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The Impact Of Mouth Breathing Dysfunction On The Formation Of Orthodontic Malocclusions

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Abstract:
The involvement of mouth breathing and its impact on dental, facial and structural growth alterations, especially during childhood, has been discussed in medical and dental literature. The prelevance of airway obstruction and its assumed effect on facial growth continues to be debated because it is closely related to malocclusions. The etiology of mouth breathing may be multifactorial and attributable to anatomic factors, including narrow airways, adenotonsillar hypertrophy, nasal septal deviation, nasal polyps, respiratory allergies, nasal turbinate hypertrophy and sleep position. Mouth breathing habit generally have severe effects on the vertical growth of the face and also on the occlusion of teeth, high or gothic palate, maxillary narrow arch, V-shaped dental arch, posterior cross bite, anterior open bite, reduced anterior vertical fold, overjet, class II malocclusion, bacterial plaque and gingivitis around the frontal teeth.

Finally, the different methods for evaluating are described, as well as possibilities for treatment, including the interrelation of several specialties and the role of the orthodontist.

Key Words: *mouth breathing, facial growth, extra- and intraoral features*

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I. Introduction

The orofacial skeleton and tooth development are inextricably linked to the development of orofacial functions. The orofacial neuromuscular components in the newborn function primarily to meet the most basic needs of feeding, airway maintenance, and emotional needs.

Orthodontic malocclusions and craniofacial dysmorphology can be the result of chronic orofacial myodysfunction, which may begin very early. It can become apparent when children learn to talk or when they start eating table food. Most children with oral myofunctional dysfunction are diagnosed after experiencing an articular disorder, sleep-disordered breathing, or malocclusion.

Orthodontic relapses, obstructive sleep apnea, and TMJ disorders are predictable consequences of long-term oral myodysfunctions. It involves dysfunction of the lips, jaw, tongue, and / or oropharynx that interferes with the normal growth, development, or function of other oral structures and is the result of a series of events or lack of intervention during critical periods, resulting in malocclusion and suboptimal facial development [1,2].

Orofacial myodysfunctions are often the result of a series of events or a lack of intervention in critical periods, and the impact is cumulative. Children with low breastfeeding rates, poor oral habits, and breathing through the mouth during sleep are more likely to have malocclusions.

When orofacial dysfunctions occurs during childhood, these disorders then becomes a contributing factor for other diseases and disorders.

Unresolved dysfunctions can contribute to serious dental and medical conditions that endanger a person's quality and length of life. If the jaw rotates back toward the airways and invades the hard palate, separating the sinuses, then nasal breathing may be difficult. The long-term concern factor goes beyond the bad aesthetics of the face [3].

The airways, mode of respiration and malocclusion are interrelated during growth and development. Respiratory dysfunction can cause malocclusion and skeletal deformity. The typical breathing of a newborn is usually quiet and with the lips closed. But at an early age there are many factors that can interrupt this process and change the course of craniofacial growth thereby causing changes in dentofacial morphology [4].

The sinuses experience their greatest growth during early childhood, and nasal breathing activates the growth of the occipital and nasal sutures of the facial bones. Breathing through the mouth encourages lower jaw posture which can change the direction of growth over time.

Unbalanced facial muscles occur as a result of mouth breathing, which causes changes in the positioning of the teeth, lips, tongue, palate, and jaws in order to adapt to the new breathing pattern. When abnormal muscle pressure interferes with facial growth, malocclusion may occur.

As the person grows, the appearance of unbalanced pressure on the craniofacial bones may contribute to TMJ dysfunction. Airway-based malocclusions and those associated with sleep-disordered breathing (SDB) are further complicated by cooccurring symptoms, including clenching and gnashing of teeth, all of which contribute to bruxism, facial pain and tooth damage.

Many studies of children with orofacial dysfunction have found articulatory changes, errors characterized by replacement, and distortion, although the type of malocclusion did not affect speech performance.

Normal human breathing takes place through the nasal passages. Properly developed airways allow normal breathing through the nose with the mouth closed. Studies show that the air that is inhaled through the nose is different from the air that is inhaled through the mouth. People who breathe through their mouths experience more physical exertion due to the increased need for oxygen [5].

