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Sleep Apnea And Orthodontics: A Review

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Abstract
Obstructive Sleep Apnea (OSA) is a prevalent sleep-related breathing disorder characterized by recurrent episodes of upper airway collapse during sleep, leading to intermittent hypoxia, fragmented sleep, and increased cardiovascular and metabolic risks. With rising global prevalence, OSA poses a significant public health burden affecting quality of life and systemic health. Craniofacial morphology plays a pivotal role in its pathogenesis, as structural abnormalities such as maxillary constriction, mandibular retrusion, and airway narrowing predispose individuals to airway obstruction. Orthodontists are uniquely positioned to contribute to both diagnosis and management through cephalometric analysis, 3D imaging, and clinical assessment. Treatment options include rapid maxillary expansion, mandibular advancement devices, functional appliances, and adjunctive myofunctional therapies. Emerging approaches emphasize personalized orthodontic interventions integrated with medical care. Effective management of OSA requires an interdisciplinary framework combining orthodontics, sleep medicine, and otolaryngology to ensure long-term stability and improved patient outcomes.
Keywords: *Obstructive Sleep Apnea, Orthodontics, Craniofacial morphology, Mandibular advancement device, Interdisciplinary management*

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I. Introduction

Obstructive sleep apnea (OSA) is a common and serious sleep-related breathing disorder marked by recurrent episodes of partial or complete collapse of the upper airway during sleep, resulting in airflow limitation, oxygen desaturation, and sleep fragmentation.[1] Among the different types of sleep-disordered breathing, OSA is the most prevalent, accounting for nearly 85% of all cases. It leads to repetitive hypopneas (shallow breathing) or apneas (cessation of breathing for ≥10 seconds), often accompanied by arousals and significant drops in oxygen saturation.[2] These disturbances impair sleep quality and contribute to excessive daytime sleepiness, reduced productivity, and increased risk of accidents. Moreover, OSA is strongly associated with cardiovascular disease, hypertension, stroke, obesity, type II diabetes, and neurocognitive dysfunctions, including memory deficits and depression.[3]

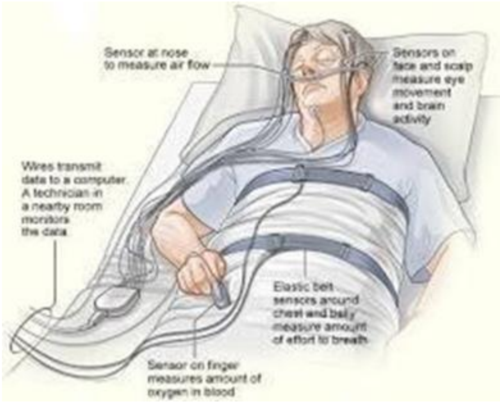
The upper airway (UA) plays a central role in the pathophysiology of OSA. Structurally, it extends from the nasal cavity and pharynx to the larynx, with the pharynx being most relevant to orthodontists due to its proximity to craniofacial structures. The pharynx is divided into three regions: the nasopharynx, oropharynx, and hypopharynx, with the velopharynx being a critical site of obstruction in OSA. Unlike the rigid trachea, the UA is a collapsible structure whose patency depends on surrounding soft tissues, neural control, and pharyngeal dilator muscle activity.[4] During sleep, reduced muscle tone—particularly in the tongue, soft palate, and lateral pharyngeal walls—predisposes the airway to collapse, most commonly at the retropalatal and retrolingual levels. Patients with mild OSA often exhibit single-level obstruction, while multilevel obstruction is characteristic of severe disease.[5]

Although OSA may affect individuals of any age, it is most prevalent in middle-aged adults, particularly men, with estimated symptomatic prevalence rates of 24% in males and 9% in females. Alarmingly, up to 85–95% of individuals with OSA remain undiagnosed. Pediatric OSA, affecting around 3% of children, is most common during the preschool years and is frequently associated with adenotonsillar hypertrophy.[6]

Beyond OSA, other forms of sleep apnea include central sleep apnea (CSA), caused by impaired neural respiratory drive, and mixed sleep apnea (MSA), which combines obstructive and central features. However, given its high prevalence and direct links to craniofacial anatomy, OSA is of particular relevance to orthodontists, who are well positioned to identify structural risk factors, aid in diagnosis, and contribute to multidisciplinary management.[7] This article gives an overview about Sleep Apnea and Orthodontics.

