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Bucco-maxillo and systemic repercussions of the mouth breathing syndrome: a comprehensive review

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Abstract

Introduction: Mouth breathing syndrome is characterized by full or partial breathing through the mouth. Its most frequent causes are allergic rhinitis and enlarged tonsils and/or adenoids. These conditions interfere with the passage of air through the nose and upper airways, causing the child to breathe through the mouth. The treatment of the syndrome is done in a multidisciplinary way and counts on the participation of the dental surgeon, who will monitor and take care of any damage to oral health. **Objective:** It was to present, through a comprehensive review, the main considerations of mouth breathing syndrome in childhood and youth and the role of orthodontics in the management of this problem. **Methods:** The research and development of the work were carried out from January to March 2023 in the Scopus, PubMed, Science Direct, and Scielo databases, using scientific articles from 2009 to 2022, following the PRISMA rules. **Results and Conclusion:** It was found 94 studies performed eligibility analysis. The final sample had 28 eligible studies and only 13 studies were described in the comprehensive review. The major cause of mouth breathing syndrome is nasal obstruction, but nasal and facial deformities, allergic rhinitis, septum deviation, tonsils, and nasal conchae, and adenoid hypertrophy also frequently occur. Mouth breathing syndrome negatively affects the respiratory system, cardiovascular system, sleep, hematopoietic system, gastrointestinal tract, endocrine system, and Dental-Skull-Facial development. Thus, the dental surgeon needs to acquire in-depth knowledge about the subject, so that he can develop educational-preventive programs in the place where he works, to promote health and quality of life.

Keywords: Mouth breathing syndrome. Bucco-maxillo impacts. Systemic impacts. Preventive care. Quality of life.

Introduction

Mouth breathing syndrome is characterized by full or partial breathing through the mouth. Its most frequent causes are allergic rhinitis and enlarged tonsils and/or adenoids. These conditions interfere with the passage of air through the nose and upper airways, causing the child to breathe through the mouth [1,2].

The most frequent manifestations are sleeping with your mouth open, snoring, saliva on the pillow, difficulty sleeping or restless sleep, irritability, and drowsiness during the day. Sleep impairment can interfere with school performance, development, and child behavior. In the long term, mouth breathing can bring a series of consequences, such as facial and oral changes, even leading to the need for correction with orthodontic appliances [3,4].

In this sense, the diagnosis is made by a professional dentist based on the symptoms and examination of the nose and mouth. Treatment is aimed at correcting whatever is causing the air obstruction and allowing breathing to be done through the nose again. Early diagnosis and treatment prevent facial and postural changes and poor sleep quality caused by mouth breathing [5].

Mouth breathing syndrome often happens during childhood, but it can harm patients in different aspects, ranging from cognitive to physical development. The treatment of the syndrome is done in a multidisciplinary way and counts on the participation of the dental surgeon, who will monitor and take care of any damage to oral health. In this context, we will explain important aspects of care in the dental office. The name is quite explanatory and refers to patients who breathe through their mouths instead of through their noses. For the individual to fit the syndrome, this pattern must be repeated for more than six months. The patient in this condition will rarely breathe 100% orally, in most cases, the mixed pattern (oral-nasal) happens [6,7].

Furthermore, it is noteworthy that breathing through the nose plays a fundamental role in the correct development of the craniofacial complex, as well as protecting the upper airways and purifying the air thanks to the existing structures within the nasal cavity, protecting the organism from harmful particles coming from the environment [8].

Therefore, the present study aimed to present, through a comprehensive review, the main considerations of mouth breathing syndrome in childhood and youth and the role of orthodontics in the management of this problem.

Methods

Study Design

This was followed by a comprehensive review model on the main clinical findings of mandible fractures, according to the PRISMA rules.

Data Sources and Research Strategy

The literary search process was carried out from January to March 2023 and was developed based on Scopus, PubMed, Science Direct, Scielo, and Google Scholar, using scientific articles from 2009 to 2022, using the descriptors (MeSH Terms): *Mouth breathing syndrome. Buccomaxillo impacts. Systemic impacts. Preventive care. Quality of life,* and using the Booleans "and" between the descriptors (MeSH Terms) and "or" between the historical findings.

