

Neurosurgical Practice Liability: Relative Risk by Procedure Type

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BACKGROUND: Neurosurgeons have the highest exposure to litigation of all medical and surgical specialties.

OBJECTIVE: To determine the relative risk of claims for compensation and indemnity by procedure type. The most common alleged factors and clinical outcomes are also determined.

METHODS: The Physician Insurers Association of America Data Sharing Project was queried for all claims involving a neurosurgeon with an incident date during the calendar year 2006. Data were compared with the American Association of Neurological Surgeons National Neurosurgical Procedural Statistics 2006 Survey. Statistical analysis was performed using the χ^2 test and Fisher exact test as appropriate.

RESULTS: Claims were most common after spine surgery, followed by medical management and cranial surgery. Compared with spine surgery, cranial surgery was significantly less likely to result in a claim ($P < .0001$, relative risk: 0.45). However, the average indemnity for spine surgery was \$278 362 vs \$423 539 for medical management and \$438 183 for cranial surgery. The most common alleged factors in spine surgery were improper performance, wrong level operated on, and unindicated procedure. The most common alleged factors in medical management were errors in diagnosis and failure to monitor a patient. The most common alleged factors in cranial surgery were errors in diagnosis and improper performance. For all claims, the most common clinical outcomes were paraplegia, infection, other unspecified complications, and cauda equina syndrome.

CONCLUSION: Claims are statistically less likely to occur after cranial surgery. However, indemnity is higher in cranial and medical management cases than in spine surgery cases. Nonsurgical treatment is a common source of liability in neurosurgical practice.

KEY WORDS: Indemnity, Lawsuit, Liability, Litigation, Malpractice, Neurosurgery

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Medical professional liability is an important topic for neurosurgeons. On average, neurosurgeons spend more than 27% of their career with an open malpractice claim.¹ Neurosurgeons have the highest exposure to litigation of all medical and surgical specialties.² Furthermore, indemnity (the amount of money paid) for each adverse claim is higher in neurosurgery than in any other specialty.³ Information that improves our understanding of medical professional liability may help us to decrease

our exposure to litigation and to decrease the associated costs.⁴

Litigation is most common after spine surgery.^{5–9} However, spine surgery is also the most common procedure in neurosurgical practice. To determine the incidence and relative risk of litigation in neurosurgery by procedure type, the PIAA Data Sharing Project (DSP)¹⁰ was queried for all claims involving a neurosurgeon with an incident date in a single calendar year. PIAA DSP is the largest independent database of medical professional liability claims. PIAA is an industry trade association of medical professional liability carriers.

PIAA DSP does not collect exposure data; therefore, the incidence of claims reported cannot

ABBREVIATIONS: AANS, American Association of Neurological Surgeons; DSP, Data Sharing Project; PIAA, Physician Insurers Association of America

be measured using PIAA DSP data alone. Therefore, PIAA data for all claims in 2006 were compared with the AANS National Neurosurgical Procedural Statistics Survey 2006 (subsequently referred to as “2006 Survey”).¹¹ The American Association of Neurological Surgeons (AANS) survey is the most comprehensive survey of neurosurgical practice in the United States. Furthermore, although these data reflect patient encounters in 2006, previous studies have shown that time to closure of a neurosurgery claim averages 6 years.¹² To determine the relative risk of litigation by procedure type, the incidence of claims for compensation after spine surgery was compared with the incidence of claims after cranial, cerebrospinal fluid (CSF) shunting, peripheral nerve, functional, endovascular, and extracranial cerebrovascular cases.

METHODS

PIAA is an industry trade association including domestic and international medical professional liability carriers. The PIAA DSP is the largest independent database of medical professional liability claims in the United States. PIAA DSP participants are listed in Table 1. Data are anonymized regarding the plaintiff, defendant, and any other involved parties. Defendant physician specialty is included. The PIAA DSP provides aggregated data including the total number of closed claims, the percentage of paid claims, and the average indemnity. Clinical information includes diagnosis codes, unique PIAA-created procedure codes, and chief medical factors.

