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journal homepage: [www.elsevier.com/locate/ijporl](http://www.elsevier.com/locate/ijporl)Outcomes of adenoidectomy-alone in patients less than 3-years old<sup>☆</sup>Kishan M. Thadikonda<sup>a</sup>, Amber D. Shaffer<sup>b</sup>, Amanda L. Stapleton<sup>b,\*</sup><sup>a</sup> University of Pittsburgh School of Medicine, 3550 Terrace St, Pittsburgh, PA 15213, USA<sup>b</sup> Division of Pediatric Otolaryngology, 4401 Penn Ave, Children's Hospital of Pittsburgh of UPMC, 7th Floor Faculty Pavilion, Pittsburgh, PA 15224, USA

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## ABSTRACT

**Objectives:** 1. Determine the percentage of patients under the age of 3 undergoing adenoidectomy-alone who require subsequent management of residual sleep disordered breathing (SDB). 2. Characterize complications following adenoidectomy and determine if any perioperative factors are associated with intra-operative or post-operative complications and outcomes.

**Methods:** Case series with chart review was conducted including children seen at a tertiary care children's hospital between 2008 and 2012. Consecutive patients under the age of 3 who underwent adenoidectomy-alone were identified by billing codes. After excluding those with syndromes, partial adenoidectomies, and those without follow-up, 148 patients were included. Predictors of requiring additional surgery for SDB were evaluated using log-rank tests or Cox proportional hazards regression.

**Results:** Median age at time of initial adenoidectomy was 27.5 months (range 11–36 months) and the patient population was comprised of 66.2% males (n = 98/148) and 89.2% Caucasians (n = 132/148). 56.5% (n = 74/131) of patients continued to have residual symptoms of SDB and 34.5% (n = 51/148) underwent additional surgical intervention. Multivariable survival analysis revealed GERD (HR, 6.21; CI, 1.29–29.77, p = .022) and tonsil size (HR, 4.07; CI, 1.57–10.51, p = .004) were significant predictors of additional surgery in this group of patients under the age of 3. There was no observed difference in intra- and post-operative complication rates between patients with and without additional operative intervention.

**Conclusions:** Residual SDB symptoms following adenoidectomy in patients less than 3 years of age are common and require additional surgery at a high rate. Medical comorbidities such as GERD and large tonsil size may help predict the need for additional surgery.

## 1. Introduction

Sleep disordered breathing (SDB) represents a growing problem in the pediatric population. This trend is reflected by a six-fold increase in the incidence of SDB as an indication for adenotonsillectomy relative to other indications over 35 years [1]. Current practice guidelines from the American Academy of Otolaryngology - Head and Neck Surgery (AAO-HNS) support tonsillectomy as treatment for SDB, but there is significant morbidity associated with the procedure, particularly in younger children [2,3]. Furthermore, a recent Cochrane review indicated that the effectiveness of an adenotonsillectomy (T&A) for SDB in patients under the age of 5 is unclear [4]. As a result, adenoidectomy-alone is being offered for younger children given the decreased risk profile and potential for relief of troubling obstructive symptoms [5]. Unfortunately it has been shown that residual symptoms and subsequent procedures, such as tonsillectomy or tonsillectomy with revision adenoidectomy, are not uncommon following adenoidectomy. The

rate of additional surgery has been reported as high as 21%. These studies also demonstrated that revision rates might be even higher in younger children (age < 3 years) [6–9]. Despite identification of this trend, relatively little literature exists focusing exclusively on very young children undergoing adenoidectomy with respect to residual symptoms, rate of additional surgery, and perioperative factors which may predict their response to treatment.

The goal of this study was to obtain a clear characterization of pediatric patients less than 3 years of age undergoing adenoidectomy-alone and their post-operative course. This data will help provide physicians with a road map for determining appropriate surgical interventions for this patient population. In addition, this information will be useful to the practicing surgeon when counseling patients' families about the effectiveness of adenoidectomy-alone and potential need for future interventions.

Therefore, we performed a retrospective cohort study of children (up to 36 months of age) undergoing adenoidectomy-alone for chronic

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infection, sleep disordered breathing, or both. The objective of this study was to investigate the effectiveness and morbidity of adenoidectomy-alone in children younger than 3 years of age and identify risk factors for subsequent surgery.

## 2. Material and methods

### 2.1. Study population

Approval of the University of Pittsburgh Institutional Review Board was obtained prior to initiation of this study. A retrospective analysis was performed reviewing the medical records of patients undergoing adenoidectomy only at Children's Hospital of Pittsburgh between the years of 2008–2012. Subjects under the age of 3 were identified via CPT (42830) and ICD9 (28.6) diagnosis codes for adenoidectomy as a solitary procedure. Exclusion criteria consisted of patients who 1) were syndromic, 2) required partial adenoidectomies, or 3) did not attend at least one follow up appointment. Patients with inadequate medical records were also excluded from the study.

