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Prevalence of malocclusion among mouth breathing children: Do expectations meet reality?

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ABSTRACT

Objective: The aim of this study was to report epidemiological data on the prevalence of malocclusion among a group of children, consecutively admitted at a referral mouth breathing otorhinolaryngological (ENT) center. We assessed the association between the severity of the obstruction by adenoids/tonsils hyperplasia or the presence of allergic rhinitis and the prevalence of class II malocclusion, anterior open bite and posterior crossbite.

Methods: Cross-sectional, descriptive study, carried out at an Outpatient Clinic for Mouth-Breathers. Dental inter-arch relationship and nasal obstructive variables were diagnosed and the appropriate cross-tabulations were done.

Results: Four hundred and one patients were included. Mean age was 6 years and 6 months (S.D.: 2 years and 7 months), ranging from 2 to 12 years. All subjects were evaluated by otorhinolaryngologists to confirm mouth breathing. Adenoid/tonsil obstruction was detected in 71.8% of this sample, regardless of the presence of rhinitis. Allergic rhinitis alone was found in 18.7% of the children. Non-obstructive mouth breathing was diagnosed in 9.5% of this sample. Posterior crossbite was detected in almost 30% of the children during primary and mixed dentitions and 48% in permanent dentition. During mixed and permanent dentitions, anterior open bite and class II malocclusion were highly prevalent. More than 50% of the mouth breathing children carried a normal inter-arch relationship in the sagital, transversal and vertical planes. Univariate analysis showed no significant association between the type of the obstruction (adenoids/tonsils obstructive hyperplasia or the presence of allergic rhinitis) and malocclusions (class II, anterior open bite and posterior crossbite).

Conclusions: The prevalence of posterior crossbite is higher in mouth breathing children than in the general population. During mixed and permanent dentitions, anterior open bite and class II malocclusion were more likely to be present in mouth breathers. Although more children showed these malocclusions, most mouth breathing children evaluated in this study did not match the expected "mouth breathing dental stereotype". In this population of mouth breathing children, the obstructive size of adenoids or tonsils and the presence of rhinitis were not risk factors to the development of class II malocclusion, anterior open bite or posterior crossbite.

1. Introduction

The association between nasal respiratory impairment and dento-facial morphology has been studied for more than a century [1–3] and for decades it has been strongly accepted that inter-arch growth pattern can be influenced by an unbalanced muscular function on mouth breathers [4].

The knowledge that obstruction of nasal breathing most likely will perversely impact the facial growth even led some authors to propose classic terms to describe such patients as "adenoid faces" [5], "long face syndrome" [6] and "respiratory obstruction syndrome" [7].

A stereotype of these patients, therefore, can be drawn, where an anterior open bite [8], a reduced transversal dimension [9,10], associated or not with posterior crossbite [11], and a class II malocclusion [12–14] are expected.

However, as individual facial genotypes have different sensitivity on developing malocclusion, following the exposure to mouth breathing, a wide variety of inter-arch relationships can be found.

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The emphasis on this mouth breathing stereotype has been unfortunate because it implies that all patients with those clinical findings are mouth breathers and that nasal impaired respiration will ultimately result in this malocclusion. Besides that, one question arises: can we predict the outcome of these malocclusions based on the presence and on the type of airway obstructive cause which led to this deleterious habit?

Routinely, Ear, Nose and Throat (ENT) specialists and general clinicians use the diagnosis of the airflow blockage by adenoids and tonsils hyperplasia as a parameter to the establishment of the treatment planning [15]. Although this axiom has been used routinely by clinicians, it has not been sufficiently tested regarding the development of malocclusion.

The aim of this study was to report epidemiological data on the prevalence of malocclusion among a group of children, consecutively admitted at a referral mouth breathing ENT center. We assessed the association between severity of the obstruction by adenoids/tonsillar hyperplasia or the presence of allergic rhinitis and the prevalence of class II malocclusion, anterior open bite and posterior crossbite.

2. Patients and methods

2.1. Population

Four hundred and forty four children consecutively referred by pediatricians and primary care physicians to the Outpatient Clinic for Mouth-Breathers, at the Hospital das Clínicas at Federal University of Minas Gerais (UFMG), Brazil, between November of 2002 and November of 2007, with the chief complaint of mouth breathing were systematically evaluated by a multidisciplinary team comprised by ENT doctors, allergologists and orthodontists, in a single day visit.

Children whose mouth breathing could not be confirmed, those who have had previous orthodontic treatment or were younger than 2 years of age were excluded from the analysis. Therefore, the sample of this cross-sectional study totaled 401 patients.

