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Impact of the Habit of Mouth Breathing on the Development of the Stomatognathic System- Literature Review

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ABSTRACT

Introduction: Mouth breathing is a syndrome characterized by the exclusive passage of air through the oral cavity because of a pathological condition due to nasal, pharyngeal, or habitus obstruction.

Objective: To analyze the impact of mouth breathing habit on the development of the stomatognathic system.

Materials and Methods: Search through PubMed, Science Direct, Scielo, Web of Science (WOS) and Google Scholar, it is a qualitative approach research, documentary bibliographic type, cross-sectional, retrospective in the search, descriptive-analytical design and deductive method; following inclusion and exclusion criteria, 49 articles were included.

Analysis and Discussion of Results: Obstructive, inflammatory and functional factors are associated with mouth breathing; mirror test, butterfly and water retention test characterize the mouth breather ; they present adenoid facies, skeletal class II, narrow upper dental arch, anterior open bite, lip incompetence and tongue in a lower position than usual, gingival inflammation, dental caries, halitosis, obstructive sleep apnea, snoring, alteration of phonemes and masticatory deficiency; the use of steroids, antibiotics, antiallergic drugs, surgical treatment, speech therapy and myofunctional therapy are the standard therapy.

Conclusion: Mouth breathers present skeletal, facial, oral and soft tissue changes and associated pathologies; their treatment will depend on their etiology.

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Introduction

Nasal breathing plays a substantial role in the growth and development of the craniofacial complex [1]. The main function of the nose is to moisten, warm and purify inhaled air from dust and bacteria before it is carried into the lungs [2].

When nasal breathing is affected by external or internal factors, gives way to mouth breathing; which leads to changes in the position of the jaw, head and tongue [1].

Mouth breathing (MB) is a syndrome characterized by the exclusive passage of air through the oral cavity as a consequence of a pathological condition due to nasal or pharyngeal obstruction, or by habit [2].

It can cause alterations in the stomatognathic system, affecting the morphology of the face, giving an elongated appearance (adenoid facies), V-shaped narrowing of the maxillary arch with a high palatal vault and backward growth of the mandible [2,3].

Regarding the state of health of the dental structure, studies by Ballikaya et al. report the presence of carious lesions and gingivitis [4].

Motta et al. stated that, during MB the mouth dries out due to the evaporation of saliva when it is held open, which causes halitosis [5]. In another study, 17.5% of the population presented dry and chapped lips [3].

This oral habit can cause occlusal changes, alterations in orofacial muscle tone, deviations in the chewing and swallowing pattern, sleep disorders, speech alterations and learning difficulties [6-8].

Mouth breathers need more time and chewing activity due to low muscle tone [9]. The pressure of the tongue in mouth breathers is lower in relation to nasal breathers, Bezerra et al. reported that tongue pressure in mouth breathers was 38.27 kPa and in nasal breathers it was 53.73 kPa [10].

Different studies on harmful oral habits in populations between 2 and 15 years old indicate a prevalence of mouth breathing between 4.3% and 56.8% [11-19]. The associated anterior open bite habit is between 6.1% and 37%; linked to tongue thrusting between 2.7% and 29.4% in mouth breathers. It is also indicated that there is a possible relationship between the habit of mouth breathing and posterior open bite in 30.3%.11 On the other hand, other studies relate Angle Class II dental malocclusion in 3.2% and 18.2% in BR and crossbite between 1.2% and 17% [11-17].

This literary review evinces a close relationship between the habit of RB and disorders of dentomaxillofacial development, establishing the purpose of this work to analyze the impact of the habit of mouth breathing on the development of the stomatognathic system.

Risk Factors of Mouth Breathing

Mouth breathing replaces nasal breathing, its etiology is complex. It can be caused by several obstructive, inflammatory or functional factors [20].

Obstructive Factors

Adenotonsillar hypertrophy occurs when Waldeyer's ring, lymphoid tissue, defense against microorganisms and antigenic substances, is affected due to the presence of microorganisms, allergies or some local inflammatory reaction causing an increase in the size of the adenotonsillar tissue, which occupies a larger space in the wall of the nasopharynx preventing nasal breathing, causing mechanical obstruction of the passage of airflow [3,21].

