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Review

The Relationship Between Breathing Patterns and Craniofacial Development

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Abstract

Craniofacial development is influenced by a combination of genetic and environmental factors, with breathing patterns playing a central role in shaping the growth of facial structures. Nasal breathing supports proper tongue posture, muscle tone, and jaw alignment, creating conditions that favor balanced skeletal development. In contrast, chronic mouth breathing disrupts this functional equilibrium, often leading to changes in muscle activity, tongue positioning, and head posture that impact the maxilla, mandible, and surrounding tissues. These compensatory mechanisms can result in morphological alterations such as narrow maxillary arches, high palatal vaults, elongated lower facial height, and mandibular retrusion. Airway resistance caused by conditions like enlarged adenoids, allergic rhinitis, or nasal septum deviation often initiates this shift in breathing pattern. The persistent use of oral respiration, particularly during critical growth periods in childhood, exerts prolonged pressure on orofacial structures. Electromyographic and imaging studies have shown that children with altered respiratory function exhibit increased use of accessory muscles, changes in tongue and lip posture, and significant skeletal remodeling. These adaptations can also influence dental eruption patterns, leading to malocclusions including anterior open bite and Class II profiles. The relationship between breathing and facial growth is dynamic, where functional habits become embedded in structural form. The degree of morphological change depends on the duration, timing, and severity of the breathing disturbance. Early identification of altered breathing patterns is essential for preventing long-term skeletal changes. Interventions that restore nasal airflow and promote functional rehabilitation can redirect craniofacial growth. These findings emphasize the importance of interdisciplinary assessment involving orthodontists, pediatricians, ENT specialists, and myofunctional therapists to manage the airway and support optimal orofacial development. Recognition of breathing patterns as a developmental factor is fundamental in understanding and guiding facial growth trajectories in pediatric populations.

Keywords: *Craniofacial development, mouth breathing, nasal obstruction, orofacial growth, airway resistance*

Introduction

Craniofacial development is a complex and dynamic process influenced by both genetic programming and environmental factors. Among these environmental influences, respiratory function, particularly the mode of breathing, has garnered increasing attention in recent decades due to its potential impact on the growth and morphology of the craniofacial complex. Proper nasal breathing supports balanced facial growth, while chronic mouth breathing may disrupt normal developmental trajectories, leading to altered skeletal and dental structures (1).

Breathing patterns are closely tied to the posture and function of oral and oropharyngeal muscles, which play a critical role in shaping craniofacial structures during growth (2). Normal nasal respiration promotes optimal positioning of the tongue against the palate, which contributes to the transverse development of the maxillary arch. In contrast, habitual mouth breathing may result in low tongue posture and altered orofacial muscle function, contributing to vertical maxillary excess, increased anterior facial height, and retrognathic mandibles (3). This deviation from normal development is particularly relevant during critical periods of growth in childhood and adolescence, when craniofacial bones are most responsive to functional stimuli.

The etiology of mouth breathing is multifactorial and may include anatomical obstructions such as enlarged adenoids or tonsils, allergic rhinitis, and deviated nasal septum (4, 5). These conditions can induce a compensatory shift from nasal to oral breathing, which in turn alters the balance of muscular forces acting on craniofacial structures. Several studies have demonstrated associations between chronic mouth breathing and specific dentofacial patterns such as narrow maxillary arches, open bites, and Class II malocclusions (6). While the exact causal relationship is still under investigation, there is strong evidence to suggest that disordered breathing exerts both direct and indirect influences on craniofacial morphology.

Early identification and intervention in children presenting with altered breathing patterns are considered crucial, as correcting airway function may have a positive impact on craniofacial development. Interdisciplinary collaboration among pediatricians, otolaryngologists, orthodontists, and myofunctional therapists is increasingly emphasized in the management of these cases. Clinical approaches may include addressing the underlying cause of airway obstruction, as well as implementing orofacial myofunctional therapy to retrain breathing and muscular function (7). This review aims to discuss the relationship between breathing patterns and craniofacial development.

Review

Breathing patterns exert a significant influence on craniofacial growth by modulating muscle function, posture, and airway dynamics during critical developmental periods (8, 9). Chronic mouth breathing has been shown to alter the resting posture of the tongue and perioral muscles, which in turn can affect maxillary arch width, vertical facial proportions, and mandibular positioning. These muscular adaptations lead to dentofacial changes such as increased lower facial height, narrow palates, and Class II malocclusion patterns (10, 11). Moreover, altered breathing patterns can induce changes in head posture, which may further impact mandibular rotation and cervical spine alignment, compounding the effects on craniofacial morphology.

Recent imaging and longitudinal studies have reinforced the link between airway obstruction and altered craniofacial development. Children with hypertrophic adenoids or tonsils are particularly susceptible to airway compromise, leading to mouth breathing and its associated skeletal changes (12, 13). Surgical or therapeutic intervention in such cases has been reported to partially reverse or halt undesirable growth patterns, particularly when performed early (14). These findings highlight the need for interdisciplinary evaluation in pediatric patients presenting with abnormal breathing patterns, as early correction may guide the

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craniofacial complex toward more favorable developmental trajectories.

