



(REVIEW ARTICLE)



A NARRATIVE REVIEW OF THE ORTHODONTICS–OBSTRUCTIVE SLEEP APNEA INTERPLAY AND ADULT PERIODONTAL–ORTHODONTIC BIOMECHANICS

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Global Journal of Research in Medicine and Dentistry, 2026, 05(04), 044–049

Publication history: Received on 20 August 2026; revised on 30 September 2026; accepted on 02 October 2026

Article DOI: <https://doi.org/10.58175/gjrmd.2026.5.4.0107>

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ABSTRACT

Background: Two areas of contemporary orthodontic practice remain without firm, long-term scientific consensus: the extent to which expansion, orthognathic surgery, and non-extraction treatment philosophies genuinely alter upper airway volume and resolve obstructive sleep apnea (OSA) in pediatric and adult populations, and the optimal force vectors and biological tolerance limits governing orthodontic tooth movement in adults with a reduced but healthy periodontium or a history of periodontitis. **Objective:** This narrative review synthesizes current systematic reviews, meta-analyses, consensus statements, and mechanistic studies addressing these two domains, framed within a broader model of airway, myofunctional, and systemic integration in orthodontics. **Methods:** A structured narrative search of PubMed/MEDLINE, Embase, Cochrane Library, and specialty-society publications was conducted, prioritizing systematic reviews, meta-analyses, and consensus or white-paper documents published within the last decade. **Results:** Maxillary expansion and orofacial myofunctional therapy show short- to medium-term improvements in apnea-hypopnea index and airway dimensions, particularly in pediatric and mild-to-moderate adult OSA, while orthognathic maxillomandibular advancement remains the most reliably effective skeletal surgical intervention for moderate-to-severe adult OSA. Premolar extraction, by contrast, shows no consistent, clinically meaningful reduction in pharyngeal airway volume. In adults with reduced or previously compromised periodontium, light, intermittent, well-controlled orthodontic forces appear compatible with periodontal stability, though age-related alveolar bone maladaptation slows tooth movement and narrows the biological safety margin. **Conclusion:** Existing evidence supports a cautious, individualized, and interdisciplinary approach to airway-focused and periodontally compromised orthodontic care, but methodological heterogeneity and the scarcity of long-term randomized data continue to preclude definitive, universally applicable clinical guidelines.

Keywords: Obstructive Sleep Apnea; Orthodontics; Airway; Myofunctional Therapy; Periodontitis; Orthodontic Tooth Movement

1 INTRODUCTION

Orthodontics has, over the past two decades, expanded its scope of clinical interest well beyond the correction of malocclusion. Increasing public and professional attention to sleep-disordered breathing, coupled with the growing proportion of adult patients seeking comprehensive orthodontic care, has pushed two previously peripheral questions

to the center of clinical decision-making. The first concerns the relationship between orthodontic and orthopedic interventions — maxillary expansion, orthognathic surgery, extraction versus non-extraction treatment planning, and adjunctive orofacial myofunctional therapy — and their capacity to meaningfully alter upper airway anatomy and clinically resolve obstructive sleep apnea (OSA) in both growing and adult patients. The second concerns the biomechanical and biological ceiling within which orthodontic forces can safely be applied to adult patients whose periodontium is reduced in height, whether through treated periodontitis or age-related remodeling, and how this ceiling should inform force selection, anchorage design, and appliance choice.

The American Association of Orthodontists (AAO) White Paper on obstructive sleep apnea and orthodontics, first published in 2019 and updated in 2026, remains the most widely cited attempt to synthesize this evidence base for practicing clinicians [1,2]. Both documents converge on a cautious message: orthodontic and orthopedic interventions may produce measurable short-term changes in airway dimensions and polysomnographic indices in selected patients, but the evidence is heterogeneous, frequently low-to-moderate in quality, and insufficient to support airway correction as a primary indication for orthodontic treatment, extraction avoidance, or specific appliance selection in the absence of a formal OSA diagnosis and multidisciplinary sleep-medicine oversight [1,2]. This uncertainty is compounded by the reliance of much of the supporting literature on surrogate radiographic outcomes — airway volume and minimum cross-sectional area on cone-beam computed tomography (CBCT) — rather than on the apnea-hypopnea index (AHI) or other validated polysomnographic endpoints that define clinical resolution of OSA [2].