In 1918, Norlund introduced the "compression theory" which states that the narrowing of the maxillary arch is related to the absence of lateral pressure of the tongue on the palate. In response to nasal obstruction, the tongue descends and the mesializing effects of the buccal musculature remain unobtrusive. The effect is further enhanced by differential pressure across the hard palate in the absence of nasal airflow, leading to a narrow, high palate.

Norlund also promoted the "theory of inactivity", according to which there is reduced growth of the nasal cavity due to its inactivity, as previously suggested by Komer (1891) and Bentzen (1903).

“The air pump theory” described by Kantorowicz (1916) and James & Hastings (1932) argues that a change in mouth breathing causes the normal negative pressure in the anteriorly closed oral cavity produced by nasal breathing to be lost and the palate not move downward with growth of the maxillary alveolar proces [6].

Quinn[7] confirmed that oronasal breathing was one of the early symptoms of an unnatural act of breathing and that dramatic deformities of the face, jaws and teeth could be caused by the inability to breathe properly through the nose.

A year later, Ricketts[8] stated that when there is abnormal nasal function, growth can be inhibited, the pressure changes to a vacuum and the maxillary complex is sucked in, limiting the basal bone. 3 mechanisms have been identified by which mouth breathing affects the etiology of facial formation and dentition : compression, dissection atrophy (“theory of inactivity”) and alternative air pressure (“air pump theory”).

In random selected 370 subjects, the prevalence of mouth breathing was found to be 55% in Brazilian investigation, in 2008-year study[9] and 56.8% in Portugal study in 2010 [10].

In the study conducted by Bhayya et all [11], mouth breathing habit was found to be the second most prevalent habit with the incidence rate of 17%, and it is little higher when compared to the findings of the previous studies.

The etiology of mouth breathing is multifactorial, and can be classified into three groups, according to Finn and Sim [12]:

1. Obstructive mouth breathing (obstruction of the normal flow of air through the nasal passages)
2. Habitual mouth breathing (continually mouth breathes by habit, although the obstruction has been removed)
3. Anatomical breathing of the mouth (short upper lip does not permit closure without undue effort)

Mouth breathing is mainly caused by nasal obstruction which is the most common cause. It may be due to congenital or postnatal causes and is due to the presence of obstruction in the nasopharyngeal region, which increases nasal resistance.

More benign, short-term obstructive forms result from mucosal accumulation in infections or allergic chronic rhinitis. Less extreme forms include unilateral nasal atresia, hernial stenosis or nasal septal defects associated with cleft palate. Other mechanical disturbances predominate during late development, such formation of nasal polyps or obstructive tissue like adenoid and / or tonsillar hypertrophy.

The adenoids gradually enlarge and eventually outgrow the nasopharyngeal space by 3-5 years, reducing the size of the nasopharynx. After the age of 5, the expansion of the bony nasopharyngeal space continues to the maximum growth, after which, continuously, there is a constant decline of these tissues as the child matures with a simultaneous increase in the nasopharyngeal area. If these tissues do not atrophy, the patient is at risk of developing orthodontic abnormalities. The condition known as the "long adenoid face" is characterized by enlarged tonsils or adenoids that accompany the retrograde lower jaw, a sharp mandibular angle, and a larger lower anterior facial height.

In 1872, Tomes coined the term “Adenoid Facies” or ‘Long Face Syndrome’ to describe the dentofacial changes associated with chronic nasal airway obstruction. Any condition that causes nasal obstruction could lead to this typical facial morphology, characterized by an increased LAFH, increased dentoalveolar height, gummy smile, high arched palate, steep mandibular plane, excess incisal show, anterior marginal gingivitis and long-standing nasal obstruction may lead to "disuse atrophy" of the lower lateral cartilages , resulting in as slit-like external nose with a narrow nasal vault.

The "long face syndrome" is often associated with crossbite, tension nose, a Class II and mandibular retrognathism. Another group of children develop Class III occlusion due to anterior displacement of the tongue due to tonsillar hypertrophy. This creates a pressure affects on the lingual aspect of the lower dental arch, causing a prognathic mandible and undererupted lower teeth. Children who have hypertrophied adenoids, tonsils and inferior turbinates develop long face syndrome in 30%, in contrast of 2% in children with normal respiratory airways [13].

