Original Article



# Factors associated with paediatric revision adenoidectomy: the Flinders experience

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**Background:** Adenoidectomy is performed to treat obstructive and/or infective conditions. Adenoid regrowth following adenoidectomy may cause recurrence of symptoms. This study investigated the revision rate and risk factors associated with symptomatic paediatric patients requiring revision adenoidectomy in our institution.

**Methods:** A retrospective study of 1,359 paediatric patients who had an adenoidectomy with or without concurrent otolaryngology surgery at Flinders Medical Centre between 2007 and 2017 was conducted. Patients were identified through the hospital operating room management information system. Case notes were reviewed to identify patient and surgical factors. Univariate analysis was performed using relative risk to determine risk factors of revision adenoidectomy.

**Results:** Fifty-seven patients required revision adenoidectomy, with two of these patients requiring an additional secondary revision (i.e., patient's third surgery overall). This resulted in 59 cases of revision adenoidectomy overall (revision rate =4.3%; 59/1,359). The median time between primary and revision surgery was 21 months (range, 4–96 months). Younger patients ≤6 years (RR =2.99; 95% CI, 1.29–6.90) and patients with otitis media with effusion (RR =6.83; 95% CI, 3.57–13.07) were more likely to undergo revision surgery. Concurrent tonsillectomy was associated with fewer revision surgeries (RR =0.33; 95% CI, 0.20–0.55). Gender, obstructive indications, recurrent upper airway infection, concurrent nasal surgery, surgical technique, surgeon grade and adenoid size were not significantly related to risk of revision.

**Conclusions:** Young age and otitis media with effusion requiring myringotomy with or without ventilation tube insertion was associated with increased risk of revision adenoidectomy.

**Keywords:** Adenoids; adenoid regrowth; risk factors; reoperation; otolaryngology; child

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## Introduction

Adenoidectomy is a commonly performed paediatric otorhinolaryngological procedure (1,2). Indications for adenoidectomy include adenoid hypertrophy causing upper airway obstruction, recurrent upper airway infections, or chronic otitis media (2-4). Adenoidectomy can be performed alone, but is often done in conjunction with other procedures such as tonsillectomy and myringotomy to insert ventilation tubes or grommets (3). In addition to conventional curettage, a variety of techniques including electrocautery, microdebrider, and coblation have been used to perform adenoidectomies (5,6).

Adenoid regrowth is a recognised phenomenon that

contributes to the recurrence of symptoms following initial surgery (3). Estimated risk of symptomatic regrowth requiring revision adenoidectomy is generally reported between 0.5% to 3%, with a recent meta-analysis of 16 studies estimating a revision rate of 1.9% (1-4,7-11). This figure is unlikely to be an accurate representation of true adenoid regrowth proportions, as many patients remain asymptomatic despite the presence of adenoidal tissue post-surgery (4). A study from Taiwan found that male gender, young age (age ≤3 years), and concurrent ventilation tube insertions were factors associated with an increased risk of revision adenoidectomy (3). Other studies have also found that contributing factors for adenoid regrowth include younger age at initial surgery and possibly gastroesophageal reflux disease (1,3,4,7,12). The recent meta-analysis investigated risk factors of revision adenoidectomy including hospital setting, country, age at surgery, and surgical technique. Despite the growing body of evidence, they determined there is a lack of consistent evidence regarding these factors (11). There is also no existing Australian study on the rates and risk factors of revision adenoidectomy.

The aim of this study is to identify the paediatric revision adenoidectomy rate at Flinders Medical Centre (FMC), a tertiary public hospital in South Australia, and to identify factors associated with revision surgery. We present the following article in accordance with the STROBE reporting checklist (available at http://dx.doi.org/10.21037/ajo.2020.04.03).

## Methods

This is a retrospective cohort study of all paediatric patients undergoing an adenoidectomy between 2007 and 2017 at Flinders Medical Centre (FMC).

The study was approved by the Flinders Medical Centre human research ethics committee (HREC/17/SAC/249).