Diagnosis and Risk Assessment of Obstructive Sleep Apnea

The diagnosis of obstructive sleep apnea (OSA) relies primarily on polysomnography (PSG), which is considered the gold standard for assessing sleep-related breathing disorders. PSG simultaneously monitors multiple physiological parameters, including airflow, oxygen saturation, respiratory effort, heart rate, brain activity, and body position, thereby providing a comprehensive evaluation of sleep quality and breathing patterns. A key diagnostic index obtained from PSG is the apnea–hypopnea index (AHI), which quantifies the number of apneic and hypopneic episodes per hour of sleep.



Polysomnography (PSG)

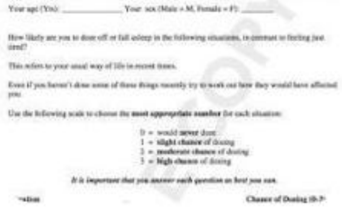
In adults, OSA severity is classified as mild (5≤AHI<15 events/hour), moderate (15≤AHI<30 events/hour), or severe (AHI≥30 events/hour). In contrast, children are diagnosed with OSA when AHI ≥1, with severity stratified into mild (1≤AHI<5 events/hour), moderate (5≤AHI<10 events/hour), and severe (AHI≥10 events/hour).[8]

Instruments such as the Berlin Questionnaire, STOP-BANG, Pediatric Sleep Questionnaire (PSQ), and Epworth Sleepiness Scale (ESS) are widely used. Among these, STOP-BANG has demonstrated high sensitivity in identifying adults at risk of moderate-to-severe OSA, while pediatric-specific tools such as the PSQ provide structured screening in children.[9]

Berlin Questionnaire

Stop-Bang

PSQ-Pediatric Sleep Questionnaire

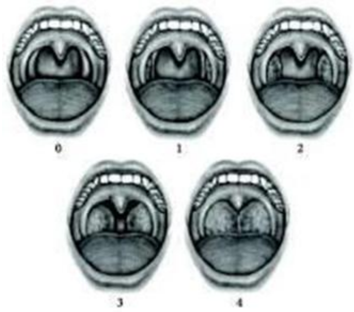


Epiworth Sleepiness Scale

Routine dental visits, typically recommended every 4–6 months, allow dental professionals to recognize potential risk factors, such as craniofacial abnormalities, narrow upper airways, enlarged tonsils, macroglossia, mandibular retrusion, or obesity. Notably, overweight individuals have double the risk of OSA, and the risk is nearly fourfold in obese patients compared with non-obese counterparts.

Clinical assessments such as Mallampati scoring (for tongue size relative to the oral cavity) and Brodsky grading (for tonsillar hypertrophy) provide practical chairside methods of estimating upper airway collapsibility. Similarly, macroglossia, adenoidal hypertrophy, or enlarged uvula are established anatomic contributors to airway obstruction. In pediatric patients, adenoids represent the most common risk factor, with chronic hypertrophy often presenting with mouth breathing, recurrent infections, and facial features such as a high-arched palate or increased vertical facial height—often referred to as "adenoid facies." These clinical observations underscore the need for orthodontists and dentists to collaborate closely with sleep physicians and otolaryngologists when such risk factors are identified.[10]

Mallampati scoring



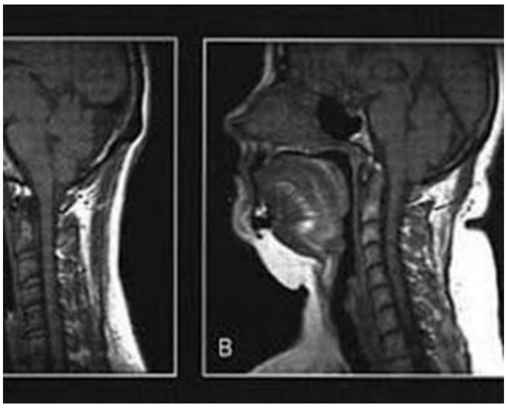
Brodsky grading

Beyond clinical screening, several diagnostic tools complement PSG in airway evaluation. Home sleep apnea testing (HSAT) has gained popularity due to its cost-effectiveness and convenience. Unlike laboratory PSG, HSAT can be self-administered and primarily measures airflow, respiratory effort, and oxygen saturation. While it offers high sensitivity and specificity for diagnosing OSA, it cannot assess sleep stages, leg movements, or other sleep disorders, and false negatives remain possible. Imaging modalities also hold relevance in orthodontic practice. Cone-beam computed tomography (CBCT) provides three-dimensional evaluation of craniofacial structures, airway spaces, and minimum cross-sectional areas, which may correlate with increased risk of obstruction.[11]