Mild obstruction is characterized by snoring and speech disorders, but moderate obstruction has mild features of sleep disturbance and apnea. On the other hand, severe obstruction has more pronounced signs and symptoms observed in moderate obstruction and periods of obstructive sleep apnea.

Intranasal defects such as deviant nasal septum, bone osteophytes or polyps, dermoid cysts, tumors of the nasopharynx, macroglossia, micrognathia, TMJ ankylosis, laryngo-tracheanial atresia, increased nasopharyngeal depth may also cause mouth breathing.

In about 85% of cases, mouth breathing is an adaptation of nasal obstruction. Allergic rhinitis, with and without oral habits, as an etiology is involved in the anterior and posterior open bite. Otitis media is correlated with a high gothic palate and a posterior cross bite.

Mouth breathing generate recurrent ear infections, snoring at night, breathing stops for a few seconds at night during snoring or during loud breathing. Obstructive sleep apnea, which causes changes in the upper airways and changes in the craniopharynx, is characterized by an increase in the size of the soft tissue in the upper airways which reduces the functional size of the upper airways predisposing to sleep apnea, abnormal anatomy of upper airways, retrognathia, tonsillar hypertrophy, macroglossia, and soft palate enlargement or elongation [14].

Warren et al [15] , demonstrated that less than 0.4 cm2 may represent an inadequate airway and some mouth breathing would be expected. As etiology they point them out : allergic rhinitis, nasal polyps, enlarged adenoids or tonsils, abnormally short upper lip preventing proper lip seal, obstruction in the bronchial tree or larynx, obstructive sleep apnoea syndrome, genetically predisposed individuals, traumatic injuries to the nasal cavity and thumb sucking as the instigting agent.

There are different general mechanisms which may explain the consequences of mouth breathing and are mainly composed of biochemical, physiological, immunological and anatomical disturbances. Main physiological and biochemical disorders are the lower oxygen absorption (chronic hypoxemia), increased CO2 concentration (hypercapnia), and its related changes in the acid-base balance, towards respiratory acidosis. Also, there is increased water and energy loss, and changes in salivary profile. It has been shown that healthy subjects, experience a 42% increase in net water loss when they switch the breathing mode from nasal to oral expiration during tidal breathing. The authors considered that increased water and energy loss by oral breathing could be a contributing factor to the symptoms seen in patients suffering from nasal obstruction [16].

Inflammatory and oxidative mediators release had also been linked to mouth breathing, however it is not clear are they the result of mouth breathing or other related disturbances or by complex interactions. The oxidant nitric oxide (NO) is produced by the action of the enzyme NO synthase (NOS) on Larginine in different cell types and found in air exhaled by humans. Most of the exhaled NO is derived from the upper airways and increases in patients with untreated asthma and allergic rhinitis, diseases which exhibit mutual interactions with mouth breathing. The induction of iNOS in patients with allergic rhinitis increases nasal NO which in turn produces the symptoms of nasal obstruction and rhinorrhoea, contributing to mouth breathing [17].

II. Clinical Features Of Mouth Breathing Patients

In the literature it is accepted and confirmed that one or all of the three neuromuscular responses must be present for malocclusion and skeletal relationship changes to occur:

1. altered position of the mandible (the mandible rotates down and back in response to the etiological factor).
2. changed lingual position (lingue moves up and forward in response to the etiological factor).
3. extended posture of the head (the mandible is held in position while the cranium and maxilla rotate upwards).

Extraoral morphological features in individuals breathing through the mouth are: elongated face, incompetence of the lips, shorter upper mouth, dry and chapped lips, enlarged anterior lower third of the face, increased mandibular angle, dark circles around the eyes, narrow, small and sloping nostrils, crooked nose, head position in extension, nasal speech, constantly dry mouth, increased salivary viscosity.

Mouth breathing during the critical period of facial growth is associated with clockwise rotation of the mandible and an increase in the lower anterior height of the face. Breathing through the mouth not only changes the anterior part of the face, but also changes the shape of the oropharyngeal airways. As the anterior facial height increases, there is often a reduction in the back height [18, 19, 20, 21, 22, 23].

But, based on own findings Bianchini at coworkers [24] were unable to demonstrate a relation between mouth breathing and increased facial height, and their paper showed that there is individual, genetic and regional variation.

