

Morbidity and mortality in the surgical treatment of 10,329 adults with degenerative lumbar stenosis

Clinical article

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Object. The purpose of this study was to evaluate the prospectively collected Scoliosis Research Society (SRS) database to assess the incidences of morbidity and mortality (M&M) in the operative treatment of degenerative lumbar stenosis, one of the most common procedures performed by spine surgeons.

Methods. All patients who underwent surgical treatment for degenerative lumbar stenosis between 2004 and 2007 were identified from the SRS M&M database. Inclusion criteria for analysis included an age ≥ 21 years and no history of lumbar surgery. Patients were treated with either decompression alone or decompression with concomitant fusion. Statistical comparisons were performed using a 2-sided Fisher exact test.

Results. Of the 10,329 patients who met the inclusion criteria, 6609 (64%) were treated with decompression alone, and 3720 (36%) were treated with decompression and fusion. Among those who underwent fusion, instrumentation was placed in 3377 (91%). The overall mean patient age was 63 ± 13 years (range 21–96 years). Seven hundred nineteen complications (7.0%), including 13 deaths (0.1%), were identified. New neurological deficits were reported in 0.6% of patients. Deaths were related to cardiac (4 cases), respiratory (5 cases), pulmonary embolus (2 cases), and sepsis (1 case) etiologies, and a perforated gastric ulcer (1 case). Complication rates did not differ based on patient age or whether fusion was performed. Minimally invasive procedures were associated with fewer complications and fewer new neurological deficits ($p = 0.01$ and 0.03 , respectively).

Conclusions. The results from this analysis of the SRS M&M database provide surgeons with useful information for preoperative counseling of patients contemplating surgical intervention for symptomatic degenerative lumbar stenosis. (DOI: 10.3171/2009.11.SPINE09531)

KEY WORDS • spine surgery • complication • lumbar stenosis • adult • Scoliosis Research Society

LUMBAR stenosis is a common condition referred to spine surgeons for evaluation, and the literature supports the effectiveness of lumbar decompression

as a treatment for symptomatic lumbar stenosis.^{1,3,6,7} As the population ages, surgeons will be faced with the treatment of increasingly elderly patients who may be prone to higher rates of complications. An understanding of the potential likelihood of complication is therefore essential in both decision making and preoperative patient counseling.

Abbreviations used in this paper: IRB = institutional review board; M&M = morbidity and mortality; SRS = Scoliosis Research Society.

Authors of several smaller studies have evaluated the complication rates associated with surgical intervention for lumbar stenosis, as listed in Table 1.^{2,8-10} These studies document varying rates of complications and methodologies. In addition, the definition of what constitutes a complication also differs substantially across the literature. What is consistent is that these prior studies were performed on small populations in which the complication rate can be significantly affected by a single incident.

This study uses the SRS M&M database to report the complication rates based on over 10,000 cases of surgically treated lumbar stenosis. Our data were collected from a multisurgeon, multicenter database reporting on the M&M of procedures performed by members and candidate members of the SRS. This analysis provides benchmark complication rates for lumbar stenosis decompression and potentially useful information for decision making and preoperative patient counseling.

Methods

Prior to application for active membership in the SRS, surgeons must complete a 5-year period of candidate membership. Candidate members are required to prospectively collect and submit data on all spine cases treated, including all associated M&M. Active and international members are also encouraged to submit their cases.⁴ Data are gathered using a questionnaire developed by the SRS M&M Committee in the early 1990s and updated to a secure internet-based data entry form in 2001. The SRS has invested substantial resources in this database and emphasizes to its membership the importance of accurate and consistent reporting. In addition, data submission includes a process in which members formally attest that submitted data are true and complete. All data are de-identified upon entry into the database, and the patient, surgeon, and institution cannot be determined. Reported complications do not influence whether a candidate is offered membership, given that the SRS Membership Committee is provided only with an indication of whether each candidate member has completed the required case submission process, and not the number or types of complications for each candidate. This project was submitted to the Hospital for Special Surgery IRB and was determined to be exempt from IRB approval based on the use of de-identified data (IRB number 29045).

To assess the incidence of complications associated with the surgical treatment of lumbar stenosis, all reported surgical cases with this diagnosis between 2004 and 2007 were extracted from the SRS database. Inclusion criteria for this study included a patient age ≥ 21 years and a primary diagnosis of degenerative lumbar stenosis. Patients were not excluded based on secondary diagnoses. Excluded patients were those who had prior lumbar surgery.

