# Improvement in Snoring and Sleep Apnea after Adenotonsillectomy in Children of 3 to 10 years of age

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## Abstract

**Background:** Variability is found about the severity of upper airway obstruction ranging from primary snoring to obstructive sleep apnea syndrome (OSAS). Adenotonsillectomy (AT) is taken as the primary treatment option.
**Objective:** To evaluate the efficacy of adenotonsillectomy among children having obstructive sleep apnea syndrome.
**Methodology**: This was a cross-sectional study conducted at Bahawal Victoria Hospital Bahawalpur from January 2017 to January 2018. A total of 52 children of both genders, aged 3 to 10 years, having obstructive sleep apnea syndrome (OSAS) and selected for Adenotonsillectomy (AT) were enrolled. Adenotonsillectomy was performed in all the study participants employing general anesthesia. Preoperative and postoperative characteristics as well as respiratory and sleep parameters were compared adopting chi-square test for qualitative variables while t-test was employed for quantitative variables. Data was entered and analyzed by SPSS 20.
**Results:** Out of a total of 52 children, 32 (61.5%) were male. The majority of the children, 27 (51.9%) were between 3-6 years of age. Statistically significant improvement (p-value < 0.05) was noted at the postoperative interval following AT for obstructive AHI score, respiratory disturbance index, obstructive apnea and hypopnea index, SpO2 nadir, TSpO2<90%, and respiratory arousal index. Obstructive AHI score < 1 episode / hour was seen in 37 (71.2%) children while AHI score < 5 episodes / hour were noted in 47 (90.4%).
**Conclusion:** Adenotonsillectomy for obstructive sleep apnea syndrome improved quality of life and polysomnographic parameters in most of the children.
**Keywords**: Adenotonsillectomy, Obstructive sleep apnea syndrome, Obstructive apnea index, Respiratory disturbance index.

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## Introduction

Upper airway obstruction is considered to be a frequent disorder among children with a documented prevalence of 3-15%.[1,2] Variability is found about the severity of upper airway obstruction ranging from primary snoring to obstructive sleep apnea syndrome (OSAS). OSAS is noted to be the most major sleep disorder related to breathing and has been seen to affect 2 to 3% of children.[3-6] OSAS is described as recurrent episodes of raised upper airway resistance with semi or complete intermittent blockage of the upper airway while sleeping and is normally accompanied by snoring, episodic oxyhemoglobin desaturation, hypercapnia, and recurrent arousal.[3,7] OSAS has been shown to be linked with long-lasting cardiovascular, neuro-behavioral, and somatic growth implications.[8-10]
Adenotonsillectomy (AT) is taken as the primary treatment option for dealing with OSAS and several studies highlighted the benefits of AT in reducing or even reversing the symptoms linked with OSAS.[11,12] Annually, more than 500,000 ATs are being done in the United States only.[13,14] Learning, as well as factors related to behavior of children with OSAS following AT, have been documented in several studies.[15]
The Childhood Adenotonsillectomy Trial (CHAT), which was aimed to assess the efficacy of early AT in comparison to watchful waiting along with supportive management. After 7 months, cognitive, behavioral, and sleep factors were analyzed in children having OSAS.[16] In CHAT Trail,[16] AT was not found to enhance attention or executive functions in comparison to wait and manage strategy but AT was shown to minimize symptoms of OSAS while improving behavioral factors, quality of life, and polysomnographic (PSG) findings.
In Pakistan, AT is adopted frequently but not much work is on record to assess the efficacy in OSAS among children so this study was aimed to evaluate the efficacy of adenotonsillectomy among children

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having Obstructive Sleep Apnea Syndrome. The findings of our study were aimed to provide useful data regarding the use AT among children having OSAS.

## Methodology

This was a cross-sectional study conducted at Bahawal Victoria Hospital Bahawalpur from January 2017 to January 2018. A total of 52 children of both genders, aged 3 to 10 years, having Obstructive Sleep Apnea Syndrome and selected for Adenotosillectomy, were enrolled. OSAS was diagnosed based on snoring as well as adenotonsillar hypertrophy employing physical examination. All children having recurrent adenotonsillitis, not having snoring, history of repeated surgical procedures, genetic disorders, Down syndrome, children having low oxygen saturation in pre-procedure findings, or needing respiratory support before the operation were not enrolled. Approval from the Institute's Ethical Committee was sought for this study while informed consent was taken from parents or guardians of all the study participants. Adenotonsillectomy was performed in all the study participants employing general anesthesia. Tonsillar tissue was eradicated using dissection or adopting guillotine methods and hemostasis was achieved with bipolar electrocautery. Adenoid tissue was removed with a microresecting instrument employing endoscopy.