Oral respiration is associated with a smaller retropalatal and retrogloseal area, as well as pharyngeal elongation, as a risk factor for obstructive sleep apnea.

Acording Basheer at all [25], subjects with mouth-breathing habit exhibited a significant increase in lower incisor proclination, lip incompetency and convex facial profile. The presence of adenoids accentuated the facial convexity and mentolabial sulcus depth.

Intraoral features are: high or gothic palate, maxillary narrow arch, V-shaped dental arch, posterior cross bite, anterior open bite, reduced anterior vertical fold, overjet, class II malocclusion, bacterial plaque and gingivitis around the frontal teeth.

A change in the breathe mode, leads to a change in the jaw, tongue and head position. The balance between the action of the tongue, on the one hand, and the mimic and masseter muscles, on the other, is disturbed. The "forming" action of the middle face of the air that passes through the nasal cavity and affects the normal development of the palate is also disturbed.

When comparing nasal and mouth breathing patterns, mouth breathing is far more specifically associated with constriction of the maxillary arch, high gothic palate, posterior cross bite and anterior open bite [26].

While breathing through the mouth, the tongue usually moves back and down and does not participate in the development of the hard palate, resulting in the formation of a high gothic palate. The head is developed forward for easier inhalation through the mouth, the lower jaw is underdeveloped and placed down and back, which leads to its distal position and the formation of an overjet. Tight cheek muscles exert an increased external force on the upper jaw that causes a V-shape. Low and forward position of the tongue is common in the presence of hypertrophic palatine tonsils in an attempt to enlarge the posterior airway and facilitate breathing, causes the mandible to go down, causing an imbalance between the masticatory, mimic, and lingual muscles leading to an adenoid face or long face syndrome. Facial morphology may vary with nasorespiratory obstruction depending on size, duration, and time of onset. With the habit of breathing through the mouth, the negative pressure is lost, the tongue is lowered and there is no stimulating effect on the maxilla. At the same time, the outside of the pressure in m.buccinator dominates and maxilla remains undeveloped. Prolonged mouth breathing develops an adenoid type of face characterized by a narrow maxilla, narrow and elongated dentition due to protrusion, high gothic palate, edema pain, cross bite, decreased salivation, frequent caries, and gingival hyperplasia [27, 28].

Mouth breathers tended to have a retrognathic maxilla and mandible, vertical growth pattern with high mandibular plane angle, downward and backward rotation of the mandible and an increase in total and lower anterior facial height and decrease in posterior facial height [29].

Franco et all [30], found out that the cephalometric pattern of mouth and nose breathing children was not similar. Measurements of the mouth breathing group differed according to the etiology of upper airway obstruction. Children with isolated hypertrophy of the palatine tonsils presented more forward and upward positioned mandible, compared to children obstructed only by the enlarged adenoid.

Prolonged periods of oral respiration lead to extensive eruption of the posterior molars which exerts a downward vector of force on the mandible, causing the lower jaw to rotate down and back in a "clockwise" direction. Because of the backward mandible rotation, retrognathia and open bite deformities are common. With a lowered tongue position, the lateral expansile forces of the tongue on the palate are lost, and the unopposed medial forces of the buccinator and masseter muscles leads to a narrow, high arched palate. The incomplete lateral expansion of the maxilla often leads to a unilateral or posterior crossbite

Schwartz in his 1926 and 1931 studies found that this position of the head relative to the body, especially during sleep, led to distal displacement of the mandible and the development of class II.

Vig [31] found that in such persons there is a tendency to keep the head higher. Extended posture observed in people breathing through the mouth is thought to affect the position of the mandible. The SN angle is lower in patients with extended head posture.

Mouth breathing at night, without any other symptoms, is associated with upper airway collapse, and is a risk factor for obstructive sleep apnea and snoring. Snoring children are more likely to develop a high gothic palate and a posterior cross bite. After a child is diagnosed with obstructive sleep apnea, extreme malocclusions and cranial dysmorphology often occur, significantly increased overjet, reduced overbite, narrower and shorter dental arches.

