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# Surgical site infection rates in open versus endoscopic lumbar spinal decompression surgery: A retrospective cohort study

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A R T I C L E I N F O

*Keywords:*
Lumbar decompression
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A B S T R A C T

*Background:* Lumbar decompression is a commonly performed procedure for the operative management of several degenerative lumbar spinal pathologies. Although open approaches are considered the traditional method, endoscopic techniques represent a relatively novel, less-invasive option to achieve neural element decompression. Here within, we examine if the use of endoscopic techniques decreases the risk of post operative infections.

*Methods:* We performed a retrospective cohort analysis to directly compare patients who underwent either open or endoscopic lumbar decompression at a single institution. Rates of postoperative outcomes such as surgical site infection, hospital length of stay, estimated blood loss, and others were compared between the two treatment groups. A multivariate logistic regression model was constructed using patient comorbidities and procedural characteristics to identify the risk factors for surgical site infection.

*Results:* 150 patients were identified as undergoing lumbar spine decompression surgeries that met inclusion criteria for the study, of whom 108 (72.0%) underwent open and 61 (28.0%) underwent endoscopic approaches. Unpaired analysis revealed positive associations between operative duration, estimated blood loss, drain placement rates. Multivariate logistic regression did not reveal an association between surgical approach (open versus endoscopic) and the development of surgical site infection.

*Conclusions:* Surgical site infections following endoscopic lumbar spine decompression are relatively uncommon, however, after adjusting for baseline differences between patient populations, surgical approach does not independently predict the development of postoperative infection.

## 1. Introduction

Lumbar spinal stenosis, due to degenerative processes such as facet joint hypertrophy, osteophyte formation, and intervertebral disc disorders, may result in compressive symptoms such as low back pain or claudication.[1,2] In many patients with symptoms of lumbar spinal stenosis, conservative treatments may provide symptomatic relief, usually over a course of one year.[3,4] In those who fail to improve despite conservative measures, decompression surgery remains the preferred treatment for lumbar spinal stenosis.[3,5–7] Lumbar decompression can be performed either via traditional open procedures or relatively newer endoscopic approaches.[3,6,7]

Open decompression has long been considered the standard of care for lumbar decompression surgery.[7] Provider experience with open techniques, its overall success with resultant symptomatic improvement, and patient satisfaction have all contributed to the significant use of open decompressive techniques.[8] However, open surgery carries several risks, including damage to muscles, skin, and adjacent structures to gain access to the spine.[7,9,10] Manipulation of adjacent tissue to access the vertebrae also may result in devascularization of tissue, which can result in poorer postoperative healing. In addition, the increased anatomical exposure necessitated by open approaches increases the risk of bleeding, infection, functional damage, and post operative pain.[8]

Alternatively, endoscopic decompression represents a minimally invasive surgical method used for patients with significant symptoms due to spine and nerve compression.[11] Benefits of endoscopic decompression include decreased trauma to tissue leading to a reduced risk of vessel or neurological trauma, scaring, and quicker functional

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recovery.[12] Broadly, endoscopic techniques in spine surgery have improved alongside advances in imaging technology and their applications to medicine. Endoscopic techniques in spine surgery have expanded to involve lumbar, cervical, and thoracic operations.[13]

Endoscopic surgery may provide different rates of complications following lumbar decompression when compared to traditional open approaches.[14] This study's goal is to compare the surgical site infection rates between endoscopic and open spinal decompression in one hospital system, as well as identify potential variables that can be mitigated. We hypothesize that endoscopic approaches, by means of their smaller incisions and lesser degree of tissue manipulation and damage, will result in lower infection rates and post operative complications when compared to open approaches.

## 2. Methods

### 2.1. Data acquisition and population selection

Patients who received either endoscopic or open decompressive lumbar spine surgery at a large tertiary care facility between November 2017 and November 2021 were included in this study. A total of 202 cases were studied for the retrospective analysis. All data used for analysis were obtained from the medical record and were identified through individual chart review.

### 2.2. Cohort comparison

Cases were stratified by surgical approach, either open or endoscopic. Patient demographics, comorbidities, perioperative attributes, and surgical outcomes were compared between the two cohorts. For an open case, it is defined as a midline incision with elevation of the paraspinal musculature to expose the elements of the spine such as lamina, pars interarticularis and facet joins. For an endoscopic case, fluoroscopy is used to identify the surgical target, and either a paramedian or midline incision is made. A series of dilators is used to spread the soft tissue to allow a working channel for the endoscope to be used. With the endoscope, tools can be used such as Kerrison rongeurs or micro-curettes.

