outpatients: dysphagia & vocal cord paralysis (not fully resolved at > 1 yr): 1 (2%); inpatients: superficial wound infection: 1 (1.9%)	Direct cost not reported. Comments that outpatient ACDF may save 100 million dollars annually.
Villavicencio 2007	Single institution, 2003-2005, 103 outpatients compared to 633 patients identified from meta-analysis	1- to 3-level ACDF	ACDF w/ instrumentation as outpatient is safe & feasible without increased complications.	Overall complication rate: 3.8%. Major complications: 1.9% (vertebral fracture & dehydration resulting in readmission); Minor complications: 1.9% (allergic reaction to medications that did not require hospitalization, transient neurological deficit)	Direct cost not reported.
Garringer 2010	Single surgeon, 1993–2006, prospective analysis of 645 outpatients	1 level ACDF	1-level ACDF safe in outpatient setting with 4-hr observation.	Mortality: 0 (0%), any complication: 0.3% both epidural hematomas that occurred within 4-hour observation period, resolved without permanent deficit; unplanned admission: 6%, >80% of admission due to pain or nausea	Direct cost not reported.
Trahan 2011	Single Surgeon, 2005–2009, retrospective analysis of 59 outpatients, 58 inpatients	1- to 2-level ACDF	1- to 2-level ACDF can be done on an outpatient basis; low complication rate that is identifiable and manageable in the immediate postoperative period.	Outpatients: all complications: 1.4%, neck swelling & difficulty breathing & anxiety requiring readmission. No complications or readmissions in the inpatient group.	Direct cost not reported.
Sheperd 2012	ASC dedicated to spine surgery 2007–2009, retrospective analysis of 152 outpatient	1- to 2-level ACDF	75 patients completed self-reported survey reporting 100% satisfaction	ED visit: 3.9%; neck pain (1.3%), dysphagia 1 (0.7%), vocal cord paralysis (0.7%), nausea (0.7%), cervical swelling (0.7%); required readmission: (0.7%); complication rate: 3.9%	Direct cost not reported.
McGirt 2015	NSQIP, 2005-2011, 6120 inpatient, 1168 outpatient	1- to 2-level ACDF	1- to 2-level ACDF can be safely performed in ASCs in patients who are deemed appropriate candidates.	Major morbidity: 0.94% for outpatient and 4.5% for inpatient. 30-day reoperation rate: 0.3% for outpatient and 2.0% for inpatient.	Direct cost not reported.
Adamson 2016	Single institution, 1000 outpatient, 484 inpatient	1- to 2-level ACDF	4-hour observation in PACU is adequate time to diagnose complications and allow for safe	0.8% complication rate: 0.8% 30-day readmission rate: 2.2%	Direct cost not reported.

(continued)

Table 1. (continued)

Author & Year	Study Information	Type of Surgery	Clinical Outcomes	Complications and readmissions	Cost-Effectiveness
Purger 2017*	State Database of California, Florida, and New York, 2009 to 2011, 3135 outpatient and 46 996 inpatient	1 - to 3- level ACDF	transfer to inpatient status given the low complication rate. ACDF can be performed in an ambulatory setting with comparable morbidity and readmission rates, and lower costs, to those performed in an inpatient setting.	90-day surgical morbidity was not different between outpatient and inpatient cohorts. Morbidity not reported. Readmission and ED visits in 30 days were not significantly different. Readmission: 1.6% outpatient and 3.8% inpatient ED visits: 5.4% outpatient and 5.5% inpatient	Outpatient cost significantly less than inpatient ACDF. Outpatient cost: \$33 362.51 versus inpatient cost: \$74 667.04
Steiber 2005	Single Institution, Retrospective cohort study of 30 outpatient matched to 60 inpatient controls	1 - to 2- level ACDF	Outpatient ACDF was safer than inpatient ACDF, likely due to selection bias	Complications: 1% outpatient and 1.2% inpatient 30-day Readmission: 0% outpatient and 6.7% inpatient	Direct cost not reported.
Liu 2009	Retrospective Study 64 inpatient, 45 outpatient	1-level ACDF	Outpatient and Inpatient ACDF are equally safe in carefully selected patients.	Complications: 0% outpatient and 6% inpatient.	Direct cost not reported. Suggests that a savings of up to \$8000 per surgery with 150,000 cases per year may save 100 million dollars.
Erickson 2007	Single institution, retrospective study, 56 outpatient	1 - to 2- level ACDF	Outpatient ACDF has a high satisfaction rate (78%) and is comparably safe to inpatient.	One major complication: infection of bone graft donor site. One mild complication. 4 ED visits, 0 readmissions.	Direct cost not reported. Suggests cost savings of outpatient ACDF between \$4000 and \$8000 compared to inpatient.