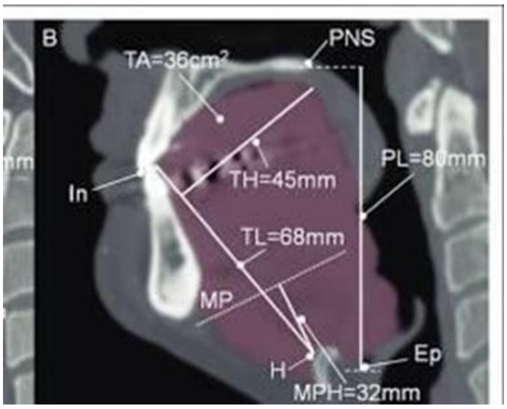
Home sleep apnea testing (HSAT)

Cone-beam computed tomography (CBCT)

Although CBCT captures only static images of a dynamic airway and cannot confirm OSA diagnosis, it remains a valuable tool for orthodontic airway assessment and surgical planning. Other imaging modalities, such as MRI, offer superior soft-tissue visualization without radiation exposure, while conventional CT provides excellent detail at the expense of higher radiation doses. Complementary examinations, including nasoendoscopy, acoustic rhinometry, and acoustic pharyngometry, allow for direct or functional visualization of airway structures, each with distinct advantages and limitations.[12]

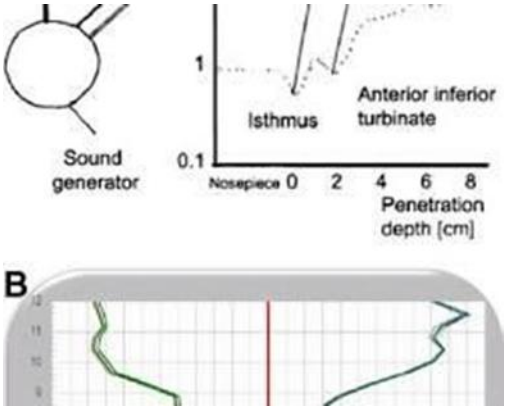


MRI scan for sleep apnea



CT scan for sleep apnea

Ultrasonography has emerged as a promising noninvasive tool in OSA assessment, particularly due to its portability, low cost, and absence of radiation exposure. Early ultrasound studies primarily examined static anatomical features, whereas recent advances focus on airway collapsibility and dynamic soft-tissue function, providing insights into the neuromuscular mechanisms underlying OSA. Submental ultrasound, for example, has been explored to correlate pharyngeal parameters with OSA severity, further enhancing its utility as a screening modality.



Acoustic rhinometry

Ultrasonography for sleep apnea

In addition, oral manifestations such as xerostomia, halitosis, periodontal disease, bruxism- related tooth wear, and dental erosion secondary to gastroesophageal reflux disease (GERD) may also alert dental professionals to the presence of OSA. Orthodontists must therefore incorporate both intraoral and extraoral examination findings into risk assessments.[13]

The Mallampati score, introduced in 1985, is a simple clinical tool used to predict difficult intubation by assessing oropharyngeal structures and is graded on a 1–4 scale, depending on the visibility of the tonsils, uvula, and palate. Patients scoring 3 or 4 are often considered at higher risk for obstructive sleep apnea (OSA) due to the association between tongue size, airway patency, and sleep-disordered breathing. While some studies have shown a strong correlation between Mallampati score, apnea–hypopnea index (AHI), and tonsil sizeparticularly in pediatric populations—others suggest its reliability is limited, with factors like BMI, age, and gender being more accurate predictors of OSA severity in adults.