All subjects were evaluated by otorhinolaryngologists to confirm mouth breathing resulting from at least one of the following airway pathologies: obstructive tonsillar hyperplasia, obstructive adenoidal hyperplasia and allergic rhinitis. The children whose obstruction by one of these conditions could not be diagnosed were classified as functional mouth breathers [16].

The participant's rights were protected, and informed consent and assent were obtained according to the Ethics Committee of the Federal University of Minas Gerais.

2.2. ENT data collection

An interview with children's parents, or guardians, asking about the quality of the children's sleep, snoring, oral breathing and throat infections, confirmed the "chief complaint" of mouth breathing. Parents were also asked if the child had been undergone an adenoidectomy or tonsillectomy earlier. Clinical ENT examination was performed by two of the authors (L.F. and H.B.), according to the following guidelines.

Palatine tonsil hypertrophy was classified by mouth examination according to the criteria of Brodsky and Koch [17] as follows: grade 0, tonsils limited to the tonsillar fossa; grade 1, tonsils occupying up to 25% of the space between the anterior pillars in the oropharynx; grade 2, tonsils occupying 25–50% of the space between the anterior pillars; grade 3, tonsils occupying 50–75% of the space between the anterior pillars; and grade 4, tonsils occupying 75–100% of the space between the anterior pillars.

Tonsils grade 0, 1 and 2 were considered as non-obstructive and those classified as grade 3 and 4 were named as obstructive [18].

Adenoids were assessed by flexible nasoendoscopy and were grouped into two categories based on nasopharyngeal obstruction ($<$75% and $\geq$75%). A cut-point of 75% was chosen to classify the blockage of the nasopharynx as obstructive or non-obstructive [19].

2.3. Allergological data collection

The allergological assessment, to diagnose allergic rhinitis, included a structured medical interview, physical examination, following the standard volar forearm skin prick method, as described elsewhere [20]. These exams were performed in 326 children under the supervision of one of the authors (J.P).

2.4. Dental data collection

The dental clinical examination was performed by a team of orthodontists, who worked together for at least 10 years, and were previously calibrated. The subjects were grouped by stage of dental development, according to the variation in primary and permanent teeth eruption, into deciduous, mixed and permanent periods.

The inter-arch occlusion dental classification was based on Barnett [21]:

Vertical: relationship was classified as (1) normal, (2) anterior open bite or (3) deep bite. An open bite was registered in cases that lacked any overbite, regardless of the amount. A deep bite was registered when more than half of the lower incisors were overlapped by the incisal edges of the upper incisors.
Transversal: relationship was classified as (1) normal, (2) posterior crossbite, without mandibular functional shift, and (3) posterior bite, with mandibular functional shift.
Sagital: relationship was classified as (a) normal occlusion, (b) class I malocclusion, (c) class II malocclusion and (d) class III malocclusion. During the deciduous and mixed dentitions, it was considered a class I dental relationship when the upper deciduous cuspid intercuspation was set between the lower deciduous cuspid and first deciduous molar. When in permanent dentition the Angle classification was followed.

2.5. Dental data comparison

A large number of studies on the prevalence of malocclusion in different populations have been published. These data served as a reference of what should be the distribution on inter-arch anomalies among a general population, where mouth and nasal breathers were sampled together [28–32,35–41].

2.6. Statistics

Epi-data was used to enter data. SPSS version 12.0 was used for the analysis. Descriptive statistics and univariate analysis in cross-tables are showed. The significance level of $p < 0.05$ was chosen. Normality of age distribution was tested using Kolmogorov–Smirnov test.

For each dental and ENT variable, the number of children with the diagnosed status (n) and its prevalence (%) are given.

For the purpose of statistical analysis, dental variables were binarily grouped according to the expected inter-arch relationships in mouth breathing subjects. Therefore the dependent variables examined were class II malocclusion, anterior open bite and posterior crossbite.

The independent ENT variables were the obstructive grade of tonsil and adenoids and the presence of rhinitis.

3. Results

The mean age of this sample was 6 years and 6 months and the standard deviation was 2 years and 7 months. The age of the children ranged between 2 and 12 years. With the exception of 38 children (9.5%), whose mouth breathing was due to functional habit, 363 subjects had an objective airway obstructive factor. Of these children, 288 (71.8%) were judged to have tonsil and/or adenoid obstruction, combined or not with rhinitis. Allergic rhinitis, as the only obstructive cause, was found in 75 children (18.7%).

