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Factors Associated with Revision Adenoidectomy

Amy C. Dearking, MD¹, Brian D. Lahr², Admire Kuchena³, and Laura J. Orvidas, MD¹

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Abstract

Objective. To determine whether patient factors (eg, indication for initial surgery, medical comorbidity, or age) are associated with adenoid regrowth and subsequent need for revision adenoidectomy and whether surgical factors (eg, surgical technique or level of surgeon’s training) are associated with adenoid regrowth and subsequent need for revision adenoidectomy.

Study Design. Historical cohort study.

Setting. Tertiary care academic medical center.

Subjects and Methods. Children (≤18 years) who underwent adenoidectomy or adenotonsillectomy between 1980 and May 2009 were identified. Medical and surgical records were reviewed for sex, age at surgery, indication for surgery, training level of surgeon, surgical technique, and history of allergies, asthma, or gastroesophageal reflux disease.

Results. Of 8245 surgical cases (53.8% male), 163 were revision adenoidectomies. Age at initial adenoidectomy was a significant factor for revision adenoidectomy, with younger ages associated with higher increased risk. Indication for adenoidectomy was also a significant risk factor; adjusted for age, patients with ear rather than infectious indications were about 10 times more likely to require revision. A diagnosis of gastroesophageal reflux disease was a significant risk factor (hazard ratio, 2.23; P = .002).

Conclusion. Several risk factors are associated with revision adenoidectomy: young age at initial procedure, indication for adenoidectomy, and diagnosis of gastroesophageal reflux disease. Surgical technique, level of experience of the initial surgeon, and diagnosis of asthma or allergies were not significant risk factors for revision adenoidectomy.

Keywords

adenoidectomy, adenoids, revision adenoidectomy

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Adenoidectomy with or without tonsillectomy is one of the most common major surgical procedures performed on children in the United States.¹ Enlarged adenoids play a central role in nasopharyngeal airway obstruction, sleep-disordered breathing, recurrent otitis media with effusion, chronic rhinosinusitis, and adenotonsillitis. Fortunately, symptoms usually resolve completely or improve greatly after a successful adenoidectomy. In some instances, symptoms of nasopharyngeal obstruction have either persisted or recurred after adenoidectomy, with possible adenoid regrowth.² The phenomenon of symptomatic adenoid regrowth requiring revision adenoidectomy has not been studied extensively. Studies evaluating the frequency of revision adenoidectomy and patient or surgical risk factors associated with it are lacking. Limited data in the medical literature give estimates of a <1% to 3% incidence of symptomatic adenoid regrowth.³,⁴ Curettage adenoidectomy reportedly leaves residual adenoid tissue in about 60% of patients.⁵ Residual adenoid tissue and/or tubal tonsils have also been implicated in the recurrence of nasal obstruction symptoms.⁵,⁶ Patient factors possibly associated with adenoid regrowth include allergic rhinitis and extraesophageal or gastroesophageal reflux disease (GERD).⁴,⁷

Regardless of whether adenoid regrowth or hypertrophy of residual adenoid tissue is the cause of recurrence, some patients will require revision adenoidectomy. An understanding of factors possibly associated with adenoid regrowth aids not only in counseling parents before their child undergoes adenoidectomy but also in potentially modifying and treating risk factors that may result in the need for a second operation. Therefore, we sought to determine whether there are patient or surgical factors associated with symptomatic adenoid regrowth requiring revision adenoidectomy. To do so, we examined patient demographic data

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Methods

A retrospective review of the medical and surgical records of patients treated at our tertiary care academic medical center was completed after approval from the Mayo Clinic Institutional Review Board. All patients aged 18 years or younger who underwent adenoidectomies (with or without tonsillectomy) between January 1980 and May 2009 were identified by searching the institution’s surgical case database for adenoidectomy or adenotonsillectomy in the procedure codes. Exclusion criteria included opting out of the Minnesota Research Authorization and having a primary adenoidectomy or adenotonsillectomy at another medical center.

Our institutional medical and surgical records were then searched for the following data points: age at the time of initial adenoidectomy or adenotonsillectomy; date of surgery; sex; indication for surgery; level of training of surgeon involved in the case (PGY1-PGY5 resident or staff consultant); medical diagnosis of asthma, allergies, or GERD; and surgical technique used for adenoidectomy.

