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Obstructive sleep Apnea: A multidisciplinary challenge: The roles of pediatric dentists, orthodontists, and prosthodontists in diagnosis and management: A comprehensive review

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Abstract

Obstructive Sleep Apnea (OSA) is a chronic, multifactorial sleep-related breathing disorder marked by repeated episodes of partial or complete upper airway collapse during sleep. With a prevalence ranging from 5% to 20%, and an alarming 80-90% of cases remaining undiagnosed, OSA poses significant risks to cardiopulmonary, metabolic, neurocognitive, and immunological health. As new evidence highlights anatomical and non-anatomical factors across age groups, the role of dental professionals in screening, early intervention, and interdisciplinary management has come into sharper focus. This comprehensive review explores the evolving and collaborative roles of Pediatric dentists, Orthodontists, and Prosthodontists in the diagnosis and treatment of OSA. Pediatric dentists are pivotal in early detection during craniofacial growth, particularly when tonsillar hypertrophy and malocclusions coexist. Orthodontists play a therapeutic role using functional appliances and maxillary expansion to remodel the airway. Prosthodontists contribute significantly to adult OSA care through oral appliance therapy in CPAP-intolerant patients. This article further discusses current diagnostic tools-including the Apnea-Hypopnea Index (AHI), pulse oximetry, and sleep questionnaires-as well as recent advancements such as biomimetic expanders, neuromodulation devices, and tele-dentistry screening. A unified, interdisciplinary dental approach is essential to bridge the diagnostic gap, optimize patient outcomes, and integrate OSA management into routine dental care.

Keywords: Obstructive sleep apnea, pediatric dentistry, orthodontics, prosthodontics, oral appliances, airway management, sleep disordered breathing, interdisciplinary approach

Introduction

Obstructive Sleep Apnea (OSA) is a complex and increasingly prevalent sleep-related breathing disorder characterized by repeated episodes of upper airway obstruction during sleep, leading to intermittent hypoxia, fragmented sleep, and reduced oxygen saturation. Affecting approximately 5% to 20% of the global population, OSA remains significantly underdiagnosed, particularly in children and middle-aged adults. Its consequences extend beyond disturbed sleep, contributing to a range of systemic complications including cardiovascular disease, neurocognitive impairment, metabolic dysfunction, hormonal imbalance, and impaired quality of life ^[1].

The pathophysiology of OSA involves a dynamic interplay between anatomical factors such as adenotonsillar hypertrophy, retrognathia, and maxillary constriction, as well as non-anatomical contributors like obesity, neuromuscular tone loss, and genetic syndromes ^[2]. While traditionally managed by sleep physicians, pulmonologists, and ENT specialists, the evolving understanding of craniofacial growth and airway dynamics has positioned dental professionals-especially pediatric dentists, orthodontists, and prosthodontists-as critical stakeholders in its diagnosis and treatment.

Pediatric dentists play a frontline role in identifying early anatomical risk factors during routine dental visits, especially in children aged 2-8 years where adenotonsillar development peaks. Orthodontists contribute through airway-focused treatment planning, leveraging growth modulation, maxillary expansion, and functional appliances to alleviate obstructions [3]. Prosthodontists, on the other hand, are essential in adult care by fabricating mandibular advancement devices for patients intolerant to CPAP therapy, which remains the gold standard.

The interdisciplinary collaboration among these dental specialists not only enhances early detection but also tailors treatment strategies according to patient-specific anatomical and functional needs. With advancements in imaging, appliance design, and digital monitoring, the role of dentistry in sleep medicine is undergoing a paradigm shift [4]. This comprehensive review aims to explore the individual and collective roles of Pediatric dentists, Orthodontists, and Prosthodontists in the management of OSA, underscore the latest innovations in therapy, and emphasize the importance of integrated dental care in tackling this silent epidemic [5, 6].