New research on sleep-disordered breathing and obstructive sleep apnea has linked poor sleep and airway obstruction to daily behavioral disorders in children. The relationship between SBD and the increased risk of academic and social failure is also well documented. By the time a child reaches their peers, their dysmorphic facial structure may put them at permanent risk for life by impairing airway function. The combination of a long face, reduced prominence, nasal width, open bite, class II as well as asymmetric molar ratio and retrograde mandible may be diagnostic features of people with SDB who require referral to specialists to assess other clinical symptoms.

This proves that the structural changes are caused by the long-term impact of functional changes in the head, neck and tongue in order to maintain the breathing pattern during sleep.

Mouth breathing may result in low oxygen concentration in the blood. This is associated with high blood pressure and heart failure. Studies show mouth breathing may also decrease lung function, and worsen symptoms and exacerbations in people with asthma. In children, mouth breathing can lead to physical abnormalities and cognitive challenges [32, 33].

Study published in the International Journal of Pediatrics investigating the long-term changes to facial structure caused by chronic mouth breathing noted that this seemingly 'benign' habit "has in fact immediate and/or latent cascading effects on multiple physiological and behavioral functions". [34]

Therefore, mouth breathing can have a tremendous impact on the mental and physical health of children; as it can be associated with the restriction of the lower airways, poor quality of sleep, reduced cognitive functioning and a lower quality of life [35].

Recent study confirmed the positive association between mouth breathing (especially during sleep) and allergic diseases, including the atopic dermatitis in school-aged children [36].

Wargerwick [37] found that the extensor reflex of the masseter muscle plays an important role in controlling the position of the mandible. The masticatory muscle may function as an adjunct to the respiratory muscle when the nasal airways are obstructed.

Basner [38] showed that there was more EMG activity in the genius muscle during nasal breathing than during oral respiration.

Early intervention to correct nasal obstruction may lead to reversal of associated craniofacial changes. Normalization of the shape of the face after adenoectomy in a child can take up to five years. Delaying the intervention may result in unsuccessful orthodontic treatment. If chronic mouth breathing persists or recurs after adenoectomy, allergic rhinitis with hypertrophy should be ruled out.

The Linder-Aronson study found that children who underwent adenoectomy and returned to nasal breathing showed changes in craniofacial growth. There was a relatively large increase in the inclination of the upper incisors during the first year after adenoectomy along with normalization of the lower incisions. The width of the arch and nasopharynx increased postoperatively during the 1st year, and the size of the ML / NL angle decreased [39].

III. Diagnosis

Early diagnosis of airway obstruction, obligate mouth breathing and malocclusion, with identification of the underlying causes, is essential to prevent worse orofacial growth abnormalities and avoid any associated conditions. The most important step in diagnosis of mouth breathing is proper record of detailed case history, through anamnestic data (are the lips separated, is there frequent inflammation of the tonsils, recurrent respiratory infections, allergic rhinitis or otitis media) and examination on breathing pattern.

A complete examination of the head and neck must be performed.

The general well-being of the child should also be determined, including growth and development, birth or early childhood trauma, previous hospitalizations, medication and surgical history, sleep history, can often detect loud snoring, restless sleep, abnormal sleep position and nocturnal mouth breathing.

Difficulty swallowing and history of rhinorrhea, epistaxis, and allergy should be noted. The allergy should be investigated. Itching, sneezing and rhinorrhea are usually early symptoms, later itching can affect the soft palate and external auditory canal. Sneezing, sinus congestion, mouth breathing and disturbed sleep patterns as well as conjunctivitis are common. On examination we notice an allergic character - pallor, swollen nose and mucoid, throat - inflamed with lymphoid follicles, ears - otitis media.

Other craniofacial abnormalities that may be associated with these symptoms include cleft palate and Down syndrome. Tonsillar hypertrophy, macroglossia, and oropharyngeal mass should be evaluated.

Ears should be evaluated because otitis media is certainly associated with problems with nasal obstruction. Bone nasal anomalies, external masses, pits, etc. should be assessed, as well as nasal cavity for the presence of secretions, edema and erythema of the nasal mucosa.

Voice quality (degree of nasality) and clarity, daytime hypersomnolence, and learning / behavioral difficulties should be assessed too. In a hyponasal child, the resonance is poor even with the nostrils open, and closing the nostrils results in little or no reduction in resonance.