Indications for surgery were categorized into 4 groups: (1) symptomatic adenoid hypertrophy only (nasal obstruction, sleep-disordered breathing/obstructive sleep apnea), (2) recurrent otitis media with effusion and/or Eustachian tube dysfunction (ear only), (3) adenoid hypertrophy plus ear indications, and (4) infectious indications with or without hypertrophy or ear indications. In our practice, children who require a second set of tympanostomy tubes for chronic or recurrent otitis media and/or Eustachian tube dysfunction will undergo an adenoidectomy, regardless of any nasal obstruction or adenoid hypertrophy symptoms. This group of patients was identified as “ear only.” Infectious indications refer to recurrent adenoiditis, adenotonsillitis, or rhinosinusitis. The surgical techniques were classified into 3 categories: (1) curettage/adenotome, (2) electrocautery (including suction diathermy), and (3) microdebrider or coblation.

The medical diagnoses of asthma, allergies (allergic rhinitis or environmental allergies), and GERD were obtained by searching the medical index database, which includes all International Classification of Diseases, Ninth Revision (ICD-9) and Hospital International Classification of Diseases Adapted (HICDA) codes for each patient treated anytime from 1975 through 2010 per the medical record. Abstracted data included the diagnoses of asthma, allergies, or GERD and the date that each diagnosis first appeared for each patient.

Levels of training for surgeons involved in these cases were categorized into 3 groups: (1) junior resident (PGY1 or PGY2), (2) senior resident (PGY3 or PGY4), and (3) chief resident/staff consultant. All residents had completed at least 2 quarters of pediatric service rotations by the end of PGY2. It was assumed that the resident with the lowest level of training recorded on the operative record was the primary surgeon for the case. If no resident was recorded, it was assumed that the staff consultant was the primary surgeon. Resident surgeons were not recorded in the surgical database before 1988, so cases prior to 1988 were not included in the cohort for this data point.

Patient demographics and clinical characteristics were summarized using descriptive statistics. The Kaplan-Meier (KM) method was used to estimate survival free of revision after the index procedure, and the log-rank test was used to test for an association of this with patient factors. Patients free of revision were censored at their last known medical visit or, if earlier, by their 19th birthday, when they were considered no longer at risk. Cox proportional hazards regression was used to further evaluate the relationship between patient or clinical factors and the rate of survival free of revision, with hazard ratios (HRs) and 95% confidence intervals (CIs) reported to convey the strength of association.

Among the clinical factors assessed were baseline indications for asthma, GERD, and allergies, in which the diagnosis date preceded the adenoidectomy date. Using time-dependent covariates, a second set of analyses was carried out for these comorbidities, allowing any diagnosis before or after their index adenoidectomy. For feasibility purposes, surgical technique was obtained and analyzed for only a subset of the cohort, including all revision patients and a 1:1 age- and sex-matched set of revision-free patients with equal or greater follow-up. All analyses were carried out using SAS statistical software (version 9.2; SAS Institute Inc, Cary, North Carolina). Statistical significance was defined as $P < .05$.

Results

Of the 8245 patients with an adenoidectomy who met inclusion criteria, 163 underwent a revision adenoidectomy during the 10-year follow-up period, which corresponded to a 5- and 10-year cumulative incidence of 2.2% and 3.0%, respectively (Figure 1). The mean ± standard deviation (SD) age of the patients at initial adenoidectomy was 6.7 ± 3.7 years, and 54% were male. Table 1 summarizes the demographics of patients and their clinical characteristics.

Table 2 summarizes the regression results assessing factors associated with having a revision adenoidectomy. Among demographic variables, younger age was associated with increased risk of revision. In particular, for each increasing year of age, the risk of revision surgery decreased by almost 30% (HR, 0.72; 95% CI, 0.67-0.77; $P < .001$). Similarly, among age groups of patients younger than 4 years, 4 to 7 years, and 8 years or older, children younger than age 4 years had a considerably poorer chance of being free from revision at follow-up (10-year KM rate = 93.5% vs 97.6% and 99.2% in the 2 older age groups, respectively; Figure 2).