Epidemiology

Obstructive Sleep Apnea (OSA) affects a significant portion of the global population, with prevalence estimates of 5%-20% in adults and up to 10% in children, particularly between 2 to 8 years of age [7]. In children, adenotonsillar hypertrophy is the predominant cause, whereas adult OSA is influenced by multifactorial factors such as obesity, craniofacial anatomy, and lifestyle [8]. Males are more commonly affected, and higher prevalence rates are reported among African, Asian, and Hispanic populations, likely due to genetic and craniofacial variations. However, variations in diagnostic criteria and underreporting-especially in developing countries like India-lead to wide prevalence discrepancies [9]. Studies in the Indian population suggest a rising OSA burden, with estimates ranging from 4% to 13% in adults, compounded by increasing obesity and urban lifestyle changes.¹⁰ Alarming, 80%-90% of adult OSA cases remain undiagnosed globally, with Pediatric cases often overlooked due to atypical symptoms such as hyperactivity or poor academic performance [11, 12]. Early detection through dental and orthodontic screening is thus critical.

Etiology

OSA is a multifactorial disorder characterized by repetitive upper airway collapse during sleep, mainly at the oropharyngeal and hypopharyngeal levels, causing apnea or hypopnea [11]. Key anatomical factors include adenotonsillar hypertrophy (especially in children), retrognathia, mandibular deficiency, high-arched palate, macroglossia, and nasal obstructions [12]. Non-anatomical contributors encompass obesity, pharyngeal muscle hypotonia, impaired ventilatory control, and positional dependency. Genetic syndromes like Down syndrome and Pierre Robin sequence further increase OSA risk due to craniofacial and neuromuscular abnormalities.

Risk Factors

Risk factors vary by age group but include

- **In children:** adenotonsillar hypertrophy, allergic rhinitis, craniofacial anomalies (e.g., Class II malocclusion, narrow maxilla), obesity, and neurological disorders affecting muscle tone.
- **In adults:** male sex, postmenopausal status, high neck

circumference, obesity, smoking, alcohol use, sedatives, supine sleeping position, and comorbidities like reflux and hypothyroidism [13, 14].

In the Indian context, early childhood malnutrition, delayed diagnosis of adenotonsillar hypertrophy, and increasing urban obesity contribute significantly. Early dental and orthodontic evaluations are pivotal for identifying craniofacial risk patterns and preventing progression [15].

Screening for Obstructive Sleep Apnea

The Kushida Index is a practical, chairside tool developed for identifying individuals at high risk for OSA by evaluating craniofacial and physical parameters commonly observable during dental examinations [16, 17]. The index scores based on the following criteria

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Parameter	Score Range
BMI	0-3
Neck circumference	0-3
Tonsillar size	0-2
Tongue size (Mallampati)	0-2
Palatal vault height	0-1

A total score ≥ 5 suggests a high risk of OSA, prompting further diagnostic evaluation such as polysomnography.

Dental professionals can efficiently apply the Kushida Index during routine examinations to identify at-risk individuals and facilitate timely referral and intervention. It bridges the gap between subjective complaints and objective craniofacial observations, making it highly relevant in dental settings using following formula

$$\{P + (Mx - Mn) + 3 \times OJ\} + 3 \times [Mx (BMI - 25, 0)] * NC / BMI$$

- P-palatal height
- Mx-maxillary intermolar distance
- Mn-mandibular intermolar distance
- OJ-overjet
- BMI-body mass index
- NC-Neck circumference
- $\{P + (Mx - Mn) + 3 \times OJ\}$ -contribution of craniofacial dysmorphism
- $[Max(BMI - 25, 0)] * NC / BMI$ -contribution of obesity for prediction of OSA

Clinical Features and Diagnosis

Obstructive Sleep Apnea (OSA) manifests through a variety of symptoms that differ somewhat between children and adults but share common core features. Typical clinical signs include loud, habitual snoring, observed episodes of breathing cessation during sleep (Apneas), restless or disrupted sleep, and excessive daytime sleepiness [18, 19]. Children often exhibit additional symptoms such as hyperactivity, poor academic performance, behavioural problems, and nocturnal enuresis, which can complicate diagnosis as these may be mistaken for other disorders like ADHD. Adults commonly report morning headaches, fatigue, decreased concentration, and mood disturbances.

Physical examination focuses on identifying anatomical contributors to airway obstruction. Key findings include adenotonsillar hypertrophy, narrow or high-arched palate, retrognathia or micrognathia, macroglossia, nasal septal deviation, and enlarged soft tissues in the oropharynx. Neck

circumference and body mass index (BMI) are also important clinical parameters [20, 21].