In the diagnostic procedures, the expertise and skills of the otorhinolaryngologist must be included. Three independent and blind evaluations were conducted by 2 orthodontists independently (anamnesis and breathing tests, respectively) and an otolaryngologist (rhinoscopy, nasal endoscopy, and visual assessment). Unfortunatelly, weighted kappa coefficient showed poor interrater agreement for most comparisons [40].

By cephalometric analysis, performed examination will shows the size of the hypertrophied tonsils and/or adenoids, the size of the pharyngeal space, and the patient's skeletal pattern. Cephalometric analysis of the nasopharyngeal airways usually indicates altered parameters.

The following diagnostic tests are performed to confirm the diagnosis of mouth breathing [41, 42]:

Rosenthal test: As the child takes 10 to 15 deep breaths with the mouth closed, inhaling and exhaling through the nose, the examiner measures the patient's heart rate. Children who normally breathe through the nose have no difficulty and do not show an increase in heart rate. This reaction is considered a negative breath test.

Water test: The patient is given water to hold it in his mouth. The inability to hold it with the mouth closed for just over 2 minutes confirms that the individual is breathing through the mouth.

Mirror condensation test or fog test: A cold double-glazed mirror is placed under the nose. If moisture condenses on the upper surface then breathing is through the nose, and if it condenses on the lower surface, breathing is through the mouth.

Butterfly test: Butterfly-shaped cotton threads are placed over the upper lip, under the nostrils. On exhalation, if the filaments fly down, respiration takes place nasally.

Rhinometric analysis: nasal resistance and air flow are measured with a rhinomanometer. This is a very precise technique for quantifying the respiratory regime, where nasal and oral breathing are simultaneously recorded and calibrated. The readings are recorded in waves, which can later be converted to digital format.

Functional breathing test: The enlargement of the nostrils is observed with the help of a mirror. The external nostrils dilate (tremble) in individuals who breathe through the mouth.

Nasal reflex: Indicates whether or not the nose is functioning normally. While the child's mouth is closed, the operator closes the patient's nostrils for 2 seconds and then releases them. The alleles of the nose should tremble and separate.

IV. Treatment

Early treatment is necessary to normalize growth and development. It maximizes the success of corrective orthodontics. Dentists and otolaryngologists provide unique treatments that can reduce airway obstruction and craniofacial deformity.

Etiological agents for mouth breathing habit should be treated first. If any nasal or pharyngeal obstruction is present then removal of obstruction by surgery or local medication should be pursued. If a respiratory allergy is present, it should be brought under control.

The team approach is needed for patients who have adenoid-associated malocclusion and allergies to appropriate care with anti-inflammatory drugs, bronchodilators, and antibiotic therapy to control superinfection, as well as surgical evaluation to remove enlarged and enlarged tonsils.

Maxillary expansion is a simple, rutine conservative method of treating impaired nasal breathing in patients with mixed or permanent dentition. But the younger the patient, the better are long-term results. It is an effective method of increasing the width of narrow maxillary arches and also reduces nasal resistance.

Various exercises are recommended for correction of mouth breathing habit. It includes: hold a sheet of paper between the lips; stretch the upper lip to maintain lip seal or stretch in downward direction toward the chin or pulling a button exercise.

V. Conclusion

Signs and symptoms of orofacial myodysfunction can occur in the first months of life, but they can also occur at any time in life. In addition to providing structural solutions to problems as they arise, dentists and orthodontists must play a proactive role in preventing acquired craniofacial disorders and supporting optimal craniofacial growth. In response to the growing scientific and clinical evidence, all medical and dental professionals have responsibility for screening mouth breathing disorders, enlarged and restrictive oral soft tissue in patients in all ages, and oral dysfunction early in life. Habit have to be intercepted before child needs to undergo corrective treatment. If mouth breathing is treated early, its negative effects on dental and facial development, along with the medical and social problems associated with it, can be reduced or averted.