The respiratory disturbance index (RDI), derived from PSG, further quantifies the frequency of apneic and hypopneic events across different sleep stages, and aids in severity classification. From an orthodontic standpoint, while direct diagnosis is outside the professional scope, the ability to identify craniofacial and intraoral risk factors, record anthropometric measures such as body mass index (BMI) and neck circumference, and refer at-risk individuals for appropriate testing, positions orthodontists as vital contributors to the interdisciplinary management of OSA.[14,15]

Relationship Between Craniofacial Abnormalities, Malocclusion, and OSA

A growing body of evidence suggests a strong link between craniofacial abnormalities, malocclusion, and the development of obstructive sleep apnea (OSA). A large systematic review and meta-analysis by Lombardo (2020), synthesizing 77 studies, reported that the worldwide prevalence of malocclusion is as high as 56%, with the highest rates found in Africa (81%) and Europe (72%), followed by the Americas (53%) and Asia (48%), providing high- quality evidence of its global burden.[15] Similarly, Alhammadi (2018), in a systematic review of 53 studies, highlighted geographic and racial variations, noting that Class I malocclusion was most common in Africa (89%), Class II malocclusion was predominant among Caucasians (23%), while Class III was more frequent in Mongoloid populations, offering moderate-level evidence.[16] From an etiological perspective, Miles (1996), through a meta-analysis of 143 studies, concluded that only specific craniofacial features—such as mandibular length, mandibular plane angle, and the mandibular–hyoid relationship—showed a strong correlation with OSA, though the quality of evidence was low. More recent observational studies provide further insights: Banabilh (2010) reported that Malay adults with OSA exhibited a higher prevalence of convex facial profiles (71%) and Class II malocclusion (51%), while Lam (2005) found that OSA patients had significantly higher thyromental angles and Mallampati scores compared to controls. Likewise, Johal (2004) demonstrated that male OSA patients exhibited more obtuse palatal angles, narrower minimum palatal airway widths, and greater palatal heights, suggesting maxillary morphological differences as contributory factors. Earlier, Jamieson (1987) provided foundational evidence through cephalometric analysis, showing that retruded mandibles, altered cranial base flexion, and inferior hyoid bone displacement were common among OSA patients.[17,18,19]

Management

The management of obstructive sleep apnea (OSA) requires a multidisciplinary approach, drawing from both medical and dental specialties, with treatment options broadly divided into behavioral, nonsurgical, and surgical modalities. According to the American Academy of Sleep Medicine (AASM), patients with OSA have five conventional and eight surgical therapy options. Lifestyle and behavioral modifications, such as weight reduction, aerobic and oropharyngeal exercises, sleep posture adjustments, and good sleep hygiene practices, form the first line of therapy, with cognitive behavioral strategies aimed at reducing risk factors that exacerbate OSA.

Positive airway pressure devices, particularly Continuous Positive Airway Pressure (CPAP), and oral appliances like mandibular advancement devices (MAD) represent the most effective nonsurgical alternatives, often considered standard care. Surgical interventions are typically reserved for patients who fail conservative therapies and include procedures such as uvulopalatopharyngoplasty, glossectomy, adenotonsillectomy, tracheostomy, nasal surgery, maxillomandibular advancement (orthognathic surgery), and in select cases, bariatric surgery to aid weight loss, or hypoglossal nerve stimulation. Regardless of the chosen therapy, all OSA patients are strongly advised to avoid alcohol and sedatives, as these worsen upper airway collapse. While weight loss has been shown to improve airway patency and reduce apnea episodes in some individuals, the role of pharmacotherapy remains unclear, with its clinical effectiveness and long-term feasibility yet to be fully established.[20,21]

Behavioral Changes in the Management of OSA

Behavioral modifications form the first line of non-invasive therapy for obstructive sleep apnea (OSA), aiming to improve airway patency and overall sleep quality. Weight loss is particularly significant, as obesity increases pharyngeal fat deposition and airway collapse, while lifestyle interventions such as aerobic exercise, dietary changes, alcohol and tobacco cessation, and sleep hygiene practices have shown marked improvements in apnea-hypopnea index (AHI) and quality of life. Aerobic exercises not only aid weight reduction but also benefit cardiometabolic health, though adherence can be difficult in individuals with comorbidities. Oropharyngeal (myofunctional) exercises, targeting the tongue, soft palate, and pharyngeal muscles, have been shown in randomized clinical trials to reduce OSA severity and primary snoring by strengthening and coordinating upper airway muscles, though their effectiveness is limited by poor long-term compliance.[22]