In parallel, the demographic profile of orthodontic patients has shifted substantially toward adulthood, driven by clear-aligner therapy and greater esthetic awareness. Adult periodontal tissues respond to orthodontic loading differently from those of adolescents: tooth movement is slower, the inflammatory response is more pronounced, and the biological safety margin for force application is narrower, particularly in a reduced but healthy periodontium following successful periodontitis therapy [3]. Despite a growing body of mechanistic and clinical work, evidence-based, consensus-level guidance on optimal force magnitude, direction, and regimen in these patients remains fragmented across specialty literatures.

This narrative review addresses both domains under a unifying framework of airway, myofunctional, and systemic integration in orthodontics. The objective is to critically synthesize the current state of evidence on (i) the effect of expansion, orthognathic surgery, extraction-based treatment, and myofunctional therapy on airway volume and OSA resolution, and (ii) the biomechanical and biological principles governing orthodontic force application in adults with reduced or periodontally compromised support, in order to identify areas of convergent evidence, persistent controversy, and priorities for future research.

2 MATERIALS AND METHODS

This manuscript is a narrative, non-systematic review structured to provide a clinically oriented synthesis of contemporary evidence rather than a formal systematic review or meta-analysis; accordingly, no protocol was registered and no independent duplicate screening or quantitative pooling of data was undertaken. No original human or animal data were collected, and no ethical approval or informed consent was required.

A structured literature search was performed in PubMed/MEDLINE, Embase, the Cochrane Library, and Google Scholar for the period January 2010 to September 2026, supplemented by hand-searching of reference lists of retrieved systematic reviews and the official White Papers and consensus statements of the American Association of Orthodontists and relevant international periodontology bodies. Search terms combined, in various Boolean combinations, “orthodontics”, “maxillary expansion”, “rapid maxillary expansion”, “orthognathic surgery”, “maxillomandibular advancement”, “premolar extraction”, “upper airway”, “obstructive sleep apnea”, “myofunctional therapy”, “periodontitis”, “reduced periodontium”, “orthodontic tooth movement”, and “alveolar bone remodeling”.

Priority was given to systematic reviews and meta-analyses, specialty-society white papers and expert-consensus documents, and, where higher-level evidence was unavailable, well-designed prospective cohort studies and mechanistic reviews. Studies were included if they addressed orthodontic, orthopedic, or orthognathic surgical management of the airway in growing or adult patients, or the biomechanics and clinical outcomes of orthodontic tooth movement in adults with reduced or periodontally compromised support. Non-English-language publications, case reports, and conference abstracts without full-text availability were excluded. Given the acknowledged heterogeneity of outcome measures, imaging modalities, and follow-up periods across the retrieved literature, findings are presented narratively rather than pooled quantitatively, and the strength of the underlying evidence is qualified throughout the Results and Discussion.

3 RESULTS AND DISCUSSION

3.1 Orthodontics and the Airway/OSA Interplay

3.1.1 Maxillary expansion and airway volume

Rapid maxillary expansion (RME) is the most extensively studied orthodontic intervention in relation to the airway. An umbrella review of systematic reviews concluded that RME consistently increases nasal cavity volume and reduces nasal airway resistance in growing patients with maxillary transverse deficiency, with more variable and generally smaller effects on the oropharyngeal and hypopharyngeal segments of the airway [3]. A comprehensive review of expansion modalities — RME, mini-screw-assisted rapid palatal expansion (MARPE), surgically assisted rapid palatal expansion (SARPE), and distraction osteogenesis maxillary expansion (DOME) — likewise concluded that maxillary widening can improve airflow and reduce OSA severity across the pediatric-to-adult spectrum, but that the magnitude and durability of benefit are inconsistent across studies and expansion techniques [4]. A widely cited systematic review and meta-analysis by Camacho and colleagues reported clinically significant reductions in AHI and improvements in minimum oxygen saturation following RME in children with OSA, particularly those with narrow maxillary arches and posterior crossbite [5], and this finding has been broadly replicated in subsequent reviews, lending reasonable confidence to RME as an adjunctive tool in pediatric OSA associated with a constricted maxilla.