Polysomnography (PSG), or overnight sleep study, remains the gold standard diagnostic tool, providing objective data on apnea-hypopnea index (AHI), oxygen desaturation, and sleep architecture. However, due to cost and accessibility issues, especially in pediatric populations and resource-limited settings, screening questionnaires such as the Pediatric Sleep Questionnaire (PSQ), Berlin Questionnaire, or home sleep apnea tests are frequently utilized as preliminary diagnostic aids [22, 23, 24].

Dental professionals are uniquely positioned to identify early orofacial signs of OSA during routine examinations. Pediatric dentists, orthodontists, and prosthodontists each contribute distinctively to diagnosis based on their specialty's focus on craniofacial growth, airway anatomy, and oral appliance therapy [25, 26].

The ICSD-3 Classification. It is divided into 7 main categories:

In 2023, the AASM revised the third edition with the International Classification of Sleep Disorders, third edition, text revision (ICSD-3-TR) [9].

Insomnia

- Chronic insomnia disorder
- Short-term insomnia disorder
- Other insomnia (when the patient has insomnia symptoms but does not meet criteria for the other two types of insomnia)

Isolated Symptoms and Normal Variants

Sleep-Related Breathing Disorders

Obstructive sleep apnea (OSA) syndromes

1. OSA, adult
2. OSA, pediatric

Central Sleep Apnea Syndromes

1. Central sleep apnea with Cheyne-Stokes breathing
2. Central sleep apnea due a medical disorder without Cheyne-Stokes breathing
3. Central sleep apnea due to high altitude periodic breathing
4. Central sleep apnea due to a medication or substance
5. Primary central sleep apnea
6. Primary central sleep apnea of infancy
7. Primary central sleep apnea of prematurity
8. Treatment-emergent central sleep apnea

Sleep-Related Hypoventilation Disorders

1. Obesity hypoventilation syndrome
2. Congenital central alveolar hypoventilation syndrome
3. Late-onset central hypoventilation with hypothalamic dysfunction
4. Idiopathic central alveolar hypoventilation
5. Sleep-related hypoventilation due to a medication or substance
6. Sleep-related hypoventilation due to a medical disorder

Sleep-Related Hypoxemia Disorder

Isolated Symptoms and Normal Variants

1. Snoring
2. Catathrenia

Central Disorders of Hypersomnolence

1. Narcolepsy type 1

2. Narcolepsy type 2
3. Idiopathic hypersomnia
4. Kleine-Levin syndrome
5. Hypersomnia due to a medical disorder
6. Hypersomnia due to a medication or substance
7. Hypersomnia associated with a psychiatric disorder
8. Insufficient sleep syndrome

Circadian Rhythm Sleep-Wake Disorders

1. Delayed sleep-wake phase disorder
2. Advanced sleep-wake phase disorder
3. Irregular sleep-wake rhythm disorder
4. Non-24-hour sleep-wake rhythm disorder
5. Shift work disorder
6. Jet lag disorder
7. Circadian sleep-wake disorder not otherwise specified

Parasomnias

NREM-Related Parasomnias

1. Confusional arousals
2. Sleepwalking
3. Sleep terrors
4. Sleep-related eating disorder

REM-Related Parasomnias

1. REM sleep behavior disorder
2. Recurrent isolated sleep paralysis
3. Nightmare disorder

Other parasomnias

1. Exploding head syndrome
2. Sleep-related hallucinations
3. Sleep enuresis
4. Parasomnia due to a medical disorder
5. Parasomnia due to a medication or substance
6. Parasomnia, unspecified

Isolated symptoms and normal variants

1. Sleep talking

Sleep-Related Movement Disorders

1. Restless legs syndrome
2. Periodic limb movement disorder
3. Sleep-related leg cramps
4. Sleep-related bruxism
5. Sleep-related rhythmic movement disorder
6. Benign sleep myoclonus of infancy
7. Propriospinal myoclonus at sleep onset
8. Sleep-related movement disorder due to a medical disorder
9. Sleep-related movement disorder due to a medication or substance
10. Sleep-related movement disorder, unspecified

Isolated symptoms and normal variants

1. Excessive fragmentary myoclonus
2. Hypnagogic foot tremor and alternating leg muscle activation
3. Sleep starts (hypnic jerks)

Other Sleep Disorders

Other sleep-related symptoms or events that do not meet the standard definition of a sleep disorder.