Positional therapy is another effective adjunct, particularly in positional OSA, as sleeping in a lateral decubitus position enlarges the retroglossal airway; modern approaches even employ smartphone-based vibration alarms to discourage supine sleep. Sleep hygiene practices, including maintaining a quiet and dark sleep environment, limiting caffeine, alcohol, and late meals, reducing screen exposure before bedtime, and establishing a consistent routine, further optimize restorative sleep. However, while these behavioral changes can significantly complement OSA management, they are best considered supportive strategies alongside other primary interventions such as CPAP or oral appliances rather than standalone treatments.[23]

Positive airway pressure (PAP) devices are considered the gold standard therapy for obstructive sleep apnea (OSA), central sleep apnea, and chronic hypoventilation, offering strong evidence of efficacy in eliminating airway collapse, snoring, hypopnea, and obstruction events. These devices function by delivering a continuous flow of pressurized air via a mask fitted to the mouth, nose, or both, thereby maintaining pharyngeal patency during sleep. Common types include continuous positive airway pressure (CPAP), bilevel positive pressure (BPAP), and auto-adjusting positive pressure (APAP), with their administration strictly under medical supervision rather than dental practice. Despite their high effectiveness, adherence remains a major limitation, as many patients find long-term use challenging.[24,25,26]

Mandibular Advancement Devices (MADs) in OSA Treatment

Mandibular advancement devices (MADs) are intraoral appliances designed to reposition the mandible forward during sleep, thereby enlarging the upper airway, reducing collapsibility, and improving airflow. Their mechanisms of action include advancing the tongue, soft palate, and hyoid bone, widening the velopharyngeal airway, and stimulating airway dilator muscles. MADs are widely used in the management of primary snoring and mild to moderate obstructive sleep apnea (OSA), and are also beneficial for severe OSA patients intolerant to CPAP.[27] Clinical studies report that MADs significantly reduce apnea–hypopnea index (AHI), daytime sleepiness, and snoring, with success often defined as a ≥50% reduction in AHI or a downgrade in disease severity. While they do not cure OSA, MADs consistently improve sleep quality and oxygen saturation.[28] Devices may be prefabricated or customized, monoblock or titratable, with custom titratable designs offering superior comfort and outcomes. Treatment involves stepwise mandibular advancement ("titration") over several months to optimize efficacy and tolerance.[29] Side effects are generally mild and include salivary changes, muscle or TMJ discomfort, and occlusal alterations such as reduced overjet and overbite, though most are clinically insignificant and manageable. Long-term use can cause minor dental movements and skeletal changes, requiring periodic monitoring.

MADs are generally well tolerated, with high adherence compared to CPAP, and may also be combined with PAP therapy to reduce airway pressure needs in severe cases. In growing patients, MADs are sometimes combined with rapid maxillary expansion, though their long- term skeletal effects remain uncertain. Overall, MADs represent a safe, effective, and patient- friendly treatment option within multidisciplinary OSA management, especially when administered by trained dental professionals.[30,31]

Oral Appliance Therapy (OAT) and Tongue Stabilizing Devices (TSD) in OSA Management

Oral sleep appliances represent the leading alternative to positive airway pressure (PAP) devices, with high tolerance and adherence reported both subjectively and through objective monitoring. The American Academy of Dental Sleep Medicine (AADSM) has defined mandibular advancement devices (MADs) as the standard oral appliance for treating obstructive sleep apnea (OSA) and primary snoring. MADs function by repositioning the mandible forward, thereby enlarging the upper airway and preventing collapse during sleep.[32] Clinical efficacy is measured through polysomnography (PSG) parameters, such as reductions in apnea–hypopnea index (AHI) and improvements in oxygen saturation, alongside non-PSG measures like the Epworth Sleepiness Scale (ESS), quality of life, cardiovascular outcomes, and cognitive function. Complete therapeutic response to MADs occurs in about one-third of patients, with another third achieving partial response. Although PAP is more efficacious in eliminating respiratory events, MADs demonstrate comparable effectiveness in improving health outcomes due to higher adherence rates.[33]

