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Review

Role of Orthodontics and Otorhinolaryngology in the Management of Pediatric Obstructive Sleep Apnea (POSA)

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Abstract

Pediatric Obstructive Sleep Apnea (POSA) is a sleep disorder that disrupts breathing and leads to developmental and health issues. Orthodontic treatments, such as Rapid Maxillary Expansion (RME) and mandibular advancement, improve the airway, while otorhinolaryngological procedures, including adenotonsillectomy, address structural obstructions. This review examined the combined roles of orthodontics and otorhinolaryngology in diagnosing and treating POSA, with a focus on early multidisciplinary interventions to enhance children's outcomes. A review of literature revealed that POSA affects 1-5% of children, with risk factors such as adenotonsillar hypertrophy, obesity, craniofacial anomalies, and socioeconomic disparities. Orthodontic and otorhinolaryngological interventions are crucial for management, with early detection and a multidisciplinary approach being the key to success. Challenges include residual Obstructive Sleep Apnea (OSA), variable treatment responses, and the need for standardized protocols. Effective management requires addressing risk factors and combining treatments, such as adenotonsillectomy, orthodontic interventions, and Continuous Positive Airway Pressure (CPAP). Early diagnosis and tailored interventions are essential to minimize long-term health effects.

Keywords*:*

Pediatric obstructive sleep apnea, Obstructive sleep apnea, Orthodontics, Otorhinolaryngology, Interdisciplinary

Introduction

Sleep-related respiratory disorders, ranging from simple breathing pauses to serious conditions, affect children of all ages. Understanding children's respiratory physiology and sleep science is crucial to comprehending these disorders (1). Infants and young children have small, easily obstructed airways due to swelling, mucus, inhalation of foreign bodies, and anatomical features like large tongues, soft cartilage, and a narrow larynx. Their high metabolic rate increases oxygen demand and water loss. Weak chest muscles and soft ribcage make them prone to fatigue, and as nasal breathers, even minor blockages can cause labored breathing. Limited alveoli and more dead space reduce gas exchange, requiring rapid breathing to maintain ventilation (2).

Obstructive Sleep Apnea (OSA) is defined as repetitive episodes of complete or partial collapse of the upper airway during sleep, followed by transient awakening, which results in restriction of upper airway permeability (3). OSA disproportionately affects young children owing to naturally narrower airways (exacerbated by enlarged tonsils/adenoids) and unique respiratory physiology. Obesity, allergic rhinitis, craniofacial abnormalities, Down syndrome, and neuromuscular diseases further compromise airway patency and respiratory function (4).

The diagnosis of OSA is primarily based on a patient's history and physical evaluation. The symptoms of Pediatric Obstructive Sleep Apnea (POSA) include nocturnal issues such as snoring, breathing difficulties, gasping, restless sleep, and excessive sweating. Daytime symptoms include mouth breathing, frequent infections, hearing and speech problems, gastrointestinal symptoms, excessive daytime sleepiness, and neurocognitive/behavioral issues. Patients with advanced disease may present with cardiac morbidities (5).

Upper airway evaluation is conducted using nasopharyngoscopy, pharyngometry, radiographic evaluation, and upper airway collapsibility. Screening studies also included the use of questionnaires, audio recordings, video recordings, continuous pulse oximetry recording, electrocardiography, home monitoring, and laboratory tests. Polysomnography (PSG) is the gold standard for diagnosing POSA. The American Academy of Pediatrics (AAP) recommends PSG after positive screening. PSG includes many variables like Electroencephalogram (EEG) and Electrooculogram (EOG) (5).

Several treatment approaches have been developed for this condition. Adenotonsillectomy is the first-line treatment. Additionally, septoplasty, Uvulopharyngopalatoplasty (UPPP), epiglottoplasty, glossopexy, or maxillomandibular surgery may be necessary in some cases. Positive Airway Pressure (PAP) therapies, including Continuous Positive Airway Pressure (CPAP) and Bilevel Positive Airway Pressure (BiPAP), treat residual OSA and are ineligible for surgery.

Positional therapy is another treatment option, used when a patient's Apnea-Hypopnea Index (AHI) is at least twice as high while sleeping on their back (supine), and they spend more than 20% of total sleep time in this position. Its use in children is limited. On the other hand, OSA can be treated non-surgically. For mild OSA or unsuitable surgical cases, weight management, orthodontics such as Rapid Maxillary Expansion (RME), and medical (nasal corticosteroids and montelukast) are recommended. Myofunctional therapy improves AHI/oxygen saturation, especially post-tonsillectomy or as an adjunct. Also, it is worth mentioning that OSA can resolve spontaneously, particularly in children with mild OSA and adenotonsillar hypertrophy (6). This study aimed to evaluate the role of orthodontics and otorhinolaryngology in managing POSA and their impact on diagnosis, treatment, and quality of life.