For each case included in the present study, age, procedure type, and the presence or absence of complications and/or death were included in the database. In cases in which a complication had occurred, the complications were classified into categories (for example, pulmonary embolus, deep venous thrombosis, and deep wound infec-

TABLE 1: Previous retrospective studies of lumbar stenosis complications

Authors & Year	Age Group (yrs)	No. of Patients	Complication Rate (%)*
Deyo et al., 1992	median of 65	3380	14.4
Sanderson & Wood, 1993	>65	31	6
Vitaz et al., 1999	>75	65	10
Arinzon et al., 2003	>65	283	13.7
Ragab et al., 2003	>70	118	12

* Excludes minor medical complications (for example, urinary retention, depression, and hypoglycemia).

tion). Information regarding the occurrence of, extent of (spinal cord, cauda equina, or nerve root), and recovery from (complete, partial, or none) neurological deficits was also available and extracted. Not consistently included in the database was information on the American Society of Anesthesiology grade, long-term follow-up, and objective outcome measures; therefore, analyses related to these parameters were not performed in the present study.

Statistical comparisons between subgroups were performed using Fisher exact tests. A p value ≤ 0.05 was considered statistically significant. Comparisons of complications and neurological deficits that occurred were made between those who underwent decompression alone versus those who underwent decompression and fusion procedures. Comparisons of morbidity were also made between cases listed as minimally invasive and those that were not. Comparisons of age with complications or with new neurological deficits were also performed.

Results

Of the 10,329 cases submitted to the SRS M&M database that met the inclusion criteria, 72% had been reported by full active members, 21% by candidate members, and 7% by international members. Of these, 719 cases were reported to have had a complication, for an overall rate of 7.0%. The complication rate was lower for full active (6.5%) versus candidate (8.7%) members ($p = 0.002$). International members had a complication rate of 5.4%. Table 2 provides a list of the most common complications. Dural tears (3.1%) and wound infections (2.1%) were the most often reported complications, followed by new neurological deficits (0.6%). Deaths were reported in 13 cases (0.13%), all in patients who were older than 60 years, including 4 patients who were older than 75 years. Five deaths occurred as a result of postoperative respiratory problems, and 4 deaths occurred due to postoperative myocardial infarction. Other deaths occurred due to pulmonary embolus (2 cases), sepsis (1 case), and a perforated gastric ulcer (1 case).

Sixty-two new neurological deficits were reported. Of these, 49 (79%) were nerve root injuries and 13 (21%) were cauda equina type injuries. In the majority of cases (92%), these injuries were reported to be transient. Of the cauda equina type injuries, 9 completely resolved and 3

Degenerative lumbar stenosis morbidity and mortality

partially resolved. Only 1 patient was reported to have made no recovery. Of the nerve root injuries, 23 and 22 cases were reported to have made complete and partial recoveries, respectively. Four patients had no improvement. Electrophysiological monitoring was performed in 2474 cases (24%). There was no statistical difference in the new neurological deficit rate between those monitored (0.56%) and those who were not (0.61%; $p = 0.9$). The use of electromyography, somatosensory evoked potential, and motor evoked potential recordings was noted in the database. Most cases involved the use of multiple modalities. Electromyography was performed in 75% of the cases, whereas motor evoked potentials and somatosensory evoked potentials were recorded in 17 and 65% of the monitored cases, respectively.

No significant differences ($p > 0.05$) were found when patients of different age groups were compared in terms of complications or new neurological deficits. Two comparisons were made: patients over and under the age of 60 years as well as patients over and under the age of 75 years. The patients younger than 60 years had a complication rate of 6.4% and a new neurological deficit rate of 0.6%. Those older than 60 years had rates of 7.1 and 0.6%, respectively, for complications and new neurological deficits. Patients over the age of 75 years had rates of 6.9 and 0.5%, respectively. Note, however, that patients older than 60 years had a statistically significant higher mortality rate ($p = 0.01$) as all deaths occurred in patients older than 60.

The overall complication rate and the rate of new postoperative neurological deficits did not differ significantly between patients who underwent decompression alone (6.5 and 0.5%, respectively) and those who underwent decompression and concomitant fusion (7.4 and 0.8%, respectively; $p > 0.05$). However, the new neurological deficit rate in patients who underwent instrumented fusions (0.9%) was statistically higher than in those who underwent decompression only (0.5%; $p = 0.01$). There were significant differences between patients undergoing procedures classified as minimally invasive (1260) versus traditional (9069) procedures. The respective complication rate was 5.8 and 7.6% for those who underwent minimally invasive versus traditional procedures ($p = 0.01$). Similarly, the patients who underwent minimally invasive procedures had lower rates of new neurological deficits (0.2 vs 0.7%; $p = 0.03$).

Discussion

Consultations for operative intervention in the treatment of lumbar stenosis are common for spine surgeons. One component of informed decision making is the relative safety of the procedure. Authors of several studies have reported on complication rates in various series of patients undergoing operative treatment for lumbar stenosis.^{1,2,8,9} One of the largest series is that reported by Deyo et al.,⁵ in which the authors evaluated the discharge coding of ~ 18,000 patients who had undergone lumbar surgery to quantify various coded complications. Three thousand three hundred eighty patients were identified as having undergone surgery for lumbar stenosis. For this subset,

TABLE 2: Most commonly reported complications affecting surgical intervention for lumbar decompression

Complication	Overall Occurrence (%)
dural tear	3.1
wound infection	2.1
new neurological deficit	0.6
hematoma	0.5
respiratory/pulmonary embolus	0.2
deep vein thrombosis	0.1
death	0.1

whose median age was 65 years, the overall complication rate was 14.4%. A clear definition of what was considered to be a complication was not specified, nor was the occurrence of death. Also not reported were the specific rates of complications for these patients. The database used in the present study, which is not based on billing or coding data, offers greater detail of complication rates than does the study of Deyo et al.