In consultation with the PIAA Research Database Manager, the PIAA DSP was queried for all claims involving a defendant neurosurgeon with an incident date in the calendar year 2006. Claims from encounters occurring outside the United States were excluded. All procedure codes included in these records were subsequently categorized by the author according to categories defined by the 2006 survey. These included spine,

cranial, CSF shunting, peripheral nerve, pain/interventional/functional (identified as “functional”), catheter/endovascular/percutaneous (identified as “endovascular”), and extracranial cerebrovascular. One additional category was added for encounters that did not include a major surgical procedure: medical management. The PIAA Research Database Manager then aggregated cases by procedural category and reported summary data. Some information was redacted by the Research Database Manager to eliminate the possibility of identifying an insurer or insured.

In 2006, PIAA DSP participants provided medical professional liability insurance to approximately two-thirds of practicing physicians in the United States. However, the PIAA DSP does not collect exposure data; therefore, the incidence of claims reported cannot be measured from the PIAA DSP data alone. Therefore, aggregated data from the PIAA DSP were normalized to match the entire neurosurgeon population of the United States. Subsequently, using the 2006 survey as the denominator, the incidence of claims was determined for each category. Categories were compared using spine surgery as the reference. A statistician was consulted, and statistical analysis was performed using the χ^2 test and Fisher exact test as appropriate. Dollar values are reported in nominal terms (not adjusted for inflation).

The 2006 survey was performed by Perception Solutions, Inc, under the direction of the AANS. Three rounds of e-mail invitations were sent to 3614 neurosurgeons, and an additional 868 invitations were sent by mail. The return rate was 17% (comparable to similar studies performed by Perception Solutions Inc), resulting in an accuracy of $\pm 5\%$. Results were subsequently normalized to the 3443 neurosurgeons board certified by the American Board of Neurological Surgery at that time.¹¹ Selected Physician and Practice Demographic Profile results from the 2006 survey are shown in Table 2.

RESULTS

Claims were most common after spine surgery, followed by medical management, and cranial surgery. Compared with spine

TABLE 1. PIAA Data Sharing Project Participants^a

Connecticut Medical Insurance Company
Cooperative of American Physicians, Inc
COPIC
First Professionals Insurance Company
Healthcare Providers Insurance Exchange
Kansas Medical Mutual Insurance Company
MAG Mutual Insurance Company
MDAdvantage Insurance Company of New Jersey
Medical Assurance Company of Mississippi
Medical Liability Mutual Insurance Company
Medical Mutual Insurance Company of Maine
MMIC
Mutual Insurance Company of Arizona
NORCAL Mutual Insurance Company
Physicians Insurance A Mutual Company
Physicians Liability Insurance Company
ProAssurance Corporation
State Volunteer Mutual Insurance Company
The Doctors Company
Utah Medical Insurance Association

^aPIAA, Physician Insurers Association of America.

TABLE 2. Selected Physician and Practice Demographic Profile Results From the 2006 Survey¹¹

Sex, %	
Male	91
Female	9
Age, y, %	
<35	4
35-45	40
46-55	37
56-65	15
>65	4
Years in practice, %	
<10	35
10-19	36
20-29	21
30-39	7
≥40; no longer practicing	0
Type of practice, %	
Private practice	49
Private practice (academic affiliate or appointment)	20
Full-time academic	28
Military	1
Other (federal government)	1

surgery, cranial surgery was significantly less likely to result in a claim ($P < .0001$, relative risk: 0.45). There were no significant differences in the incidence of claims after CSF shunting, peripheral nerve, functional, endovascular, and extracranial cerebrovascular procedures as compared to spine surgery. The incidence of claims was highest after extracranial cerebrovascular and functional procedures; however, these differences did not reach statistical significance. The incidence and relative risk of claim by procedure type are shown in Table 3.