Factors associated with better response include mild-to-moderate AHI, younger age, lower BMI, smaller neck circumference, and sometimes positional OSA, though variability exists. Custom titratable devices are recommended, designed to be retentive, durable, and adjustable in small increments.[34] Candidacy requires sufficient and healthy dentition to support retention, and contraindications may include compromised periodontal health, missing teeth, or bruxism. Titration may be subjective (symptom-based) or objective (PSG-guided), and long-term follow-up is critical to monitor adherence, side effects, and efficacy. While OAT does not cure OSA, it provides long-term control, though side effects may occur, including short-term discomfort, dry mouth, salivation changes, and long-term occlusal alterations. To mitigate dental changes, morning occlusal guides are recommended to reposition the mandible after nightly use.[35]

Tongue stabilizing devices (TSDs), in contrast, are silicone-based appliances that use suction to hold the tongue forward, stretching the upper airway tissues and preventing collapse. Unlike MADs, they do not rely on teeth for retention, making them suitable for edentulous patients, those with poor dental health, or patients intolerant to mandibular advancement. Clinical trials have demonstrated that both MADs and TSDs significantly reduce AHI and improve symptoms, with MADs generally showing higher complete response rates, better acceptance, and improved compliance. TSDs remain valuable alternatives for specific patient populations, though side effects such as transient morning tongue numbness or irritation at the tongue tie region are common but typically resolve quickly. Overall, OAT with MADs remains the gold standard oral therapy, while TSDs provide an important option for patients with contraindications to mandibular advancement.[36,37]

Rapid Maxillary Expansion in the Management of OSA

Rapid maxillary expansion (RME) has emerged as a potential adjunctive therapy in managing obstructive sleep apnea (OSA), particularly in pediatric patients who remain symptomatic after adenotonsillectomy.[38] While adenotonsillectomy has long been established as an effective intervention for children with sleep-disordered breathing (SDB), not all patients are surgical candidates, prompting interest in orthodontic alternatives. RME, first suggested by Haas in 1970 for inadequate nasal breathing, significantly increases nasal airway volume, oropharyngeal space, and minimal nasal cross-sectional area, thereby improving nasal airflow and reducing resistance. Although several studies support its positive effects on breathing, others report no significant correlation with polysomnographic parameters, suggesting that only certain phenotypes benefit from the procedure.[39] Evidence demonstrates improvements in quality of life, sleep duration, apnea–hypopnea index (AHI), and sleep architecture in children with transverse maxillary deficiency and persistent

OSA post-adenotonsillectomy, though normalization of sleep patterns is not always achieved. Importantly, long-term studies indicate that RME can maintain positive outcomes for over a decade, though the lack of control groups warrants cautious interpretation.[40]

In adults, effective expansion often requires adjunctive procedures such as mini-implant- assisted rapid palatal expansion (MARPE) or distraction osteogenesis maxillary expansion (DOME), which have shown improvements in OSA severity, nasal obstruction, and REM sleep quality. However, research gaps remain, particularly regarding standardized definitions of a "narrow maxilla," the relationship between expansion magnitude and therapeutic outcomes, and integration of polysomnography as a primary endpoint.[41] Additionally, craniofacial and airway assessments, including tonsillar hypertrophy (graded by Brodsky's scale), nasal septum deviation, and turbinate hypertrophy, are essential, as these anatomical and neuromuscular factors often coexist with OSA. Dentists play a crucial role in screening patients for maxillary constriction and airway abnormalities, facilitating referrals to otolaryngologists when necessary.[42,43]

Surgical and Orthodontic Interventions in the Management of OSA

Surgical and orthodontic approaches play a significant role in the management of obstructive sleep apnea (OSA), particularly in patients who are intolerant to conventional therapies such as CPAP. Uvulopalatopharyngoplasty (UPFP), introduced in 1981, involves resection of the uvula and posterior soft palate to enlarge the velopharyngeal space and may be combined with multilevel airway surgeries, though its long-term effectiveness remains limited, leading the American Academy of Sleep Medicine to recommend against its use as a standalone treatment. Maxillomandibular advancement surgery (MMAS), performed with Le Fort I osteotomies in the maxilla and sagittal split osteotomies in the mandible, enlarges the upper airway by advancing the facial framework and is considered the most effective surgical treatment for OSA, especially in severe cases or CPAP-refractory patients, with strong evidence of long-term stability and superiority over multilevel surgery.[44]

