Trends in the treatment of lumbar spine fractures in the United States: a socioeconomics perspective

Clinical article

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Object. The objective of this study was to investigate a national health care database and analyze demographics, hospital charges, and treatment trends of patients diagnosed with lumbar spine fractures in the US over a 5-year period.

Methods. Clinical data were derived from the Nationwide Inpatient Sample (NIS) for the years 2003 through 2007. The NIS is maintained by the Agency for Healthcare Research and Quality and represents a 20% random stratified sample of all discharges from nonfederal hospitals within the US. Patients with lumbar spine fractures were identified using the appropriate ICD-9-CM code. Data on the number of vertebral body augmentation procedures were also retrieved. National estimates of discharges, hospital charges, discharge patterns, and treatment with spinal fusion trends were retrieved and analyzed.

Results. More than 190,000 records of patients with lumbar spine fractures were abstracted from the database. During the 5-year period, there was a 17% increase in hospitalizations for lumbar spine fractures. This was associated with a 27% increase in hospital charges and a 55% increase in total national charges (both adjusted for inflation). The total health care bill associated with lumbar spine fractures in 2007 exceeded 1 billion US dollars. During this same time period, there was a 24% increase in spinal fusions for lumbar fractures, which was associated with a 15% increase in hospital charges. The ratio of spinal fusions to hospitalizations (surgical rate) during this period, however, was stable with an average of 7.4% over the 5-year period. There were an estimated 13,000 vertebral body augmentation procedures for nonpathological fractures performed in 2007 with a total national bill of 450 million US dollars.

Conclusions. An increasing trend of hospitalizations, surgical treatment, and charges associated with lumbar spine fractures was observed between 2003 and 2007 on a national level. This trend, however, does not appear to be as steep as that of surgical utilization in degenerative spine disease. Furthermore, the ratio of spinal fusions to hospitalizations for lumbar fractures appears to be stable, possibly indicating no significant changes in indications for surgical intervention over the time period studied. (DOI: 10.3171/2011.5.SPINE10934)

Key Words • lumbar spine • fracture • spinal fusion • outcome • Nationwide Inpatient Sample • trauma

L umbar spine trauma is among the most common entities facing spine surgeons. Management decisions, whether surgical or conservative, significantly affect length of stay, discharge disposition, and hospital costs. On a national level, these cumulative decisions likely have a significant socioeconomic impact.

There is a limited number of peer-reviewed published studies addressing recent socioeconomics of traumatic lumbar spine diseases in the US.2,4,8,10 The goal of this work is to analyze trends of lumbar spine fractures using a nationwide database in an effort to highlight major trends in hospitalizations, hospital charges, and surgical interventions in this entity.

Methods

Clinical data were derived from the Nationwide Inpatient Sample (NIS) for the years 2003 through 2007. The NIS is maintained by the Agency for Healthcare Research and Quality and represents a 20% random stratified sample of all discharges from nonfederal hospitals within the US. It is the largest all-payer inpatient care database in the US and contains data from approximately...
8 million hospital stays from 1000 hospitals each year. The NIS is the only national hospital database containing charge information on all patients, regardless of payer, including persons covered by Medicare, Medicaid, and private insurance, as well as the uninsured. More information on the NIS database can be found online (http://www.hcup-us.ahrq.gov/nisoverview.jsp).

Patients with lumbar spine fractures were identified using the appropriate ICD-9-CM code (805.4). The records of patients who underwent surgical fusion (Clinical Classification Software code 158) were also abstracted. In addition, the number of vertebral body augmentation procedures (kyphoplasties and vertebroplasties) were identified using the codes 81.65 and 81.66.

The Healthcare Cost and Utilization Project (HCUP) Internet tool (HCUPnet, http://hcupnet.ahrq.gov/) was used to obtain the number of discharges, hospital charges, national bill (sum of all charges for all hospital stays in the US), spinal fusion rates, and discharge patterns (accessed April 6, 2010). The HCUPnet utilizes a weighted factor to provide national estimates based on the NIS data set. A Bureau of Labor statistics tool (http://www.bls.gov/data/inflation_calculator.htm) was used to adjust hospital and national charges for inflation (accessed November 25, 2010). Population-adjusted rates (discharges per measure of population) were calculated using population estimates generated by the US Census Bureau.

