Time, Resident Involvement, and Supply Drive Cost Variability in Septoplasty with Turbinate Reduction

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Abstract

Objective. To determine factors that influence cost variability in septoplasty with inferior turbinate reduction.

Study Design. Case series with chart review.

Setting. Tertiary care hospital and affiliated ambulatory surgical center.

Subjects and Methods. Surgical costs were reviewed for adult patients undergoing septoplasty with inferior turbinate reduction between December 2014 and September 2017. Cases where additional procedures were performed were excluded. Operative supply costs, operative time, room time, and resident involvement were determined. Contribution of these factors to total costs and variability were analyzed.

Results. The study included 116 patients (mean age, 38 years) and 4 faculty surgeons. Total cost was primarily driven by operative time (74%), with a smaller portion of total cost arising from supplies (26%). Time cost ($P < .0001$) and supply cost ($P = .006$) varied significantly among surgeons. A resident was involved in 46.6% of cases. When subanalyzed by resident year, no-resident and senior resident (postgraduate years 4 and 5) cases had nearly identical mean times, while junior resident (postgraduate years 1-3) cases had mean times and operative time costs that were 39% greater ($P < .001$).

Conclusion. For septoplasty with inferior turbinate reduction, the greatest driver of cost variation was operative time. Resident involvement correlated with increased time and cost. Supply costs had a much smaller impact. When subanalyzed by resident year, junior resident–involved cases were significantly longer than no-resident cases.

Keywords
cost, septoplasty

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cost with resident involvement. The current study addresses both points using STR as a model procedure. The primary outcome measures were operative time, supply cost, and cost of resident involvement. The present educational goals are to (1) appreciate factors that contribute to cost variation in STR and (2) understand the cost of surgical training in resident education.

Materials and Methods

Subjects and Data Collection

This study was approved by the Institutional Review Board at the University of Utah. Study participants were enrolled from the University of Utah patient population. The ORCA database was used to select applicable surgical cases retrospectively for dates beginning December 1, 2014, and ending September 30, 2017. Cases were included only when “septoplasty” was listed as the primary procedure and were performed by a surgeon in the otolaryngology division. This list was reviewed with Current Procedural Terminology procedure codes to ensure that the primary procedure was 30520 and either or both of 30140 and 30930, as there is variance for how providers code the inferior turbinate reduction (no providers at our institution used codes 30130, 30801, and 30802 regarding turbinate procedures). Patients were excluded if any other procedures were performed (eg, endoscopic sinus surgery), if any nasal valve modifications were performed (30465), or if an open approach to the septum was required (30410 or 30450). Operative time (surgical time), time cost, supply cost, and total cost were obtained directly from the ORCA database. Operative time was measured from the time of the procedural start (incision) to procedural stop, sometimes called surgeon time. The cost for operative time is calculated by multiplying the number of minutes by the facility cost per minute such that this value represents the total cost for the duration of the procedure. Supply costs include all disposable items. Surgeon and anesthesia fees are not included in this analysis. All cost data were adjusted to a nominal arbitrary dollar value for the sake of comparison. This does not reflect the actual monetary cost of surgery and was performed to preserve the confidentiality of contractually privileged purchasing information; however, all ratios were preserved to allow for accurate comparison among groups. Manual chart review was performed with attention to the operative report. Resident involvement, including postgraduate year (PGY) and room time, was recorded. Room time was defined as the time in which the patient is physically present in the operating room (OR). This includes the operative time plus the time when the patient is in the room but the surgeon may not be directly involved (patient transfer, induction, emergence, etc). Mean costs and times were calculated for the individual surgeon, for each facility, and for cases with and without resident involvement. Subgroup analysis was performed by grouping cases involving a junior resident (PGY2 or PGY3) or senior resident (PGY4 or PGY5).

Statistical Analysis

Statistical analysis was performed with SPSS Statistics (v 23: IBM, Chicago, Illinois). Basic descriptive statistics were calculated to summarize participant characteristics. Independent samples t tests and 1-way analyses of variance were used to compare mean scores for surgical time, room time, time cost, supply cost, and total cost according to surgeon, facility type, and resident involvement. When appropriate, a Tukey post hoc test was calculated to determine specific group differences.

Results

The study included 116 patients with a mean age of 38 years, ranging from 16 to 77 years. There were 68 (58.6%) male and 48 (41.4%) female patients. Four faculty surgeons and 2 facilities were identified in the data.

Time and Supply Costs

Overall the mean room time was 110.9 minutes, and the mean surgical time was 77 minutes (Table 1). Room time accounted for the largest component (74%) of the total cost, and operative time constituted 51.4% of the total cost. Consequently, a mean 67.2% of total room time was spent as operative time. Supply costs accounted for the remaining 26% of total costs. Total costs, operative time costs, and supply costs were significantly lower at the ambulatory surgical center (ASC) as compared with the main hospital (P < .01; Table 1), and additional room time (room time minus operative time) was 13 minutes shorter at the ASC. The effect of resident involvement could not be excluded, however, and is addressed later.