Discussion

Prevalence and risk factors of POSA

Lumeng and Chervin's 2008 review reported high parent-reported snoring (1.5-6%), male predominance in OSA (1.5:1–3:1), and significantly higher OSA prevalence (1-4%) in severely obese

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children, emphasizing the need for further research on risk factors (7). Gulotta et al. in 2019 found adenotonsillar hypertrophy to be the primary POSA cause. Other contributing factors for this age group include obesity, craniofacial abnormalities, and increased nasal resistance. Environmental pollutants and allergic rhinitis aggravated OSA, emphasizing early identification and multidisciplinary management (8). Xu et al. in 2020 found that adenotonsillar hypertrophy is the main risk factor for POSA, along with obesity, craniofacial anomalies, allergic rhinitis, and passive smoking. Early intervention and multidisciplinary management are crucial (9).

Xiao et al. in 2022 studied the risk factors related to the incidence and severity of OSAS. It was found to be higher in males and obese children. Enlarged tonsils, nasal obstruction, and family history were linked to OSA, with male gender, obesity, tonsillar hypertrophy, and nasal obstruction as key risk factors (10). On the other hand, Liao et al. in 2024 found that among school-aged children and adolescents, 88.6% were low-risk and 11.4% were high-risk for OSA, with obese children at greater risk. Elevated Body Mass Index (BMI), fat mass, and waist-to-height ratio correlated with higher OSA risk, as did insulin resistance and dyslipidemia (11).

Alkhalifah et al.'s 2024 global review found 3.5% POSA prevalence, varying regionally (highest in Africa: 6% and lowest in Asia: 3%). Within countries, the prevalence was highest in Kenya (10%) and lowest percentage Italy (2%). POSA is a global health concern requiring targeted screening and management (12). Similarly, Chau et al. in 2023 found OSA in 36% of children, higher than the reported Obstructive Sleep Apnea Syndrome (OSAS) prevalence of 0.7 to 10.3% in the literature. Snoring every night turned out to be the only significant risk factor, although observed apnea was found to approach significance. The study emphasizes early detection and targeted interventions due to the strong association with anatomical and familial factors (13). Dékány et al. in 2023 observed a significant association between a higher BMI percentile and a significant correlation under and above 7 years of age. Age was significantly related to OSA severity (14).

Impact of OSA

Capdevila et al. in 2008 found that 2-4% of children were affected by POSA, with associated cognitive, learning, and behavioral issues. POSA also increases cardiovascular risk (e.g., hypertension). Early diagnosis and treatment are crucial( ). Brockmann and Gozal in 2022 emphasize that not all children with Sleep-Disordered Breathing (SDB) will suffer neurocognitive deficits, and that the severity of respiratory metrics alone is insufficient to identify those at-risk. They advocate for the development of multidimensional risk profiling—incorporating sleep architecture, biological markers, and clinical phenotypes—to enable targeted prevention and early treatment (16).

An interesting study by Malicki et al. in 2022 found that OSA disrupts the body's circadian clock, which in turn impairs metabolic processes like glucose and lipid metabolism. The study concludes that this disruption is a key factor in the development of metabolic diseases such as type 2 diabetes and obesity in patients with OSA (17). A systematic review by Zaffanello et al. in 2024 linked POSA and adenotonsillar hypertrophy to increased left ventricular mass, elevated blood pressure, right ventricular hypertrophy, and arrhythmias. Early intervention is crucial to prevent long-term cardiac complications (18).

A twenty-year follow-up study by Nosetti et al. (2022) examined the long-term outcomes for children with severe OSA. The researchers found that, when compared to a healthy control group, young adults who had severe childhood OSA had a significantly higher BMI, a greater incidence of snoring, and lower academic achievement. The study concludes that severe OSA in childhood may increase a person's risk for chronic diseases later in life (19). According to a 2022 review article by Thomas et al., POSA can lead to serious long-term consequences if left untreated. The study highlights that OSA can affect a child's cardiovascular, metabolic, endocrine, neurocognitive, and psychological systems. Early identification and

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treatment are crucial to prevent these long-term issues and improve a child's overall health (20).