Table 1 shows the prevalence of the studied variables, by gender. As there was no gender statistically difference ($p > 0.05$), the analysis was done considering boys and girls as a single group.

As seen in Table 1, the majority of the children was within the deciduous (41.4%) or mixed (52.1%) dentitions. In this growth period of their lives, they were susceptible to the unbalanced muscular adaptation to mouth breathing. Only few children (6.5%) were in permanent dentition.

Based in Table 1, 58.1% of the sample had a normal sagital relationship (class I dental relationship). Class I malocclusion was found in 46.9% of these children, the other 11.2% represents the normal occlusion children. Regarding the three stages of occlusal development (Table 2), Class I dental relationship was found in 64.2% during deciduous dentition, 53.8% and 54.2% during mixed and permanent dentitions, respectively.

About 42% of this sample presented with a sagital disharmony, represented by class II or III. The prevalence of class III gets higher as kids get older (Table 1).

Considering the 384 children whose sagital classification was done, dental Class II was the sagital relationship of 27% during primary dentition, 32.8% on mixed dentition and 25% on permanent dentition (Table 2).

The vertical inter-arch relationship must be studied in the dental stage of development because of its known physiologic difference along the growing period. Nevertheless, Table 2 brings the information that a normal vertical relationship was found in, at least, 52.7% of the sample, regardless of the dental stage of development. Open bite prevalence was around 30% during the deciduous and mixed dentitions and 20% in permanent dentition.

In the transversal analysis, posterior crossbite was detected in close to 30% of the kids during deciduous and mixed dentitions and 48% in permanent dentition (Table 2).

All comparisons in Table 2 demonstrate that there is no difference in the malocclusion occurrence when comparing the three stages of dental development (p values >0.05).

Regarding the tonsils (Table 1), the more obstructing grades (3 and 4) were found in about 40.9% of the kids, but considering the stratified groups by age (Table 2), kids during early stages

Table 1
Prevalence of dental and ENT findings according to gender distribution. Number of children (n) and prevalence given in percentage ($n/N \times 100\%$).

Variables	Boys		Girls		Total	
	n	%	n	%	n	%
Stage of development (N = 401)						
Deciduous dentition	106	26.4	60	15.0	166	41.4
Mixed dentition	110	27.4	99	24.7	209	52.1
Permanent dentition	12	3.0	14	3.5	26	6.5
χ^2 = 6.050 (2 d.f.) p value = 0.05						
Sagital relationship (N = 384)						
Normal occlusion	26	6.8	17	4.4	43	11.2
Class I malocclusion	97	25.3	83	21.6	180	46.9
Class II malocclusion	64	16.7	51	13.3	115	29.9
Class III malocclusion	30	7.8	16	4.2	46	12.0
χ^2 = 2.230 (3 d.f.) p value = 0.526						
Vertical relationship (N = 385)						
Normal	115	29.9	98	25.5	213	55.3
Deep bite	38	9.9	21	5.5	59	15.3
Open bite	67	17.4	46	11.9	113	29.4
χ^2 = 2.349 (2 d.f.) p value = 0.309						
Transversal relationship (N = 392)						
Normal	158	40.3	116	29.6	274	69.9
Posterior crossbite w/o shift	31	7.9	22	5.6	53	13.5
Posterior crossbite w shift	32	8.2	33	8.4	65	16.6
χ^2 = 1.631 (2 d.f.) p value = 0.443						
Tonsils status (N = 399)						
Grades 0, I, II	141	35.3	95	23.8	236	59.1
Grades III, IV	86	21.6	77	19.3	163	40.9
χ^2 = 1.918 (1 d.f.) p value = 0.166						
Adenoid obstruction status (N = 390)						
<75%	95	24.4	70	17.9	165	42.3
≥75%	124	31.8	101	25.9	225	57.7
χ^2 = 0.235 (1 d.f.) p value = 0.628						
Rhinitis (N = 326)						
Yes	133	40.8	102	31.3	235	72.1
No	51	15.6	40	12.3	91	27.9
χ^2 = 0.008 (1 d.f.) p value = 0.928						

Table 2
Prevalence of dental and ENT findings in the deciduous. Mixed and permanent dentitions. Number of children (n) and prevalence given in percentage ($n/N \times 100\%$).