hematoma are the most common complications that ultimately lead to hospital admission, reoperation and increased cost.²⁹ In order to safely perform these procedures in an outpatient setting, protocols for patient selection may reduce these risks.³⁰ In a retrospective cohort study, Bekelis et al. found male gender, private insurance, lower CCI, and being at a higher volume center to be associated with improved success in performing outpatient lumbar discectomy.³¹

As many variables effect the success of outpatient lumbar discectomy, the cost can vary greatly.³² Major driving forces of the cost variability are obesity, history of myocardial infarction, opioid independence, length of surgery, length of hospital stays, and time in rehabilitation centers post-operatively.³² Some suggest the grand majority of cost occurs from the length of surgery and admission to hospital and rehabilitation centers postoperatively. Readmission within the 90-day global period also accounted for 36% of the overall cost.³² It is therefore important to recognize that lumbar microdiscectomy has similar complication rates and readmission rates when performed in the inpatient setting, outpatient setting at an ASC, or hospital based outpatient setting. In a recent insurance based database study, Malik et al. reported that lumbar microdiscectomy performed at an ASC compared to a hospital based outpatient setting (HOS) procured a total cost saving of \$2000 and \$3500 for Medicare and Commercial Insurance respectively.³³ This further supports that identifies that hospital operative fees are greater than those of ASCs even without the additional cost of inpatient admission.

Ultimately, primary lumbar microdiscectomy can be safely performed in an outpatient setting in a select patient population. Performing these procedures with recuperation at home is safe and effective at reducing cost without compromising patient satisfaction.³⁴ As is the case for ACDFs, appropriate patient selection is of the utmost importance when considering performing lumbar microdiscectomies in the ambulatory setting. To date however, there is a paucity of evidence-based literature dedicated to guiding appropriate patient selection. Generally, the authors suggest following the selection guidelines laid out above for ACDFs when choosing patients to undergo lumbar microdiscectomies in the outpatient setting.

Of note, there is very little data regarding performing revision discectomy in the outpatient setting. As revision discectomy can have similar or higher complication rate, this decision should ultimately be left to the surgeon's discretion.^{35,36} Descriptive information regarding studies examining outpatient lumbar discectomy are listed in Table 2.

Short Segment Fusion

While the main barrier to performing ACDFs in the outpatient setting may be the complication profile, lumbar fusions offer a different set of challenges. The increased morbidity from a more invasive procedure directly tests our ability to control post-operative pain and decrease recovery time. Fear of increased readmissions and revisions associated with open approaches for lumbar fusion have previously limited the adoption into the

outpatient setting.^{37,38} However, the number of lumbar fusions has increased from 5% of outpatient spine surgeries in 1994 to 17% in 2006.³⁹ Table 3 summarizes the literature on short-segment fusions performed as same-day surgery.