The most common alleged factors in spine litigation were improper performance, wrong level operated on, and unindicated procedure. The most common alleged factors in medical management were errors in diagnosis and failure to monitor a patient. Failure to monitor a patient refers to cases in which the claimant alleged that the physician did not consult or visit with the patient frequently during hospitalization, and subsequent problems resulted. The most common alleged factors in cranial surgery were errors in diagnosis and improper performance. For all procedures, the most common clinical outcomes were paraplegia, infection, other unspecified complications, and cauda equina syndrome. The most common clinical outcomes in spine litigation were specified complications of procedures, postoperative infection, and paraplegia. The most common clinical outcomes in medical management were paraplegia, cauda equina syndrome, and cardiac or cardiorespiratory arrest. The most common clinical outcomes in cranial surgery were encephalopathy (not further defined), central nervous system complications of procedure, and anxiety.

Twenty-seven percent of claims resulted in payment by the insurer. The disposition of claims is shown in Table 4. For all cases, the average indemnity was \$324 602. The average indemnity for spine surgery was \$278 362. Average indemnity for medical management was \$423 539, and average indemnity for cranial surgery was \$438 183.

DISCUSSION

Previous studies that did not use statistical analysis suggested that liability was proportional to procedure type volume. Rovit et al⁷

reviewed data from a single insurance company. Considering the cases in their study and those in 2 previous reports,^{6,9} they suggested that the distribution of cases was “roughly comparable” to the distribution of cases treated by neurosurgeons.⁷ In a 2005 report of data from The Doctors Company, Wohls⁹ suggested that “spine practice may be the origin of most lawsuits.” However, he continued to write that “[t]he statistics of lawsuit frequency according to case type that would justify this conclusion. . . have not yet been published in the neurosurgical literature or in the indemnity insurance statistics.”⁹ The current study confirms his hypothesis through statistical analysis. In addition, using a different and more comprehensive data source, this study also confirms the results of a single recent report of neurosurgical practice liability that also found a statistically significant lower risk of litigation after cranial surgery compared with spine surgery.¹² The preponderance of evidence indicates that litigation in neurosurgery is not simply proportional to the volume of cases in a given practice, as previously suggested, but is significantly less likely after cranial surgery compared with spine cases.

The lower risk of litigation after cranial surgery may be due to a combination of clinical factors, physician-patient communication, patient expectations, aspects of the legal system, and/or other unidentified factors. For example, it may be that patients undergoing cranial surgery are more likely to have preoperative neurological deficits than patients who are undergoing spine surgery and, therefore, are more willing to accept postoperative neurological dysfunction. It may be that because cranial surgery is less frequent than spine surgery, surgeons spend more time with patients discussing the risk of complications and the alternative treatment options before cranial surgery than with patients undergoing spine surgery. It may be that patients perceive cranial surgery as inherently risky, whereas spine surgery is expected to always have a good outcome. A better understanding of the underlying cause(s) for this significant difference might help neurosurgeons to decrease the risk of litigation after spine surgery.

Not shown in any previous studies and an unexpected finding here is the higher monetary cost of adverse claims after both cranial surgery and medical management compared with spine surgery.

TABLE 3. Incidence and Relative Risk of Claim by Type of Procedure^a

Type of Procedure	Total Procedures Performed	Total No. of Claims	Incidence, %	P Value	Relative Risk
Spine	1,345,167	131	0.0097	Reference	Reference
Cranial	592,443	21	0.0035	<.0001	0.4518
CSF shunting	67,400	3	0.0045	0.1690	0.4571
Peripheral nerve	55,604	5	0.0090	0.8610	0.9234
Functional	54,606	8	0.0147	0.2588	1.5044
Endovascular	44,156	2	0.0045	0.4512	0.4651
Extracranial cerebrovascular	11,819	2	0.0169	0.3225	1.7376
Medical management	Unknown	86	N/A	N/A	N/A

^aCSF, cerebrospinal fluid; N/A, not available.

