

## Complications Associated with Surgical Treatment of Traumatic Spinal Fractures: A Review of the Scoliosis Research Society Morbidity and Mortality Database

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### Key words

- Complication
- Fracture
- Mortality
- Spine surgery
- Spine trauma

### Abbreviations and Acronyms

MM: Morbidity and mortality  
SRS: Scoliosis Research Society



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### INTRODUCTION

Traumatic fracture is a common indication for spinal surgery. The surgical treatment of these injuries remains a difficult clinical problem with a high incidence of perioperative complications (4, 15-17). This patient population frequently has associated injuries to other major organ systems or pre-existing comorbid conditions (e.g. ankylosing spondylitis), which contributes to significant perioperative morbidity (2, 3, 6, 7, 9, 10, 18, 19). Specific fracture patterns and regions are also associated with injuries to other organ systems. For example, cervical spinal trauma is frequently associated with head injury and facial fractures (11, 12), whereas thoracolumbar flexion distraction injuries are associated with abdominal organ injury (1).

■ **OBJECTIVE:** Traumatic spinal fracture is a common indication for surgery, with an associated high incidence of perioperative complications. The literature provides a wide range in the incidence of complications. We seek to assess the perioperative morbidity and mortality of surgery for traumatic spinal fractures and to identify predictors of their occurrence.

■ **METHODS:** We performed a retrospective analysis of all traumatic spinal fracture cases submitted by members of the Scoliosis Research Society from 2004 to 2007.

■ **RESULTS:** A total of 108,478 cases were submitted from 2004 through 2007, with 6,706 (6.2%) performed for treatment of traumatic fracture. Twenty-two percent of patients had preoperative neurological deficits. Intraoperative neuromonitoring was used in 58% of cases. The overall incidence of complications was 6.9%. The perioperative mortality was 0.5%. There were 59 (0.9%) new postoperative neurological deficits. Multivariate analysis demonstrated preoperative neurological deficit ( $P = .001$ ; odds ratio [OR] 1.449, 95% confidence interval [CI] [1.156 to 1.817]) and fusion ( $P = .001$ ; OR 1.12, 95% CI [1.072 to 1.168]) as predictors of complications and use of intraoperative neuromonitoring ( $P = .016$ ; OR 1.949, 95% CI [1.13 to 3.361]), and preoperative neurological deficit ( $P < .001$ ; OR 2.964, 95% CI [1.667 to 5.271]) as predictors of new postoperative neurological deficits ( $P < .001$ ).

■ **CONCLUSIONS:** Overall, surgery for the treatment of spinal fractures was performed with relatively low incidences of perioperative complications (6.9%) and mortality (0.5%). These data may prove useful for patient counseling and ongoing efforts to improve the safety of operative care for patients with spinal fracture.

Traumatic spine fractures typically occur due to high energy mechanisms, for example falls from height or motor vehicle accidents (5, 6, 16, 17). The patient population is typically young (<40 years) with a male predominance (5, 6, 16, 17). Patients often present without a neurological deficit despite potentially significant fracture to the spinal column (6). There are many patterns of spinal fracture, however the most frequently encountered are compression type injuries (6, 15). Overall injuries vary from minor end plate compression fractures to severe fracture dislocation injuries. Fractures of the cervical spine more commonly present with a neurological deficit compared to

thoracolumbar injuries (6). The most likely levels of the spine involved are junctional, including the cervicothoracic junction, thoracolumbar junction, and atlantoaxial regions (5, 6, 15).

The Scoliosis Research Society (SRS) has been collecting morbidity and mortality (MM) data from its members for over 40 years. The membership of the SRS is predominantly fellowship-trained spinal surgeons and pediatric orthopedists, and the cases submitted represent a broad range of case complexities. The SRS MM database has previously been validated using historical controls and comparing complication rates of common procedures (20). In the present study, we sought to

assess the complication rates associated with the treatment of fractures and to evaluate for factors associated with the occurrence of complications in a modern series of patients.

## METHODS

The SRS MM database is the compilation of submissions of SRS members, predominantly within North America. For the years that the data were collected and reviewed for this report, candidate members were required to report their operative cases, including MM data. Full active members were encouraged to report their cases as well. Whether candidate members ultimately achieved full membership was not impacted by the numbers or types of complications reported. The database is designed to focus on perioperative complications rather than long-term or distant complications. Perioperative complications typically occurred around the time of surgery.