Craniofacial Adaptation to Airway Resistance

Airway resistance plays a pivotal role in directing the growth of craniofacial structures during developmental years. When nasal airflow is compromised, either partially or fully, the body compensates for it by altering posture and muscle recruitment to maintain adequate oxygenation. These physiological adaptations are not temporary but often become structurally embedded in the developing craniofacial complex. The tongue, soft palate, and perioral musculature must adjust to the altered airflow dynamics, and these compensations can result in significant morphological changes over time.

Low tongue posture associated with oral breathing contributes to deficient stimulation of the palate, which affects transverse maxillary growth. Instead of expanding laterally as encouraged by proper tongue pressure during nasal breathing, the maxilla often develops with a narrowed arch and high palatal vault. This constriction leads to reduced nasal cavity volume, further exacerbating airway resistance and perpetuating the cycle. Muscle recruitment in the neck and face also changes in response to airflow resistance. Studies using electromyography have shown increased activity in accessory respiratory muscles in children with airway obstruction, which is often accompanied by a forward head posture and mandibular retrusion (15). This chain reaction can remodel skeletal positioning and disturb the balance between the upper and lower jaws.

Clinical observations and cephalometric studies have documented vertical growth tendencies in individuals with compromised nasal breathing. These subjects frequently present with increased anterior facial height, clockwise mandibular rotation, and steeper mandibular plane angles. The adaptation is not merely a matter of soft tissue behavior but involves skeletal restructuring, influenced by muscle function and head positioning. The nasorespiratory function is interconnected with craniofacial architecture in such a way that dysfunction in one domain creates a cascade of compensatory adaptations in the other. Imaging studies have further supported this by demonstrating that children with enlarged adenoids and chronic nasal obstruction display elongated lower facial height and altered hyoid bone positioning (16).

The complexity deepens when factoring in the duration and timing of airway resistance. Short-term mouth breathing in early life may not significantly impact facial development, but persistent respiratory dysfunction over critical growth periods tends to leave more permanent skeletal imprints. Growth hormone levels, sleep architecture, and muscular tone can also be indirectly affected by chronic airway resistance, introducing systemic influences into what is often treated as a localized orofacial issue. Persistent nocturnal hypoxia and disrupted sleep have been associated with changes in growth patterns and craniofacial anomalies, particularly in populations with sleep-disordered breathing (17).

From a therapeutic standpoint, addressing airway resistance requires more than alleviating the immediate obstruction. It necessitates evaluation of how altered breathing has already shaped the craniofacial profile. Some patients may require orthodontic or orthopedic interventions to reverse the skeletal adaptations that have occurred. Orthodontists increasingly collaborate with ENT specialists and myofunctional therapists to guide treatment that aligns both airway function and facial development. While structural interventions like rapid maxillary expansion have been shown to improve nasal airflow, they also provide evidence that craniofacial adaptation is, to some extent, modifiable (18).

Mouth Breathing and Morphological Changes

Mouth breathing is more than a functional shift; it modifies the spatial dynamics of the entire orofacial system. The habitual lowering of the mandible, combined with open lip posture and anterior tongue positioning, disrupts the muscular equilibrium that typically guides harmonious craniofacial growth. During nasal breathing, the tongue rests against the hard palate, exerting light, constant pressure that

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promotes lateral development of the maxillary arch. This contact is diminished or absent in mouth breathers, contributing to a narrow, V-shaped palate and reduced transverse maxillary width (19). These changes often limit nasal cavity volume, reinforcing the tendency toward oral respiration.

The dentoalveolar structures do not remain unaffected. Prolonged oral breathing is associated with altered eruption patterns, proclination of upper incisors, and the development of anterior open bite. Soft tissue balance plays a critical role in determining tooth position. When lips remain parted and the tongue assumes a low or forward posture, equilibrium between internal and external muscle pressures becomes disturbed. Over time, this imbalance reshapes dental arches and contributes to crowding and malocclusion. It is not uncommon for mouth-breathing children to display a convex facial profile with retrognathic mandibles and steep mandibular planes. These skeletal features reflect adaptations that occur during key phases of facial growth and remodeling (10) **(Table 1)**.