The operating room management information system (ORMIS) database is used to prospectively record all operative procedures at FMC. ORMIS is a surgical software package used to schedule and document operative details in real-time of all patients undergoing surgery in all South Australian public hospitals. ORMIS was searched using the terms "adenoidectomy" and "adeno" to identify all patients undergoing adenoidectomy during the study period.

The inclusion criteria were all paediatric patients that underwent adenoidectomy. Revision surgery was defined as patients with the same name and patient identification number undergoing adenoidectomy more than once during the study period. Patients who had their primary adenoidectomy at another institution or were older than 18 years were excluded from the study.

Demographic data including age, gender and operative details were recorded from the operation note. Data including adenoid size as reported by the surgeon following a mirror nasopharyngeal examination as small, moderate, large, or massive (corresponding to ≤25%, 26–50%, 51–75%, 76–100% volume filling the nasopharynx) (13); indication (obstructive *vs.* infective); technique (electrocautery, coblation, curettage); concurrent surgery (tonsillectomy, myringotomy with or without ventilation tube insertion, nasal surgery); and surgeon grade (consultant, fellow, registrar, resident medical officer of PGY2+ not in specialised surgical training) were recorded. The patients' age was grouped into toddler [0–3], preschool [3–6], school [6–12], adolescents [12–18].

Microsoft Excel was used for descriptive statistical analyses. The dataset was coded then exported to IBM SPSS Statistics Version 22 for statistical analysis. Data distribution was assessed for normality. Continuous data was presented as median with range (minimum–maximum) whilst categorical data was expressed using numbers and percentages. Incidences of variables were calculated. Univariate analysis was performed through the calculation of relative risk to identify factors associated with revision adenoidectomy.

## Results

A total of 1,365 patients were identified. Six patients were excluded as the case notes were not available, resulting in 1,359 patients included in the analysis. There were 59 cases of revision surgery, with two of these being a second revision (i.e., patient's third surgery overall). Therefore, the overall rate of revision adenoidectomy at our institution was 4.3% (59/1,359).

### *Patient demographics*

The incidence of patient and surgical factors identified during the study period are summarised in *Table 1*. The median age at time of any surgery, including all primary adenoidectomies and revision adenoidectomies, was 4 years (range, 0–17 years). A large majority of adenoidectomies were performed on patients aged ≤6 years, with most performed in the toddler 0–3-year age group (37.6%), followed by the preschool 3–6-year age group (36.4%). There were 1.3 times

**Table 1** A summary of the rate of patient and surgical factors identified during the study

| Factors | Total N, (%) [n=1,359] | Revision N, (%) [n=57][@] |
|---|---|---|
| Age group | | |
| ≤6 years | 1,006 (74.0) | 51 (89.5) |
| >6 years | 353 (26.0) | 6 (10.5) |
| Gender | | |
| Male | 763 (56.1) | 36 (63.2) |
| Female | 596 (43.9) | 21 (36.8) |
| Indication* | | |
| SDB | 808 (59.5) | 27 (47.4) |
| Infective (adenoiditis) | 401 (29.5) | 10 (17.5) |
| OME | 516 (38.0) | 46 (80.7) |
| Rhinosinusitis | 11 (0.8) | 1 (1.8) |
| Concurrent surgery^ | | |
| None | 45 (3.3) | 2 (3.5) |
| Tonsillectomy | 1,048 (77.1) | 30 (52.6) |
| Myringotomy[#] | 508 (37.4) | 47 (82.5) |
| Nasal surgery | 89 (6.6) | 4 (7.0) |
| Surgical technique | | |
| Curettage | 454 (33.4) | 20 (35.1) |
| Electrocautery | 827 (60.9) | 35 (61.4) |
| Coblation | 47 (3.4) | 1 (1.8) |
| Not specified | 31 (2.3) | 1 (1.8) |
| Surgeon experience | | |
| RMO | 13 (0.9) | 1 (1.8) |
| Registrar | 1,037 (76.3) | 40 (70.2) |
| Fellow | 69 (5.1) | 4 (7.0) |
| Consultant | 240 (17.7) | 12 (21.1) |
| Adenoid size | | |
| Small | 183 (13.5) | 6 (10.5) |
| Moderate | 497 (36.6) | 20 (35.1) |
| Large | 536 (39.4) | 26 (45.6) |
| Not specified | 143 (10.5) | 5 (8.8) |

