National Trends in Operative Treatment of Pediatric Fractures in the Ambulatory Setting

DEREK T. BERNSTEIN, MD; CHRISTOPHER CHEN, BS; WEI ZHANG, PhD; SCOTT D. MCKAY, MD

abstract

This study evaluated the expanding role of freestanding ambulatory surgery centers in pediatric fracture care based on the only national ambulatory surgery database within the United States. Released by the Centers for Disease Control and Prevention in 1996 and again in 2006, these reports were used to estimate the volume of outpatient pediatric operative fracture care in the United States over a decade, based on International Classification of Diseases, Ninth Revision, Clinical Modification, procedure codes. Particular attention focused on the prevalence of open vs closed vs percutaneous fixation. The estimated number of pediatric patients who presented to outpatient facilities and required operative fracture care between 1996 and 2006 increased by 88%, from 74,577±4663 to 140,152±9138. During this time, the use of outpatient surgical services for pediatric fractures increased threefold, from 10%±1% in 1996 to 32%±2% in 2006. An even greater preference for freestanding ambulatory surgery centers was observed during this same time by a factor of 7, from 3%±1% to 21%±4%. Additionally, a trend toward higher volumes of open and percutaneous fixation in freestanding ambulatory surgery centers and not in hospital-associated outpatient centers was observed. This study showed the expanding role of freestanding ambulatory surgery centers in the surgical treatment of pediatric fractures based on data from the only national ambulatory surgery database in the United States. The proportion of open and percutaneous treatment vs closed reduction of fractures in these facilities also greatly increased. Further study is needed to evaluate clinical outcomes and determine which fractures are most appropriately treated in the ambulatory vs hospital setting. [Orthopedics. 2015; 38(10):e869-e873.]
Pediatric fractures have become more commonplace, possibly as a result of the current trends toward childhood obesity and greater participation in competitive sports at a younger age. Most present as low-energy, isolated injuries to an extremity that require minimal to no hospitalization and do not require the services of a major trauma center. Ambulatory surgery centers are a natural option to address low-acuity fracture volume, offering improved access to care with the potential to minimize cost.

Advances in minimally invasive techniques, anesthesia, and postoperative pain management since the 1980s have promoted outpatient surgery, and these improvements have expanded its utility. These changes led to a definitive increase in the number of freestanding ambulatory surgery centers; however, trends in the use of these facilities for pediatric fracture care and the injury patterns that are most appropriately addressed in this setting have yet to be defined.

The goal of this study was to show the expanding role of freestanding ambulatory surgery centers in the treatment of pediatric fractures, based on reports released in 1996 and 2006 from the only national database detailing the volume of ambulatory surgery in the United States, with particular emphasis on trends in treatment modalities.

**Materials and Methods**

National Survey of Ambulatory Surgery (NSAS) data from 1996 and 2006 were analyzed to evaluate changes in the use of outpatient facilities for pediatric fracture care over a decade. Institutional review board approval was not required because this study used publicly available de-identified data.

**National Survey of Ambulatory Surgery**

Conducted by the National Center for Health Statistics (NCHS) within the Centers for Disease Control and Prevention (CDC), the NSAS is the only national study of ambulatory surgical volume within the United States. Conducted in 1996 and again in 2006, it distinguished between hospital-based and freestanding outpatient surgery. The NSAS evaluated data from a sample of outpatient surgical centers. The information was subsequently weighted to generate an estimate of national patient volume. Further details on the method of data acquisition are available electronically.

**Inclusion Criteria**

The International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM), was used to identify all orthopedic surgical procedures. Sample patient data identified within the NSAS database were coded by NCHS contract staff. Cases with the ICD-9-CM procedure codes of 7700 to 8499, corresponding to all orthopedic surgical procedures, were included in this study; codes 8492 and 8493, which correspond to separation of conjoined twins, were excluded. The ICD-9-CM codes of 7900 to 7999 encompass all orthopedic fracture care. All data for patients between the ages of 0 and 18 years associated with the previously described codes were evaluated.

**Statistical Analysis**

The NSAS data were sampled with a multistage probability design. Descriptive statistics, including totals and proportions, could be estimated in an unbiased manner with a corresponding multistage estimation procedure. Sampling variability was measured with standard error, which was computed with a first-order Taylor series approximation of the deviation of an estimate from its expected value. Standard error was used to generate confidence intervals for statistical testing.

The NSAS data were analyzed with SAS version 9.3 software (SAS, Cary, North Carolina) for survey data analysis. Different sampling schemes were used in the 1996 and 2006 reports (3-stage stratified cluster design and 2-stage design, respectively), and evaluation of interdatabase statistical significance was limited by the inability to calculate P values. Raw values and standard deviations were reported for estimates of population parameters and used for comparison.

**Results**

**Total Number of Pediatric Reductions in an Ambulatory Setting**

An estimated 659,648±40,845 pediatric patients underwent surgical orthopedic intervention in 2006. Of these, 140,152±9138, or approximately one-fourth, presented for treatment of fractures compared with 74,577±4663 patients in 1996. This correlated to an 88% increase in outpatient pediatric orthopedic fracture volume. A summary is shown in Figure 1. The 2 patient cohorts from 1996 and 2006 were compared based on age and sex (Table).