Role of Pediatric Dentists in Diagnosis and Treatment of OSA

Pediatric dentists are often the first healthcare professionals to detect early signs of obstructive sleep apnea in children during routine dental visits. Literature highlights that up to 60% of pediatric OSA cases are associated with adenotonsillar hypertrophy, narrow maxillary arches, and dysfunctional oral habits such as mouth breathing and tongue thrusting [27]. Pediatric dentists play a vital role in early identification by observing these anatomical and functional risk factors. For example, a child presenting with a high-arched palate, mouth breathing, and dental crowding may raise suspicion for airway obstruction. These dentists are uniquely positioned to monitor craniofacial growth patterns, recognizing deviations in maxillary and mandibular development that correlate with airway constriction. Early counseling of parents about the impact of sleep-disordered breathing on cognitive and behavioral development is crucial, as pediatric OSA often masquerades as ADHD or learning difficulties. Incorporating myofunctional therapy, aimed at strengthening oropharyngeal muscles and promoting nasal breathing, has shown promising results in reducing OSA severity in children [28]. Moreover, Pediatric dentists work collaboratively with Otolaryngologists for comprehensive management, particularly in cases where adenotonsillectomy is indicated. Their involvement ensures a multidisciplinary approach that addresses both the underlying airway obstruction and its craniofacial consequences [29].

Role of Orthodontists in Diagnosis and Treatment of OSA

Orthodontists play a pivotal role in the diagnosis and management of Obstructive Sleep Apnea (OSA) by focusing on craniofacial skeletal discrepancies and dental malocclusions that contribute to upper airway obstruction [30]. It is well-established in the literature that anatomical features such as retrognathia, mandibular hypoplasia, narrow maxillary arches, and high-arched palates are common risk factors for OSA across both Pediatric and adult populations [31].

Diagnosis and Imaging

Orthodontic evaluation for OSA begins with a thorough clinical assessment, including history taking to identify symptoms like snoring, daytime sleepiness, and mouth breathing. Clinical examination is complemented by imaging modalities such as lateral cephalograms and cone-beam computed tomography (CBCT). CBCT allows three-dimensional visualization of the airway and skeletal structures, enabling precise identification of obstruction sites and quantification of airway volume [31]. For example, a patient with a retruded mandible may show significant narrowing at the oropharyngeal level on CBCT scans, which correlates with clinical symptoms of OSA.

Treatment Modalities and Functional Scenarios Rapid Maxillary Expansion (RME)

RME is a widely used Orthopedic technique to widen a constricted maxilla, which in turn increases nasal cavity volume and reduces nasal resistance, improving airflow during sleep. Consider a 7-year-old child presenting with habitual mouth breathing, snoring, and a narrow, high-arched palate. After clinical and polysomnographic confirmation of mild to moderate OSA, the orthodontist may recommend RME. Studies have demonstrated significant improvement in

apnea-hypopnea index (AHI) post-expansion, alongside subjective relief in symptoms. The expansion creates more space for the tongue and soft tissues, reducing airway collapse during sleep [31].

Mandibular Advancement Devices (Mads) And Functional Appliances

For adolescents and adults, functional appliances such as MADs are often employed to reposition the mandible anteriorly, thereby enlarging the retroglossal airway space. A common scenario involves an adult patient with mild to moderate OSA, retrognathia, and Class II malocclusion who refuses CPAP therapy. The Orthodontist fabricates a mandibular advancement appliance that protrudes the mandible during sleep, effectively preventing airway collapse. Clinical trials have reported up to 70% reduction in AHI and marked improvement in oxygen saturation with MAD use. In adolescents, functional appliances like twin-block or Herbst can be used to stimulate mandibular growth, addressing underlying skeletal deficiencies that contribute to OSA risk.

Pre-Surgical Orthodontic Preparation

Severe skeletal discrepancies causing OSA, such as micrognathia or maxillomandibular disproportion, may necessitate surgical intervention like maxillomandibular advancement (MMA). Orthodontists play a crucial role in presurgical treatment by aligning and coordinating dental arches to optimize surgical outcomes. For instance, an adult patient with severe OSA and mandibular deficiency undergoes orthodontic decompensation to allow for forward repositioning of the jaw during MMA surgery. Literature shows that MMA achieves up to 90% success rates in reducing OSA severity, with orthodontic preparation being essential for stability and occlusion [31].