References

[1]. Graber TM, Vanarsdall R Jr, Vig K. Orthodontics: Current principles & Techniques. 4th ed, 2005, Elsevier Inc
[2]. Proffit WR, Fields HW, Sarver DM. Contemporary Orthodontics 5th ed, 2014, Mosby
[3]. Mason RM. A retrospective and prospective view of orofacial mycology. Int J Orofac Myol, 2005, Vol.31 (1): 5-14
[4]. McNamara JA. Influence of respiratory pattern on craniofacial growth. Angle Orthod. 1981 Oct;51(4): 269-300
[5]. Wasnik M, Kulkarni S, Gahlod N. Mouth breathing habit: a review. Int J Community Med Public Health. Jan 2021, 8(1): 495-501
[6]. James WW, Hastings S. Discussion on Mouth-Breathing and Nasal Obstruction. Proceedings of the Royal Society of Medicine, Jun 1932, Vol 25 (8):1343-55
[7]. Quinn GW. Are dentofacial deformities a preventable disease? N C Dent J. Summer-Autumn 1978; 61 (2-4): 5-6, 57.
[8]. Ricketts R. Early treatment, Part 1,2. Journal of Clinical Orthodontics: JCO, Jan 1979, 13 (1): 23-38
[9]. Abreu RR, Rocha RL, Lamounier JA. Prevalence of mouth breathing among children. J Pediatr (Rio J). Sep-Oct 2008;84(5):467-70
[10]. Felcar JM, Bueno IR, Massan ACS. Prevalence of mouth breathing in children from an elementary school. Cien Saude Colet. 2010 Mar;15(2):437-44
[11]. Bhayya DP, Shyagali TR. Prevalence of oral habits in 11-13 year-old school children in Gulbarga city, India. Virtual J Orthodont. 2009;8(3):1-4.
[12]. Finn, Sim JM, Finn SB. Clinical Pedodontics oral habits in children Ch. 17. 4th ed. Philadelphia: WB Saunders Co.; 2003:370-385.
[13]. Agarwal1 L, Tandon R, Kulshrestha R, Gupta A. Adenoid Facies and its Management: An Orthodontic Perspective. Ind J Orthod Dentofac Res, April–June 2016;2(2): 50-5
[14]. Page D and Mahony D. The Airway, Breathing and Orthodontics. J. Compr. Dentof. Orthod. + Orthop. (COO) Umf. Dentof. Orthod. u. Kieferorthop. (UOO). 2019, No. 1-2 : 44-50
[15]. Warren DW, Hairfield WM, Seaton DL, Hinton VA. The relationship between nasal airway cross-sectional area and nasal resistance. Am J Orthod Dentofacial Orthop. 1987 Nov; 92(5): 390-5.
[16]. Svensson S, Olin AC, Hellgren J. Increased net water loss by oral compared to nasal expiration in healthy subjects. Rhinology, 2006, 44, 74-7
[17]. Kent DT, Soose RJ. Environmental factors that can affect sleep and breathing: allergies. Clin Chest Med. 2014 Sep; 35(3): 589-601
[18]. Cheng M-C, Enlow D, Papsidero M, Broadbent BH Jr, Oyen O, Sabat M. Developmental effects of impared breathing in the face of the growing child. Angle Orthod, Oct 1988, 309-20
[19]. Souki BQ, Pimenta GB, Souki MQ, Franco LP, Becker HM, Pinto JA. Prevalence of malocclusion among mouth breathing children: do expectations meet reality? Int J Pediatr Otorhinolaryngol. 2009 May; 73(5):767-73
[20]. Zicari AM, Albani F, Ntrekou P, Rugiano A, Duse M, Mattei A, Marzo G : Oral breathing and dental malocclusions. Eur J Paediatr Dent. 2009 Jun;10(2):59-64
[21]. Harari D, Redlich M, Miri S, Hamud T, Gross M. The effect of mouth breathing versus nasal breathing on dentofacial and craniofacial development in orthodontic patients. Laryngoscope, 2010 Oct; 120(10): 2089-93
[22]. Rossi RC, Rossi NJ, Rossi NJC, Yamashita HK, Pignatari SSN. Dentofacial characteristics of oral breathers in different ages: a retrospective case–control study. Progress in Orthodontics, 2015, Vol 16, Article no: 23
[23]. Zhao Z, Zheng L, Huang X, Li C, Liu J, Hu Y. Effects of mouth breathing on facial skeletal development in children: a systematic rewiew and meta analysis. BMC Oral Health, 2021, Vol 21:108