TABLE 4. Disposition of Claims

Disposition	No. (%) of Claims
Dropped, withdrawn, or dismissed	168 (65.1)
Settled (includes alternative dispute resolution and contract payments)	69 (26.7)
Plaintiff verdict	0 (0)
Defendant verdict	17 (6.6)
Unknown	4 (1.6)
Total	258 (100)

Indemnity was approximately 33% higher after both cranial and medical management claims. It may be that juries are more sympathetic to plaintiffs with cranial disease than those with more common spine disorders, leading to higher jury awards and higher settlements to avoid a jury trial. An analysis of data from several years would determine whether this is a consistent finding. However, if this finding is reproduced, examination of the details of individual cases is probably necessary to determine why it exists.

For all cases in this study, the most common clinical outcomes were paraplegia, infection, other unspecified complications, and cauda equina syndrome. This finding is consistent with previous reports that spinal cord injury is much more common in neurosurgical litigation than in neurosurgical practice.^{8,12} Spinal cord injury is likely the most powerful predictor of litigation in neurosurgical practice. It may also be the most costly for the physician and insurer. Data from PIAA's own Closed Claim Comparative 2013 Edition³ show that "major permanent" and "grave" injuries result in much higher payouts than payouts for death. Cauda equina syndrome is also recognized as a diagnosis leading to a disproportionate share of litigation.^{13,14} Time to surgery greater than 48 hours has been shown to correlate with an adverse outcome of litigation in patients with cauda equina syndrome.¹⁵

Previous studies have underemphasized or ignored the risk of litigation due to nonsurgical management of neurosurgical patients. In this data set, medical management was the second most common category resulting in litigation. The 2006 survey was an analysis of procedural activity and did not include the number of patients managed without surgical or major procedural treatment. Therefore, incidence and relative risk of medical management could not be determined using PIAA DPS data. However, it is clear that a substantial amount of litigation arises from professional activities that take place outside the operating room (or endovascular suite or radiosurgery center). This finding should be considered whenever nonprocedural duties are delegated to nonphysician providers or resident physicians. Continued commitment to careful consideration of differential diagnosis and adequate monitoring of patients receiving nonsurgical treatment might also help reduce this risk.

This study has several weaknesses. A previous report showed that, on average, 6 years is required to close a neurosurgical claim.¹²

Therefore, this study of claims resulting from medical care provided in 2006 was not performed until 2014. A weakness of this study is that there may still be unresolved claims resulting from medical treatment in 2006 that are not included in the analysis. Neurosurgical litigation rarely requires more than 10 years for completion.¹² In addition, this study relies on an industry database representing approximately two-thirds of practicing physicians in the United States compared with a nationwide survey returned by 748 practicing neurosurgeons. Both data sets are assumed to be representative of US neurosurgical practice, but inaccuracies compounded by normalizing both data sets to the entire neurosurgical population may skew the results. There were no plaintiff verdicts in this data set, whereas Rovit et al,⁷ in a similar closed-claims analysis limited to New York State, found plaintiff verdicts in 7% of cases. Jena et al,² analyzing claims covered by a single insurance carrier, determined that the annual rate of claims leading to indemnity payments ranged from 1% to 5% across all specialties.

CONCLUSION

Allegations of medical malpractice and claims for compensation are statistically less likely to occur after cranial surgery compared with spine surgery. A better understanding of the underlying cause(s) for this significant difference might help neurosurgeons to decrease the risk of litigation after spine surgery. In this study, indemnity for claims after medical management and cranial surgery was approximately 33% higher than for spine surgery. Spinal cord injury is likely the most powerful predictor of litigation in neurosurgical practice. Cauda equina syndrome also leads to a disproportionate share of litigation. Although claims are most common after spine surgery, nonsurgical treatment is also a common source of liability in neurosurgical practice.

Disclosure

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COMMENTS

This paper explores an important topic in neurosurgical practice. It does indeed appear to be the first study to evaluate the relative risk of medical liability claims for compensation based on the medical services provided by neurosurgeons. Analyzing closed-claims data from the largest single national database of medical professional liability claims—the PIAA Data Sharing Project—and comparing that data set with the AANS National Procedural Statistics 2006 Survey allowed the author to demonstrate professional liability risk. Importantly, this paper debunks a widely held view among neurosurgeons that cranial procedures are the basis of most medical malpractice lawsuits. The paper is well written and straightforward and appears to arrive at sound conclusions based on the data analyzed.