**Pediatric Fracture Care by Facility Type**

In 1996, only 3%±1% of all pediatric patients who underwent outpatient operative fracture care were treated at freestanding ambulatory surgery centers. The rest were treated in the hospital outpatient setting. However, by 2006, freestanding facilities treated 21%±4% of pediatric patients who underwent outpatient operative fracture care. This corresponded to a sevenfold relative increase in the proportion of pediatric fractures that were treated at freestanding ambulatory surgery centers. During this time, a greater proportion of all pediatric orthopedic symptoms were
treated at freestanding ambulatory surgery centers compared with hospital outpatient centers. In 1996, 10%±1% of all outpatient pediatric orthopedic patients presented to these facilities compared with 32%±2% in 2006, a relative increase of threefold.

The increase in the volume of pediatric fracture care provided at freestanding ambulatory surgery centers significantly outpaced all pediatric orthopedic volume. This was apparent when evaluating the proportion of fracture care volume at these facilities, which increased from 10%±2% of all pediatric orthopedic care provided at freestanding ambulatory surgery centers in 1996 to 21%±5% in 2006 (Figure 2).

**Open Versus Percutaneous Versus Closed Fracture Care**

Trends in open vs closed vs percutaneous fracture fixation were also analyzed. An increase in the overall proportion of open fracture care provided at freestanding ambulatory surgery centers from 25%±8% in 1996 to 51%±13% in 2006 was observed. Concurrently, percutaneous procedures increased from 7%±3% in 1996 to 23%±17% in 2006. The number of patients treated with closed reduction decreased from 68%±8% in 1996 to 26%±8% in 2006 (Figure 3). By comparison, the distribution of these procedures was relatively stable in hospital-associated outpatient centers. In 1996, 33%±4% of fractures were treated with open reduction vs 42%±6% in 2006. Percutaneous fixation accounted for 16%±3% of fractures in 1996 vs 14%±4% in 2006, and closed reductions accounted for 51%±4% in 1996 vs 44%±6% in 2006 (Figure 4).

**Fracture Care by Anatomic Location**

Finally, the volume of patients treated for upper- vs lower-extremity fractures was evaluated. From 1996 to 2006, the proportion of lower-extremity fractures treated at freestanding ambulatory surgery centers increased dramatically, from 5%±4% to 38%±15%. In concert with this finding, the percentage of upper-extremity fractures treated decreased from 84%±7% to 61%±15%. Of note, for 10%±5% of fractures treated in 1996 and 1%±0.5% of fractures treated in 2006, the anatomic location was not specified (Figure 5). In comparison, at hospital-associated outpatient surgery centers, these proportions remained relatively stable, with upper-extremity

### Table: National Survey of Ambulatory Surgery Pediatric Orthopedic Patient Age and Sex in 1996 and 2006

<table>
<thead>
<tr>
<th>Group</th>
<th>1996 Value</th>
<th>1996 SD</th>
<th>2006 Value</th>
<th>2006 SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean, y</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5</td>
<td>2.5</td>
<td>0.3</td>
<td>2.9</td>
<td>0.3</td>
</tr>
<tr>
<td>5-9</td>
<td>7.3</td>
<td>0.3</td>
<td>7.2</td>
<td>0.2</td>
</tr>
<tr>
<td>10-13</td>
<td>11.9</td>
<td>0.2</td>
<td>12.4</td>
<td>0.2</td>
</tr>
<tr>
<td>14-18</td>
<td>15.6</td>
<td>0.2</td>
<td>17.0</td>
<td>0.2</td>
</tr>
<tr>
<td>Average</td>
<td>11.7</td>
<td>0.3</td>
<td>12.0</td>
<td>0.5</td>
</tr>
<tr>
<td>Sex, male</td>
<td>63%</td>
<td>4%</td>
<td>71%</td>
<td>5%</td>
</tr>
</tbody>
</table>

Figure 2: Proportion of pediatric fractures compared with all other pediatric orthopedic cases treated at freestanding ambulatory surgery centers in 1996 and 2006.

Figure 3: Proportion of pediatric fractures treated via open vs percutaneous vs closed procedures at freestanding ambulatory surgery centers in 1996 and 2006.

Figure 4: Proportion of pediatric fractures treated via open vs percutaneous vs closed procedures at hospital-associated outpatient surgical centers in 1996 and 2006.

Figure 5: Proportion of pediatric fractures treated at freestanding ambulatory surgery centers in 1996 and 2006 by anatomic location.
fractures accounting for 77%±3% of fractures in 1996 and 80%±5% of fractures in 2006, lower-extremity fractures accounting for 21%±3% of fractures in 1996 and 19%±5% of fractures in 2006, and 2%±1% of fractures unspecified in 1996 vs 1%±1% in 2006 (Figure 6).