Historically, standard open posterior surgical approaches for lumbar fusion, such as posterolateral fusion (PLF) and posterior/transforaminal lumbar interbody fusion (PLIF/TLIF), are associated with significant muscle dissection, increased blood loss, extensive pain control requirements, use of urinary catheters, and surgical drains. All of which create obstacles for early mobilization, including patients' fear of movement and injury, let alone same-day discharge.³⁹ However, minimally invasive surgery (MIS) techniques for lumbar fusion, such as the MIS TLIF, have demonstrated reduced blood loss, decreased pain control requirements, avoidance of patient controlled analgesia pumps, urinary catheters, and surgical drains, and reduced length of stay.⁴⁰⁻⁴² Cheng et al. estimated their own ability to shorten inpatient hospitalizations via MIS TLIFs compared with open (4.8 days vs. 6.05, respectively, $p = 0.006$) translated to an average cost reduction of \$3885 per patient based on the average cost of 1 day on an acute care inpatient ward (\$2590).⁴³ Further, long-term outcomes such as patient satisfaction and fusion rates are similar to conventional open approaches.^{44,45} As MIS techniques and enhanced recovery after surgery (ERAS) protocols advance, properly selected patients undergoing short segment lumbar fusions have been able to be successfully transitioned to the outpatient setting with large cost-saving potential.^{38,46-51}

In one of the largest case series, Eckman et al. reported on their 10-year experience of discharging patients the same-day after an MIS TLIF.⁴⁸ Among a total 1114 procedures performed by a single surgeon, 808 were discharged same-day with an overall 73% same-day discharge rate and similar improvement for scores for function and pain in both groups on follow-up. Emami et al. likewise reported on 96 patients undergoing MIS TLIF with 32 (33%) discharged same-day.⁴⁹ In both, the outpatient cohort was significantly younger, had less comorbidities, and had a lower rate of transfusions and intraoperative complications confounding comparative analysis.

While the MIS TLIF technique offers potential, it is often associated with longer operating times that is counterproductive to the ambulatory setting. Villavicencio et al documented efforts to transition TLIFs to an ambulatory surgery center (ASC) and found that the MIS or percutaneous approach had the longest operative times (245 minutes), followed by open (175 minutes), and a mini-open approach (131 minutes).⁵¹ The average ASC facility reimbursement rate was \$18420 (range, 3200–26000) for 1-level fusion surgery, compared with the average inpatient cost of \$33784, range from \$27984 to \$42082, with 2–4 days length of stay.⁵² Accordingly, open lumbar fusion techniques still have a potential to be shifted to outpatient surgery. While not technically same-day, Bednar described 22 patients discharged after an overnight-stay, totaling less than 24 hours, following standard open lumbar fusions.⁴⁶ This was accomplished through a well-defined comprehensive protocol for patient selection, screening, and

Table 2. Summary of Studies on Outpatient Microdiscectomy.

Author & Year	Study Information	Type of Surgery	Clinical Outcomes	Complications and readmissions	Cost-Effectiveness
Asch 2002	Single institution prospective, years 1994-1998 212 patients- all outpatient	1- to 2-level Lumbar Microdiscectomy	Success rate measured by leg pain, back pain, ODI, satisfaction, ADLs, return to work at 2 years follow-up. 85% satisfaction at 6 weeks- 76% by 2 years. Workers compensation and increased age had negative impact on outcome	1 (0.5%) intraoperative dural tear. 1 Readmission (0.5%) for hyperglycemia. 13% Reoperation rate in 2 years for progressive symptoms.	Direct cost not reported.
Pugley 2013	NSQP Database, years 2005-2010, 1652 outpatients, 2658 inpatient	Lumbar Microdiscectomy and Discectomy Lumbar Discectomy	Inpatient admission was associated with higher complication rate even after adjusting for multiple variables. Outpatient protocol by improving perioperative pain management, ensuring cases scheduled early in the day has proven to be successful in reducing admissions safely.	Unadjusted complication rate 3.5% outpatient, 6.5% inpatient.	Direct costs not reported.
Lang 2014	2 institutions, Retrospective study, years 2008-2012, 643 inpatient (before outpatient protocol), 368 outpatient (after protocol)	Lumbar Discectomy		Before outpatient protocol: admission rate 96.4%, 30-day readmission 2.3%, ED visit 1.1% After outpatient protocol: admission rate 50.3%, 30-day readmission 4.6%, ED visit 2.2%; Most common reasons for admission after protocol implemented: uncontrolled pain 18.9%, late operative start times 14.1%, comorbidities 13%, intraoperative complications 11.9%	Direct costs not reported
Bekelis 2014	State Database of California, Florida, and New York, North Carolina, years 2005-2008, 102,592 inpatients, 47 125 outpatients	Lumbar Discectomy	Outpatient is more commonly performed on younger, white, male patients, with private insurance and less comorbidities, in the setting of higher volume hospitals.	5.8% overall 30-day readmissions: 2.5% for outpatient 6.9% for inpatient Most commonly for wound infection. Not Reported	Inpatient: \$24273 Outpatient: \$11339
Chotai 2018	Single Institution, Retrospective study, years 2011- 2015, 203 outpatients	Single level Lumbar Microdiscectomy	90-day cost is driven primarily due to readmission, followed by hospital length of stay, and ER visits.		Average 90-day cost of outpatient Lumbar microdiscectomy is 7962+ 2092. Index procedure: 6082+1536 Postoperative care: 659+ 668
Malik 2020	Insurance Database, years 2007-2017, 990 patients in ASCs, 990 patients in hospital outpatient setting (HOS)	Single level Microdiscectomy Decompression	ASCs provide a larger cost savings compared to hospital based outpatient centers, with similar clinical outcomes.	90-day complication and readmissions were not significantly different. Complication: 9.1% ASCs, 10.3% HOS Readmission: 4.5% ASCs, 5.3% HOS	Readmission: 4865+ 1467 ASC significantly cheaper than HOS. ASC versus HOS Medicare: \$5814 vs. \$7829 Commercial: \$10116 vs. \$13623.