Demographical data like gender, age, height, weight, and medical history were recorded. The extent of adenotonsillar hypertrophy was evaluated using an endoscope by senior otolaryngology clinicians (experience > 5 years), 1 week prior to surgery. Tonsil size was graded as 1 when tonsils were lying lateral to the tonsillar fauces, 2 when at the level of fauces, 3 when medial to the fuces but not to the midline, and 4 when touching at the midline. The adenoid obstruction was labeled as grade 1 as no or minimal adenoid tissue (0-25% obstruction), 2 when a small amount (26-50% obstruction), 3 as the large amount that might cause symptomatic nasal obstruction (51-75% obstruction) and 4 as obstructing adenoid tissue (76-100% obstruction).[17]

Overnight polysomnographic (PSG) was performed evaluating apnea-hypopnea index (AHI, labeled when the average number of obstructive apneas and hypopneas/hour of total sleep time), oxygen saturation (measurement taken by pulse oximetry), and percentage time when oxygen saturation was less than 90%. Obstructive apnea was labeled in terms of the total absence of airflow through mouth and nose with continued chest and abdominal movement for at least 2 respiratory cycles. Hypopneas were labeled as the decrease in the nasal flow of a minimum 50 percent with a corresponding decrease in $SpO_2$ of a minimum 4 percent or arousal. OSAS was labeled as AHI of at least 5. AHI score of $\geq$5 to <10 was labeled as mild OSAS, $\geq$10 to <20 as moderate, and $\geq$20 as severe.[17]

SPSS Version 22.0 was used for statistical analysis. All the data was recorded on a predesigned proforma. Quantitative variables were represented as mean$\pm$SD while qualitative variables were represented as frequency and percentages. Preoperative and postoperative characteristics as well as respiratory and sleep parameters were compared adopting chi-square test for qualitative variables while a t-test was employed for quantitative variables.

## Results

Out of a total of 52 children, 32 (61.5%) were male and 20 (39.5%) female. Mean age at the time of adenotonsillectomy was noted as 6.7 years with standard deviation of 2.6 years. The majority of the children, 27 (51.9%) were between 3-6 years of age.

Regarding tonsillar size, 23 (44.2%) were grade 3 or 4 while 41 (78.8%) were having obvious adenoid hypertrophy of grade 3 or 4. Preoperatively, age and gender corrected BMI z score was noted as 39 (75.0%) children of normal weight, 5 (9.6%) as overweight, and 8 (15.4%) as obese. The mean preoperative AHI score was noted to be 23.7$\pm$15.7 while 27 (51.9%) children were having moderate OSAS and 25 (48.1%) severe OSAS. Postoperative PSG was performed in children at a mean interval of 18 months.

Table-I is highlighting the preoperative and postoperative PSG measurements for respiratory parameters and sleep architecture amongst all the children. Statistically significant improvement (p-value < 0.05) was noted for obstructive AHI score, respiratory disturbance index, obstructive apnea and hypopnea index, $SpO_2$ nadir, $TSpO_2$<90% (time in percentage while $SpO_2$ was <90%), and respiratory arousal index. Mean $SpO_2$ (%) and rapid eye movement sleep (%) were not significantly different

(p-value > 0.05) at preoperative and postoperative intervals. Obstructive AHI score < 1 episode / hour was seen in 37 (71.2%) children while AHI score < 5 episodes / hour were noted in 47 (90.4%).