Tonsillar hypertrophy was found in 47% and adenoid hypertrophy in 67%. Studies have reported that individuals with adenotonsillar hypertrophy breathe through their mouths [3,21].

The deviation of the nasal septum in charge of regulating the flow of air through the nostrils, results in the obstruction of the respiratory tract and decreased nasal permeability due to the enlargement of the nasal turbinates, preventing the normal respiratory mechanism, giving rise to mouth breathing habit [22].

Inflammatory Factors

Asthma is a chronic inflammatory disease of the airways, where wheezing, dyspnea, chest tightness, and cough occur, which can be reversible or secondary symptoms, sometimes causing airway obstruction [23,24].

There is a greater tendency for mouth-breathing patterns in asthmatic individuals compared to non-asthmatics.24 In the presence of patients with mild asthma symptoms, a mixed respiratory pattern (oral-nasal breathing) is present [24].

In asthmatic patients who suffer from the MB habit, it has been proven that the nasal cavity is affected in terms of its area and volume, which can trigger the presence of chronic rhinitis over time [24].

Allergic rhinitis is a chronic disease associated with asthma, with symptoms such as: itching, runny nose, absence of nasal airflow, snoring, conjunctivitis, sinusitis, possible obstructive sleep apnea. It has been reported that patients with allergic rhinitis have mouth breathing habit [25,26].

Functional Factors

The presence of prolonged oral habits (finger sucking) or muscular alterations make individuals susceptible to suffering from the RB habit [27].

Diagnostic Tests for Mouth Breathing

Through the different diagnostic tests, it will be possible to evaluate the breathing mode by measuring the flow of nasal air by condensation of expired air, which will help determine the type of breathing pattern [7].

Mirror Test

This test consists of the use of a double-sided mirror, it is placed under the nostrils between the nose and the mouth horizontally. If the mirror fogs up on the side where the nostrils are, it indicates a normal breathing pattern (nasal); but if the fogging is in the lower part, an abnormal breathing pattern (buccal) is suggested [16,28].

Jwemen Butterfly Test

A piece of cotton is placed in the shape of a butterfly under the nostrils on the upper lip. The movement of the cotton will indicate the breathing pattern; if the cotton fibers move upwards, it indicates a nasal breathing pattern, if the lower fibers move, it indicates mouth breathing [16,28].

Water Retention Test

This test consists of asking the patient to fill their mouth with water and hold it for 3 to 5 minutes. Patients who indicate nasal breathing retain water without difficulty, while patients with an oral breathing pattern cannot complete the test in the indicated time [16,28]. The most cited diagnostic tests in the literature are the mirror test and the water retention test [29].

Clinical Features of Mouth Breathing

Mouth-breathing patients are characterized by alterations at the skeletal-facial and dental levels, these changes that affect dento-cranio-facial development being known as "adenoid facies" [3,20].

The literature reports that more than 90% of mouth breathers present skeletal changes such as: V-shaped constriction of the maxillary arch and retrognathic mandible [3].

When opening the mouth, the buccinator muscles tense, exerting lingual pressure on the upper premolars and molars, resulting in a narrow palate and upper dental arch. While the muscles that force the mandible to open the mouth exert inward pressure on it, causing it to move distally and delay its correct development [30].

Three-dimensional analysis of the maxillary arch and palatal morphology in mouth-breathing patients indicates that the transverse dimension of the maxilla is smaller in relation to nasal breathers with greater narrowing at the level of the canines; its palatal vault has a higher morphology at the level of the second deciduous molars and first permanent molars, with a high palatal plane [31,32].

The mandible presents a postero-inferior rotation; vertical growth due to the increase in the angle of the Y axis, in addition to the angle of the mandibular plane (Go-Gn and SN plane), and lower facial height (IFA) [31].

The lack of mandibular growth (mandibular retrognathism) allows BRs to present a Class II skeletal relationship. Other studies report skeletal Class I and Class III, although to a lesser extent [3,31,33].