Table 3. Summary of Studies on Outpatient Short Segment Lumbar Fusion.

Author & Year	Study Information	Type of Surgery	Clinical Outcomes	Complications and readmissions	Cost-Effectiveness
Eckman 2014	Single surgeon, 808 Outpatients, 306 inpatients	1- or 2-level MIS- unilateral TLIF	Mean differences in outcome scores from preoperatively to 3 months were similar between groups, except for a higher VAS lower leg pain in hospital stay patients vs. same day, (3.3 vs. 2.7, $P = 0.05$)	Patients over 65 years old who stayed in the hospital overnight had a higher likelihood of complications and readmission than those who went home the same day.	Direct costs not reported. Estimated cost-benefit from reduced overnight hospital admission.
Emami 2016	Single institution, 32 outpatients, 64 inpatients	1- or 2-level MIS-TLIF	No statistical difference in final ODI or VAS scores.	No significant difference in complication or readmission rate.	Direct costs not reported. Estimated cost-benefit from reduced overnight hospital admission. The average ASC facility reimbursement rate was \$18420 (range, 3200–26000) for 1-level fusion surgery.
Villavicencio 2013	ASC (n = 27) and hospital outpatient (n = 25)	MIS, Open, and Mini-open TLIF	Four patients (14%) operated in an ASC had complications within 7 days postoperatively compared with 1 patient (4%) as an outpatient in the hospital ($P = 0.36$)	Operative time was significantly shorter ($P = 0.002$) and surgeries were performed with less estimated blood loss ($P = 0.007$) in the ASC setting	Direct costs not reported. Author cites Canadian hospital increasing driving funding from inpatient care to "overnight stay" beds
Bednar 2017	Single surgeon, 22 outpatients	Open laminoforaminotomy (full laminectomy cases excluded) open PLIF, unilateral or bilateral, with pedicle screw placement	All cases of lumbar arthrodesis were discharged successfully (100%). Discharge failures observed in other cases were all due to urinary retention.	Age (ranging up to 86 years) and obesity (ranging up to BMI 43.7 kg/m ²) were not considered contraindications in this cohort. A maximum 5-hour in-out time including induction, positioning, and reawakening used as a strict cut-off.	Direct costs not reported
Chin 2015	Single surgeon, 16 outpatients	Open, single-level, PLIF	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, ($P = 0.04$).	No subsequent hospital admissions for pain Control. One patient experienced postoperative worsened back pain diagnosed with possible discitis, improved on oral anti-biotics.	Direct costs not reported
Chin 2016	Single surgeon, inpatient hospital (n = 40) or in an ASC (n = 30)	Single- level LLIF with supplemental posterior fixation	Patients in the ASC setting had significantly greater improvements in the ODI score ($P = 0.013$) and lower rates of complications (7% vs. 20%).	Made use of a new dilating retractor system allowing for more sparing of the psoas muscle in the outpatient setting	Direct costs not reported. Most common complication was dermatome numbness, and unlikely to result in increased costs.
Smith 2016	873 outpatients and 160 inpatients retrospectively reviewed; 54 outpatients prospectively studied	1-, 2-, and Three-Level LLIFs were performed with 59% supplemental posterior fixation	In the prospective group, 92% rated themselves as excellent (14.3%) or good (77.6%) within the first 30 days post-operatively	In the prospective group, no emergent transfers to an inpatient facility, however 2 patients (3.7%) visited the emergency department within 30 days. In the retrospective group, the strongest predictors of same-day discharge were perioperative complication, # of levels treated, less advanced diagnosis (non-deformity), younger age (<65 years old), and lower BMI (<30 kg/m ²).	Direct cost and reimbursement data were not available, but comparisons of accounting reports showed 65% to 70% less reimbursement for the same procedure in an outpatient setting.