*, total does not equal n due to patients presenting with multiple indications; ^, total does not equal n due to patients undergoing multiple concurrent surgeries; [#], refers to myringotomy with or without ventilation tube insertion; [@], total 'Revision N' includes all 57 patients requiring revision adenoidectomy, but excludes the two further cases of secondary revision adenoidectomy. SDB, sleep disordered breathing; OME, otitis media with effusion; RMO, resident medical officer (PGY2+, not in specialised surgical training).

**Table 2** A summary of the risk factors associated with revision adenoidectomy

| Factors | Variable | N* | Relative risk [RR] for revision (95% CI) |
|---|---|---|---|
| Age | ≤6 *vs.* >6 years | 1,359 | 2.99 (1.29–6.90) |
| Gender | Male *vs.* female | 1,359 | 1.33 (0.78–2.25) |
| Surgeon experience | Consultant/fellow *vs.* registrar/RMO | 1,359 | 0.76 (0.43–1.34) |
| | RMO *vs.* registrar/fellow/consultant | 1,359 | 1.86 (0.28–12.42) |
| Surgical indication | Infective (adenoiditis) | 1,359 | 0.51 (0.26–1.00) |
| | OME | 1,359 | 6.83 (3.57–13.07) |
| | Rhinosinusitis | 1,359 | 2.19 (0.33–14.43) |
| | SDB | 1,359 | 0.61 (0.37–1.02) |
| Concurrent surgeries | Tonsillectomy | 1,359 | 0.33 (0.20–0.55) |
| | Myringotomy[#] | 1,359 | 7.87 (4.01–15.44) |
| | Nasal surgery | 1,359 | 1.08 (0.40–2.91) |
| Surgical technique | Electrocautery/coblation *vs.* curettage | 1,328 | 0.94 (0.55–1.60) |
| Adenoid size | Small/moderate *vs.* large | 1,216 | 0.79 (0.46–1.34) |
| | Small *vs.* moderate/large | 1,216 | 0.74 (0.32–1.70) |

[#], refers to myringotomy with or without ventilation tube insertion; *, variance in N due to exclusion of "not specified" variables from RR calculation. RMO, resident medical officer (PGY2+, not in specialised surgical training); OME, otitis media with effusion; SDB, sleep disordered breathing.

as many male patients as female patients.

### *Surgical factors*

The most common indication for adenoidectomy was sleep disordered breathing (59.5%). Majority of patients had a concurrent tonsillectomy (77.1%), followed by concurrent myringotomy with or without ventilation tube insertion (37.4%). Electrocautery was the technique most utilised (60.9%), and registrars performed most of the procedures (76.3%). Adenoid size at surgery ranged from large being the most common (39.4%) and small being the least common (13.5%), with the size not specified in 10.5% of cases.

### *Time to revision adenoidectomy*

The median time to first revision was 21 months (n=57; range, 4–96 months) overall. When comparing age groups, patients aged 0–3 years had the longest median time of 36 months (n=35; range, 4–96 months) to first revision surgery compared to the 3–6 year age group with 19 months (n=16; range, 4–58 months), the 6–12 age group with 14 months (n=4; range, 10–38 months), and the 12–18 age group with 15 months (n=2). For the two patients requiring secondary revision surgery, there was a median period of 23 months (n=2; range, 11–35 months) between second and third surgeries.