Within our cohort, we observed an increased number of adenoidectomies over time, from 1759 in the 1980s to 2654 in the 1990s and 4055 in the 2000s. In addition, there was...
Patients with only a hypertrophic adenoid indication for adenoidectomy comprised 50% (4151 of 8245) of the index cases; however, patients with hypertrophy of the adenoid in combination with any other indication comprised 89% (7319 of 8245) of the cases. Patients who underwent adenoidectomy for only an ear-related indication represented only 5% (379 of 8245) of the cases, but 30% (2463 of 8245) of patients overall had ear-related indications in combination with hypertrophy or infection. Just greater than one-fourth (26%, 2140 of 8245) of the patients had an infectious indication. The indication for initial adenoidectomy was strongly associated with having a revision adenoidectomy. In particular, patients with an indication that was exclusively ear-related had about a 20-fold higher risk of needing a revision than patients who underwent adenoidectomy for an infectious indication (HR, 20.37; 95% CI, 9.15-45.37; \( P \leq .001 \)). Patients with an ear-only indication tended to be younger, which was already identified as a significant risk for revision adenoidectomy. Adjusted for age, having an ear-related indication was still strongly associated with a revision adenoidectomy, but the increased risk relative to those with an infectious indication dropped in half to about a 10-fold increased risk (HR = 10.82, 95% CI: 4.81-24.35, \( P < .001 \)). Hypertrophic adenoid symptoms (eg, nasal obstruction, sleep-disordered breathing) with (HR = 6.35, 95% CI: 2.95-13.66, \( P < .001 \)) or without (HR = 7.32, 95% CI: 3.56-15.06, \( P < .001 \)) ear indications were also associated with an increased risk of revision adenoidectomy relative to those with an infectious indication (Table 2, Figure 4).

Junior residents performed 50.4% (3270 of 6478 cases) of the surgeries from 1988 to 2009, while senior residents performed 30.9% (2003 of 6478) and chief residents and staff performed 18.6% (1205 of 6478). The level of training of the surgeon or resident surgeon involved in the case showed a trend toward an association with a subsequent revision adenoidectomy. Specifically, patients who had inexperienced surgeons (PGY1 or PGY2) were approximately 50% more likely to require a revision procedure than did patients who had staff consultant surgeons; however, this result was not statistically significant (HR, 1.46; 95% CI, 0.92-2.46; \( P = .10 \); Table 2).

Among the subset of revision cases and matched controls, electrocautery was the most commonly used surgical technique (59.5%), followed by curette or adenotome (34.4%) and coblation or microdebrider (6.1%; Table 3). The association between surgical technique used and the likelihood of having a revision adenoidectomy was not significant.

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### Table 1. Demographics and Clinical Characteristics of 8245 Patients Who Underwent Adenoidectomy

<table>
<thead>
<tr>
<th>Variable</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age, mean ± SD, y</strong></td>
<td>6.7 ± 3.7</td>
<td>—</td>
</tr>
<tr>
<td><strong>Male sex</strong></td>
<td>4435</td>
<td>53.8</td>
</tr>
<tr>
<td><strong>Decade of index procedure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1980s</td>
<td>1759</td>
<td>21.3</td>
</tr>
<tr>
<td>1990s</td>
<td>2431</td>
<td>29.5</td>
</tr>
<tr>
<td>2000s</td>
<td>4055</td>
<td>49.2</td>
</tr>
<tr>
<td><strong>Asthma: prior to procedure/any time</strong></td>
<td>393/886</td>
<td>4.8/10.7</td>
</tr>
<tr>
<td><strong>GERD: prior to procedure/any time</strong></td>
<td>314/638</td>
<td>3.8/7.7</td>
</tr>
<tr>
<td><strong>Allergy: prior to procedure/any time</strong></td>
<td>641/2012</td>
<td>7.8/24.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Indication</strong></th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertrophy only</td>
<td>4151</td>
<td>50.3</td>
</tr>
<tr>
<td>Ear only</td>
<td>379</td>
<td>4.6</td>
</tr>
<tr>
<td>Infection with or without others</td>
<td>2140</td>
<td>26.0</td>
</tr>
<tr>
<td>Hypertrophy and ear</td>
<td>1575</td>
<td>19.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Revision, No. of events, rate %</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>At 5 y</td>
</tr>
<tr>
<td>At 10 y</td>
</tr>
</tbody>
</table>

Abbreviations: GERD, gastroesophageal reflux disease; SD, standard deviation.

*Values are number (percentage) unless indicated otherwise.

*By Kaplan-Meier cumulative incidence rate analysis.