Regarding facial changes, 95% of RBs have adenoid facies, a narrow and long face (dolichofacial), narrowing of the nostrils, open lips, short upper lip and lip incompetence, droopy eyes and a tired face appearance due to the presence deep dark spots under the eyes, weak cheek muscles [2,3,33-36].

Mouth breathers present occlusal alterations; the vertical relationship is affected due to an increase in overjet and negative overbite, giving rise to anterior open bite.The most common molar relationship in patients with alteration of the normal respiratory pattern is in its order: Class II division 1, Class I, Class II division 2, Class III [3,11-14,31,33].

Class II division 1 is common, affecting the sagittal relationship of the occlusion, with the presence of a posterior crossbite [3].

Due to maxillary constriction, it is common to observe dental crowding in the anterior region. The upper anterior teeth are protruded (tendency towards labial inclination), while there is a retrusion of the lower anterior teeth [3,4,33,36].

Among the soft tissue changes, the function of the lips is abnormal, the upper lip has no function and is usually short; the lower lip is usually bulging, everted and large, often forced into an anterior-superior position below the upper incisors [30].

Antero-superior lip tilt is usually caused by a lack of proper balance of external and internal muscle forces as the lips open to allow mouth breathing [20].

The tongue is held in a lower position than usual. Mouth breathers have been found to have dry, cracked, and sometimes even swollen lips. A possible macroglossia is reported [3,4].

Pathologies associated with mouth breathing

Saliva has antimicrobial and mechanical cleansing properties that help regulate the oral microflora [4].

RBs, due to the exclusive passage of air through the mouth, prevent saliva from fulfilling its function (buffer capacity), making the oral cavity susceptible to the presence of bacterial plaque; which causes an acidogenic oral microflora giving rise to gingival inflammation, dental caries and halitosis [4].

Bacterial plaque is considered the main etiological factor of gingival inflammation, however, the literature supports that RB can cause a possible increase in susceptibility to suffering from said inflammation [2,28,37,38].

This can be caused by dehydration and reduced salivary flow due to the constant passage of air through the mouth, causing gum irritation [28,37].

RBs have a higher plaque and gingival inflammation index than nasal breathers. The anterosuperior quadrant is the one with the highest degree of gingival inflammation, followed by the anteroinferior, posteroinferior, and posterosuperior quadrants, while the greatest presence of bacterial plaque was found in the anteroinferior quadrant [28].

Results of studies in mouth-breathing children from 3 to 4 years old and from 9 to 15 years old, express that gingival inflammation is present at mild levels and more frequently at moderate levels, in the posterior zone, followed by the anterior zone [4].

With regard to dental caries, the entry of air through the oral cavity causes dehydration and disappearance of the salivary film from the dental surface, preventing the protective function against caries from being fulfilled [37,39].

The lack of salivary flow and the usual intake of fermentable carbohydrates lowers the pH, giving way to the formation of plaque that is present by acid-forming and tolerant species: mutans streptococcus, referred to as the etiological factor of caries, and lactobacilli [2,37,39].

Studies in RB report the appearance of mild and moderate carious lesions and a higher frequency of advanced caries [4.27].

The literature has reported the presence of halitosis, a pathological condition in which the breath is unpleasantly altered due to salivary reduction; it has a negative effect on the self-cleaning of the mouth and causes odoriferous volatile compounds. It has been reported from weak but noticeable odors to moderate odors in a high percentage of children [3,4,10,24].

Obstructive sleep apnea (OSA) is due to obstruction of the upper airways, either by partial or complete obstruction, a very common syndrome in BR [6].

A study reported the existence of obstructive sleep apnea, most frequently mild, in addition to the presence of moderate and severe types [6].

Among the signs and symptoms of mouth-breathing patients, primary snoring, difficulty sleeping, bed-wetting, headache, neurocognitive complications (learning deficit, behavioral changes and hyperactivity) can be found [4,6].

Mouth breathing can be a factor that interferes with the proper development of language, presenting speech disorders [8].

The most common speech disorders in RB are due to the anterior position of the tongue during the production of lingual phonemes – dentals (t, d, n, l), bilabials (p, b, m) and fricatives (f, v, s, z) [40].

By constantly keeping the mouth ajar, RBs cause hypofunction of the orofacial muscles, which leads to a deterioration of certain phonemes such as: t, d, s, z, r [1,8].