The varying definition of what constitutes a complication also makes comparisons between studies difficult. Authors of some studies assessed the occurrence of mild transient confusion, transient constipation, and episodes of hypoglycemia.² Whether these factors affected overall outcome or even the time to discharge is not clarified. We report recognized surgical and major medical complications that can greatly affect the quality and duration of a patient's recovery.

In the present study we provide comparisons of different age groups and procedure classifications. The finding that overall complication rates are not significantly different between elderly and nonelderly patients suggests that carefully selected elderly patients can expect procedural safety similar to that experienced by their younger peers, although it should be recognized that all of the deaths were confined to those older than 60 years. Therefore, the exclusion of patients solely based on age is not readily justified by these findings. However, in counseling patients one should remember that mortality rates are higher in the elderly, and this fact should be considered in weighing the risk/benefit ratio for intervention.

Patients who underwent fusion procedures also did not have higher rates of complications or neurological deficits when compared with those who underwent decompressive procedures alone. This finding suggests that expected complication rates should not be the primary consideration in deciding whether a fusion procedure is in the best interest of the patient. One noted exception was a higher rate of neurological deficits in those in whom instrumentation had been placed. However, patients who undergo instrumented decompressions often have the most significant stenosis requiring destabilizing decompression. An increased occurrence of new neurological deficits may be associated with the performance of these extensive decompressions rather than the actual place-

ment of instrumentation, as none of the spinal implants were removed or revised in response to the new deficits.

Patients who underwent minimally invasive procedures did have lower rates of complication and new neurological deficit. This finding suggests that in considering operative options, minimally invasive procedures may convey a safety benefit when performed by experienced surgeons. However, it is important to recognize that the SRS M&M database does not detail the number of levels decompressed or the severity of compression in each case. It is possible that cases treated using a minimally invasive approach involved the decompression of fewer levels or with less severe stenosis compared with the cases treated using a traditional open approach.

The present study has several strengths. It is among the largest studies to date to document the incidence of complications in the surgical treatment of lumbar stenosis. In addition, since all cases in the study were submitted during a recent 4-year period, they likely reflect a relatively current standard of care. Furthermore, this study documents complication rates subcategorized by age group and procedure type.

There are several limitations of this study. The SRS database relies on the accurate submission of data by members. It is possible that all complications were not thoroughly documented, which could result in the underestimation of complication rates. No method currently exists to evaluate the completeness and accuracy of the input data, instead relying on the good faith of reporting surgeons. It is likely that major complications and neurological complications are more accurately reported; however, this supposition cannot be verified.⁴ Although data are reported prospectively, this study is retrospective and as such is subject to the weaknesses inherent to such investigations, including confounding variables and reporting bias. In addition, since the SRS M&M database is not designed to capture long-term outcomes, it is impossible to assess the potential clinical impact of complications.

Conclusions

Among the present series, overall complication rates for the operative treatment of lumbar stenosis do not differ across the age groups assessed. Patients who underwent fusion procedures had comparable rates of overall complications and new neurological deficits compared with the rates in those who underwent decompressive procedures without fusion. The patients who underwent minimally invasive procedures were reported to have lower complication rates. This information can aid in patient education and informed decision making.

Disclosure

Dr. Hart is a consultant for Depuy, Medtronic, and Baxano; receives research support from Acumed, Depuy, and Medtronic; receives royalties from Depuy and Seaspine; and is a speaker for AO, Depuy, Kyphon, and Medtronic. Dr. Donaldson receives research

support from Stryker. Dr. Shaffrey is a consultant for Medtronic, Depuy, and Biomet; receives support from AO North America, NIH, and the Department of Defence; and receives royalties from Medtronic. Dr. Polly is a consultant for Medtronic. Dr. Boachie-Adjei is a consultant for DePuy Spine, KZM, and Osteotech; owns stock in KZM; receives support from DePuy Spine, KZM, and Osteotech; and is on the speakers bureau for DePuy Spine and KZM. Dr. Smith is a consultant for Axial Biotech, Biomet Spine, and Medtronic; and receives study group research support from Depuy and Medtronic. The remaining authors report no conflicts of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author contributions to the study and manuscript preparation include the following. Conception and design: CI Shaffrey, JS Smith, DW Polly Jr., KMG Fu. Analysis of data: KMG Fu, JS Smith. Drafting and revising the article: all authors.

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Manuscript submitted June 22, 2009.

Accepted November 16, 2009.

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