Other surgical options include nasal procedures such as turbinectomy and septoplasty, often used in isolation or alongside orthognathic surgery to improve airway patency, while bariatric surgery may benefit obese OSA patients.[45] More recently, hypoglossal nerve stimulation has been developed as an innovative alternative for moderate-to-severe OSA in CPAP-intolerant patients, using an implanted neurostimulator to activate the genioglossus muscle and prevent airway collapse, with systematic reviews confirming significant improvements in apnea– hypopnea index (AHI), sleepiness, and quality of life, albeit at high cost and with potential complications. Orthodontic-assisted surgical options, such as miniscrew-assisted rapid palatal expansion (MARPE), minimally invasive MARPE (MISMARPE), and surgically assisted rapid palatal expansion (SARPE), aim to overcome sutural resistance in skeletally mature patients and have shown variable results, with some studies reporting reduced AHI and improved respiratory outcomes, though long-term evidence remains insufficient.

Orthognathic surgery, especially double jaw advancement with counterclockwise occlusal plane rotation, offers substantial improvements in airway dimensions and OSA severity, though isolated mandibular setback procedures have been associated with increased OSA risk, supporting the preference for bimaxillary approaches in Class III patients.[46] Additionally, concerns have been raised regarding orthodontic treatments involving first premolar extractions, which may alter tongue positioning and dental arch length; however, systematic reviews consistently indicate no significant effect on airway dimensions or respiratory function, undermining the theory that extractions contribute to OSA development. [47]

Emerging Role of Smartphone Applications and Sleep Assessment Technologies in OSA Management

The rapid growth of smartphones has fueled the development of mobile applications and technological devices increasingly integrated into daily life, particularly in healthcare, where interest in sleep and respiratory disorders continues to rise. Sleep assessment technology devices (SATDs), also known as consumer sleep technology (CST), are being explored as potential alternatives to conventional diagnostic tests, offering affordable, accessible, and continuous home monitoring of sleep-disordered breathing (SDB). However, their clinical reliability remains questionable, as many apps are still in early development stages, with limited validation and variable accuracy compared to polysomnography (PSG). The American Academy of Sleep Medicine (AASM) recommends that CST devices must undergo strict FDA evaluation before being considered for diagnostic or therapeutic use, emphasizing that they should not replace professional medical assessment.[48] Systematic reviews have identified hundreds of sleep-related apps, but only a small fraction meet scientific inclusion criteria for clinical use, with mixed outcomes: while some, like ResMed MyAir and Apnea-Q, demonstrate improved CPAP adherence, others, such as common sleep monitoring apps, fail to show strong correlation with PSG.[49]

Innovative tools such as orofacial myofunctional therapy apps (e.g., Airway Gym, Snoretech) and positional therapy apps (e.g., Apnea Sleep Position Trainer) show promise in reducing apnea–hypopnea index

(AHI) and improving patient outcomes, though larger trials are needed. Current SATDs are available as both wearables (wristbands, rings, headbands) and non-wearables (devices placed near the user), but until algorithms, calculations, and validation processes become standardized and peer-reviewed, their role should remain adjunctive rather than primary in diagnosis or treatment. Looking forward, collaboration between academia and industry is critical to improving accuracy, safety, and reliability, with future directions focusing on raising awareness of OSA and SDB among professionals and the public, conducting robust validation studies, and harnessing artificial intelligence and machine learning for more precise diagnostics and individualized therapy. While these technologies hold great potential for revolutionizing OSA management, they should currently be used with caution, complementing but not replacing traditional methods.[50]

II. Conclusion

Orthodontists are key contributors in the early detection and management of sleep apnea, particularly through interventions such as rapid maxillary expansion, mandibular advancement devices, and functional appliances. These approaches are especially effective in pediatric cases. Moving forward, interdisciplinary collaboration, advanced imaging, and personalized treatment strategies will be essential to optimize outcomes in OSA care.

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