**Table-I: Respiratory Parameters and Sleep Architecture among Children (n=52)**

| Parameter | Preoperative | Postoperative | P Value |
|---|---|---|---|
| **Obstructive AHI** | 23.8± 14.2 | 4.2 ± 6.5 | 0.0001 |
| **Respiratory Disturbance Index** | 23.5 ± 14.5 | 5.6 ± 6.4 | 0.0001 |
| **Obstructive Apnea Index** | 6.9 ± 10.8 | 2.3 ± 1.5 | 0.0001 |
| **Obstructive Hypopnea Index** | 17.5 ± 11.2 | 4.5 ± 4.8 | 0.0001 |
| **Mean $SpO_2$ (%)** | 94.1 ± 4.9 | 95.1 ± 4.7 | 0.2907 |
| **$SpO_2$ nadir (%)** | 81.3 ± 7.4 | 92.3 + 10.3 | 0.0001 |
| **$TSpO_2$ < 90% (%)** | 8.6 ± 9.1 | 4.7 ± 5.5 | 0.0095 |
| **Respiratory Arousal Index** | 16.8 ± 9.2 | 5.7 ± 6.2 | 0.0001 |
| **REM Sleep (%)** | 17.6 + 6.2 | 16.8 ± 5.3 | 0.4810 |

## Discussion

Chronic infection was considered to be the main reason for adopting AT in the past decades but airway obstruction, as well as OSAS, are taken as major causes for considering AT. Among American pediatric patients, AT has come out as the commonest otolaryngological surgery in the last few decades.[16-18] Quite a few studies have shown that AT provides benefit for OSAS in terms of overall growth, academic performance as well as neurological and cardiac parameters.[8-10]

This is perhaps one of the pioneering studies analyzing changes between pre and postoperative PSG measurements following adenotonsillectomy amongst children having OSAS from Pakistan. In the present study, surgical cure in terms of AHA score < 5 episodes/hours was seen in 90.4% of the children whereas 71.2% when we used the criteria as AHI score < 1 episode/hour. Very similar findings were noted from China by Ye J et al[17] where they noted 87% of children to have AHI score < 5 episodes/hour while 31% cases to have persistent OSAS when criteria of AHI score < 1 episode/hour was applied in their study. According to the findings of Ye J et al[17] and our findings support it that AT may not be able to fully eradicate abnormalities of breathing during sleeping, however it is very useful in controlling most of the problems arising from this condition. It has been stated previously that the cure rate related to AT differs widely and is very much dependent on the population involved and PSG criteria adopted for OSAS.[19-21] Tauman R and colleagues[22] observed that sleep parameters were normal following AT with criteria as AHI score ≤ 1 in children with OSAS in about 25% of cases. But that study had more than half of the study population as obese and more than 70% of children had some sort of allergies.

Mitchell RB while noting the outcome of AT in children having OSAS, after excluding children who had craniofacial, neuro-muscular, or genetic disorders, noted that sleep parameters were normalized in 82% of the cases.[23] Previous finding has demonstrated that AT can reduce preoperative AHI score by 70-80% but it has also been seen that residing 20-30% of airway obstruction following AT can play a major role in deciding whether OSAS is persistent or not.[17]

In the current study, the mean age at the time of AT was noted as 6.7 years with a standard deviation of 2.6 years. The majority of the children, 27 (51.9%) were between 3-6 years of age. Most previous researches,[22,23] have revealed that age is never of contributing factor to residing OSAS following AT while it has also been reported in a study that age < 3 years might post an increasing threat for residual upper airway obstruction following AT.[24] But, a study from Taiwan stated that age affects oral-facial growth as about 60% of the adult face is almost formed when a child reaches 4 years of age and age at the time of AT might play an important role referring to incomplete cure of OSAS following surgery. The same study also advocated that children with OSAS should be followed up on a long term basis.[25] Some studies have also evaluated the severity of OSAS and its impact on the quality of life but as we did not find any such correlations so we were unable to contribute to this aspect.[26,27]

Our study had few limitations as this was a single-center study and we did not have any kind of randomized controlled study makeup. We did not evaluate any craniofacial or anatomical features for this study. Regrowth related to adenoid tissue and history of allergies or OSAS can impact the outcome of AT as has been suggested by the previous research, we did not evaluate these aspects.

## Conclusion

Adenotonsillectomy for Obstructive Sleep Apnea Syndrome improved polysomnographic parameters in most of the children. More studies having a bigger sample-sized and involving longer follow ups evaluating possible risk factors contributing to the postoperative outcome of Adenotonsillectomy will prove to be more helpful.

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All authors critically revised and approve its final version.

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