Functional Integration and Monitoring

Throughout treatment, Orthodontists utilize periodic imaging and clinical evaluations to monitor skeletal changes, airway patency, and dental stability. Integration with sleep studies allows assessment of treatment efficacy beyond anatomical correction. Multidisciplinary collaboration with sleep physicians, ENT specialists, and Pediatric dentists is essential for holistic care. The use of CBCT not only aids in diagnosis but also allows customized appliance design and outcome evaluation.

This comprehensive approach highlights how orthodontists tailor interventions based on patient age, severity of OSA, and specific anatomical considerations. Through a combination of orthopedic expansion, mandibular advancement, and pre-surgical coordination, orthodontic management significantly contributes to improved airway function and quality of life in OSA patients.

Role of Prosthodontists in Diagnosis and Treatment of OSA

Prosthodontists predominantly manage adult patients with OSA, especially those who are noncompliant or intolerant to CPAP therapy, which remains the gold standard but often suffers from poor adherence [32]. Their expertise lies in the fabrication of custom oral appliances designed to maintain airway patency during sleep by advancing the mandible or stabilizing the tongue. Mandibular advancement devices (MADs), crafted by Prosthodontists, have demonstrated a 50-70% reduction in OSA severity and significant improvement in sleep quality [33]. Prosthodontists conduct thorough dental

and skeletal assessments to ensure that patients have sufficient dentition and jaw mobility for appliance retention and function. The customization process is critical to balance efficacy and comfort, reducing side effects such as temporomandibular joint (TMJ) discomfort and dental changes. Follow-up care includes regular adjustments and monitoring to optimize therapeutic outcomes. Prosthodontists collaborate closely with sleep medicine physicians and otolaryngologists to ensure coordinated care, particularly when oral appliance therapy is combined with other medical or surgical treatments^[34]. Their role is integral to expanding therapeutic options beyond CPAP and improving patient adherence and long-term management of OSA.

Discussion

United Front against Obstructive Sleep Apnea: The Power of Interdisciplinary Management

Obstructive Sleep Apnea (OSA) is a complex condition that demands a multidisciplinary approach for optimal diagnosis, treatment, and long-term management. No single specialty holds all the answers; rather, a coordinated team of Pediatric dentists, Orthodontists, Prosthodontists, Otolaryngologists (ENT), Speech therapists, and Myofunctional therapists can collectively address the multifactorial nature of OSA with greater precision and success^[34].

Importance of Collaborative Care

Early detection and effective management of OSA require integrating the unique expertise of each specialty. Pediatric dentists identify anatomical risk factors and initiate early interventions during crucial growth periods, while orthodontists provide structural corrections that optimize airway space. Prosthodontists offer custom oral appliances tailored to adult patients, especially those intolerant to CPAP, ensuring comfort and adherence. ENT specialists assess and treat upper airway obstructions surgically when indicated, such as adenotonsillar hypertrophy in children or nasal obstructions in adults. This collaborative model fosters comprehensive care that addresses both the underlying causes and symptoms of OSA, reducing morbidity and improving patient quality of life^[35].

Case Selection and Individualized Treatment Planning

Effective interdisciplinary management begins with careful case selection and personalized treatment plans. For example, a young child presenting with adenotonsillar hypertrophy and narrow maxilla may benefit from combined adenotonsillectomy, maxillary expansion by orthodontics, and myofunctional therapy to retrain breathing patterns. Conversely, an adult patient with retrognathia and moderate OSA might be managed with a mandibular advancement device fabricated by the prosthodontist, under the supervision of a Sleep physician and ENT surgeon. Each case demands tailored assessment to determine which combination of therapies will yield the best functional and anatomical outcomes^[35].

