Global Journal of
Otolaryngology
ISSN 2474-7556

Juniper PUBLISHERS key to the Researchers

Mini Review
Volume 24 Issue 5- October 2021
DOI: 10.19080/GJO.2021.24.556147

Glob J Otolaryngol

The Interconnection between Malocclusion and Mouth Breathing

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Submission: August 24, 2021; **Published:** October 11, 2021

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Abstract

For decades, the impact of mouth breathing on malocclusion has been a contentious topic within dentists and otolaryngologist. When malocclusion is correlated with mouth breathing, patients display modifications in tooth and jaw positioning, facial height, and morphological changes in the oropharynx. However, the interaction between dentists and physicians is limited, even though it is in the best interest of the patients to be treated with a joint approach. This inadequate interaction is partially due to the lack of proper communication, limited interdisciplinary knowledge, and poor coordination between the professionals that should be involved in the case. For the patient, the interdisciplinary approach between dentists and otolaryngologists is beneficial, resulting in less costly and shorter treatments. The dentist, with an early diagnosis for a mouth breathing patient, ensures a correct treatment plan, potentially avoiding progression of the malocclusion as well as further dental and skeletal deformations. The otolaryngologist can improve the respiratory function and restore oral muscle balance. This will also prevent the establishment of a malocclusion, avoid the progression and/or prevent treatment relapses if a malocclusion is present. In this mini review we present how mouth breathing is associated with malocclusion, the most common facial phenotype in mouth breathers and discuss the dental management of malocclusion cases associated with mouth breathing.

Introduction

Abnormal oral habits have a significant role in the etiopathogenesis of malocclusions. Specifically, neuromuscular behaviors can develop to counteract dent alveolar malposition and inappropriate breathing activity [1]. Hence, the establishment of risk factors related to malocclusion, is critical to understand the impact of incorrect oral habits, such as mouth breathing, attributed with aberrant craniofacial growth. Malocclusion is characterized as a disruption of the correct relation between the maxilla and mandible as they come together in occlusion. Portrayed as the "disease of civilization", it has been a growing problem since the last century [2]. This condition is, in fact, the utmost prevalent craniofacial disorder impacting approximately 70% of American children [3]. The National Health Interview Survey has suggested that about 2.5 million children and 10 million young adults need orthodontic examination due to malocclusion. Furthermore, data from American Association of Orthodontists (AAO) indicates that over 3 million individuals must use fixed orthodontic appliances per year in United States (US) in order to correct occlusion disruption [3]. In the past years, malocclusion has been broadly researched to find mechanisms that contribute to craniofacial disorders. As a result, it was established that subjects typically develop malocclusion as a product of complex traits and interacting elements that affect craniofacial development during infancy and pubertal growth [4,5]. However, it is unknown how biological mechanisms, environmental and genetic factors affect the establishment of malocclusion.

Understanding how environmental and biological factors work in normal craniofacial development is crucial to understanding how they influence the establishment of malocclusion and mouth breathing. A normal craniofacial development relies on a synchronized interaction of the neurocranium and viscerocranium. According to Enlow, skeletal growth follows the mechanisms of bone remodeling, a balanced process of bone resorption and apposition, in which the spatial displacement is an outcome of pressures and/or tractions employed by neighboring tissues [6]. Moss's vision, recognized as the functional paradigm, launched in 1962, and later recognized as the principle of "form follows function", proposed that skeletal growth was a dynamic process in which craniofacial segments respond to growth as function demands. Further theories, such as Scott's and Moss's functional matrix theory, correlates craniofacial development with the downward and forward displacement of the facial structures [7,8]. However, malocclusion is not only caused by altered relationships between hard and soft components of the face and the unbalanced process of bone apposition and resorption during craniofacial growth [6].

Mouth breathing, an action that most commonly occurs during sleep is a condition often associated as a major risk factor for the onset of malocclusion [9-14]. There is, in fact, a feedback mechanism involved in the association of malocclusion and mouth breathing as the unbalanced oral function influences an abnormal craniofacial growth. In response, the abnormal relationship of the craniofacial structures also affects oral function [10]. Oral habits are more important during childhood for malocclusion development and their damaging effects have been described in several studies [9-15]. Every person who breathes through their mouth because of a pathological adaption, is referred to as a mouth breather. Mouth breathing is caused by a variety of factors, including anatomical obstructions such as, tonsil hypertrophy, septal deviation, nasal polyps, allergic rhinitis as well as deleterious oral habits [11,13,15-17]. The alteration of facial harmony and severity of deformation of the dental arches are dependent on the intensity, frequency, and duration of the conditions. Mouth breathing is particularly critical during development as it may negatively impact the craniofacial growth [18]. The aim of this review is to explore how malocclusion is developed as an indirect result of mouth breathing and how it can be managed.

