

Review

PEDIATRIC OBSTRUCTIVE SLEEP APNEA AND FUNCTIONAL APPLIANCES: A NARRATIVE REVIEW

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ABSTRACT

Pediatric obstructive sleep apnea (OSA) is frequently associated with craniofacial abnormalities, including mandibular retrusion. Mandibular advancement appliances (MAAs) have emerged as a non-surgical therapeutic option, although their clinical effectiveness remains debated. This review critically synthesizes and discusses current evidence on the effects of mandibular advancement appliances on respiratory outcomes, airway morphology, craniofacial changes, and clinical symptoms in children with obstructive sleep apnea.

KEYWORDS: *sleep apnea, obstructive, mandibular advancement, orthodontic appliances*

INTRODUCTION

Pediatric obstructive sleep apnea (OSA) is frequently associated with craniofacial abnormalities, including mandibular retrusion. Mandibular advancement appliances (MAAs) have emerged as a non-surgical therapeutic option, although their clinical effectiveness remains debated. This review critically synthesizes and discusses current evidence on the effects of mandibular advancement appliances on respiratory outcomes, airway morphology, craniofacial changes, and clinical symptoms in children with obstructive sleep apnea.

Obstructive sleep apnea (OSA) is a sleep-associated respiratory disorder characterized by repeated episodes of partial or complete collapse of the upper airway despite continued respiratory effort (1). These events result in abnormal breathing, reduced ventilation, and fragmentation of normal sleep architecture (1, 2). OSA encompasses a broad clinical continuum, ranging from habitual snoring to more severe conditions, including upper airway resistance syndrome and clinically defined obstructive sleep apnea syndrome (1). It may affect adults or children, with different causes but similar effects (3). Pediatric obstructive sleep apnea was first recognized in 1976 (4), and in 1981, Guilleminault et al. reported

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on a series of 50 pediatric cases, highlighting that the clinical features of OSA in children differ significantly from those observed in adults. They noted that affected children more commonly exhibited disrupted nocturnal sleep rather than pronounced daytime sleepiness and frequently presented with behavioral disturbances. These included school-related difficulties such as impaired attention, poor academic performance, and hyperactivity, symptoms consistent with attention-deficit/hyperactivity disorder. Additional manifestations included nocturnal enuresis, sleep terrors, sleepwalking, confusional arousals-grouped under non-REM parasomnias-as well as depression, insomnia, and other psychiatric concerns (5).

In children, OSA most commonly arises from adenotonsillar enlargement, craniofacial structural abnormalities, or reduced neuromuscular tone (1). It has also been reported that missing teeth, whether due to syndromic or non-syndromic causes, may influence oral development and favor upper airway collapse during sleep (6, 7). Several preliminary investigations have suggested that orthodontic correction of maxillary and mandibular abnormalities may be an effective therapeutic approach in pediatric patients with OSA (8). Orthodontists have a key role in the early detection and management of pediatric OSA. Growth-modifying interventions can help improve compromised airway dimensions and contribute to favorable long-term therapeutic outcomes (9,10). Orthopedic mandibular advancement appliances function by positioning the mandible in a forward direction, thereby advancing the associated soft tissue structures. This forward displacement increases the volume of the posterior pharyngeal airway and reduces the propensity for airway collapse during sleep.

In children with OSA who are still in an active growth phase, this mechanism has been shown not only to improve apnea-hypopnea index (AHI) values but also to stimulate growth at the condylar region, resulting in an additional increase in overall mandibular length. Short-term use of these appliances has demonstrated improvements in AHI; however, the available evidence remains limited. Further studies are required to determine the effectiveness of this approach in the management of pediatric OSA (11).

MATERIALS AND METHODS

An electronic literature search was conducted in MEDLINE (via PubMed) to identify studies published between 1 January 2015 and 1 January 2026. The search strategy combined controlled vocabulary (MeSH) and free-text terms related to obstructive sleep apnea (OSA), the pediatric population, and mandibular advancement functional orthodontic appliances. The full search string was: ("*Sleep Apnea, Obstructive*"(Mesh) OR "*Sleep Apnea Syndromes*"(Mesh) OR "*sleep-disordered breathing*" OR "*obstructive sleep apnea*" or "*sleep apnea*") AND ("*Child*"(Mesh) OR "*Adolescent*"(Mesh) OR *child** OR *pediatric** OR *paediatric**) AND ("*Orthodontic Appliances, Functional*"(Mesh) OR "*functional appliance*" OR "*mandibular advancement*" OR "*twin block*" OR *herbst*).