Study Quality and Risk of Bias

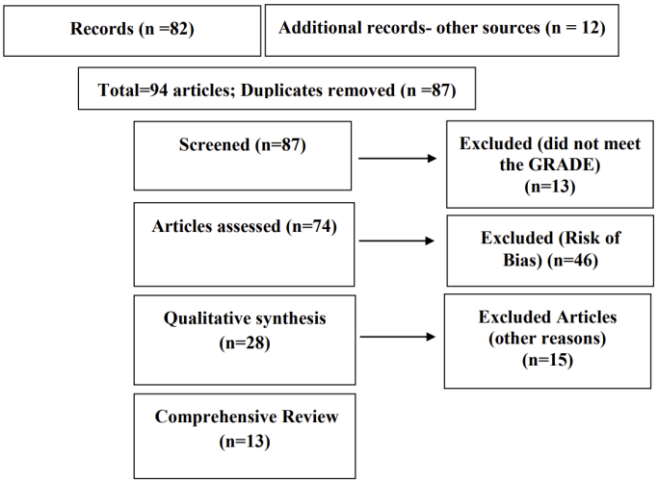
The quality of the studies was based on the GRADE instrument, with randomized controlled clinical studies, prospective controlled clinical studies, and studies of systematic review and meta-analysis listed as the studies with the greatest scientific evidence. The risk of bias was analyzed according to the Cochrane instrument.

Results and Discussion

Summary

A total of 94 articles were found. Initially, duplication of articles was excluded. After this process, the abstracts were evaluated and a new exclusion was performed, removing the articles that did not include the theme of this article, resulting in 74 articles. A total of 28 articles were evaluated and 13 were included and developed in this review study (Figure 1). Considering the Cochrane tool for risk of bias, the overall assessment resulted in 46 studies with a high risk of bias and 13 studies that did not meet GRADE.

Figure 1. Selection of studies.



Source: Own authorship.

Major Considerations - Mouth Breathing Syndrome

The biggest cause of mouth breathing syndrome is nasal obstruction. Other factors pointed out are nasal and facial deformities, allergic rhinitis, septum deviation, tonsils and nasal conchae, and adenoid hypertrophy. Some conditions can be associated (Table 1) [1-3].

Table 1. Main predictors of mouth breathing syndrome.

Craniofacial syndromes	✓ Crouzon Syndrome ✓ Apert syndrome ✓ Treacher-Collins Syndrome ✓ Goldenhar syndrome ✓ Pierre Robin Syndrome
Neurological diseases	✓ Arnold-Chiari malformation ✓ Myelomeningocele ✓ Cerebral palsy ✓ Duchenne Muscular Dystrophy
Conditions accompanied by abnormal muscle tone	✓ Down's syndrome ✓ Prader Willi Syndrome ✓ Hypothyroidism

Conditions associated with reduced upper airway patency	✓ Allergic rhinitis ✓ Adenotonsillar hypertrophy ✓ Obesity ✓ Craniofacial anomalies ✓ Macroglossia ✓ Laryngomalacia ✓ Subglottic stenosis ✓ Mucopolysaccharidosis and other metabolic storage diseases ✓ Cleft palate ✓ Functional causes: nipple and finger sucking, use of a bottle, lack of breastfeeding.

Symptoms can be assessed both through anamnesis and also through physical examination. It is noteworthy that the signs can be divided into daytime and nighttime. When talking to parents or guardians, remember to raise this question to get richer and more accurate answers. During the day, the patient may present: - Impaired school performance; -Swallowing difficulties; - Decreased appetite; - Hearing deficit; - Headache in the morning; -Difficulties to wake up when waking up; -Hyperactivity; - Drowsiness throughout the day; - Frequent airway infections. Already at night: Sleep with your mouth open; - Snoring; -Apnea; - saliva on the pillow; -Irritability; - Difficulty sleeping; - Restless sleep; -Noisy breathing [4,5].

In this respect, mouth breathing syndrome can cause a series of damages to the patient's health. The condition is capable of modifying the growth pattern of the face, generating dental alterations, among others. The patient undergoes changes in the positioning of the tongue on the floor of the mouth, a decrease in the tone of the muscles of the face that lead to maxillary hypoplasia and reduced growth of the mandible (as a consequence, there is lowering and posterior rotation of the maxilla) [6-9].