Masticatory deficiency is related to the inability to make the food bolus (crush, grind, mix food with saliva) [9]. Masseter muscle activity increases when foods are harder, leading to a correlation between occlusal force and masticatory muscle activity during the chewing process; it is evaluated by the rhythm of chewing, jaw movement, number of chewing movements and duration of chewing [41].

MB prolong the total duration of chewing, with a lower degree of chewing activity than nasal breathers [41].

The vertical position of the posterior teeth is an essential factor for there to be an adequate vertical dimension of the dentofacial complex (vertical height of the maxilla and ascending ramus of the mandible), it is determined by the degree and duration of the occlusal forces on the posterior teeth, which are responsible for chewing activity [41,42].

During mouth breathing, chewing activity is decreased and the vertical effect on posterior teeth is reduced [41,42].

Proper Treatment of Mouth Breathing

Adenotonsillar hypertrophy is a common disorder, being one of the main factors that affects the normal respiratory pattern [43]. Adenoidectomy is one of the treatments that helps to effectively reduce adenoid tissue, relieving symptoms of upper airway obstruction, alleviating therefore mouth breathing [43-45].

The use of azithromycin and nasal sprays with corticosteroids (fluticasone) in the treatment of adenotonsillar hypertrophy with RB effectively help reduce upper airway obstruction and improve all symptoms related to mouth breathing, snoring and obstructive apnea sleep [45,46].

An effective substitute for the surgical procedure in children with adenotonsillar hypertrophy and BR is the use of montelukast sodium (antiallergic). A study reported that the administration of one tablet daily for 3 months successfully reduces the severity of BR and snoring [47].

Also, speech therapy in combination with beclometasone dipropionate via nasal inhalation for control of asthma and allergic rhinitis in mouth-breathing children;, and myofunctional therapy for habitual mouth breathing, are treatments that relieve symptoms of BR and produce a positive effect on tongue behavior, which in turn improves night breathing and reduces OSA, restoring normal breathing [48,49].

Materials and Methods

The present research work is of a qualitative approach, of a documentary bibliographic type, cross-sectional, retrospective in the search; descriptive and analytical design, of deductive method.

From a universe of 2,253 articles, through the screening described in PRISMA analysis, following the inclusion and exclusion criteria, 49 articles were used.

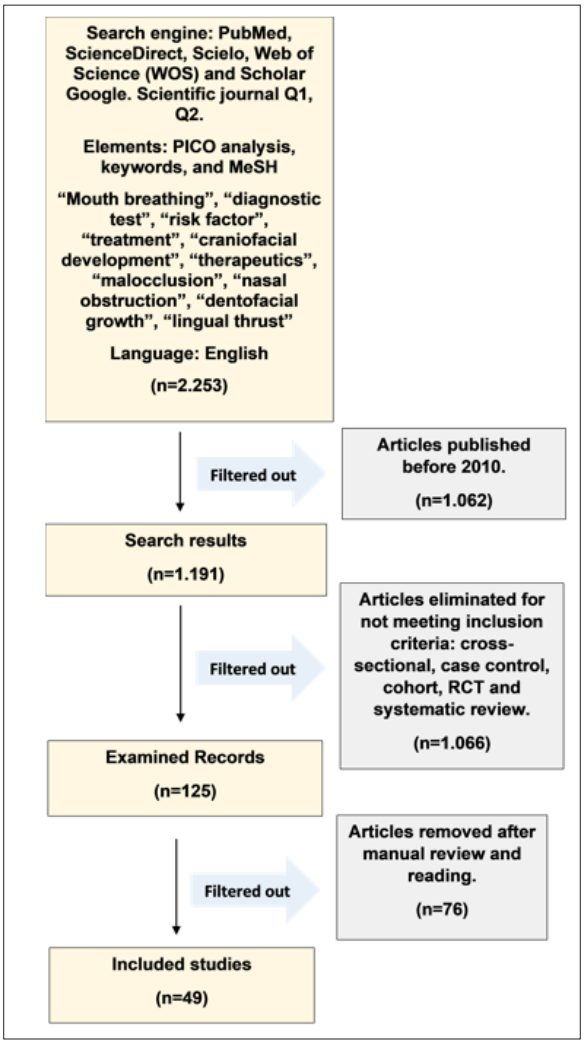
Analysis and Discussion of Results

The literature review indicates that obstructive factors such as adenotonsillar hypertrophy and deviation of the nasal septum; inflammatory factors such as asthma and allergic rhinitis; functional factors such as the appearance of oral habits are associated with the presence of mouth breathing (Graph 1) [3,20-27].