Role of Orthodontics

Triggs et al. in 2022 found that 62% of surveyed US orthodontists screened for OSA, mostly using questionnaires or observation, but only 30.4% felt confident diagnosing independently, highlighting the need for standardized protocols and training (21). A systematic review by Gorikapudi et al. (2024) found that orthodontic treatments, such as RME and Mandibular Advancement Devices (MADs), are effective for POSA. The study showed consistent improvements in the AHI and other sleep metrics. While promising, the authors noted the need for more controlled trials to fully validate these interventions (22).

Kandasamy in 2024 states that routine expansion and growth modification are not an evidence-based means of improving or curing OSA in children. The article challenges the idea of very early orthodontic intervention, citing insufficient data to support these novel approaches for treating or preventing POSA. The piece suggests that there is a significant lack of high-quality data to justify the routine use of certain therapies for this condition. (23). A systematic review by Sun et al. (2024) found that mandibular advancement orthodontic appliances combined with maxillary expansion are effective in treating OSA in children. The study indicated that this treatment approach led to a decrease in the AHI, improved sleep quality, and increased oxygen saturation. The authors noted that more extensive, well-designed trials are needed to confirm the long-term efficacy (24).

A review by Bariani et al. (2022) found that functional orthodontic appliances can be an alternative treatment for POSA. While all studies reviewed showed improved AHI scores and enlarged airways, the authors concluded that definitive effectiveness could not be confirmed due to significant evidence deficiencies, including small sample sizes and a lack of long-term data (25). The review by Yu et al. (2023) found that Mandibular Advancement Appliances (MAAs) alone and in combination with other treatments are effective for POSA. Specifically, MAAs and Myofunctional Therapy (MFT) alone showed significant AHI reductions, and the combined treatments of RME + AT and RME + MAAs were even more effective (26).

Role of Otorhinolaryngology

De Benedetto et al. in 2019 stated that Otorhinolaryngologists are key in POSA, using airway evaluation, polysomnography, and surgical expertise. Adenotonsillectomy usually improves breathing, while residual OSA is managed with Drug-Induced Sleep Endoscopy (DISE) to guide further treatment (27). According to the article by Hussein et al. (2020), overnight pulse oximetry is a useful tool for estimating the severity of OSA in children, aiding in the appropriate referral for adenotonsillectomy and planning for perioperative care (28).

An interesting study conducted by Li et al. (2023) found that palatal hybrid surgery, a refined uvulopalatopharyngoplasty technique, effectively treated OSA with minimal complications. In 46 patients, it significantly improved snoring, daytime sleepiness, and sleep parameters. AHI reduced from 41.8 to 18.2; min oxygen saturation increased from 72.4% to 81.5%, with an overall success rate of 63%, and low postoperative pain (29). Polytarchou et al. (2024) highlight that OSAS management in children under 2 requires age-specific assessment, with adenotonsillectomy, adenoidectomy, or supraglottoplasty for anatomical causes, and PAP or high-flow nasal cannula for persistent cases, guided by polysomnography and a multidisciplinary approach (30).

In contrast, Olszewska et al. (2022) found that pharyngoplasty in 25 adults with OSAS who failed PAP therapy led to long-term improvements, including reduced AHI (29.8→19.5), lower snoring {Visual Analog Scale (VAS) 8.13→3.78}, higher oxygen saturation (94.5%), and improved daytime sleepiness {Epworth Sleepiness Scale (ESS) 6.17}, demonstrating sustained benefits for upper airway obstruction (31).

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Yuan et al. (2023) found that extended UPPP combined with simultaneous multiplane surgery in 62 OSA patients significantly improved AHI (from preoperative 42.3 to postoperative 16.8 events/hour), ESS (from 13.2 to 6.1), and lowest oxygen saturation (from 78.5% to 89.4%), achieving an 87.1% overall response rate (22.6% cured, 32.3% marked effectiveness, 32.3% moderate effectiveness) with no severe complications, demonstrating the approach is safe and effective (32). Guidelines for the diagnosis of pediatric Obstructive Sleep Apnea-Hypopnea Syndrome (OSAHS) were provided by Leclere et al. in 2019, with emphasis on comprehensive evaluations. Adenotonsillar hypertrophy and anatomical obstructions were common findings. Imaging and nasal resistance assessments were performed. A multidisciplinary approach guided by Ear, Nose, and Throat (ENT) specialists is crucial for accurate diagnosis and management (33).