Craniofacial Abnormal Growth and Resulting Phenotypes Associated with Mouth Breathing

According to Moss's theory of functional matrix, proper nasal breathing warrants optimal craniofacial complex growth and development [8]. This hypothesis is based on the idea that a correct nasal respiratory activity positively interacts with the oral functions and head and neck structures leading to a well synchronized craniofacial development [8,19]. The incorrect function of the oral facial complex including the lips, mandible-maxilla relationship, tongue, and/or oropharynx interferes with normal growth, development, or function of other oral structures because of a series of events or a lack of intervention at critical times, resulting in malocclusion and suboptimal oral health [1].

If habitual mouth breathing is present during the critical craniofacial growth period, an abnormal relationship of orofacial structures is established. As a result, deformations of craniofacial structures are observed including altered position of the head relative to the neck, anterior open bite, increased overjet, narrowing of the palatal plates and clockwise rotation of the mandible leading to an increase in facial height [1,12,18]. However, mouth breathing has not been found to be the sole or even the major cause of these conditions [18]. In this regard, previous literature has reported conflicting findings on the impact of mouth breathing on the maxilla and mandible, as well as the location of the maxilla relative to the skull base. Children with mouth breathing frequently present long adenoid faces. This phenotype is characterized by incompetent upper lip, a retro positioned hyoid bone, a narrow upper dental arch, retro positioned mandibular incisors, an increased anterior face height, a narrow or "V"-shaped maxillary arch, an increased mandibular plane angle, and a posteriorly rotated mandible [14]. These characteristics are, in fact, normally seen in individuals presenting class II malocclusion phenotype [20].

Although the studies have suggested mouth breathing as a risk factor for malocclusion, the etiology of this condition is still unclear. Knowledge inconsistencies lie in understanding the simultaneous influence of genetic factors in individuals with abnormal breathing activity. Previously it has been shown that malocclusion susceptibility is influenced by genetic factors [5]. Craniofacial phenotypes such as middle and lower facial proportions, arch dimensions and dental spacing have been found to have moderate to high heritability proportions (>60%) as Class III malocclusion is suggested to have polygenic inheritance and autosomal dominance patterns, with incomplete penetrance [4].

On the other hand, studies of Class II malocclusion (commonly associated with mouth breathing) suggested a lower heritability pattern. For instance, associated phenotypes such as overjet and overbite show heritability varying from 28% to 53% respectively, suggesting a higher susceptibility to environmental factors [21,22]. Even though class II seems to have larger environmental factor influence compared to class III phenotypes, there is a bulk of evidence associating genetic variations and other specific phenotypes [4,23-26]. Therefore, the probability of an individual to develop malocclusion due to mouth breathing relies, in many cases, on the combination of factors happening during a specific period of time. To evaluate the risk level, it is important to analyze the timing of skeletal growth, genetic susceptibility and the presence or absence of mouth breathing activity of the patient.

Management of Malocclusion Related Mouth Breathing

Ongoing studies investigating the influence of abnormal breathing activities influencing craniofacial development have shown its clinical implications in the treatment and prevention of malocclusion [9-13]. The study of this relationship is fundamental for the treatment of malocclusion since the condition for a successful outcome is based on the elimination of the causes. Severe malocclusion will invariably end in craniofacial distortion, ultimately affecting oral function and esthetics as previously described [5]. The clinician's adoption of the optimal treatment regimen tailored to a precise diagnosis and understanding of the patient`s growth potential, physiological and environmental factors determine the therapy's effectiveness. Treating class II malocclusion patients can be challenging due to relapses that are

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more frequent when the case increases in severity or is associated with risk factors such as mouth breathing.