Role of Speech and Myofunctional Therapy

An often underutilized but essential component of interdisciplinary OSA care is **speech and myofunctional therapy**, which focuses on retraining oropharyngeal muscles to improve airway stability. Dysfunctional tongue posture, weak pharyngeal muscles, and mouth breathing contribute significantly to airway collapse during sleep. Myofunctional therapy exercises—such as tongue positioning, lip seal, and

nasal breathing training—complement dental and orthodontic treatments by enhancing muscle tone and coordination. Studies show that when combined with orthodontic or oral appliance therapy, myofunctional therapy can reduce apnea severity and improve long-term outcomes^[35].

Current Challenges and Research Gaps in Obstructive Sleep Apnea Management

Despite significant advances in understanding and managing Obstructive Sleep Apnea (OSA), several challenges continue to impede optimal care, highlighting critical gaps in research and clinical practice.

Diagnostic Limitations and Underdiagnosis

One of the foremost challenges is the underdiagnosis of OSA, especially in pediatric populations and dental settings. Many patients remain undetected due to nonspecific symptoms, lack of awareness among healthcare providers, and limited access to gold-standard diagnostic tools like polysomnography (PSG). The high cost and limited availability of sleep labs pose barriers, particularly in low-resource and rural areas. There is an urgent need for affordable, accessible, and validated screening tools that can be implemented in dental and primary care environments to facilitate early detection.

Standardization of Diagnostic Criteria and Tools

Variability in diagnostic criteria and classification systems for OSA complicates consistent identification and comparison of cases across studies and clinical practices. There is a pressing need to standardize diagnostic thresholds, including Apnea-Hypopnea Index (AHI) cut-offs tailored for different age groups, ethnicities, and comorbidities, to improve diagnostic accuracy and treatment planning.

Integration and Coordination of Multidisciplinary Care

Although the benefits of interdisciplinary management are recognized, effective integration of care among Pediatric dentists, Orthodontists, Prosthodontists, ENT specialists, and Sleep physicians remains limited. Communication gaps, fragmented healthcare systems, and unclear referral pathways often delay comprehensive treatment, leading to suboptimal patient outcomes. Research on models of collaborative care delivery, digital health platforms, and interprofessional education is needed to promote seamless teamwork.

Treatment Adherence and Long-Term Outcomes

Patient adherence to treatments such as mandibular advancement devices (MADs) and myofunctional therapy varies widely and impacts long-term efficacy. Understanding the factors that influence adherence—including device comfort, patient education, and behavioral support—remains an important research focus. Additionally, longitudinal studies evaluating sustained outcomes of dental and orthopedic interventions, particularly in children undergoing growth modification, are limited and warrant further exploration³⁶.

Gaps in Understanding Pathophysiology and Personalized Therapy

OSA is a heterogeneous disorder with multifactorial etiology involving anatomical, neuromuscular, and genetic factors. Current treatment algorithms often adopt a one-size-fits-all approach, overlooking patient-specific pathophysiological differences. There is a critical gap in identifying phenotypes and endotypes of OSA to enable personalized therapy tailored to individual anatomical and functional profiles. Advances in

imaging, biomarker discovery, and computational modeling may help bridge this gap.

Pediatric-Specific Challenges

In children, distinguishing OSA from behavioral or developmental disorders is challenging, often resulting in delayed or missed diagnosis. Moreover, evidence-based guidelines for dental and orthodontic interventions in Pediatric OSA are still evolving. Research on the long-term impact of early orthodontic treatments on airway development and neurocognitive outcomes is essential to optimize pediatric care^[36].

Addressing these challenges through targeted research, improved clinical protocols, and interdisciplinary collaboration will be crucial in reducing the global burden of OSA and enhancing patient quality of life.

Conclusion

Obstructive Sleep Apnea represents a complex and multifaceted health challenge that transcends traditional disciplinary boundaries. Early recognition and effective management require the combined expertise of Pediatric dentists, Orthodontists, Prosthodontists, ENT specialists, and allied health professionals working in concert. Through timely diagnosis, tailored interventions, and ongoing collaborative care, dental professionals play a pivotal role in mitigating the far-reaching consequences of OSA on growth, development, and overall health. Despite notable advances, continued research, enhanced interdisciplinary communication, and innovative treatment strategies are essential to bridge existing gaps and deliver personalized, comprehensive care. Embracing a unified, patient-centered approach not only improves clinical outcomes but also empowers individuals to reclaim restful sleep and healthier lives.

Conflict of Interest

Not available

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