Patient demographics studied include age, gender, and body mass index. Comorbidities collected included hypertension, diabetes mellitus, malignancy, smoking status, and American Society of Anesthesiologists (ASA) Physical Status Classification. Perioperative attributes included intraoperative steroid use, postoperative steroid use, intraoperative antibiotic use, postoperative antibiotic use, resident physician involvement in surgery, use of drains, classification of wound as clean, number of spinal levels operated on, operative duration, estimated blood loss, and hospital length of stay. The operative outcome analyzed was presence of surgical site infection at any point following the procedure. Surgical site infections (SSI) were identified within 90 days postoperatively from the index surgery. SSI were found if they had positive tissue or body fluid cultures or had a return to surgery with incision and debridement. Patient were lost to follow up, primary pathology was tumor, did not have two approaches mention, non-clean case, no use of perioperative antibiotics, or had redo surgery were excluded for the cohort.

### 2.3. Statistical analysis

Statistical analysis was performed using SPSS Version 28 (IBM Corporation). Continuous variables were described as mean and standard error. Categorical variables were described with percentages. Student's *t*-tests and Fisher's exact tests were used to compare differences between two groups for continuous and categorical variables, respectively. A *p*-value <0.05 was considered statistically significant. Multivariate analysis was performed by calculating surgical site infection odds ratios, confidence intervals and *p*-values for the variables identified.

## 3. Results

A total of 150 decompressive lumbar spine cases performed were analyzed. After stratification by surgical approach, 108 (72.0%) patients underwent open surgery and 48 (28.0%) underwent an endoscopic approach. Surgical site infection occurred in 6 (5.6%) cases in the open cohort and 1 (2.4%) case in the endoscopic cohort.

All variables studied in each cohort were tabulated (Table 1). Among the patient demographics studied, patients in the open surgery cohort were more likely to have a gender listed as male (63.0% vs 31.0%, P = <0.001). No significant difference was identified for age or Body Mass Index (BMI) ($P < 0.05$). For the comorbidities analyzed, ASA Physical Status Classification (38.3% vs 12.9%, $P = <0.001$) was significantly different, whereas comorbid hypertension, diabetes mellitus, history of malignancy, and smoking status were not significantly different ($P < 0.05$). The perioperative attributes studied were notable for differences in resident physician involvement (92.2% vs 68.9%, $P = <0.001$), use of drains (17.7% vs 0.0%, $P = <0.001$), the number of spinal levels operated on (2.05 ± 0.11 vs 1.71 ± 0.07, P=<0.001), operative duration (215.94 ± 10.22 vs 121.81 ± 6.96, $P = <0.001$), estimated blood loss (121.81 ± 17.84 vs 10.8 ± 5.92, $P = <0.001$), and hospital length of stay (2.49 ± 0.38 vs 0.13 ± 0.06, $P = <0.001$). Intraoperative steroid use, and postoperative steroid use were not significantly different ($P < 0.05$). Following multivariate analysis for surgical site infection, the odds ratio for all the included variables not statistically significant (Table 2).

## 4. Discussion

Lumbar decompression is becoming increasingly common in the United States, especially in elderly individuals who often have several comorbidities.[1] Historically, most spinal decompression surgeries were done with as open decompression procedures.[7] Despite this, endoscopic decompression techniques, which are relatively new, have increased in popularity.[15] Increased utilization of endoscopic procedures can be attributed to the minimally invasive nature of endoscopic procedures.[12] Previous studies comparing open to endoscopic decompression surgery have found fewer surgical complications in the latter cohort.[14] Decreased complication rates in endoscopic surgery support its increasing popularity, however, endoscopic surgery is not without risk of surgical site infection. To this end, we sought to compare postoperative outcomes between endoscopic and open lumbar decompression and identify predictors for surgical site infection.

In the present study, surgical site infections were more likely to occur when open surgical techniques were utilized over endoscopic techniques; however, this finding was not statistically significant even after

**Table 1**
Patient characteristics.

| | Open $n = 108$ | Endoscopic $n = 42$ | *p*-Value |
|---|---|---|---|
| Age | 62.11 ± 8.92 | 68.67 ± 22.8 | 0.79 |
| **Gender (Male)** | **68(63.0%)** | **13(31.0%)** | **<0.001** |
| BMI | 31.21 ± 0.87 | 29.06 ± 0.92 | 0.09 |
| **Length of Stay** | **2.14 ± 0.43** | **0.07 ± 0.04** | **<0.001** |
| HTN | 44(40.7%) | 12(28.6%) | 0.01 |
| DM | 20(18.5%) | 6(14.3%) | 0.64 |
| Malignancy | 13(12.0%) | 3(7.1%) | 0.56 |
| **ASA Greater than 2** | **41(38.0%)** | **4(9.5%)** | **<0.001** |
| Smoker | 17(15.7%) | 2(4.8%) | 0.09 |
| Intraoperative steroids | 72(66.7%) | 28(66.7%) | 1.00 |
| Postoperative steroids | 11(10.2%) | 4(9.5%) | 0.78 |
| **Resident Involvement** | **97(89.8%)** | **23(54.8%)** | **<0.001** |
| **Drains** | **14(13.0%)** | **0(0.0%)** | **0.01** |
| **Number of Levels** | **2.05 ± 0.11** | **1.71 ± 0.07** | **0.01** |
| **Operative Duration** | **219.82 ± 11.95** | **158.36 ± 8.32** | **<0.001** |
| **Estimated Blood Loss** | **134.81 ± 22.29** | **12.8 ± 8.25** | **<0.001** |
| Surgical site infection | 6(5.6%) | 1(2.4%) | 0.67 |