optimization, including a maximum 5-hour “in-out” time for the operating room. Chin et al. also reported experience with an open PLIF procedure in the outpatient setting.⁴⁷ Sixteen consecutive patients were able to be discharged same-day (versus 23-hour observation) without a drain in all patients. Thus, with proper planning traditional open or more invasive procedures may still be safely “fast-tracked” without requirement for formal hospital inpatient admission.

More recent publications include moving lateral lumbar interbody fusions (LLIF) to the ambulatory setting. In a retrospective comparative analysis of 70 patients, outcomes and complications were evaluated for LLIF in an inpatient hospital (n = 40) or in an ASC (n = 30).⁵³ There were no significant differences in baseline demographics or VAS back pain scores, however patients in the ambulatory setting had significantly greater improvements in the ODI score (p = 0.013), lower rates of complications (7% vs. 20%), and had shorter surgical times (224 ± 103 vs. 97 ± 49 min, p = 0.005). While no multivariate analysis was performed, these results suggest improved efficacy and safety in the outpatient setting; although in a separate publication the same authors report use of a modified trans-psoas technique for use in the outpatient setting that may account for the improved results.⁵⁴ Smith et al. also demonstrated that same-day discharge after LLIF is well tolerated with results from 1033 patients retrospectively reviewed and 54 patients in a prospective arm.⁵⁰ Among the prospective patients there were no transfers to an inpatient facility, however 2 additional patients (3.7%) visited the emergency department within 30 days—one <24-hour admission for urinary retention, and one admission for pain control after a three-level fusion.

Reports of same-day discharge after lumbar fusion have overall limited clinical data regarding its safety and efficacy, but appears to have potential in cost-savings by reducing admissions.⁵⁵ As all the techniques described require a high degree of surgical expertise, even further consideration in terms of patient selection and a vast experience with these procedures is necessary to prevent complications. Moreover, in addition to ideal patients and masterful technique, advanced anesthesia and pain control protocols are necessary given the increased invasiveness that comes with lumbar fusion procedures.⁵⁶ Indeed, a new frontier of rapid recovery after lumbar fusion is to avoid general anesthesia altogether with the “awake TLIF,” which employs several key innovations including conscious sedation and long-acting local analgesia.^{57,58}

Future studies are needed to standardize the appropriate patient screening and selection criteria for consideration of ambulatory short-segment lumbar fusions. These authors believe that, at a minimum, potential patients would meet the criteria for the “less invasive” spine procedures (i.e. ACDF and lumbar microdiscectomy) outlined above which are already commonly being performed in the ambulatory setting.

Conclusion

The increasing pressure of cost-effective treatment modalities have caused spine surgeons to search for ways of safely

reducing the cost of common procedures. ACDF, lumbar discectomy, and short segment fusions are commonly performed spine surgeries with potential to move to the ambulatory setting. There is increasing literature to support this transition as a safe and effective way of reducing cost in select patient populations. Ultimately, the ability to perform these routine procedures in the ambulatory setting is multifactorial and should be left to each individual surgeon’s discretion.

Authors’ Note

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Declaration of Conflicting Interests


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