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**Figure 1.** Overall rate of revision adenoidectomy in the cohort over time.

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also an increased rate of revision adenoidectomies over these 3 decades. Compared with the risk of revision in the 1980s, the risk of revision in the 1990s was more than 3-fold higher (HR, 3.09; 95% CI, 1.69-5.66; \( P < .001 \)), and the risk in the 2000s was 5-fold higher (HR, 5.19; 95% CI, 2.89-9.31; \( P < .001 \); Table 2, Figure 3).

Of the medical diagnoses of asthma, allergies, and GERD that could have occurred any time before or during follow-up, GERD was the only diagnosis significantly associated with having a revision adenoidectomy (HR, 2.23; 95% CI, 1.33-3.74; \( P = .002 \)). Although not statistically significant, a diagnosis of GERD before the initial surgery was suggestive of increased risk of a revision adenoidectomy (HR, 1.80; 95% CI, 0.92-3.53; \( P = .09 \)), as was a diagnosis of asthma any time before or during follow-up (HR, 1.51; 95% CI, 0.92-2.46; \( P = .10 \); Table 2).
Over a 30-year period at a single tertiary care academic medical center, there was an increase not only in the number of adenoidectomies but also in the rate of revision adenoidectomies. This increase in adenoidectomies is likely related to the growing awareness of sleep-disordered breathing and obstructive sleep apnea in children during this same period, resulting in the performance of more adenoidectomies and adenotonsillectomies.8 In addition, the increase in the number of adenoidectomies may have been affected by reports in the late 1980s and early 1990s that advocated the use of adenoidectomy as well as tympanostomy tube placement in children with persistent and/or recurrent otitis media despite initial treatment with tympanostomy tubes and antibiotics.9-11 Several factors were found to be associated with the increased risk of revision adenoidectomy.

In our cohort, a KM event rate of revision adenoidectomy was found to be 2.2% at 5 years and 3.0% at 10 years. This is higher than the reported rate of revision adenoidectomy of less than 1% from a large study of more than 13,000 cases4 but consistent with other reported rates of 3%.3 One possible explanation for the higher rate of revisions could be from children who were undergoing tonsillectomy for later diagnosis of sleep-disordered breathing after initial adenoidectomy. In our practice, the adenoid bed is inspected in these patients, and any residual adenoid tissue is removed at the time of tonsillectomy. In some cases, the amount of residual adenoid tissue may not be significant enough to warrant revision adenoidectomy alone.

![Figure 2. Age at initial adenoidectomy. Kaplan-Meier plot showing proportion of patients free from revision by age group.](image-url)
but if the patient is already undergoing tonsillectomy, removal of any remaining adenoid tissue is reasonable.

The age of the child at the time of initial adenoidectomy was a significant factor for patients at risk of revision adenoidectomy in the future. Younger age was associated with increased risk. There are several possible contributors to this association. First, younger children have a smaller nasopharynx, which may lead to more conservative adenoidectomy to avoid causing unwanted injury to nearby structures such as the vomer or Eustachian tube orifices and thus leaving residual adenoid tissue behind. Second, the immune systems of younger children are highly active, and therefore, any residual lymphoid tissue in the adenoid bed may become hypertrophic and subsequently symptomatic. Third, younger children are more likely to have a diagnosis of recurrent otitis media that requires the placement of tympanostomy tubes, and they may have initially undergone adenoidectomy for indications related to their ear disease. Thus, as these children grow older, their sleep-disordered breathing becomes more prevalent, and revision adenoidectomy of any residual adenoid tissue is indicated, along with tonsillectomy, as part of the treatment for their sleep-disordered breathing.

Extraesophageal reflux is associated with respiratory mucosa irritation, edema, and increased secretions. Children younger than 2 years who have symptomatic adenoid enlargement requiring adenoidectomy have a considerably higher incidence of GERD. Our study also showed a significantly increased risk of revision adenoidectomy in patients with a diagnosis of GERD at any time either before or after their initial adenoidectomy. However, a diagnosis of GERD prior to the patient’s initial adenoidectomy was not significantly associated with revision adenoidectomy. While reflux may affect adenoid regrowth, it is also possible that patients with GERD have more physician visits and closer follow-up. Therefore, the need for revision surgery is more likely to be identified and suggested. A diagnosis of allergies was not associated with increased risk of revision adenoidectomy, while patients with asthma diagnosed any time before or after their initial adenoidectomy showed a trend toward increased risk, albeit not statistically significant.