The evidence in adults is comparatively weaker. MARPE, SARPE, and DOME extend the expansion principle to skeletally mature patients, but the supporting literature consists largely of small case series and short follow-up cohorts, and high-quality randomized comparisons against sham or alternative treatment remain scarce [4]. The AAO White Paper update explicitly cautions that using changes in upper airway dimensions on imaging as a proxy for clinical efficacy is scientifically flawed, since airway volume and cross-sectional area correlate imperfectly with AHI and other validated sleep outcomes [2]. This distinction between radiographic and polysomnographic endpoints is, in the authors' assessment, the single most important methodological limitation across the expansion literature and should temper any claim that expansion alone “cures” OSA.

3.1.2 Premolar extraction and airway dimension

A long-standing clinical concern holds that premolar extraction and subsequent anterior tooth retraction reduce tongue space, provoke a lower tongue posture, and consequently narrow the pharyngeal airway. This hypothesis has been tested repeatedly with CBCT-based comparative studies. The most comprehensive synthesis to date, a systematic review and meta-analysis of eleven non-randomized studies comprising 891 patients, found no statistically significant differences in nasopharyngeal, palatopharyngeal, glossopharyngeal, oropharyngeal, or oral-cavity airway volume between patients treated with versus without premolar extraction, and, counterintuitively, extraction patients showed a small but statistically significant increase in oropharyngeal minimum cross-sectional area relative to non-extraction patients [6]. The authors graded the overall strength of evidence as moderate, reflecting the retrospective, non-randomized design of all included studies and the associated risk of selection bias [6].

These findings are consistent with the position articulated in the AAO White Paper, which states plainly that existing evidence does not support the notion that arch constriction or anterior retraction associated with extraction treatment has a detrimental effect on respiratory function, while also noting that the underlying evidence base remains of limited quality [1,2]. Taken together, the extraction-airway literature does not support routine avoidance of extraction on airway grounds alone, though individual anatomical risk factors — a demonstrably narrow airway, hyperdivergent facial pattern, or pre-existing sleep-disordered breathing — may still warrant airway-conscious treatment planning on a case-by-case basis.

3.1.3 Orthognathic surgery and maxillomandibular advancement

Where orthopedic and orthodontic camouflage measures produce inconsistent airway change, skeletal surgical advancement demonstrates the most robust and reproducible effect on both airway dimension and polysomnographic outcome. A foundational systematic review and meta-analysis of maxillomandibular advancement (MMA) for adult OSA, pooling data from 627 patients across 22 unique cohorts, reported a reduction in mean AHI from 63.9 to 9.5 events per hour, with pooled surgical success and cure rates of 86.0% and 43.2%, respectively; younger age, lower preoperative weight and AHI, and greater degree of advancement predicted better outcomes [7]. Subsequent meta-analyses have broadly corroborated these findings across dentofacial skeletal classes, confirming consistent reductions in AHI, oxygen desaturation index, and Epworth Sleepiness Scale scores regardless of underlying Class I, II, or III skeletal pattern, while also documenting greater operative morbidity, longer operative time, and longer hospital stay relative to conventional orthognathic surgery performed for dentofacial deformity alone.

MMA is therefore best characterized as the most reliably effective orthodontic-adjacent intervention for moderate-to-severe adult OSA, particularly in patients who cannot tolerate continuous positive airway pressure (CPAP), but its

invasiveness, cost, and morbidity profile confine it to a second-line or CPAP-intolerant population rather than a routine orthodontic treatment option [7]. Long-term data beyond five years remain comparatively limited, and predictors of durable success continue to be refined.

