Adenotonsillectomy in Pediatric Obstructive Sleep Apnea: Current Evidence and Future Directions

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Abstract

Pediatric obstructive sleep apnea (OSA) is a prevalent and underdiagnosed condition with important implications for growth, neurocognition, and cardiometabolic health. Adenotonsillar hypertrophy is the leading anatomical substrate in otherwise healthy children, making adenotonsillectomy the cornerstone of surgical management. Recent evidence demonstrates that adenotonsillectomy significantly improves polysomnographic indices, symptoms, and quality of life, but residual disease remains common, especially in severe OSA, obesity, and syndromic populations.,, This narrative review summarizes current concepts in the epidemiology, pathophysiology, diagnosis, and treatment of pediatric OSA with emphasis on surgical outcomes and long-term follow-up.,,, It also contrasts adenotonsillectomy with conservative and adjunctive therapies, and highlights research gaps relevant for otorhinolaryngologists.

Keywords: pediatric, obstructive sleep apnea, adenotonsillectomy, otorhinolaryngology, polysomnography, outcomes, residual disease, growth

Introduction

Pediatric OSA affects approximately 1–5% of children worldwide and is characterized by recurrent upper airway obstruction during sleep, resulting in intermittent hypoxia, sleep fragmentation, and increased work of breathing., Adenotonsillar hypertrophy and, increasingly, obesity are the predominant risk factors in otherwise healthy children, while craniofacial anomalies and genetic syndromes further contribute to airway collapsibility in selected populations.,, If left untreated, pediatric OSA is associated with neurocognitive impairment, behavioral disturbance, failure to thrive, and cardiovascular and metabolic complications that may persist into adulthood.,,

Clinical practice guidelines from the American Academy of Pediatrics recommend routine screening for snoring in primary care and referral for in-laboratory polysomnography in children with frequent snoring, labored breathing during sleep, or learning and behavioral problems.,, For uncomplicated OSA associated with adenotonsillar hypertrophy, adenotonsillectomy is endorsed as first-line therapy, while

medical and orthodontic strategies are reserved for selected or residual cases.,,, Nevertheless, emerging data suggest that a substantial proportion of children exhibit persistent OSA after surgery, underscoring the need for risk stratification, perioperative optimization, and long-term surveillance within otorhinolaryngology practice.,,,

Methods

This article is a narrative, non-systematic review focusing on pediatric OSA and adenotonsillectomy from an otorhinolaryngology perspective. Recent clinical guidelines, key narrative reviews, and meta-analyses indexed in PubMed and major open repositories were prioritized, with emphasis on publications addressing epidemiology, diagnostic strategies, surgical outcomes, and postoperative follow-up. Preference was given to pediatric cohorts with polysomnographic outcomes and validated quality-of-life instruments. No formal risk-of-bias assessment or quantitative meta-analysis was undertaken; instead, data were synthesized descriptively to highlight clinically relevant patterns, limitations, and implications for practice.

Results

Epidemiology, Pathophysiology, and Clinical Presentation

Pediatric OSA is estimated to affect 1–5% of children, with higher prevalence reported in those with obesity, Down syndrome, and craniofacial anomalies., Adenotonsillar hypertrophy narrows the retropalatal and retroglossal airway, while developmental factors such as reduced neuromuscular compensation, increased upper airway compliance, and REM-predominant vulnerability further promote nocturnal obstruction., In contrast to adults, daytime sleepiness may be less prominent in children, who more commonly present with hyperactivity, inattention, behavioral dysregulation, and learning difficulties.,,

Typical nocturnal symptoms include habitual snoring, witnessed apneas, gasping, restless sleep, paradoxical chest movements, and secondary enuresis, while morning headaches and mouth breathing suggest chronic upper airway obstruction.,, Prolonged increased work of breathing and disrupted growth hormone secretion can lead to failure to thrive and impaired linear growth, although catch-up growth is often observed after effective treatment.,, Cardiovascular sequelae such as elevated blood pressure, pulmonary hypertension, and early metabolic dysregulation have been documented in long-standing disease, reinforcing the need for early diagnosis.,,

Diagnostic Pathway in Otorhinolaryngology

Polysomnography remains the reference standard for diagnosing pediatric OSA, allowing quantification of apnea–hypopnea index (AHI), oxygen desaturation, and sleep architecture disturbances.,, Guidelines recommend in-lab polysomnography in children with frequent snoring and symptoms such as labored breathing during sleep, learning problems, or growth failure, and before adenotonsillectomy in high-risk patients.,, Home sleep testing and nocturnal oximetry are increasingly explored but

currently serve as adjuncts or triage tools given variable sensitivity and specificity in children.,

In the otorhinolaryngology clinic, comprehensive airway evaluation includes endoscopic assessment of adenoid and tonsillar size, nasal patency, and laryngeal and subglottic anatomy., For persistent or complex OSA, drug-induced sleep endoscopy (DISE) helps localize sites of obstruction and guide tailored multilevel surgery, particularly in syndromic or obese children., Validated questionnaires such as the OSA-18 and pediatric sleep questionnaires complement objective testing by capturing disease burden and change in quality of life.,

Adenotonsillectomy Outcomes and Residual Disease

Adenotonsillectomy is widely regarded as the first-line surgical treatment for pediatric OSA attributable to adenotonsillar hypertrophy.,, Early polysomnographic series reported marked reductions in AHI, with mean values decreasing from approximately 27.5 events/h to 3.5 events/h postoperatively, and complete normalization of sleep studies in 71–90% of otherwise healthy children depending on the definition of cure., In children with mild OSA, postoperative respiratory parameters are frequently normal, whereas 12% of those with moderate and up to 36% with severe preoperative OSA may have persistent disease.,,