Changes also occur on the face, including on the lips. The lower one becomes hypotonic and inverted, while the upper one is shorter. In addition, the patient, due to craniofacial alterations, has a longer and narrower face. Periodontal tissues are affected and have a greater chance of mucosal dryness, gingivitis and periodontitis due to plaque accumulation and gingival recession. The patient also has an ogival palate, protruded incisors and occlusal disharmonies, such as crowding, open bite and posterior crusade [9,10].

Systemic Repercussions

Respiratory System

Mouth breathing leads to increased lung resistance, decreased lung compliance, decreased arterial pO_2 and consequent change in the minute-flow curve. The decrease in resistance to airflow resulting from mouth breathing leads to lower ventilation and oxygenation of the most peripheral alveoli. Sudden infant death syndrome may be associated with nasal obstruction in neonates, since they breathe almost exclusively through the nose and do not use oral breathing if not encouraged. The chronic cough presented by many mouth breathers occurs because, through mouth breathing, there is not adequate heating and humidification of the inspired air [11].

Cardiovascular System

A recurrent hypoxia regimen can lead to pulmonary hypertension and progresses to pulmonary discoloration. Nasal obstruction may lead to the indiscriminate use of sympathomimetic amines with alpha-dilator activity. These drugs increase blood pressure, predispose to arrhythmias (extrasystoles) and even cardiac arrest [1,3].

Sleep

Patients with mouth breathing may present with daytime sleepiness, desynchronized sleep (alteration of the REM phase of sleep), depression of the ability to wake up, restless sleep, and nocturnal enuresis. Obstructive sleep apnea-hypopnea syndrome (OSAHS) is the ultimate expression of sleep-disordered breathing. It is present in about 0.7% of children and 2 to 4% of middle-aged adults. In children, the main cause is hypertrophy of the pharyngeal tonsils. Apneas and hypopneas lead to sleep fragmentation due to micro-arousals, causing daytime sleepiness, irritability, and hormonal changes. Frequent breathing pauses also lead to hypoxia, hypercapnia, and acidosis, which can lead to reduced school performance and morning headaches. Repeated respiratory effort during the night causes an increase in intrathoracic negative pressure, which, associated with the relative flaccidity of the anterior thoracic wall, causes thoracic deformities such as pectus scavatum [3,7].

During periods of hypoxia, reflex vasoconstriction of the pulmonary microcirculation occurs, causing pulmonary hypertension, and increased afterload of the right ventricle (cor pulmonale). Right heart failure leads to hepatomegaly and lower limb edema due to blood accumulation in the peripheral circulation. The evaluation of OSAHS in children involves anamnesis and complete physical examination, nasofibroscopy to investigate any point of airway obstruction, and radiography. Although there are monitors that only assess the respiratory part, the gold standard for the diagnosis of OSAHS remains overnight polysomnography [8].

Hematopoietic System

Patients with mouth breathing may be in a state of hypoxemia during sleep and develop compensatory polycythemia [3,11].

Gastrointestinal Tract

Nasal obstruction can cause dysphagia when the nasopharyngeal disease makes it difficult to coordinate breathing with swallowing or when the nasal disease has an obstructive effect by extending caudally into the pharynx. Aerophagia is frequent in these patients [3,11].

Endocrine System

Many hormones are dependent on the circadian cycle, so respiratory disorders caused by nasal obstruction lead to inadequate production of these hormones. An example is the change in the release of the hormone GnRH leading to weight and height growth retardation and the decrease in the secretion of the anti-diuretic hormone can lead to nocturnal enuresis [3].

Dental-Skull-Facial Development

The splanchnocranium grows in an anteroinferior direction, through the nasomaxillary complex (nasal, maxillary, zygomatic, palatine, and vomer bones). Lateral growth is highly dependent on nasal airflow, the latter of which promotes bone resorption on the nasal side and deposition on the palate. Face types can be grouped into 2 large groups: dolichocephalic (long and narrow) and brachycephalic (short, wide, and round). Dolichocephalic individuals present the nasomaxillary complex in a more protruding position, since the base of the skull is narrower and longer, as are the maxillary arch and plateau. So is the nasopharynx, longer and narrower. The condyle of the mandible has a lower relative position, resulting in a posterior rotation of the mandible that tends to be retracted, thus making the profile more convex. Brachycephalic individuals have a wider and shorter skull base and, therefore, a smaller position of the nasomaxillary complex, and a wider maxillary arch and palate. The nasopharynx is also shorter but wider. Its branch is larger and the mandible tends to rotate anteriorly, giving a straighter profile, sometimes leading to prognathism [1,2,7,11].