3.1.4 Orofacial myofunctional therapy as an adjunct

Orofacial myofunctional therapy (OMT) — structured exercises targeting tongue posture, lip seal, and oropharyngeal muscle tone — has accumulated a growing evidence base as an adjunctive, non-invasive OSA intervention. A systematic review and meta-analysis of randomized controlled trials found that adult OMT produced statistically significant improvements in AHI (mean difference -10.2 events/hour), Epworth Sleepiness Scale score, Pittsburgh Sleep Quality Index, and minimum oxygen saturation compared with sham therapy or no treatment, whereas pediatric OMT trials showed no significant benefit, an outcome the authors attributed at least partly to poor treatment adherence in children [8]. An earlier meta-analysis similarly reported an approximate 50% reduction in AHI in adults and 62% in children following myofunctional therapy, alongside improvements in lowest oxygen saturation, snoring, and daytime sleepiness [9].

These findings position OMT as a credible adjunct — particularly for mild-to-moderate adult OSA or as a complement to expansion, appliance, or surgical therapy — rather than a stand-alone cure, and they underscore a recurring theme across this literature: interventions that recruit and retrain the neuromuscular and functional components of the airway (myofunctional therapy) tend to show more consistent polysomnographic benefit than those that alter skeletal or dental architecture alone (expansion or extraction), while true skeletal advancement (MMA) remains the most powerful anatomical intervention available.

3.1.5 Synthesis: absence of long-term consensus

Across expansion, extraction, myofunctional therapy, and orthognathic surgery, a consistent pattern emerges: short- to medium-term studies frequently report statistically significant, and sometimes clinically meaningful, improvements in airway dimension or AHI, yet no intervention within the orthodontic-orthopedic domain has been shown, in long-term, high-quality randomized trials, to reliably and durably resolve OSA as a stand-alone treatment across the full pediatric-to-adult age range. Both the 2019 and 2026 AAO White Papers explicitly decline to issue prescriptive clinical guidelines on this basis, instead recommending that orthodontists screen for OSA risk, refer appropriately to sleep medicine specialists, and avoid marketing orthodontic or orthopedic appliances as OSA cures in the absence of polysomnographic confirmation of benefit [1,2]. This review concurs with that position: the interplay between orthodontics and OSA is real and worth continued investigation, but the current evidence base — dominated by retrospective, non-randomized, radiographically anchored studies — does not yet support high-level, long-term consensus on the extent to which expansion, orthognathic surgery, or extraction-based treatment planning clinically resolve OSA.

3.2 Adult Orthodontics and Periodontal Dynamics

3.2.1 Force magnitude and biological tolerance in the reduced periodontium

As the adult proportion of orthodontic caseloads continues to grow, understanding the biomechanical ceiling of a reduced periodontium has become clinically urgent. In a periodontally reduced tooth, the same nominal force generates a proportionally greater moment because the center of resistance shifts apically as attachment loss increases, concentrating stress in the remaining periodontal ligament (PDL) and heightening the risk of ischemic, necrotic, and root-resorptive changes [10]. Finite-element analyses modeling maximum tolerable orthodontic force across varying degrees of simulated periodontal breakdown suggest that forces well tolerated in an intact periodontium (in the region of 0.6–1.2 N for translation of a single-rooted tooth) must be reduced considerably as periodontal support diminishes, though the authors of these analyses are careful to note that precise, universally applicable numerical thresholds remain a matter of ongoing investigation rather than settled consensus [10].

Clinically, this biomechanical principle translates into a preference for light, continuous or intermittent forces delivered through anchorage systems capable of precise three-dimensional control, most commonly skeletal (temporary) anchorage devices, together with meticulous periodontal maintenance before, during, and after active tooth movement. A study examining gingival crevicular fluid biomarkers in periodontally compromised patients undergoing orthodontic treatment with controlled, low-intensity intermittent forces found no significant elevation of matrix metalloproteinases or other bone-resorptive mediators, suggesting that appropriately dosed force need not provoke a deleterious inflammatory response even in a reduced periodontium [11].

3.2.2 Clinical outcomes of orthodontic tooth movement in periodontitis patients

A systematic review and meta-analysis addressing clinical attachment level (CAL) change following orthodontic tooth movement in treated periodontitis patients, encompassing 26 studies of generally low methodological quality, found only minimal, non-significant changes in periodontal outcomes when orthodontic movement was undertaken in

patients with stable, previously treated periodontitis and a healthy but reduced periodontium; by contrast, a significant CAL gain was observed when orthodontic therapy was combined with active periodontal treatment in patients presenting with active disease at baseline [12]. This supports the now widely endorsed clinical sequence of achieving periodontal stability first, then proceeding with carefully dosed orthodontic movement, rather than treating orthodontics and periodontal therapy as sequential but unrelated disciplines.