Table 1: Key Craniofacial Changes Associated with Mouth Breathing

Craniofacial Feature	Common Observation in Mouth Breathers
Maxilla	Constricted, high palatal vault
Mandible	Retrusive, vertical growth pattern
Nasal Cavity	Reduced volume
Lower Facial Height	Increased
Dental Arch	Crowded, malocclusion patterns

Even the positioning of the head and cervical spine shows compensatory adjustments. To ease airflow during oral respiration, children often extend their necks or tilt their heads forward. This cranio-cervical posture repositions the mandible inferiorly and posteriorly, promoting vertical facial growth patterns. The lower anterior facial height elongates, and lip incompetence becomes more evident as the soft tissues struggle to maintain closure. Lateral cephalometric analyses frequently reveal increased lower facial height and backward mandibular rotation in mouth-breathing patients compared to nasal breathers (1, 20). These structural shifts do not occur in isolation but interact dynamically with airway resistance, tongue tone, and soft tissue strain.

Myofunctional assessments underscore the neuromuscular dimension of these changes. The tongue, lips, and buccinator muscles adapt in response to altered airflow, often functioning inefficiently or asynchronously. This poor coordination interferes with efficient mastication, speech articulation, and swallowing. The developmental impact becomes more pronounced as children age, particularly if the oral breathing habit persists through puberty, when skeletal growth is rapid and more difficult to redirect. At this stage, the potential for spontaneous correction diminishes, and intervention becomes increasingly reliant on orthodontic, surgical, or multidisciplinary strategies.

These morphological consequences have also been linked to psychosocial implications. Children with facial profiles altered by chronic mouth breathing are more likely to experience self-consciousness about their appearance and may be perceived by peers as having atypical expressions or posture. Researchers using standardized aesthetic indices have found correlations between oral breathing patterns and lower attractiveness scores, suggesting a subtle but measurable social impact tied to craniofacial development (21). While these findings do not imply causality in every case, they underscore the broader relevance of respiratory patterns on both structural and behavioral dimensions of health.

Breathing Patterns and Orofacial Growth

Orofacial growth is intricately shaped by the way air moves through the upper airway during early development. Breathing patterns influence both the direction and intensity of growth forces acting on craniofacial structures. Nasal breathing fosters a balanced orofacial environment by encouraging proper tongue posture, efficient muscle tone, and

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stable jaw positioning. This functional equilibrium supports forward mandibular growth and a broad, symmetrical maxillary arch. When the pattern shifts toward chronic oral respiration, this balance is lost. The tongue drops from its palatal position, the lips often remain apart, and the mandible rotates downward and backward, modifying the spatial relationships between facial bones (22).

These postural changes carry lasting structural effects. Studies examining children with persistent oral breathing habits show that the maxilla tends to narrow, the palatal vault deepens, and the nasal cavity volume declines. The mandible frequently appears retrognathic in profile, not necessarily due to underdevelopment, but because of its rotated position and altered growth vector. Cephalometric data support these observations, highlighting increased lower anterior facial height and decreased SNB angles in mouth breathers. It is not simply the bones that respond, the surrounding musculature adapts as well. Overuse of the mentalis, altered perioral tone, and inconsistent orofacial muscle patterns introduce compensations that interfere with harmonious development (23).

Growth is not a static process, and breathing patterns serve as a continuous input shaping it over time. Children typically do not switch abruptly from nasal to oral respiration. Instead, transitional or mixed breathing patterns are often seen during key growth phases, particularly in the presence of nasal obstruction or seasonal allergies. These fluctuations complicate the clinical picture and introduce variability in outcomes. Longitudinal tracking of such children has shown that even intermittent mouth breathing can lead to notable skeletal alterations if it persists during growth spurts. This finding has directed attention to the importance of monitoring breathing function in early childhood and not just in orthodontic settings, but also in pediatric and otolaryngologic evaluations (24).

The plasticity of the growing face means that functional pressures, like altered airflow, leave architectural footprints. Not all children exposed to the same breathing irregularities develop identical facial features, suggesting that genetic predispositions modulate responsiveness. Nonetheless, patterns do emerge. Children with habitual nasal breathing tend to show more balanced facial thirds, stronger chin projections, and broader arches. In contrast, habitual oral breathers are disproportionately represented in Class II malocclusion groups and frequently exhibit open bites or deep palatal vaults. Interceptive orthodontics can sometimes redirect these growth paths, but effectiveness depends heavily on the timing of intervention. Once the orofacial complex begins to solidify during adolescence, the impact of breathing-related dysfunction becomes harder to reverse.

Breathing function is often overlooked in discussions of facial growth, despite its foundational role. Diagnostic tools such as acoustic rhinometry, nasoendoscopy, and 3D facial scans are helping clinicians map this relationship more precisely. Interdisciplinary collaboration, especially between orthodontists and airway-focused specialists, has helped shift the clinical paradigm toward a more integrative model. Functional assessment is no longer just an adjunct to structural analysis; it increasingly drives decision-making in early developmental care (25).

Conclusion

Breathing patterns significantly influence craniofacial and orofacial development during growth. Disruptions such as chronic mouth breathing can lead to structural and functional changes in facial morphology. Early detection and intervention are essential for guiding proper development. A multidisciplinary approach remains vital for comprehensive management.

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Conflict of interest

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Data availability

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

Author contribution

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

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