Variable	Deciduous		Mixed		Permanent	
	n	%	n	%	n	%
Dental						
Sagital relationship (N = 384)	159		201		24	
Normal occlusion	24	15.1	19	9.5	1	4.2
Class I malocclusion	78	49.1	89	44.3	12	50.0
Class II malocclusion	43	27.0	66	32.8	6	25.0
Class III malocclusion	14	8.8	27	13.4	5	20.8
χ^2 p value = 0.196						
Vertical relationship (N = 385)	165		195		25	
Normal	87	52.7	111	56.9	15	60.0
Deep bite	27	16.4	27	13.8	5	20.0
Open bite	51	30.9	57	29.2	5	20.0
χ^2 p value = 0.731						
Transversal relationship (N = 392)	164		203		25	
Normal	118	72.0	143	70.4	13	52.0
Posterior crossbite w/o shift	19	11.6	29	14.3	5	20.0
Posterior crossbite w shift	27	16.5	31	15.3	7	28.0
χ^2 p value = 0.314						
ENT						
Tonsils status (N = 399)	165		208		26	
Grades 0, I, II	83	50.3	133	63.9	20	76.9
Grades III, IV	82	49.7	75	36.1	6	23.1
χ^2 p value = 0.005						
Adenoid obstruction status (N = 390)	161		205		24	
<75%	43	26.7	102	49.8	20	83.3
≥75%	118	73.3	103	50.2	4	16.7
χ^2 p value = 0.000						
Rhinitis (N = 326)	137		168		21	
Yes	79	57.7	136	81	20	95.2
No	58	42.3	32	19	1	4.8
χ^2 p value = 0.000						

Note: χ^2 based on $n \times 3$ tables. n = variable.

Table 3
Univariate analysis between grouped malocclusion (dependent variable) and the obstructive causes for mouth breathing (independent variables).

Variables	Tonsil/adenoid obstruction	Rhinitis only	No obstructive cause diagnosed	p value
Class II malocclusion				
Yes	78	24	13	0.589
No	196	49	24	
Anterior open bite				
Yes	79	24	10	0.710
No	198	48	26	
Posterior crossbite				
Yes	85	26	7	0.242
No	197	48	29	

(deciduous dentition) had a higher prevalence (49.7%) than latter stages (36.1% and 23.1% during mixed and permanent dentitions, respectively). Table 2 also illustrate that the distribution of tonsillar obstruction shifted according to aging. Children during the deciduous dentition stage of development have more obstructive tonsils than older ones ($p < 0.05$).

The adenoid's obstruction of the nasopharynx showed similar epidemiological behavior. Although the average prevalence of the obstructive group (≥75% occupation of nasopharynx space) was 57.7% (Table 1), when analyzing this variable under the perspective of dental stage of development, it is clear that prevalence declines steeply from 73.3% to 16.7% along the aging (Table 2), with statistically significant difference ($p < 0.05$).

The overall prevalence of allergic rhinitis was 72.1% ($n = 235/326$), as demonstrated in Table 1. During mixed and permanent dentitions the proportion of subjects with rhinitis was bigger (81% and 95.2%, respectively) than in deciduous dentition 57.7% (Table 2), a statistically significant difference ($p < 0.05$).

Table 3 shows the univariate analysis between grouped malocclusion (dependent variable) and the ENT independent variables. No association was found between the expected type of malocclusion for mouth breathers and the presence of variables that obstruct the nasal airflow ($p > 0.05$).

The comparison between our findings and the literature data inter-arch prevalence is done in Section 4.

4. Discussion

Several reports have associated mouth breathing with dental malocclusion. The first papers were limited to clinical impressions of dentistry pioneers who related the disturbance on facial and occlusal harmony to the impairment of nasal breathing in their patients. Later, many papers published reports based on the findings of scientific data collection, mostly considering the skeletal outcome evaluated by cephalometry. However, data on occlusal clinical parameters of mouth breathing children are scarce.

Dental inter-arch relationship, in the three planes of space, is the basic clinical parameter in understanding the patient's occlusion and its behavior when exposed to unbalanced muscular activity. Therefore, it is important to assess the occurrence of occlusal disorders among mouth breathing children.

Despite the large sample size of this study, the limitations of a cross-sectional design needs to be considered. As our sample is comprised only of mouth breathers, the prevalence of dental inter-arch status had to be compared with other epidemiological reports on a general population [28–32,35–41]. This methodology brings at least two biases: (1) it is fact that in a general population a significant number of children are mouth breathers [22–24]. Thus, the difference between the prevalence of malocclusion in this mouth breathing population and a "normal breathing" population would be greater. (2) The reported prevalence varies considerably between the different studies, even among the same population. This divergence in prevalence figures may depend not only on differences for specific ethnic groups [25], but also on wide ranges in number and age among the examined subjects. However, differences in registration methods, i.e. the criteria for the recorded items, are probably the most important factor explaining these differences. Despite these methodological limitations, this study brings results that deserve further discussion.