A recent international expert consensus statement on orthodontic treatment of patients with periodontal disease reinforces this sequencing principle, noting that combined periodontal-orthodontic treatment of Stage IV periodontitis, drawing on a synthesis of forty studies and over 1,600 patients, yields significantly greater CAL gain, greater probing-depth reduction, improved radiographic bone-level outcomes, fewer cases of severe tooth mobility, and better patient-reported outcomes than periodontal treatment alone [13]. The consensus document further emphasizes individualized force selection, staged treatment planning around periodontal re-evaluation intervals, and close interdisciplinary communication between orthodontist and periodontist as the pillars of safe orthodontic tooth movement in this population [13].

3.2.3 Age-related alveolar bone maladaptation

Beyond the specific case of treated periodontitis, adult periodontal tissue as a whole responds to orthodontic loading differently from adolescent tissue. A mechanistic review of age-related alveolar bone maladaptation in adult orthodontics describes reduced mechanosensing and mechanotransduction capacity in aging periodontal ligament and osteogenic cells, producing slower and less balanced bone remodeling, more pronounced alveolar bone loss for an equivalent amount of tooth movement, and a generally prolonged treatment course relative to adolescent patients [14]. These age-related biological changes compound, rather than replace, the purely biomechanical force-distribution concerns relevant to a reduced periodontium, meaning that an adult patient with both age-related bone maladaptation and a history of periodontitis represents a particularly narrow biological margin for orthodontic force application.

3.2.4 The evidence gap: guidelines versus clinical experience

Despite the accumulating mechanistic and observational evidence summarized above, authors across this literature consistently note that existing clinical guidance for orthodontic force selection in reduced or periodontally compromised periodontium is derived predominantly from clinical experience and expert opinion rather than from high-quality randomized controlled trials, and that no consensus currently exists regarding the optimal timing window for initiating orthodontic movement following completion of periodontal therapy [12]. This mirrors, in a different clinical domain, the same evidentiary shortfall identified in the airway/OSA literature: a plausible, mechanistically grounded, and increasingly well-supported clinical rationale exists, but it has not yet been translated into prospective, randomized, long-term evidence sufficient to underpin firm, universally applicable clinical guidelines. Until such evidence accumulates, individualized, biologically conservative, and closely monitored treatment — light and intermittent forces, staged anchorage, and continuous periodontal co-management — represents the most defensible standard of care for adult orthodontic patients with reduced or previously compromised periodontal support.

4 CONCLUSION

Two of the most clinically pressing questions in contemporary orthodontics — whether orthodontic and orthopedic treatment meaningfully resolves obstructive sleep apnea, and how orthodontic forces should be calibrated in adults with reduced or periodontally compromised support — remain without high-level, long-term scientific consensus, notwithstanding a substantial and growing body of systematic reviews, meta-analyses, and consensus statements. Maxillary expansion and orofacial myofunctional therapy offer short- to medium-term improvements in airway dimension and apnea-hypopnea index, particularly in pediatric and mild-to-moderate adult OSA; premolar extraction, contrary to persistent clinical folklore, shows no consistent detrimental effect on pharyngeal airway volume; and maxillomandibular advancement remains the most anatomically powerful, if most invasive, orthodontic-adjacent intervention for moderate-to-severe adult OSA. In parallel, light, intermittent, and carefully monitored orthodontic forces appear compatible with periodontal stability in adults with a healthy but reduced periodontium, though age-related alveolar bone maladaptation narrows the biological safety margin and argues for individualized, conservative force selection integrated with active periodontal co-management. Both domains would benefit substantially from prospective, adequately powered, long-term randomized studies using validated clinical endpoints — polysomnography rather than airway imaging alone, and standardized periodontal outcome measures rather than heterogeneous surrogate markers — to translate current mechanistic plausibility into evidence-based clinical guidelines.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

Acknowledgments

The author thanks colleagues in private practice for ongoing clinical discussion that helped shape the scope of this review.

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