**Table 2**
Multivariate analysis.

| Variables | Odds ratio | 95% Confidence interval | *p*-value |
|---|---|---|---|
| Endoscopic surgery | 1.04 | 0.06–18.2 | 0.98 |
| Gender (Male) | 1.35 | 0.18–9.99 | 0.77 |
| Length of Stay | 1.09 | 0.93–1.29 | 0.30 |
| ASA Greater than 2 | 3.99 | 0.46–34.5 | 0.21 |
| Resident Involvement | 0.43 | 0.02–7.97 | 0.57 |
| Drains | 3.06 | 0.16–58.9 | 0.46 |
| Number of Levels | 1.02 | 0.40–2.57 | 0.97 |
| Operative Duration | 0.99 | 0.99–1.010 | 0.76 |
| Estimated Blood Loss | 0.99 | 0.99–1.003 | 0.56 |

adjustment for other patient characteristics using multivariate logistic regression. Several variables analyzed possibly account for this. The open surgery cohort was significantly more likely to have an ASA Physical Status of 3 or greater. This suggests that open surgical procedures were more often performed on patients with increased risk of adverse outcomes, such as surgical site infections. The design of this study does not attempt to examine the reasoning behind the choice of technique, however, potential explanations for this finding include a tendency to necessitate more invasive procedures in more complicated cases as well as hospital practice patterns and policies. In any case, when correcting for these baseline differences between cohorts using the logistic regression model, endoscopic surgery was not associated with statistically significant decreased odds for infection.

Another notable set of variables involved length of operation, number of levels operated on, and length of hospital stay. The open surgery cohort mean operative duration and hospital length of stay were both greater than that of the endoscopic cohort. Longer operations and larger surgical area expose the surgical site to potential contamination for a greater amount of time, serving as a potential explanation for the correlation. In addition, the risk of nosocomial infections is a notable consideration with hospital stays, and longer periods in the hospital may contribute to the increased rate of surgical site infections observed.[16] Importantly, this study does not attribute whether the longer hospital length of stay caused the infection or possibly was a result of surgical site infection itself. Nevertheless, our observed results are consistent with those reported in other research studies.[17–19]

There are several limitations to this study. First is the small number of endoscopic cases identified in the population ($n = 42$). As a result, only one case of surgical site infection was identified from this cohort. While this is likely reflective of the increased safety of endoscopic procedures, it also could be representative of the small sample size, limiting generalizability. Additionally, the selection of surgical techniques is largely surgeon-driven, and surgeons more comfortable with endoscopic techniques are more likely to offer endoscopic options to their patients. This lack of randomization for a retrospective analysis would allow for a degree of self-selection for lower adverse events. Finally, although we accounted for several procedural nuances such as number of levels involved, use of steroids, and drain placement, this analysis does not differentiate between different types of open or endoscopic procedures. The generalization of all surgical techniques into two broad categories limits the utility of analyses performed.

## 5. Conclusion

In this analysis of patients undergoing lumbar decompression, endoscopic approaches were not independently associated with differential odds for developing postoperative surgical site infection. Future prospective studies directed at this point should consider differences in procedural characteristics such as operative duration, the use of surgical drains, and in addition to baseline patient comorbidities.

## CRediT authorship contribution statement

**Confidence K. Kpegeol:** Writing – review & editing, Writing – original draft. **Vansh S. Jain:** Writing – review & editing, Writing – original draft. **Darius Ansari:** Writing – review & editing, Writing – original draft. **Simon G. Ammanuel:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Paul S. Page:** Writing – review & editing, Writing – original draft, Formal analysis, Data curation, Conceptualization. **Darnell T. Josiah:** Writing – review & editing, Writing – original draft, Supervision, Conceptualization.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Abbreviations

*ASA:* American Society of Anesthesiologists
*BMI:* Body Mass Index
*SSI:* Surgical site infection