The indication for surgery for the initial procedure was a significant factor in predicting risk of later undergoing revision adenoidectomy. Patients with middle ear disease and/or Eustachian tube dysfunction as an indication for adenoidectomy were at greatest risk for revision, even when controlling for age. The high HR in this group may be influenced by the increasing awareness of sleep-disordered breathing in children, which may present after these children outgrow their middle ear disease. Children with symptomatic hypertrophic adenoid tissue have an increased risk of revision compared with children with an infectious indication, such as recurrent adenotonsillitis.

We hypothesized that the level of training and experience of the surgeon would be a risk factor for revision adenoidectomy.
We found that inexperienced surgeons (those with 1 to 2 years of experience) were 50% more likely to have done the initial surgery for patients who required revision; nonetheless, this finding was not statistically significant. It is possible that inexperienced surgeons are more conservative in their removal of adenoid tissue because of concern about possibly damaging nearby structures or because they are less skilled in removing adenoid tissue near the Eustachian tube orifices and in the choanae. Our data indicate that by PGY3, surgeons have no increased risk of revision adenoidectomy compared with chief residents and staff surgeons. The type of surgical technique used in adenoidectomy was not a significant factor leading to revision adenoidectomy.

Limitations of this study include the retrospective nature of the study, and extraction of data from the medical and surgical records may not completely describe the actual clinical picture of this study’s subjects. Indication for surgery was extracted from the surgical dictation and for feasibility purposes was not cross-checked for accuracy with the indication(s) documented in the clinic notes. The medical diagnoses of allergies, asthma, and GERD recorded for this study are only as accurate as the documentation of diagnoses using ICD-9 or HICDA codes for billing. In addition, the surgical technique data point was examined only in a matched case-control subset, but we feel it should be an accurate representation of the entire patient cohort. The documentation of residents involved in the surgical cases was not available prior to 1988; however, the typical pattern of resident involvement in pediatric cases did not differ significantly during those years prior to 1988 compared with the years in which documentation was available. Lastly, as a tertiary care center, some of our patients travel from a distance to receive care. It is possible that some children with symptomatic adenoid regrowth sought follow-up care and possible revision surgery elsewhere, therefore affecting the overall event rate of revision adenoidectomy.

Our findings can be used to counsel parents about the low risk to their child of a future revision adenoidectomy. However, young children (especially younger than 4 years) who have an adenoidectomy in conjunction with tympanostomy tube placement as treatment for recurrent otitis media or Eustachian tube dysfunction are at greatest risk of requiring subsequent revision adenoidectomy. Patients with GERD may also have an increased risk. To help reduce the risk of future revision adenoid surgery, surgical training programs should provide appropriate supervision and teaching of junior residents performing adenoidectomy.

**Author Contributions**

Amy C. Dearking, design, acquisition of data, analysis, interpretation, drafting, revising, approval; Brian D. Lahr, analysis, interpretation, drafting, revising, approval; Admire Kuchena, acquisition of data, analysis, drafting, approval; Laura J. Orvidas, conception, design, acquisition of data, analysis, interpretation, revising, approval.

**Disclosures**

Competing interests: None.

Sponsorships: None.

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**References**


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**Table 3. Effect of Surgical Technique on Revision Cases and Matched Controls**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Revision-Free, No. (%) (n = 163)</th>
<th>Revision, No. (%) (n = 163)</th>
<th>Stratified Cox PH Regression</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curette/adenotome</td>
<td>56 (34.4)</td>
<td>51 (31.3)</td>
<td>1.00 (reference)</td>
<td>.53b</td>
</tr>
<tr>
<td>Electrocautery</td>
<td>97 (59.5)</td>
<td>99 (60.7)</td>
<td>1.39 (0.66-2.91)</td>
<td>.28</td>
</tr>
<tr>
<td>Coblaster/microdebrider</td>
<td>10 (6.1)</td>
<td>13 (8.0)</td>
<td>1.91 (0.59-6.16)</td>
<td>.39</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; HR, hazard ratio; PH, proportional hazards.

*Values are number (percentage) or HR (95% CI) unless indicated otherwise.

*By the Wald χ² test.