Interdisciplinary Approach

Lin et al. in 2021 described an interdisciplinary POSA approach for an 11-year-old with missing premolars. Treatment with combined functional/fixed appliances with adenotonsillectomy and UPPP resulted in significant improvements in OSA symptoms, facial aesthetics, and dental alignment. This highlights the effectiveness of combined orthodontic-surgical approaches for complex (34). The role of pediatric dentists in OSA diagnosis and treatment was emphasized by Giuca et al. in 2021, including adenotonsillectomy and orthodontic interventions such as RME. Interdisciplinary collaboration is crucial for effective management and improved outcomes (35).

Savin et al. in 2024 emphasized early POSA diagnosis and multidisciplinary care, involving clinical evaluation, PSG, and risk factor assessment (e.g., adenotonsillar hypertrophy, obesity). Adenotonsillectomy is the primary treatment, with RME recommended in some cases. Tailored interdisciplinary approaches and monitoring are crucial for effective management (36).

An interesting study by Weber et al. in 2021 emphasized a multidisciplinary OSA approach (otolaryngology, orthodontics, sleep medicine) for personalized care, combining strategies such as adenotonsillectomy, MMAs, MADs, and lifestyle changes. Tailored, interdisciplinary care is crucial for improved outcomes and long-term success (37). Law et al. in 2023 evaluated CPAP combined with Mandibular Advancement Therapy (MAT) for OSA treatment. Their trial suggested Positive Airway Pressure plus Mandibular Advancement Therapy (PAPMAT) offers superior patient benefits and cost-effectiveness, highlighting its potential as an integrated, improved OSA management strategy (38).

Bignotti et al. in 2019 presented a 12-year-old with severe OSA, managed through adenotonsillectomy, orthodontics, and CPAP therapy. The study emphasized that a multidisciplinary approach involving pediatricians, ENT specialists, orthodontists, and sleep specialists is crucial for optimal outcomes and enhanced quality of life (39). Chang et al.'s 2023 international consensus on OSA emphasized its multifactorial nature and impact on various health domains. Early diagnosis and personalized treatments (lifestyle changes, medications, surgery) were stressed, along with a multidisciplinary approach to improve outcomes, reduce comorbidities, and advance research (40).

Oros et al. in 2021 investigated OSA management in children with genetic disorders, emphasizing early multidisciplinary care due to the increased risk linked to craniofacial abnormalities and comorbidities. Involving geneticists, pediatricians, and ENT specialists is crucial for early diagnosis and tailored treatment to prevent complications and improve quality of life (41). Stark et al. in 2020 explored an interdisciplinary approach to treating POSA, showing that combining medical, dental, and surgical treatments effectively addressed the complexity of OSA in children. The study emphasized the importance of early diagnosis and a collaborative, tailored treatment plan involving multiple healthcare professionals for optimal outcomes (42).

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On the other hand, Bitners and Arens highlighted POSA's varied presentations and treatments (medical, surgical, lifestyle changes), emphasizing a multidisciplinary approach. Effective management requires comprehensive evaluation, accurate diagnosis, and personalized treatment to prevent long-term consequences (43).

Study limitations

This study is limited by its reliance on secondary sources with varying methodologies and diagnostic criteria, which may affect data consistency. Regional differences in POSA prevalence and treatment were noted but not deeply analyzed, limiting generalizability. Many studies relied on subjective, parent-reported data, introducing potential bias. Additionally, long-term outcomes of treatments were often lacking, and the variability in patient response highlights the need for standardized protocols and further clinical trials.

Future directions

Future research should standardize the diagnostic protocols for orthodontists to improve POSA management. Long-term studies on interdisciplinary treatments and investigations of genetic and environmental factors are needed. Integrating technologies such as home sleep testing and telemedicine could enhance accessibility, while stronger healthcare collaboration would improve personalized care and outcomes.

Conclusion

POSA affects cognitive, cardiovascular, and metabolic health. Its prevalence varies, necessitating a standardized evaluation. The risk factors include adenotonsillar hypertrophy, obesity, craniofacial anomalies, and socioeconomic status. Multidisciplinary management (pediatricians, orthodontists, ENT, and sleep specialists) is key. Adenotonsillectomy is first line, but residual OSA may require CPAP, orthodontic devices (MAD, RME), or surgery. Orthodontists play a crucial role in early detection, treatment, and referral to specialists for surgery. Early personalized interventions are essential for optimal outcomes.

Disclosure

Conflict of interest

There is no conflict of interest.

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Ethical consideration

Non applicable.

Data availability

Data that support the findings of this study are embedded within the manuscript.

Author contribution

All authors contributed to conceptualizing, data drafting, collection and final writing of the manuscript.

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