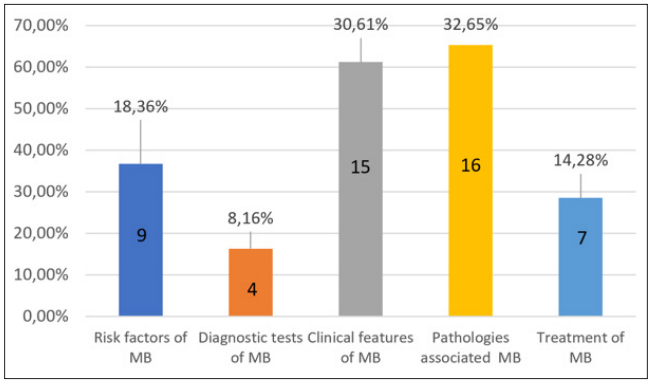
Among the diagnostic means, Melo, Pacheco, Sharma and Darwish, agree that the mirror test, the Jwemen butterfly test, the water retention test characterize and differentiate the nasal breather from the mouth breather. (Graph 1) [7,16,28,29].

İnönü, Zhao and others, believe that mouth breathers present skeletal, facial, occlusal and soft tissue changes; palate and narrow upper dental arch, increased palatal height, mandibular retrognathism and skeletal class II; Mummolo, among others, highlight a narrow and elongated face, narrowing of the nostrils, hooded eyes and marked dark spots under the eyes, weak cheek muscles, convex profile and lip incompetence (Graph 1) [2,3,20,30-36].

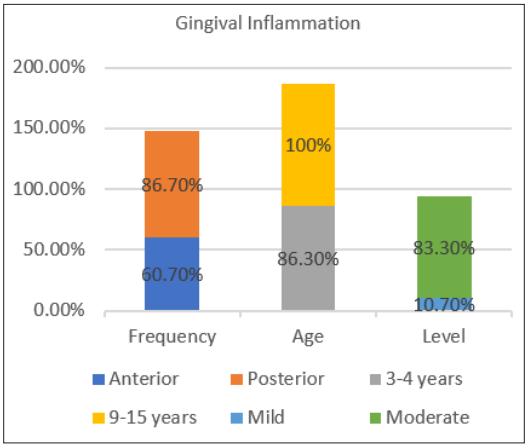
Santos, Paolantonio, Araújo, among others, mention that mouth breathing prevents saliva from fulfilling its function, with susceptibility to bacterial plaque, causing acidogenic oral microflora, which induces gingival inflammation, dental caries and halitosis (graphs 1,2,3,4) [2-4,10,24,27,28,37-39].



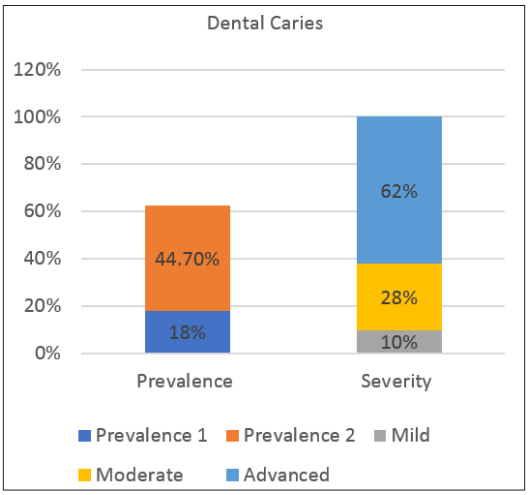
Prism Analysis, Bibliographic Search Flowchart