Because the treatment starts at mixed dentition, the use of functional appliances is critical to inhibit the growth of the maxilla and enhance the growth of the mandible in a timely manner to decrease the severity of malocclusion [27]. Briefly, this treatment can be carried out in 2 steps using removable and fixed appliances according to the growth period of the patient. In the mixed dentition, the class II malocclusion triggered by mouth breathing is managed with an early functional corrector (with the use of myofunctional appliances), orthodontic treatment such as rapid maxillary expansion, as well as combined orthodontic and orthognathic treatment. The treatment of Class II malocclusion when in permanent dentition, is usually done with fixed orthodontic appliances for correcting phenotypes such as midline misalignment, open bite, overjet, posterior cross bite, correct mandibular vertical growth as well as teeth crowding and rotations [27,28].

To ensure a proper orthodontic diagnosis and treatment of malocclusion, it is critical to understand basic principles of craniofacial development. When health care providers develop a treatment plan for malocclusion triggered by mouth breathing or other orofacial dysfunctional habits, they invariably must acknowledge the critical role of interdisciplinary approaches. Many orthodontic treatments begin during childhood, around the age of seven [1]. However, signs and symptoms of mouth breathing can appear much earlier. In this scenario, if a coordinated approach is not established, two situations can occur:

i. Mouth breathing is left untreated, and a malocclusion may develop as consequence.

ii. Orthodontic treatment is performed without considering mouth breathing, invariably leading to an increased risk of orthodontic relapse.

Therefore, routine evaluations for abnormal breathing activities and subsequent referral to the specialized professionals should be a requirement to ensure a proper treatment plan.

To summarize, the otolaryngologist should keep in mind that mouth breathers have a high risk of developing malocclusions and should refer patients with this condition to dentists, especially during infancy and pubertal growth. Likewise, the dentist, when treating a case of malocclusion associated with mouth breathing should refer the patient to an otolaryngologist for an interdisciplinary approach that will result in more effective treatment and less probability of recurrence.

Discussion

For decades, the impact of mouth breathing on malocclusion has been a contentious topic between orthodontic and otolaryngology professionals. While a growing number of researchers confirm the association between mouth breathing and craniofacial development [11,13,15-17], preceding ones did not believe that breathing abnormalities play a key role in the craniofacial development process [29,30]. This perception is questionable, in part, due to the subjective nature of the criteria's used to diagnose mouth breathing. On the other hand, while informative, many malocclusion studies are limited by modest sample sizes, unclear generalized information and, most importantly, by the use of exclusive categorical phenotypes (i.e. class II malocclusion) which do not capture the phenotypic complexity of the condition. As mentioned before, genetic factors play an important role in influencing the constitution of the craniofacial phenotypic variations. Therefore, a critical obstacle for studying malocclusion conditions lies in the complex nature and the ability to capture the full spectrum of malocclusion phenotypes.

These limitations can be mitigated using more sophisticated methods for the analysis of shape to minimize the impact of the phenotypic variability and detailed descriptions of the environmental factors present. The study of variables associated with malocclusions etiology is also critical for developing public health strategies targeted at preventing and therapeutically intercepting this health condition. Around 20% of the US population present abnormalities of occlusion. Class II malocclusion it is estimated to affect 15% of the population while Class III malocclusion affects just 1% [3]. Thus, growth modification appliances can be used alone or in combination with fixed orthodontic therapy to address malocclusions. Yet, severe cases of malocclusion sometimes require orthognathic and dental surgery.

As a result, the estimated Medicaid expenditure on orthodontic treatments in the United States ranges from $29.5 million to $75.2 million per year -FY 2013, 2014 [31]. This expenditure is obviously higher if moderate and mild cases of malocclusions are included. The interdisciplinary referral between dentists and otolaryngologists, particularly for patients in growth ages, allow for less severe cases of the malocclusion potentially resulting in shorter and cheaper treatments. The complex relation between malocclusion and mouth breathing highlights the importance of further research to ensure an early diagnosis, preventive measures and proper multi professional treatments. Future research should also look at identifying functional variants predisposed to abnormal breathing activity correlated to malocclusion development.

Conclusion

In conclusion, better diagnostic tools and interdisciplinary approaches that avoid costly and time-consuming treatments are necessary. Therefore, it is critical to recognize causal factors and phenotypic characteristics associated with cases of malocclusion related to mouth breathing. The correct treatment for these cases should involve dentists and otolaryngologists, aimed not only at

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correcting the dental and jaw positioning, but also the oral and respiratory function.

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