### 2.2. Data collection

All data were collected from review of electronic medical records. Presenting symptoms and demographic data including age, race, weight, height, tonsil size, and comorbid conditions were obtained from the initial evaluation by an otolaryngologist. Chronic and recurrent sinusitis were diagnosed based on established criteria [10,11]. Sleep disordered breathing was defined as parental report of persistent snoring, gasping, or pausing of breathing at night or polysomnography (PSG) reporting obstructive sleep apnea. Gastro esophageal reflux disease (GERD) was diagnosed based on symptoms and physical exam findings. Symptoms included vomiting, poor weight gain, dysphagia, abdominal or substernal/retrosternal pain, and esophagitis. GERD was also diagnosed based on the presence of chronic cough, reflux, throat pain, or vomiting in the absence of other causes. No invasive pH probe or impedance monitoring was performed due to the young age of this cohort. Those with signs and symptoms of GERD were treated with an empiric trial of acid-suppression therapy for 4 weeks (histamine-2 receptor antagonist and proton pump inhibitors) as well as dietary modifications. If symptoms improved, acid-suppression management was continued.

The operative report from the initial adenoidectomy was reviewed for surgical indication (recurrent otitis media, recurrent upper respiratory infections, sleep disordered breathing, or a combination), operative technique, and intraoperative findings (adenoid size, tonsil size, and purulent secretions). Adenoid size was assessed in the operating room via indirect visualization with a mirror prior to resection and quantified as percent nasal obstruction. Anesthesia records and the adenoidectomy operative report were reviewed in combination to determine any complications during the intraoperative or immediate post-operative period. Patients were followed from the time of the procedure until the most recent follow up appointment with Otolaryngology. Parent reported residual or resolved symptoms were obtained from the review of systems questionnaire provided at each visit. Any complications, emergency department visits, readmissions, or revision operations related to the original adenoidectomy were recorded. If the patient had additional surgery for persistent symptoms, their clinical course following the operation was recorded. Of note, PSG data was collected when available. However, they were not routinely used in the pre- or post-operative evaluation.

### 2.3. Data analysis

The retrospective cohort was initially analyzed to determine the proportion of patients with residual symptoms following initial adenoidectomy, the rate of additional surgery (revision adenoidectomy,

tonsillectomy, or tonsillectomy and revision adenoidectomy), and the proportion of patients with residual SDB symptoms following additional surgery.

Patients were then divided into two groups, those who received additional surgery (T&A, revision adenoidectomy, or tonsillectomy) for residual symptoms after their initial adenoidectomy and those who did not have any further operative management. In order to address the variability in duration of follow up following initial adenoidectomy, the impact of each independent variable on time to revision was assessed using Cox proportional hazard regression for continuous variables or log-rank test for categorical variables. Predictor variables were then included in the final multivariable survival analysis via Cox proportional hazard regression if they were significant individually ( $p$  value  $< .05$ ). Additionally, differences in the time from initial adenoidectomy to additional surgery between the different additional surgery types (T&A, revision adenoidectomy, or tonsillectomy) was evaluated using a Kruskal-Wallis test. All statistical analyses were performed using Stata/SE 13.1 (StataCorp, College Station, TX).

## 3. Results

We identified 148 patients who met our inclusion and exclusion criteria with a median follow up of 25 months (range = 0–94 months). Baseline characteristics of patients included in the study are summarized in Table 1. The median age at time of adenoidectomy was 27.5 months (range = 11–36 months) and the patient population was comprised of 66.2% males ( $n = 98/148$ ) and 89.2% Caucasians ( $n = 132/148$ ). Median percentile for weight was 71% (range 1.25–100%). Since 32.4% ( $n = 48/148$ ) of patients were younger than 24 months, body mass index was not reported. Isolated SDB was the indication for initial adenoidectomy in 17.6% of patients ( $n = 26/148$ ). Recurrent infections (otitis media or upper respiratory tract infections) were the primary indication in 18.9% patients ( $n = 28/148$ ). 63.5% patients presented

**Table 1**  
Patient baseline characteristics.

	No. (%) of Patients	N
Baseline Characteristics		
Age, median (range), mo	27.5 (11–36)	148
Weight %, median (range)	71 (1.25–100)	148
Height %, median (range)	56 (0.67–100)	148
Male	98 (66.2)	148
Female	50 (33.8)	148
Tonsil Size, mean $\pm$ standard deviation	2.3 $\pm$ 0.8	45
Adenoid Size %, median (range)	80 (30–100)	129
Race		
White	132 (89.2)	148
Black	15 (10.1)	148
Other	1 (0.7)	148
Presenting Symptoms		
Nasal Obstruction	130 (87.8)	148
Chronic/Recurrent Sinusitis	40 (27.4)	146
Chronic Nasal Congestion	101 (68.2)	148
Comorbidities		
Allergic Rhinitis	12 (8.1)	148
Asthma	17 (11.5)	148
Prematurity	19 (12.8)	148
GERD	40 (27.0)	148
Dysphagia	14 (9.5)	148
Indication		
Isolated Infectious	28 (18.9)	148
Infectious + SDB	94 (63.5)	148
Isolated SDB	26 (17.6)	148
Polysomnogram before Adenoidectomy		
AHI	4.6, 7.1	2
OAH1	1.3, 1.4	2

GERD = Gastroesophageal Reflux Disease.

(O)AHI = (Obstructive) Apnea Hypopnea Index.

SDB = Sleep Disordered Breathing.

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