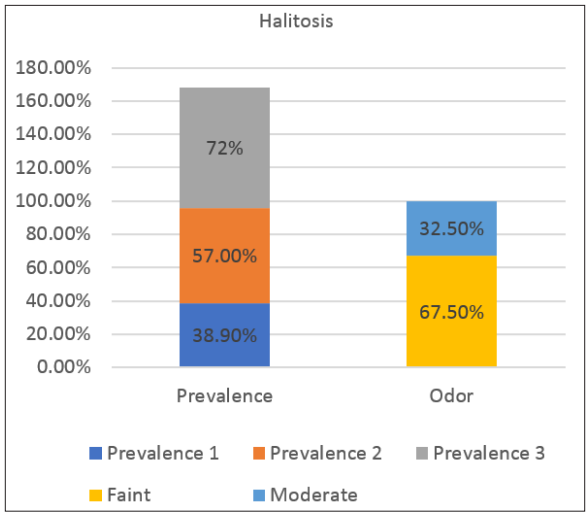
Graph 1: Qualitative, Descriptive Analysis of the Bibliography



Graph 2: Gingival Inflammation

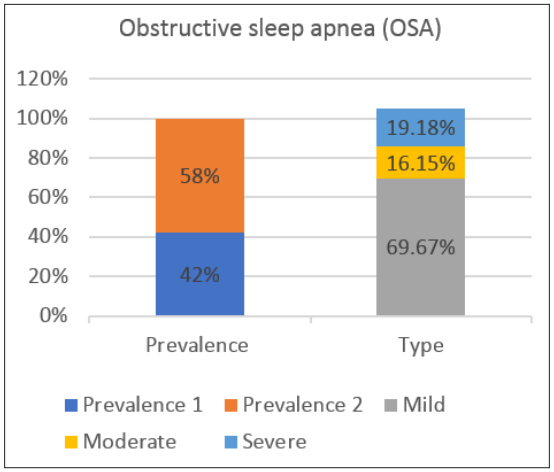


Graph 3: Dental Caries

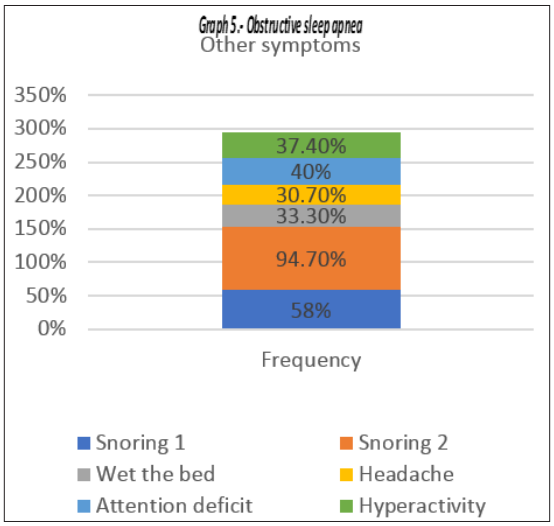


Graph 4: Halitosis

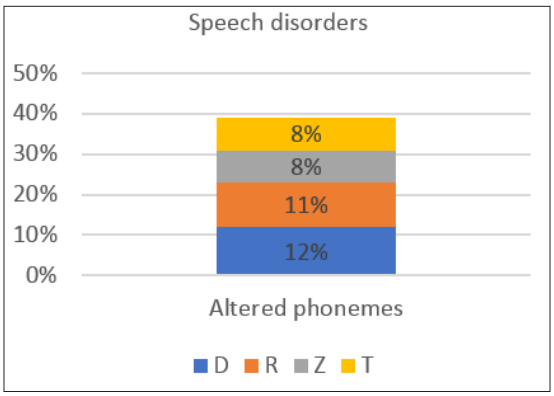
Izu, Ballikaya, coincide regarding associated signs and symptoms: snoring 58% - 94.7%, OSA 42% - 58%, bedwetting 33.3%, headache 30.7%; behavioral difficulties: attention deficit 40%, hyperactivity 37.4%. In addition, Hsu, Hitos, Ikenaga, Nagaiwa and Borox mentioned alteration of certain phonemes: 12% (d), 11% (r), 8 % (z – t) and masticatory deficiency. (graphs 1,5,6,7) [4,6,8,9,40-42].