**Discussion**

Using NSAS data reported in 1996 and again in 2006, the authors conducted an epidemiologic study of trends in outpatient pediatric orthopedic fracture care. Specifically, the authors distinguished between the volume of patients treated at freestanding ambulatory surgery centers vs the volume treated at hospital-associated outpatient centers. The NSAS is the only publicly available outpatient surgery database in the United States, and it was used previously to analyze trends in knee arthroscopy and anterior cruciate ligament reconstruction.17

Between 1996 and 2006, the estimated number of pediatric patients with fracture presenting for treatment at outpatient surgical centers increased by 88%. This finding suggests an expanded role for the treatment of pediatric fractures in the outpatient surgical setting, and this can likely be attributed to improvements in intraoperative and postoperative care without the need for subsequent inpatient monitoring.

Coinciding with this shift toward outpatient care, an estimated 3000 new freestanding ambulatory surgery centers were built during this time frame, assuming that approximately 300 facilities were built per year.17 There was a threefold increase in the use of these designated outpatient centers for all pediatric orthopedic procedures and an even greater preference for their use for fracture care. From 1996 to 2006, there was a sevenfold relative increase in the number of patients with fracture presenting to freestanding ambulatory surgery centers. The volume of pediatric fracture care in these centers grew more than twice as quickly as the volume of all pediatric orthopedic procedures.

The analysis included open, percutaneous, and closed treatment trends. An increase in both open and percutaneous procedures was observed in the outpatient surgical setting, with the vast majority performed at freestanding ambulatory surgery centers. Additionally, stratification by anatomic location of pediatric fractures (upper vs lower extremity) was performed, and a large increase in the proportion of lower-extremity fractures treated at freestanding ambulatory surgery centers was observed, without a significant change in the proportion performed at hospital-associated outpatient centers. Although it was not explicitly stated, bones of the lower extremity tend to be larger and more robust than those of the upper extremity, and this increase may reflect a greater number of higher-energy injuries treated at freestanding ambulatory surgery centers. In addition, the increased percentage of open or percutaneously treated fractures reported at freestanding ambulatory surgery centers suggests that improvements in postoperative pain management and wound care have allowed for more complex procedures to be performed adequately in settings where higher-acuity care is not available and is likely to be unnecessary. Another possible explanation is that closed manipulation of fractures in children is being done outside of the operating room. This procedure could potentially be done with sedation, such as in the emergency department.

This study may raise concern that freestanding ambulatory surgery centers may preferentially treat fractures more aggressively than hospital-based emergency centers. However, patients with operative fractures often are seen initially at an emergency center and then scheduled an outpatient procedure. Because freestanding ambulatory surgery centers do not typically have an associated emergency department, they are more likely to be sites of definitive treatment rather than initial presentation. Therefore, these facilities may treat a higher proportion of fractures that require fixation.

As long as outpatient pediatric operative fracture care continues to increase, further expansion of the role of freestanding ambulatory surgery centers is likely. These facilities provide several potential benefits to patients and the health care system. First, they can be built in suburban and rural areas, offering improved access to care in areas that may be several hours away from major medical centers. Further, follow-up care is likely to improve if access to facilities is more convenient. Finally, freestanding ambulatory surgery centers have the potential to alleviate health care costs by minimizing excessive charges associated with the use of high-acuity centers for low-acuity injuries.

What type of orthopedists staffed these freestanding facilities in 1996 and 2006? Anecdotal experience suggests that ambulatory surgery centers have more community-based, non–pediatric-trained orthopedists, whereas hospitals have more pediatric-trained orthopedists. This potentially means that a greater proportion of ambulatory pediatric operative fracture care was being performed by community orthopedic surgeons vs pediatric orthopedists between 1996 and 2006.

**Limitations**

The current study had several limitations. First, the national numbers quoted in this report are only estimates calculated from the sample obtained via the survey.
As previously stated, clinical outcomes are noticeably absent because the data were obtained from hospital administrative records. The NSAS is prone to sampling bias, and like any large database, it is prone to error from inaccuracies in data entry. However, this bias was minimized by the use of trained NCHS and CDC contract staff for data entry. Additionally, because the sampling schemes used in the 1996 and 2006 studies were different, direct comparison via calculation of $P$ values was not possible. However, comparison was possible through calculation of raw values and standard deviations for each report individually. Finally, many other factors may affect the use of these facilities for pediatric fracture care, including insurance coverage, patient and surgeon preferences, and the complexity of each individual injury.

**Conclusion**

This study suggested that ambulatory surgery for pediatric fractures was increasingly performed at freestanding facilities vs hospital-based facilities from 1996 to 2006 in the United States. This was true for both open and percutaneous procedures. Fracture care moved to freestanding facilities at a higher rate than pediatric orthopedic procedures in general, suggesting a specific preference for treating these conditions increasingly at freestanding ambulatory surgery centers. Additionally, this study allowed for comparison with future data reported by the CDC from the NSAS database if made available. Further study is needed to determine the safety of outpatient pediatric fracture care.

**References**