The search yielded 240 records. Records were managed and screened in a stepwise selection process. Titles and abstracts were screened for relevance. Records not meeting the scope of the review were excluded. The remaining articles underwent full-text retrieval; studies were excluded when the full text was unavailable or eligibility criteria were not met. Full-text articles were then assessed in detail. At the end, 28 studies were included in the final review. Eligibility criteria were defined a priori using a PCC framework:

- Population (P): children and adolescents under 16 years of age diagnosed with a sleep-disordered breathing and treated with mandibular advancement functional orthopedic appliances; no restrictions by sex;
- Concept (C): use of mandibular advancement functional orthopedic appliances in the management of pediatric OSA, specifically in combination with maxillary expansion;
- Context (C): orthodontic and functional orthopedic treatment delivered in clinical settings for pediatric patients, with outcomes relevant to OSA.

RESULTS

This narrative review synthesizes current evidence on the role of mandibular advancement appliances (MAAs) and related functional orthopedic devices in the management of pediatric obstructive sleep apnea (OSA), whereas the role of maxillary expanders has already been reported and vastly discussed in the literature (12, 13). Overall, the literature suggests that mandibular advancement is associated with clinically meaningful improvements in respiratory parameters, airway morphology, and patient-reported outcomes in selected pediatric populations, although the strength and consistency of the evidence are limited by substantial heterogeneity and variable methodological quality across studies (11, 14-20).

Effects on respiratory outcomes

Across multiple systematic reviews, meta-analyses, and controlled studies, MAAs were generally associated with reductions in the apnea-hypopnea index (AHI), with reported mean decreases ranging from modest (approximately 1.7-2.2 events/h) to marked reductions exceeding 50% in selected cohorts (8, 14, 18, 19, 21-23). Notably, one large meta-analysis reported an 89% reduction in AHI accompanied by a substantial improvement in lowest oxygen saturation (LSAT), highlighting the potential magnitude of treatment effect under optimal conditions (24). Similar findings were reported in pooled analyses focusing on Twin-block therapy and modified monoblock appliances, which demonstrated significant reductions in AHI despite considerable interstudy heterogeneity (16, 21, 25). However, several meta-analyses failed to demonstrate statistically significant overall reductions in AHI, despite favorable mean differences, underscoring the variability in treatment response (11, 17).

Heterogeneity was consistently attributed to differences in appliance design, treatment duration, baseline OSA severity, diagnostic modality, and study design. Importantly, studies employing full polysomnography tended to report more pronounced and reliable reductions in AHI than those using portable sleep monitoring (8, 16, 17), underscoring the importance of standardized outcome assessment. Improvements in oxygenation parameters appeared more consistent than AHI reductions across the literature. Significant increases in mean and minimum oxygen saturation, as well as reductions in oxygen desaturation indices and snoring time, were reported in multiple studies and meta-analyses (14, 18, 22, 24-26). Nevertheless, subgroup analyses suggested that these effects varied by appliance type, with silicon-based or modified monoblock devices demonstrating greater oxygenation benefits than traditional Twin-block appliances in some reports (16, 17).

Airway morphology and craniofacial effects

Cephalometric and imaging studies consistently demonstrated enlargement of the upper airway following mandibular advancement therapy, particularly at the oropharyngeal and hypopharyngeal levels (27-34). Reported changes included increases in airway volume, minimum cross-sectional area, and anteroposterior and lateral airway dimensions, often accompanied by favorable modifications in tongue posture and hyoid bone position (27, 30, 33). These morphological adaptations provide a plausible anatomical basis for the observed improvements in respiratory function.

Skeletal effects were also frequently reported in growing patients, including increases in SNB angle, reductions in ANB, mandibular lengthening, and marked decreases in overjet (27, 30-33). In some studies, these changes were accompanied by reductions in adenoid thickness, tonsillar size, and Mallampati score, suggesting that mandibular advancement may influence multiple anatomical contributors to airway obstruction (27, 31, 33). Nevertheless, the long-term stability of these skeletal and airway changes remains uncertain, as post-treatment assessments were often performed with the appliance in situ, making it difficult to distinguish between transient mandibular repositioning and permanent growth-related adaptations (11, 15, 20, 35).

Treatment duration, timing, and patient selection

Treatment duration and timing relative to craniofacial growth emerged as key determinants of efficacy. Several reviews and subgroup analyses indicated that longer treatment durations (≥ 6 months) were associated with greater and more stable reductions in AHI and more pronounced airway changes (18-21). Initiation of therapy before or during the pubertal growth phase appeared particularly advantageous, especially in patients with skeletal Class II malocclusion and mandibular retrusion (11, 18, 28, 36). Subgroup analyses further suggested that children with more severe OSA or greater craniofacial imbalance may experience larger treatment effects, while age alone did not consistently modify outcomes (14, 18, 21). Despite these trends, there remains no consensus regarding optimal advancement protocols, titration strategies, daily wear time, or total treatment duration. Moreover, compliance, although generally reported as good, was rarely assessed objectively, limiting interpretation of dose-response relationships and long-term effectiveness (11, 22, 23, 37).