Also, mouth-breathing patients unconsciously try to widen the oropharynx in an attempt to reduce resistance to respiratory flow. Bone remodeling is dependent on continuous pressure exerted by muscles and tendons. The extension of the neck and the constant opening of the mandible cause the caudal growth of the mandible and the vertical growth of the face. Prognathism may occur in an attempt to increase the anteroposterior angle of the pharynx. The impossibility of breathing and chewing at the same time leads to the use of the lateral rotation of the mandible, allowing airflow on the side contralateral to chewing. The repositioning of the tongue, which no longer exerts pressure on the palate, leads to the formation of an ogival palate. The ogival palate, together with the absence of constant contact between the upper and lower dental arches, causes malocclusion, and prominence of the upper incisors [9,11].

Dentist's Role in Treatment

There are several consequences that the mouth breathing syndrome causes to the patient, and these are not just the oral alterations, there are other risks to the child's health, both physical and mental. The treatment is carried out with the help of several professionals due to the complexity of the situation, after all, it is a syndrome that affects breathing, which is a vital process for anyone [2,5,7].

When the patient does not receive proper treatment, stomatognathic functions (chewing, swallowing, breathing, and speech) are at risk, in addition to other serious morphofunctional, pathological, and behavioral changes. It is, therefore, necessary that intervention and treatment begin as soon as possible, with the presence of a multidisciplinary team. The dentist, in addition to treating the manifestations already mentioned, is crucial in providing guidance on the importance of breastfeeding, which should be done for any patient. Breastfeeding is the main means of preventing mouth breathing syndrome, as it offers some benefits for babies, such as the development of orofacial structures. Thus, the dental surgeon needs to acquire in-depth knowledge about the subject, so that he can develop educational-preventive programs in the place where he works, to promote health and quality of life [1-4].

In this context, a retrospective study evaluated the short-term effects of rapid maxillary expansion on the skeletal structures and soft tissues of the nose, in mouth-breathing patients, using a reliable and reproducible, but simple, methodology with the aid of computed tomography. Fiftyfive mouth-breathing patients with maxillary hypoplasia were evaluated, and divided into an experimental group treated with rapid maxillary expansion (39 patients, 23 male, and 16 female, mean age 9.7 years and standard deviation of 2. 28, ranging from 6.5 to 14.7 years) and a control group (16 patients, 9 male, and 7 female, mean age 8.8 years, a standard deviation of 2.17, ranging from 5.11 to 13.7 years). There were significant increases in all skeletal and soft tissue variables in the experimental group ($p<0.05$), but no significant changes were found

in the control group. When comparing the experimental group and the control group, the most important change occurred in the width of the piriform aperture ($p<0.001$) [12].

Finally, the authors Saitoh et al., 2018 clarified the relevant factors and the interrelationships between the factors that affect mouth breathing syndrome in children. 380 elementary school children between 6 and 12 years old were surveyed. The questionnaire consisted of 44 questions about daily health conditions and life habits and was answered by those responsible for the children. 26 of the 44 questions were selected, and classified into seven factors. Factors 1-7 were defined as "Incompetent lip seal", "Nose and throat disorders", "Eating and drinking habits", "Bad breath", "Swallowing and chewing problems", "Condition of teeth and gums", and "dry lips", respectively. There were also correlations between these factors themselves. Therefore, mouth breathing syndrome was categorized according to 7 main factors. As Factor 1 was defined as "Incompetent lip seal", which was representative of the physical appearance of mouth breathers and correlated with other factors, it was suggested that the mouth breathing syndrome should consist of 7 factors in total [13].

Conclusion

The major cause of mouth breathing syndrome is nasal obstruction, but nasal and facial deformities, allergic rhinitis, septum deviation, tonsils, and nasal conchae, and adenoid hypertrophy also frequently occur. Mouth breathing syndrome negatively affects the respiratory system, cardiovascular system, sleep, hematopoietic system, gastrointestinal tract, endocrine system, and Dental-Skull-Facial development. Thus, the dental surgeon needs to acquire in-depth knowledge about the subject, so that he can develop educational-preventive programs in the place where he works, to promote health and quality of life.

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Ethical Approval

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Informed consent

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Data sharing statement

No additional data are available.

Conflict of interest

The authors declare no conflict of interest.

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