### *Association between patient demographics and revision adenoidectomy*

The median age of the 57 patients requiring revision adenoidectomy was 3 years (range, 1–13 years) at the time of primary surgery. Most patients (61.4%) undergoing revision were between 0-3 years at initial surgery, followed by 3–6 years (28.1%). Younger aged patients (≤6 years) were more likely to undergo revision surgery, as shown in *Table 2* (RR =2.99; 95% CI, 1.29–6.90). A larger proportion of male patients required revision surgery in comparison to females (63.2% *vs.* 36.8%). However, gender was not significantly associated with requiring revision surgery (RR =1.33; 95% CI, 0.78–2.25).

### *Association between surgical factors and revision adenoidectomy*

Patients that underwent revision surgery were more

likely to have otitis media with effusion as an indication at the time of their primary surgery (RR =6.83; 95% CI, 3.57–13.07). In comparison, an initial indication of sleep disordered breathing was not statistically associated with revision surgery (RR =0.61; 95% CI, 0.37–1.02). *Table 2* demonstrates the association of the remaining surgical indications with risk of revision, none of which were statistically significant.

Majority of patients (82.5%) requiring revision surgery had concurrent myringotomy with or without ventilation tube insertion for otitis media with effusion during primary adenoidectomy and this association was statistically significant (RR =7.87; 95% CI, 4.01–15.44). In comparison, 52.6% had concurrent tonsillectomy, with a significant negative association with rates of revision (RR =0.33; 95% CI, 0.20–0.55). The association between concurrent nasal surgery and rates of revision adenoidectomy were not statistically significant (RR =1.08; 95% CI, 0.40–2.91).

The association between surgical technique, surgeon experience and adenoid size were analysed but found not to be statistically significant in their relation to revision surgery, as shown in *Table 2*. However, it was of note that 13 of the 59 revision cases documented findings of only residual small adenoids at the time of revision adenoidectomy which was performed with other concurrent surgery (i.e., tonsillectomy and/or grommet insertion) for indications of either otitis media or sleep disordered breathing.

## Discussion

The aim of this study was to identify patient and surgical related factors associated with revision adenoidectomy within the paediatric population, and to compare the rates of revision in an Australian tertiary public hospital to the published rates in other countries.

The rate of paediatric revision adenoidectomy found at our institution during the ten-year study period was 4.3%. We identified two cases requiring a second revision adenoidectomy. We also identified that 13 of these 59 revision cases involved removal of only small residual adenoids in adjunct to tonsillectomy and/or grommet insertion due to symptoms of otitis media or sleep disordered breathing. Our revision rate was slightly higher than that generally reported (0.5% to 3%) from other single hospital-based studies (1,2,4,7,10). However, a population-based study from Germany found a 9% re-adenoidectomy rate because of recurrent symptoms (12). The most recent published data was a meta-analysis from Taiwan by Lee *et al.* which showed a revision rate of 1.9% (11). The discrepancy between our revision rate compared to those overseas is likely be multi-factorial including a different variation in our patient population, as well as our smaller study sample size, given that the recent meta-analysis is indicative of smaller sized studies reporting higher rates of revision (11).

Our study analysed for factors associated with increased risk of symptomatic regrowth requiring revision adenoidectomy. Our results showed the median time to developing symptoms resulting in revision adenoidectomy is 21 months from the initial surgery. Our results also demonstrated that younger age (≤6 years) patients at their initial surgery had an almost three-fold increased risk of revision adenoidectomy. Young age at initial adenoidectomy is an established risk factor of revision adenoidectomy (1,3,7,12,14). Duval *et al.* and Lesinskas *et al.* found that patients ≤5 years of age at initial surgery were at increased risk of revision adenoidectomy, whilst Lee *et al.* and Thomas *et al.* found an increased risk in patients ≤3 years (1,3,12,14). Proposed reasons for younger aged children being more prone to revision adenoidectomy include both physiological and surgical factors. Firstly, adenoid growth continues until the age of five due to the high level of immune activity in younger patients (7,14,15). This could potentially result in any residual lymphoid tissue in the nasopharynx becoming hypertrophic from exposure to upper respiratory tract infections in young children over several years after the primary surgery. There may also be a higher chance of residual tissue remaining due to a conservative surgical approach being taken to prevent injury of the smaller paediatric nasopharynx in the younger aged child (7). Two patients in our study, aged 1 and 6, were identified as having a shorter than expected period of 4 months between primary and revision surgery. Several factors may have influenced this; however both patients were noted to have concurrent surgery during their primary or revision adenoidectomy. The first patient initially had an adenoidectomy for sleep disordered breathing, and underwent tonsillectomy with concurrent removal of small residual adenoids for the second procedure. The second patient had adenoidectomy with concurrent bilateral grommet insertion for otitis media with effusion at primary surgery followed by adenotonsillectomy for sleep disordered breathing (with revision adenoid surgery). The short duration between primary and revision surgery in these two patients may have therefore been due to the adenoidectomy being performed as an adjunctive procedure, rather than being the primary