Surgeon Variation

Four surgeons were included in this study, and significant cost variation was seen among them. Total cost (P < .001), surgical time cost (P < .001), additional room time cost (P < .001), and supply cost (P < .01) all varied significantly among surgeons, with time having a greater impact on total cost variation. The total case cost for the surgeon with the highest total cost (surgeon 1) was 66% greater than that of the surgeon with the lowest total cost (surgeon 4). Mean operative time was 120% longer when surgeons at either extreme were compared. Supply cost comparison showed a 34% increased cost when surgeons at either extreme were compared. See Figure 1 for details.

Resident Involvement

A resident was involved in 46.6% of total cases, although there was significant variation in resident involvement based on location. Notably, 41 of 57 cases (72%) at the main hospital had resident involvement, while only 13 of 59 (22%) at the ASC had resident involvement. Furthermore, cases performed at the main hospital had 27 of 41 (47%) with involvement by a junior resident, as opposed to 3 of 59 (5.1%) at the ASC.

Total cost in cases with resident involvement showed significant increases as compared with those with no resident
Mean operative time cost \( P < .01 \) and supply cost \( P = .032 \) also were increased per resident involvement (Table 2). When subanalyzed by resident seniority, no-resident and senior resident cases had nearly identical mean operative times at 68.7 and 70.8 minutes, respectively \( P = .78 \). Junior resident case mean times were 99.1 minutes, and operative time costs were 40% greater \( P < .001 \). Supply costs were 27% lower in cases performed by a junior resident \( P < .001 \) than by a senior resident.

Naturally, some surgeons had longer mean operating times than others, and so the impact of resident involvement was compared relative to each surgeon to control for this variation. There was a significant time impact for surgeons 2, 3, and 4 \( P < .01 \) but no significant difference for surgeon 1 (Figure 2). Surgeons 3 and 4 retained shorter operative times overall as compared with surgeons 1 and 2, regardless of resident involvement.

### Discussion

Value in health care is a balance between outcomes and costs. Improving outcomes and/or decreasing costs will improve value. Our goal in this study was to examine variations in the cost portion of the value equation and identify where this variation and, thus, cost can be decreased. Using a novel tool at our institution that examines true cost (not charges or payments), we found time and junior resident involvement to be the main drivers of total cost in nasal airway obstruction surgery.

Differences in attending surgeon’s operative time and supply usage were greater drivers of cost variability in our study. Since all cases were performed within the University of Utah system, we can assume that these costs were related to individual surgeon practices, as the OR fee per minute, unit cost of supplies, and additional OR fees are universal across our system. Specifically, time cost was the more variable factor, with a 120% difference in operative time when the surgeon with the longest operative time was compared with the one having the shortest. OR supply cost varied to a lesser degree, with an increase by a factor of 34% when the surgeons at either extreme were compared. It is important to remember that these costs are not fully independent of one another and that there may have been trade-offs. For example, use of an item such as a septal stapler increased the supply cost for surgeon 3 but decreased the procedure time of the procedure (verified with unpublished data after current study had taken place), with a net effect of a lowered total cost.

Ultimately, if the goal is to reduce variability and thus reduce total cost, then precise cost accounting is necessary that can evaluate these nuanced details. Subsequent dissemination of this information to surgeons regarding their results, as compared with those of their peers, is a simple

### Table 1. Cost Data Analysis by Location.

<table>
<thead>
<tr>
<th></th>
<th>Mean (SD)</th>
<th>Main Hospital (n = 57)</th>
<th>ASC (n = 59)</th>
<th>( P ) Value$^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time, min</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgical</td>
<td>77.0 (33.9)</td>
<td>90.7 (27.2)</td>
<td>51.4 (24.1)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Room</td>
<td>110.9 (38.6)</td>
<td>128.9 (27.7)</td>
<td>77.0 (23.8)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Time cost, $^b$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgical</td>
<td>0.61 (0.19)</td>
<td>0.61 (0.19)</td>
<td>0.42 (0.22)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Additional room</td>
<td>0.23 (0.06)</td>
<td>0.27 (0.06)</td>
<td>0.18 (0.03)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Cost, $^c$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supplies</td>
<td>0.28 (0.09)</td>
<td>0.28 (0.09)</td>
<td>0.24 (0.07)</td>
<td>.0052</td>
</tr>
<tr>
<td>Total</td>
<td>1.16 (0.21)</td>
<td>1.16 (0.21)</td>
<td>0.85 (0.24)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Abbreviation: ASC, ambulatory surgical center.

$^a$P values represent comparison between main hospital and ASC.

$^b$Normalized relative cost data.

![Inter-Surgeon Cost Variation](image-url)

**Figure 1.** Intersurgeon time and supply cost variances. Surgery time cost: surgeron 1 vs surgeons 3 and 4 \( P < .05 \), surgeon 2 vs surgeons 3 and 4 \( P < .05 \). Additional (add'l) room time cost: surgeron 4 vs surgeons 1, 2, and 3 \( P < .05 \). Supply cost: surgeon 3 vs surgeon 4 \( P < .05 \).
and easily implemented method from which they can make immediate changes.