[24]. Bianchini AP , Guedes ZCF, Vieira MM. A study on the relationship between mouth breathing and facial morphological pattern. Rev Bras Otorrinolaringol 2007;73(4):500-5
[25]. Basheer B, Hegde KS, Bhat SS, Dilshad Umar D, Baroudi K. Influence of Mouth Breathing on the Dentofacial Growth of Children: A Cephalometric Study. J Int Oral Health. 2014 Nov-Dec; 6(6): 50–55
[26]. Lione R, Buongiorno M, Franchi L, Cozza P. Evaluation of maxillary arch dimensions and palatal morphology in mouth-breathing children by using digital dental casts. Int J Pediatr Otorhinolaryngol. 2014 Jan; 78(1): 91-5
[27]. Paskay L. OMD Orofacial Myofunctional Disorders: Assessment, prevention and treatment. JAOS. 2012 march-april; 34-40.
[28]. Schmidt JE, Carlson CR, Usery AR, Quevedo AS. Effects of tongue position on mandibular muscle activity and heart rate function. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2009;108:881-888
[29]. Zheng W, Zhang X, Dong J, He J. Facial morphological characteristics of mouth breathers vs. nasal breathers: A systematic review and meta-analysis of lateral cephalometric data. Exp Ther Med. 2020 Jun; 19(6): 3738–3750
[30]. Franco LP, Souki BQ, Cheib PL, Abrão M, Pereira TB, Becker HM, et al. Are distinct etiologies of upper airway obstruction in mouthbreathing children associated with different cephalometric patterns? Int J Pediatr Otorhinolaryngol. 2015 Feb; 79(2): 223-8
[31]. Vig K. Nasal obstruction and facial growth: the strength of evidence for clinical assumptions. Am J Orthod Dentofacial Orthop 1998;113:603-11
[32]. Hallani M, Wheatley JR, Amis TC. Enforced mouth breathing decreases lung function in mild asthmatics. Respirology. Jun 2008; 13 (4): 553-8
[33]. Veron HL, Antunes AG, de Moura Milanesi J, Corrêa ECR. Implications of mouth breathing on the pulmonary function and respiratory muscles. Rev. CEFAC, Jan-Feb 2016, 18 (1): 242-51
[34]. Trabalon M, Schaal B. It Takes a Mouth to Eat and a Nose to Breathe: Abnormal Oral Respiration Affects Neonates' Oral Competence and Systemic Adaptation. International Journal of Pediatrics. 2012. (207605):10 pages
[35]. Borres MP. Allergic rhinitis: more than just a stuffy nose. Acta Paediatrica, 2009 Jul;98(7):1088-92
[36]. Lee DW, Kim JG, Yang Y. Influence of mouth breathing on atopic dermatitis risk and oral health in children: A population-based cross-sectional study. J Dent Sci, Jan 2021, 16 (1): 178-85
[37]. Vargervik K, Miller AJ, Chierici G, Harvold EP, Tomer B. Morphologic response to changes in neuromuscular patterns experimentally induced by altered mode of respiration. Am J Orthod. 1984; 85: 115-124

[38]. Basner RC, Schwartzstein RM, Weinberger SE, Weiss JW. Effect of inspired air temperature on genioglossus activity during nose breathing in awake humans.J Appl Physiol (1985). 1990 Sep; 69 (3): 1098-103
[39]. Linder-Aronson S, Woodside DG, Lundström A. Mandibular growth direction following adenoidectomy. Am J Orthod. 1986 Apr; 89 (4): 273-84.
[40]. Costa JG, Costa GS, Costa C, de Vasconcellos Vilella O, Mattos CT, de Alcantara C-SA: Clinical recognition of mouth breathers by orthodontists: a preliminary study. Am J Orthod Dentofacial Orthop, 2017 Nov; 152(5): 646-653.
[41]. Ramírez-Velásquez1 M, Molina AM , Añez Y , Abad V , Nava R. Protocol for the functional evaluation of the stomatognathic system. Int J Med Surg Sci. 2018; 5(4): 154-159
[42]. Pacheco MCT, Casagrande CF, Teixeira LP. Guidelines proposal for clinical recognition of mouth breathing children. Dental Press J Orthod. 2015 Jul-Aug; 20(4): 39–44

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