reason for surgery. For example, the predominant issue at revision surgery may have been tonsillar hypertrophy causing obstructive symptoms, but revision adenoidectomy would be done as a concurrent procedure to remove any residual "small" adenoid tissue from their initial adjunctive surgery with grommet insertion. The protocol at our institution is for children undergoing tonsillectomy to be two years or older. Both cases were children who underwent adenotonsillectomy only after they had fulfilled our hospital's protocol.

Analysis of risk factors in our study found that the initial indication for surgery was a significant risk factor in patients undergoing revision adenoidectomy. Our local practice is to offer and perform adjuvant adenoidectomy with patients requiring reinsertion of ventilation tubes with the aim to reduce the likelihood of additional operations (16). In our study, the most common indication at initial surgery found to increase the risk of requiring revision adenoidectomy were for patients with otitis media with effusion (RR =6.83; 95% CI, 3.57–13.07). The risk of revision adenoidectomy was found to be 7.87 times (95% CI, 4.01–15.44) greater in patients that had concurrent myringotomy (with or without ventilation tube insertion during primary surgery) compared to patients that did not. The positive association found between these two factors is supported by previous studies (6-8,10). There are several potential reasons for this finding. Ventilation tube insertion for otitis media is common in young children, therefore our results showing young age of the patient at the time of initial adenoidectomy as a risk factor for adenoid regrowth may explain the association. Furthermore, it is hypothesised from the literature that the development of otitis media with effusion is largely a result of inflammatory processes and adenoidal bacterial biofilms rather than actual anatomical obstruction of the Eustachian tube outlet by the adenoid (15). Children who present with otitis media with effusion may initially have undergone adenoidectomy predominantly as an adjunct to assist in the treatment of middle ear disease (7,17-19). However, if there was incomplete clearance of the bacterial colonisation following the concurrent procedures, there is the potential for persistent infection and inflammation of the middle ear to occur and cause a recurrence of symptoms. A potential confounder of the association with otitis media may be due to guidelines by the AAO-HNS recommending the consideration of adenoidectomy in conjunction with grommet insertion to reduce subsequent need for grommet surgery in children presenting with otitis media with effusion (20). These guidelines would influence the rates of adenoidectomy being performed because what may be recorded as a revision adenoidectomy may have only been performed as an adjunct to grommet insertion (21,22).

In our study, concurrent tonsillectomy during primary adenoidectomy demonstrated a statistically significant decreased association with risk of revision surgery (RR = 0.33; 95% CI, 0.20–0.55). This result was also demonstrated in previous studies, and was postulated to be due to differences in visualisation and access of surgical field during adenoidectomy alone compared to adenotonsillectomy (1,23). This could lead to incomplete removal of adenoid tissue at the time of surgery as the patient was a younger age and the indication for initial adenoidectomy was not due to obstructive symptoms.