Beyond polysomnography, adenotonsillectomy yields substantial improvements in parent-reported symptoms, behavior, and health-related quality of life scores such as OSA-18, with significant postoperative gains across all domains.,,, Recent data further indicate improvements in growth and sleep outcomes, even among children with mild sleep-disordered breathing, suggesting benefit on somatic development., However, large multicenter analyses and meta-analyses show that residual OSA is common, particularly in older children, those with obesity, severe baseline OSA, craniofacial anomalies, neuromuscular disease, or chronic asthma.,,, These findings support routine postoperative clinical assessment and selective repeat polysomnography in high-risk groups.,,

Conservative and Adjunctive Therapies

Non-surgical strategies play an important role as alternatives or adjuncts to adenotonsillectomy, especially in mild OSA or residual disease. Anti-inflammatory regimens such as intranasal corticosteroids and leukotriene receptor antagonists can reduce adenotonsillar tissue and improve mild OSA indices in some children, although responses are heterogeneous and typically less robust than surgical outcomes., Weight management is essential in obese children, in whom adenotonsillectomy alone often fails to normalize AHI, and multidisciplinary interventions targeting diet, physical activity, and metabolic risk are recommended.,,

Continuous positive airway pressure (CPAP) is indicated for children with persistent moderate-to-severe OSA after adenotonsillectomy or those in whom surgery is

contraindicated, yet adherence remains a major challenge in pediatrics.,, Orthodontic and dentofacial interventions, including rapid maxillary expansion and mandibular advancement devices, may benefit selected children with craniofacial narrowing or malocclusion but require close collaboration between otorhinolaryngologists, orthodontists, and sleep specialists., Emerging surgical approaches—such as lingual tonsillectomy, tongue-base reduction, and hypoglossal nerve stimulation—are under investigation in adolescents and complex cases but are not yet standard of care.,

Comparison of Treatment Modalities

The table below contrasts key features of common therapeutic options for pediatric OSA from an otorhinolaryngology standpoint.,

Treatment modality	Typical indication	Expected effect on AHI	Main advantages	Key limitations / risks
Adenotonsillectomy	Uncomplicated OSA with adenotonsillar hypertrophy ,	Large AHI reduction; cure in many mild cases , , ,	One-time intervention; marked symptom and QoL improvement , ,	Residual OSA in severe, obese, or syndromic cases; surgical risks , , ,
Intranasal steroids / anti-leukotrienes	Mild OSA or residual symptoms after AT ,	Modest AHI reduction in responders ,	Non-invasive; useful when surgery deferred ,	Variable response; requires adherence; limited long-term data ,
Watchful waiting	Very mild, minimally symptomatic OSA ,	Possible spontaneous improvement in some children ,	Avoids surgery and long-term devices ,	Risk of ongoing neurocognitive and growth impact if disease persists ,
CPAP	Persistent moderate–severe OSA or non-surgical candidates , ,	Normalizes AHI when used consistently , ,	Reversible, titratable therapy ,	Poor adherence; mask discomfort; device burden ,

Orthodontic / craniofacial interventions	OSA with maxillary constriction or malocclusion ,	Variable AHI improvement, best in selected phenotypes ,	Addresses structural contributors; long-term airway remodeling ,	Limited evidence base; specialist availability; cost ,

Discussion

Current evidence confirms pediatric OSA as a significant public health concern with multisystem consequences that extend beyond snoring and sleep disturbance, reinforcing the central role of otorhinolaryngologists in early recognition and intervention.,, Routine screening for snoring in primary care and timely referral for polysomnography and ENT evaluation remain essential, particularly for children with neurobehavioral symptoms, growth failure, or high-risk comorbidities.,,, As first-line surgical therapy, adenotonsillectomy yields robust improvements in polysomnographic indices, quality of life, and growth, yet the high prevalence of residual OSA in severe, obese, or syndromic patients warrants an individualized, risk-stratified approach.,

For otorhinolaryngologists, these data support systematic preoperative assessment of disease severity, comorbidities, and craniofacial features, along with structured postoperative follow-up to identify persistent symptoms that should trigger further testing.,,, Integrating DISE and multilevel airway surgery may improve outcomes in selected children with complex obstruction patterns, but high-quality comparative trials are still limited., Non-surgical options, including anti-inflammatory therapy, weight management, orthodontic interventions, and CPAP, form critical components of a multimodal strategy, particularly in cases where adenotonsillectomy is insufficient or inappropriate.,,, Future research should focus on precision phenotyping, prediction of surgical response, long-term neurocognitive and cardiometabolic trajectories, and pragmatic models of multidisciplinary care involving pediatrics, ENT, sleep medicine, dentistry, and psychology.

Conclusion

Adenotonsillectomy remains the **cornerstone** of treatment for pediatric OSA driven by adenotonsillar hypertrophy, delivering substantial improvements in sleep, behavior, growth, and quality of life for most children. However, residual disease is frequent in severe, obese, and syndromic populations, making careful preoperative risk stratification and structured postoperative surveillance indispensable components of modern otorhinolaryngology practice. By combining targeted surgery with evidence-based medical, orthodontic, and CPAP therapies in a multidisciplinary framework, clinicians can move from a uniform to a personalized approach that addresses both airway anatomy and systemic risk.,,, As the burden of pediatric OSA grows in parallel with childhood obesity, innovation in diagnostics, risk prediction, and

long-term outcome research will be crucial to protect neurodevelopmental and cardiometabolic health across the lifespan

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