Descriptive statistics are reported as means ± SEMs for continuous variables and as frequencies and percentages for categorical variables. The 2-group t-test and the chi-square test were used to evaluate the yearly changes for continuous variables and as frequencies and percentages for categorical variables. A p value < 0.05 was considered statistically significant.

### Results

Over 190,000 records of patients with lumbar spine fractures were abstracted from the database (Table 1). During the 5-year period, there was a 17% increase in hospitalizations for lumbar spine fractures (11.9 to 14.0/100,000; p < 0.001). This was associated with a 27% increase in hospital charges ($21,047 to $26,828; p < 0.001) and a 55% increase in total national charges ($730 million to $1.13 billion; p < 0.001; Fig. 1A–C). Both of these charges were adjusted for inflation. The total health care bill associated with lumbar spine fractures in 2007 exceeded $1 billion. During this same time period, there was a 24% increase in spinal fusions for lumbar fractures (adjusted for population growth; p < 0.001) and this was associated with a 15% increase in hospital charges (p < 0.001). The ratio of spinal fusions to hospitalizations during this period, however, was relatively stable with an average of 7.4% over the 5-year period (range 6.55%–7.81%; Fig. 1D). In 2007, approximately 35,000 vertebroplasties/kyphoplasties were performed nationwide but only 13,000 were for nonpathological fractures. The national bill associated with these hospitalizations was close to $450 million. It should be noted, however, that the number of vertebral augmentation procedures potentially includes nonlumbar fractures as well.

### Discussion

Lumbar spine trauma is a common entity facing spine surgeons. Whereas the nuances of diagnosis and management of these injuries are well described, their socioeconomic parameters on a national level are not well characterized. The goal of this work was to highlight the pertinent socioeconomic parameters in the management of lumbar spine trauma in the US. Specifically, we sought to determine whether there was an increasing trend of surgical utilization, a common finding in degenerative spinal disease.

Our findings show that the rate of surgical fusion in lumbar spine fractures has been stable during the 5 years analyzed, with an average surgical rate of 7.4% over the 5-year period. This finding contrasts with results from similar studies on rates of fusions in degenerative disease. Cowan et al., in a study using the same NIS database, indicated an increase of more than 300% in spinal fusions for degenerative lumbar disease between 1993 and 2001. Similarly, the authors’ analysis demonstrated a 39% increase in spinal fusions for lumbar trauma during the same time period. In this study, we found a 24% increase in spinal fusions for lumbar trauma between 2003 and 2007.

| TABLE 1: Hospitalizations, spinal fusions, charges, and national bill data for patients with lumbar fractures from 2003 to 2007 |
|-------------------------------|----------------|----------------|----------------|----------------|----------------|
| Variable                      | 2003           | 2004           | 2005           | 2006           | 2007           |
| hospitalizations              |                |                |                |                |                |
| total                         | 34,709         | 37,082         | 38,646         | 41,536         | 42,248         |
| per 100,000                   | 11.95          | 12.64          | 13.06          | 13.90          | 14.00          |
| inflation-adjusted charges ($)| 21,047         | 21,140         | 23,163         | 24,616         | 26,828         |
| national bill ($)             | 730,520,323    | 783,913,480    | 895,157,298    | 1,022,450,176  | 1,133,429,344  |
| spinal fusions                |                |                |                |                |                |
| total                         | 2,563          | 2,873          | 2,530          | 3,165          | 3,301          |
| per 100,000                   | 0.88           | 0.97           | 0.85           | 1.05           | 1.09           |
| inflation-adjusted charges ($)| 88,412         | 81,106         | 93,068         | 95,872         | 102,082        |
| national bill ($)             | 226,599,956    | 233,017,538    | 235,462,040    | 303,434,880    | 336,972,682    |
| surgical rate (%)             | 7.38           | 7.75           | 6.55           | 7.62           | 7.81           |
Even with a stable surgical ratio, the trend of increased rates of hospitalizations and spinal fusions warrants discussion. The diagnosis of spine fractures has undoubtedly increased due to enhanced imaging modalities and increased CT/MR imaging utilization in the emergency room setting. Increased detection leads to increased hospitalizations (as our results demonstrate), as complete evaluation and management by a spine specialist (including reviewing of imaging, bracing if necessary, and trauma workup) likely necessitates at least 24 hours of hospitalization. This hospitalization subsequently leads to additional charges/costs. A more efficient protocol to manage these largely nonsurgical diagnoses could potentially decrease hospitalizations and thus costs. Another reason for increased hospitalizations may be due to the increasingly aging population overall (the so-called “demographic transition”). Because spine fractures are common in the elderly, enhanced imaging along with the growing elderly population may also account for the increased incidence of spinal fractures.