Most of the surgeries were done by surgical trainees ("registrars") and we speculated that less experienced surgeons were more likely to be more conservative in their surgical removal of adenoid tissue. However, this was not statistically significant, potentially due to confounding factors previously mentioned such as the retrospective nature of the study, as well as the majority of our surgeries being performed by registrars and therefore making the sample size of other experience levels too small for statistical significance. The impact of surgical technique on rates of revision surgery was also not significant, and this is supported by studies from Lee *et al.*, Dearking *et al.* and Sapthavee *et al.* (4,7,11). Other studies found microdebrider use during adenoidectomy was associated with an increased risk in revision surgery, however this technique was not used in our study (6,24). We investigated a number of additional factors but they did not reach statistical significance (gender; surgical indications such as sleep disordered breathing, chronic adenoiditis and rhinosinusitis; concurrent nasal surgery; surgeon grade; and adenoid size at primary surgery), which is consistent with various previous studies (1,3,7).

This is the first Australian study that investigates rates and factors associated with revision adenoidectomy. The strengths of the study include the long study period of ten years at a public tertiary teaching hospital where paediatric adenoidectomy cases are performed and surgeons of varying expertise were analysed, as well as a range of surgical techniques. Our findings could be used to inform parents about the risk of requiring future revision adenoidectomy especially in patients of younger age requiring adenoidectomy with grommet insertion. The follow-up process for children post-adenoidectomy at Flinders Medical Centre involves a 6-week post-operative follow-up in clinic to assess progress. Children who

undergo adenotonsillectomy for sleep disordered breathing are often discharged back to GP and reviewed in the ENT clinic if the GP refers back for persistent symptoms. Children with OME are more likely to be under review due to the presence of grommets, therefore possibly resulting in a higher incidence of revision adenoids in children with OME compared to sleep disordered breathing.

Limitations of this study were the retrospective nature, inconsistent documentation, missing case note or operative note data, lack of a standardised method for reporting adenoid size, and patients who may have had revision surgery in private hospitals. In this study, revision surgery was identified when a patient had more than one encounter involving adenoidectomy during the study period. This definition of revision adenoidectomy meant that patients who had either a primary or revision surgery at another institution were excluded from our data analysis, and therefore is a key limitation to the study. Another limitation to the study is the subjectiveness of the adenoid grading system used. Due to the lack of a universal grading tool for adenoids, the use of descriptive terms to describe the size of the adenoid tissue in relation to its surrounding structures following visual examination with or without equipment (i.e., palpation, mirror or nasendoscopy) remains highly subjective (13). The introduction of a standardised paediatric operative template for adenoidectomy would potentially be useful for future audits and research. Various confounders were also identified such as adenoidectomy being performed as adjunct to other procedures rather than being the only surgery, including the removal of small residual adenoids in conjunction to concurrent surgery at the time of revision. The scope of the study was limited because the impact of patient co-morbidities and antibiotic prescription following adenoidectomy were not studied. It was also beyond the scope of this study to investigate the proportion of patients who had adenoid tissue regrowth following primary surgery, however remained asymptomatic and therefore did not require revision surgery. In the future, better documentation is required, particularly regarding surgical indications, surgical technique and adenoid size. There would also be benefit in further research into the association between middle ear disease and increased risk of revision adenoidectomy.

## Conclusions

The revision rate of paediatric adenoidectomy at Flinders Medical Centre over a 10-year period was 4.3%. Factors that increased risk included age ≤6 years old at primary surgery, and an indication of otitis media with effusion requiring concurrent myringotomy (with or without ventilation tube insertion). In contrast, concurrent tonsillectomy was associated with lower rates of revision adenoidectomy. These results may assist clinicians with parental consent, as well as stratifying appropriate follow-up for patients at increased risk.

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## Footnote

*Reporting Checklist:* The authors have completed the STROBE reporting checklist. Available at http://dx.doi.org/10.21037/ajo.2020.04.03

*Conflicts of Interest:* All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/ajo.2020.04.03). EHO serves as an unpaid editorial board member of *Australian Journal of Otolaryngology*. Dr. Ooi reports personal fees from Medtronic, outside the submitted work. The other authors declare no conflicts of interest.

*Ethical Statement*: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Flinders Medical Centre human research ethics committee (HREC/17/SAC/249), and informed consent was waived due to its retrospective nature.



 

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