Clinical outcomes, tolerability, and safety

Beyond polysomnographic outcomes, several studies reported improvements in sleep quality, daytime and nighttime symptoms, behavior, cognition, and quality of life, as measured by validated instruments such as the OSA-18, PSQ, ESS, and Sleep Disturbance Scale for Children (14, 18, 22, 26, 31). These patient-centered outcomes are particularly relevant in pediatric OSA, given its well-documented neurobehavioral sequelae.

MAAs were generally well tolerated, with low dropout rates and predominantly mild, transient adverse effects, such as initial discomfort or excessive salivation (22, 26, 33). Dental and occlusal changes were the most commonly

reported long-term concerns, while temporomandibular joint symptoms were infrequent and usually reversible (11, 20, 35). However, the limited follow-up duration in most studies precludes definitive conclusions regarding long-term safety, relapse risk, and effects on temporomandibular joint health or sleep architecture (20, 38).

Limitations of the current evidence and future directions

Despite the overall favorable trend, the available evidence is constrained by small sample sizes, heterogeneous study designs, inconsistent reporting of outcomes, and a predominance of low- to moderate-quality studies (11, 17-20, 37). Asymmetry in funnel plots and selective reporting raise concerns about publication bias in several meta-analyses (17, 24). Furthermore, substantial overlap among primary studies included in multiple systematic and umbrella reviews highlights redundancy in the literature and underscores the need for new, high-quality primary research (19, 20). Future investigations should prioritize well-designed randomized controlled trials with standardized diagnostic criteria, uniform outcome measures, objective compliance monitoring, and long-term follow-up. Particular emphasis should be placed on distinguishing temporary appliance-dependent effects from stable skeletal and airway adaptations, as well as on evaluating MAAs within a multidisciplinary treatment framework that includes adenotonsillectomy, rapid maxillary expansion, and myofunctional therapy (11, 18, 20, 39).

DISCUSSION

This narrative review highlights the potential role of mandibular advancement appliances (MAAs) as a non-invasive therapeutic option for pediatric obstructive sleep apnea (OSA), particularly in children with craniofacial abnormalities, such as mandibular retrusion. Overall, the available evidence suggests that MAAs are associated with short-term improvements in key polysomnographic parameters, including reductions in the apnea-hypopnea index (AHI) and improvements in oxygenation, although results vary across studies (14, 16-21, 24, 25). Imaging and cephalometric studies consistently demonstrate enlargement of the upper airway following mandibular advancement, particularly at the oropharyngeal and hypopharyngeal levels, accompanied by favorable changes in tongue posture, hyoid bone position, and mandibular skeletal relationships (27-34). These anatomical adaptations provide a plausible mechanistic explanation for the observed improvements in respiratory outcomes. In addition, several studies report clinically relevant benefits in sleep quality, daytime and nighttime symptoms, behavior, and quality of life, further supporting the potential therapeutic value of MAAs in pediatric OSA (14, 18, 22, 26, 31).

Despite these encouraging findings, the overall strength of the evidence remains limited. Substantial heterogeneity in study design, appliance type, diagnostic methodology, and treatment duration has been consistently reported and limits the comparability of results (11, 16, 17, 20, 37). Moreover, many studies have small sample sizes and low to moderate methodological quality. Importantly, uncertainty persists regarding the long-term stability of treatment effects and the extent to which observed improvements reflect temporary appliance-dependent mandibular repositioning rather than permanent growth-related adaptations (11, 15, 20, 35). Pediatric OSA is a multifactorial condition in which adenotonsillar hypertrophy, obesity, craniofacial disharmony, and environmental factors, including parental smoking, may contribute to disease risk; accordingly, parental education on modifiable exposures may have preventive relevance within a broader oral-health framework (40, 41).

CONCLUSIONS

Mandibular advancement appliances represent a promising non-surgical therapeutic option for pediatric OSA, particularly in children with craniofacial abnormalities, mandibular retrusion, or residual disease following first-line interventions. While short-term improvements in respiratory outcomes, airway morphology, and quality of life are well supported (16, 18, 21, 22, 24, 31), uncertainties persist regarding long-term stability, optimal treatment protocols, and patient selection. Until higher-quality longitudinal evidence becomes available, MAAs should be considered as part of an individualized, multidisciplinary approach rather than a definitive standalone treatment for pediatric OSA.

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