Resident involvement had a significant impact on cost variation in STR procedures. These data are in line with previously published work that also showed resident-involved cases requiring longer operative times and increased cost.

Even when controlled per individual surgeon, resident involvement did demonstrate significant time increases ($P < .01$) for all but 1 surgeon. Significantly shorter times at the ASC appeared to be in part due to a disproportionately low number of cases involving junior residents. Most interesting, unique to the data in this study is a subanalysis by resident year that demonstrates significantly longer operative times for cases involving a junior resident. Senior resident-involved cases had operative times that showed effectively no difference when compared with no-resident cases, lending support to the argument that increased case time and cost of resident-involved cases are actually more accurately related to junior resident-involved cases.

From an educational and practical standpoint, this is quite encouraging, as it suggests that even in the few years of training that occur during residency, senior resident cases require less operative time than junior resident cases, on par with cases without resident involvement. One should not consider resident training as a cost liability but rather as an educational investment that will “pay off” in the future.

These times are in line with those of other studies that objectively tracked resident performance of septoplasty and noted rapid learning during PGY2 and PGY3 with subsequent higher competency scores and decreased rate of progression in PGY4 and PGY5. We recognize several limitations in this study, the most notable being the retrospective nature of the analysis, which may raise concerns with accurate coding and cost capture. Accurate Current Procedural Terminology coding for the patients who were included in the study was verified with chart review, and it is possible that some patients were not included in the initial cohort due to inaccurate coding. Additionally, there was no ability to evenly distribute patients among surgeons or locations, to control for potential comorbidities, or to control for which surgeons tend to have involvement with more senior or junior residents. Despite these drawbacks, a retrospective study was uniquely advantageous because it prevented a Hawthorne effect, where surgeons, knowing that their costs were being examined, might have changed their actions.

Looking toward the future, we recognize that cost is only 1 aspect of the value equation and that other important

### Table 2. Cost Data Analysis by Variations in Resident Level of Training.

<table>
<thead>
<tr>
<th></th>
<th>Mean (SD)</th>
<th>$P$ Value $^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>STR with Junior (n = 30)</td>
<td>STR with Senior (n = 24)</td>
</tr>
<tr>
<td>Time, min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgical</td>
<td>99.1 (31.8)</td>
<td>70.8 (22.7)</td>
</tr>
<tr>
<td>Room</td>
<td>139.7 (36.1)</td>
<td>105.0 (24.1)</td>
</tr>
<tr>
<td>Time cost, $</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgical</td>
<td>0.66 (0.21)</td>
<td>0.47 (0.15)</td>
</tr>
<tr>
<td>Additional room</td>
<td>0.66 (0.21)</td>
<td>0.47 (0.15)</td>
</tr>
<tr>
<td>Cost, $</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supplies</td>
<td>0.24 (0.06)</td>
<td>0.33 (0.10)</td>
</tr>
<tr>
<td>Total</td>
<td>1.17 (0.26)</td>
<td>1.03 (0.19)</td>
</tr>
</tbody>
</table>

Abbreviation: STR, septoplasty with turbinate reduction.

$^a$ $P$ values are based on Tukey post hoc tests.

$^b$ Junior resident vs no resident or senior resident (no resident vs senior resident, not significant).

$^c$ Senior resident vs no resident or junior resident (no resident vs junior resident, not significant).

$^d$ No resident vs junior resident (no resident vs senior resident and senior resident vs junior resident, not significant).

![Intra-surgeon Time Variance by Resident Involvement](image)

Figure 2. Intrasurgeon time variance with respect to resident involvement. $P < .01$ for all surgeons except surgeon 1. w/o, without.
measurements of value, such as outcomes, are not included. This poses an important question that the current study is unable to address: Is faster, less costly surgery better? For example, if surgeons with increased time or supply cost yield greater symptom control, then they may be justified in utilizing additional resources, time, cost, and so on. Keeping the patient at the center of our care delivery model by focusing on providing high-quality, effective care while reducing costs that do not add value to the patient must remain a priority. Certainly, this will be an ideal area for future analysis and research.

Conclusion
For STR, the greatest driver of cost variation is operative time. Supply costs had a much smaller impact. Resident involvement had a statically significant impact, with junior resident–involved cases correlating with increased operative time and cost. Senior resident–involved cases were nearly identical to cases with a faculty surgeon alone. Further research is needed to determine not simply cost but also value, which will be achieved by using patient-reported outcome measures.

Author Contributions
Nicholas A. Quinn, analysis and collection of data, wrote article, final approval; Jeremiah A. Alt, conception and design, revision of article, final approval; Shaelene Ashby, analysis and statistics, revised article, final approval; Richard R. Orlandi, conception and design of study, revised article, final approval.

Disclosures
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References