In the future, the author should consider providing an updated assessment of relative medical professional liability risk. Such a paper should reflect the data included in the 2012 AANS procedural statistics report—“AANS National Neurosurgical Procedural Statistics 2012 Survey Based on 2011 Data” compared with future PIAA closed-claims data. This would allow the author to compare the 2006 findings with more recent procedural statistics to determine whether there are any emerging trends.

Katie O. Orrico
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In the abstract, it is difficult to know pragmatically what to do with the results of this analysis. Those of cranial surgery and those of spine surgery do not seem related. However, a paper by Deyo et al¹ may have given us a clue. In 2003, the AANS shifted its Internal Revenue tax code designation from a 501(c)(3) to a 501(c)(6) entity, giving it more latitude in seeking business opportunities for its member “businesses.” In that regard, it is now a trade association instead of a professional association. Deyo et al¹ showed that the number of Medicare patients receiving complex lumbar spine fusions for spinal stenosis increased from 1.3 persons per 100 000 Medicare persons in 2002 to 19.9 in 2007, a 15-fold increase. Associated with this increase were increases in costs and in complications. Carragee,² in an editorial stated about 50% of the latter procedures were not warranted; some have labeled them unnecessary. The Deyo data were not specialty specific for neurosurgery, but today, a spine surgeon is a spine surgeon regardless of his or her primary specialty. It would be of interest if the authors applied their methodology to those to see whether the aggressive drive to locate business-related efforts on the part of the surgeons might have had something to do with

the increased liability experience of spine surgery during the decade beginning in 2003.

Clark Watts
Georgetown, Texas

1. Deyo RA, Mirza SK, Martin BI, et al. Trends, major medical complications, and charges associated with surgery for lumbar spinal stenosis in older adults. *JAMA*. 2010;303(13):1259-1265.
2. Carragee EJ. The increasing morbidity of elective spinal stenosis surgery: is it necessary? *JAMA*. 2010;303(13):1309-1310.

In this paper, the author presents medical malpractice claims data that were distilled from the PIAA Data Sharing Project. The findings are not surprising, at least not to me. The fact that spine surgery is the most likely neurosurgical procedure to lead to a claim against a neurosurgeon has been confirmed by this study. It is interesting that the cost per claim is much greater, however, for medical management and cranial surgery claims.

The rate of spine surgery is increasing at an alarming rate (“at an alarming rate” is my choice of words). There is likely an association between indications for surgery (loose vs tight indications) and medical malpractice claims. We neurosurgeons should, henceforth, take note and act accordingly.

Edward C. Benzel
Cleveland, Ohio

In this paper, the author sought to calculate the relative risk of litigation for various broad neurosurgical procedure categories. To do this, he used 2 different databases to generate the numerators and denominators, working on the assumption that these databases, taken from differing subsets of neurosurgery practice, are each representative of neurosurgical practice on the whole in the United States. They find that the incidence of litigation for spine surgery is significantly higher than for cranial surgery, the first time such a difference has been demonstrated. The risk of litigation was higher still for extracranial vascular surgery and “functional” neurosurgery, but these differences did not reach statistical significance.

Although this primary finding is of interest, I find some of the other findings of the study even more compelling. First among these was the fact that “medical management” represented the second largest source of claims (although the incidence could not be calculated) with a higher average settlement than for spine surgery litigation. Improper diagnosis and failure to properly monitor the patient were the most common allegations in these cases, and paraplegia and cauda equine syndrome were the most common clinical outcomes. In addition, the most common allegations in spine surgery cases were improper performance, wrong level operated on, and unindicated procedure. As has been observed previously, nearly two-thirds of complaints were abandoned, approximately one-fourth were settled out of court, and rarely do defendants lose if the case goes to trial.

Taken together, these data suggest that although neurosurgeons may have little ability to change a medical malpractice “system” that benefits the legal profession rather than protect patients, there do seem to be specific areas of neurosurgical practice, outside the actual performance of the procedure, that we can improve on that would reduce our exposure to litigation.

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