Graph 5: Obstructive Sleep Apnea



Graph 6: Other Symptoms



Graph 7: Speech Disorders

It is common for mouth breathing to be associated with adenotonsillar hypertrophy, allergic rhinitis, asthma or habit mouth breathing. Studies carried out by Jazi, Ozmen, Bhat, Kumar, indicated that the use of steroids, antibiotics, antiallergics and surgical treatment in adenotonsillar hypertrophy helps in the reduction of buccal respiration, persisting in 2%, 4%, 5%, 16% and 29%, the authors agree that adenoidectomy is the most effective treatment with an improvement of up to 96% of the study population [43,45-47].

Campanha et al. concluded that the use of corticosteroids in allergic rhinitis and asthma together with speech therapy favors the reduction of mouth breathing. Villa et al. reported that mouth breathing by habit improves in 66.7% of the population with myofunctional therapy (Graph 1, Table 1) [48,49].

Authors	Reference number	Sample size	Pathology	Treatment						P-value
Özmen et al 2012	43	100	Adenotonsillar hypertrophy with mouth breathing (MB)	Adenoidectomy n(%)						
				Before			After			< 0,001
				95(95%) MB			16(16%) MB			
Jazi et al 2011	45	39	Adenotonsillar hypertrophy with mouth breathing	Group A-20 (fluticasone) n (%)			Group B-19 (azithromycin) n(%)			
				Before	1 week later	8 weeks later	Before	1 week later MB	8 weeks later	0,001
				12(60%) MB	1(5%) MB	1(5%) MB	13(68,4%) MB	0	1(5,3%) MB	
Kumar et al 2020	46	60	Adenotonsillar hypertrophy with mouth breathing (RB)	Montelukast sodium						
				Before			After			< 0,007
				Montelukast sodium %		Placebo %	Montelukast sodium %		Placebo %	
				MB 18%		MB 10%	MB 2%		MB 7%	
Bhat et al 2017	47	103	Adenotonsillar hypertrophy with mouth breathing (RB)	Nasal steroid sprays vs adenoidectomy						
				Adenoidectomy / 51			Nasal steroid sprays / 52			0,001
				MB improvement 96%	(MB 4%)		MB improvement 71%	(MB 29%)		
Campanha et al 2010	48	24	Allergic rhinitis, asthma with mouth breathing	Speech therapy and beclomethasone dipropionate						
				Speech therapy (8 sessions) with drug (2 months)		Drug (2 months)	Speech therapy (16 sessions) with drug (3 months)		Drug (3 months)	0,115
				1(10%) MB		2(16,7%) MB	0% MB		2(16,7%) MB	
Villa et al 2017	49	36	Mouth breathing	Myofunctional therapy (MT)						
				With myofunctional therapy (2 months) / 18			Without myofunctional therapy (2 months) / 18			With MT 0,0002
				Before		After	Before		After	Without MT 1.0
				15(83,3%) MB		3(16,6%) MB	15 (83,3%) MB		14 (78%) MB	

Table 1: Treatment of Mouth Breathing, Review of the Literature

Conclusions

It is established that adenotonsillar hypertrophy, deviation of the nasal septum, asthma, allergic rhinitis and appearance of oral habits are associated with the presence of MB.

The mirror test, the Jwemen butterfly test, and the water retention test are effective diagnostic tests for BR.

Mouth breathers are characterized by adenoid facies, skeletal class II, palate and narrow upper dental arch, anterior open bite, lip incompetence, and tongue positioned lower than usual.

Gingival inflammation, dental caries, halitosis, obstructive sleep apnea, speech disorders and masticatory deficiency are considered pathologies associated with BR.

The treatment of mouth breathing will depend on its etiology: the use of steroids, antibiotics, antiallergics, and surgical treatment in adenotonsillar hypertrophy; use of corticosteroids and speech therapy in allergic rhinitis and asthma; and myofunctional therapy in mouth habit breathing.

Recommendations

Research on mouth breathing in other types of malocclusion and RCT studies with long-term results is suggested. Likewise, studies on the effect of the oral screen in mouth breathers by habit.

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