We evaluated all surgical cases from 2004 through 2007 from the SRS MM database. All data had previously been deidentified with regard to patient, surgeon, and institution. The database on which this project was based was submitted to an institutional review board and was deemed to be exempt from institutional review board approval based on the use of deidentified data.

We identified all cases of traumatic spinal fracture. We then evaluated for complications and associated characteristics, including preoperative neurological injury, surgical approach, patient age, and revision procedure. Specific complications were collected in the database with a focus on the intraoperative and immediate postoperative periods. Examples of these included death, new neurological deficit, wound infection (superficial or deep), pulmonary embolus, deep venous thrombosis, other pulmonary complications, implant related complications, peripheral nerve deficit, visual deficit, and epidural hematoma. A category for "other" complications, with free text entry for description of the complication, was also included.

Statistical analyses of these data were performed using SPSS for Windows version 19.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables are presented as mean with standard deviation and

median with range. Categorical variables are presented as frequency and percentage. The  $\chi^2$  or Fisher exact test was used for categorical variables as appropriate. The 2-sample unpaired t test with unequal variance was used for analysis of 2 means when normally distributed. The Wilcoxon signed rank test was used if variables were not normally distributed. All tests were 2-tailed. Univariate analysis was performed to identify predictors of complications and new neurological deficits, and those with a value of  $P < .1$  or deemed clinically important were included in subsequent multivariate binomial logistic regression analysis. Factors evaluated with univariate analysis for complications were: age, preoperative neurological deficit, revision procedure, fusion, minimally invasive technique, approach, and fracture level. Factors evaluated with univariate analysis for new neurological deficit were: age, preoperative neurological deficit, intraoperative neuromonitoring, revision, fusion, approach, and fracture level. The threshold for statistical significance was set at  $P < .05$ .

## RESULTS

### Patient and Treatment Characteristics

A total of 108,478 cases were submitted from 2004 through 2007, with 6706 (6.2%) performed for treatment of traumatic fracture. A summary of the baseline characteristics of the patient population are listed in **Table 1**. The cases were submitted by either active members (encouraged to submit) or candidate members (required to submit). The submissions were comprised of 72.2% (4842) active members, candidate 27.4% (1839), and not recorded 0.4% (25). Twenty-two percent of patients had preoperative neurological deficits. These deficits were comprised of 143 cases of cauda equina, 428 complete cord, 548 incomplete cord, and 279 nerve root injuries. Intraoperative neuromonitoring was used in 58% of cases. Minimally invasive techniques were used in 25% of cases. Thoracolumbar injuries were the most common (78.8%). A fusion was performed in 54% of cases, with a posterior approach being the most common method (69%). Among the cases treated

**Table 1.** Patient and Treatment Characteristics for 6706 Patients with Surgically Treated Traumatic Spinal Fractures

Characteristic	N (%)
Age	
Mean $\pm$ SD	57 $\pm$ 25
Median, range	61, 1–97
Preoperative neurological deficit	1452 (22)
Revision	339 (5.1)
Fracture level	
Occipitocervical	399 (5.9)
Subaxial cervical	910 (13.6)
Thoracolumbar	5283 (78.8)
Not recorded	114 (1.7)
Intraoperative neuromonitoring	
Yes	3945 (58)
No	2746 (41)
Not recorded	15 (1)
Minimally invasive	
Kyphoplasty	986 (59)
Vertebroplasty	146 (9)
Mini open	199 (12)
Thoracoscopy	15 (1)
Other	322 (19)
Fusion	3617 (54)
Fusion approach	
Posterior	2489 (69)
Intralaminar	1132 (45)
Posterolateral	1253 (50)
Transforaminal lumbar interbody fusion	53 (2)
Posterior lumbar interbody fusion	51 (2)
Anterior	659 (18)
Combined	427 (12)
Anterior/posterior	412 (96)
Posterior/anterior/posterior	15 (4)
Not recorded	44 (1)

without fusion ( $n = 3089$ ) were 986 (31.9%) kyphoplasties, 146 (4.7%) vertebroplasties, 1862 (60.3%) cases with use of instrumentation without arthrodesis, and 95 (3%) not recorded.

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