Despite increases in hospitalizations for lumbar fractures, the surgical rate has been relatively stable during the time period studied. This finding likely indicates stable indications for surgical intervention in this entity. The validity of these indications can only be studied using clinical trials and cannot be determined from this database analysis. What can be concluded, however, is that the indications to intervene surgically have not significantly changed during this time period. While the exact number of vertebral augmentation procedures performed specifically for lumbar fractures is difficult to ascertain from this administrative database, it is likely that these procedures are playing an increasing role in the treatment of spine fractures. Using the same database, Lad et al. demonstrated a significant increase in vertebral body augmentation procedures for pathological fractures between 1993 and 2004. A separate trend study investigating kyphoplasty/vertebroplasty for nonpathological spine fractures is warranted.

Our study is pertinent in the light of recent literature suggesting an alarmingly high rate of surgical utilization in spine surgery. In an analysis of Medicare claims from 2002 to 2007 for the treatment of lumbar stenosis, Deyo et al. showed that the rate of complex fusion procedures increased 15-fold (1.3 to 19.9 per 100,000 beneficiaries) during that time period.

In a review of surgical procedures for cervical degenerative disease utilizing the NIS database, Patil et al. demonstrated a 100% increase in procedures between 1990 and 2000. This increase was also associated with a 48% increase in hospital charges and a total national bill of $2 billion. Results from our study indicate that the rise in surgical utilization in lumbar spine fractures is not as steep as that of degenerative spine disease.

The limitations of the NIS and similar administrative databases include the potential for underreporting and misclassification of diagnoses, which may affect the accuracy of the data. Additionally, the use of administrative data for research purposes requires careful interpretation and validation to ensure the findings are applicable to clinical practice.

In conclusion, while the overall trend of increased hospitalizations and spinal fusions warrants further investigation, the surgical rate for lumbar fractures remains relatively stable. Further studies are needed to determine the role of improved imaging modalities and diagnostic protocols in the management of spine fractures and to identify potential areas for reducing costs and improving efficiency in spine fracture care.

**Fig. 1.** Line graphs demonstrating trends in hospitalizations (A), spinal fusions (B), charges for spinal fusions (C), and surgical rates (D) for lumbar fractures from 2003 to 2007.
databases have been previously addressed by our group and others.\(^1\)\(^,\)\(^2\)\(^,\)\(^6\) Disadvantages include potential coding inaccuracies, lack of data on mechanism and type of injuries, and lack of long-term outcomes and disability scores. Specifically in this case, for example, the severity of the fracture or type of fusion cannot be ascertained from this database. Advantages, however, include avoidance of selection bias and ability to analyze trends on a national level. The vast number of records available in this data set allows for generalizations and trend analyses that are key to tracking utilization ratios over time. Finally, and despite significant limitations on clinical outcomes and long-term parameters, this and other administrative databases are used by health care officials and policy makers with practice and reimbursement implications. It is thus prudent to understand and analyze these data, as well as to highlight the strengths, limitations, and clinical context of these findings.

Conclusions

An increasing trend of hospitalizations, surgical treatment, and charges associated with lumbar spine fractures was observed between 2003 and 2007 on a national level. This trend, however, does not appear to be as steep as that of surgical utilization in degenerative spine disease. Furthermore, the ratio of spinal fusion to hospitalizations for lumbar fractures appears to be stable, possibly indicating no significant changes in indications for surgical intervention over the time period studied.

Disclosure

The authors report no conflict 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: Baaj. Acquisition of data: Baaj. Analysis and interpretation of data: Baaj, Downes. Drafting the article: Baaj. Critically revising the article: all authors. Reviewed submitted version of manuscript: all authors. Approved the final version of the manuscript on behalf of all authors: Baaj. Study supervision: Vale.

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