Our study compared the prevalence of only one malocclusion in each plane of space: class II (sagital), anterior open bite (vertical) and posterior crossbite (transversal), since an occlusal pattern for mouth breathers is well described.

Anomaly studies usually report findings by chronological age. Malocclusion, however, is a manifestation that is related to development of the dentition. Given the great individual variations in dental maturation, it seems logical to determine the prevalence of malocclusion for groups at different stages of dental development, rather than for different age groups. It is interesting to point out that the pattern of distribution of the prevalence of malocclusions does not show any statistical difference among the three stages of dental development (Table 2), as it occurs in the general population [26]. It is expected that the prevalence of each malocclusion changes among the growth period. This fact suggests that in a mouth breathing population, the increase in the prevalence of some malocclusions alter the common pattern.

Regarding the sagital relationship, it is known that race impacts significantly the prevalence of classes I, II and III malocclusions [27]. Therefore, a good comparison is made only with Brazilian data. This was possible in the first two stages of dental development. During primary dentition, the prevalence of class II in our mouth breathing group was 27%. The prevalence found in previous publications in Brazil varies between 6.8% and 30% [28–30]. Our findings are quite similar to a large sample study ($n = 2139$) conducted by Tomita et al. [28]. However our prevalence is higher than found in other studies [29,30]. Kataoka et al. [29] concluded that the prevalence of class II in their sample was low (6.8%) because their population was comprised only by Japanese-Brazilian ethnic children. This fact, explains the difference between our findings. However, the difference in relation to the results found by Sadakyio et al. [30] (15.6%) can be justified by data collection methodology discrepancies or differences due to mouth breathing.

In mixed dentition, our study's class II prevalence (32.8%) is much higher than the 12.5% reported by Zanetti [31]. This significant discrepancy suggests that in older children, the perverse impact of mouth breathing, on sagital inter-arch development, is greater than on the deciduous dentition. Cheng et al. [11] noted that the younger a subject is, at the time of evaluation, the less the "adenoid" type of facial characteristics is expressed. This opinion corroborates our findings. We can hypothesize that the longer the exposure to the unbalanced muscular function, due to mouth breathing, the greater the risk of developing class II malocclusion. More epidemiological reports on sagital relationship during the mixed dentition stage would be helpful in testing this hypothesis, but only one was found. Longitudinal cohort studies are necessary to test if this hypothesis is correct.

During permanent dentition, the prevalence of class II in this sample was 25%. A comparison with Brazilian data was not possible because no epidemiological study involving general population at this stage was found, regarding this type of malocclusion. Comparing to Horowitz [32], who evaluated American subjects, the prevalence numbers (22.5%) are quite similar to our results. This observation corroborates the conclusions of Howard [33], Leech [34] and McNamara [3]. Nevertheless, comparing our permanent dentition class II findings with the classic study of Emrich et al. [35], also in the United States, who found 14%, our prevalence was higher. As the size of permanent dentition sample, in our study, was small ($n = 24$), we suggest that other studies, with larger samples, should test this association.

Regarding the vertical inter-arch relationship, the same type of association described to class II was found. Compared to the literature data, the prevalence of open bite during deciduous dentition, in the investigated mouth breathers, was quite similar. While our children's anterior open bite prevalence during deciduous dentition was 30.9%, the revised literature on general population varied between 20.6% and 46.3% [28,44–46]. But, when analyzing the older children (mixed dentition), an important difference was noted. The prevalence of open bite reported in the reference articles [31,36–39] varies between 12.00% and 20.1%, while our sample had a prevalence of 29.2%.

In the transverse dimension we found the most significant discrepancy in the prevalence of malocclusion. Dental literature data shows that the prevalence of posterior crossbite ranges from 8% to 22% [40]. Prevalence studies on posterior crossbite during permanent dentition are rare, but Thilander et al. [41] found a prevalence of 3.9% during this stage. Therefore we considered 22% as the top value. We found a prevalence of 30.1% of posterior crossbite in whole group. This prevalence of close to 30% in the primary and mixed dentitions and almost 50% in the permanent one is higher than in the general population and deserves additional consideration.

As the etiology of malocclusion has singular characteristics when considering the three different planes of space, this heterogeneity can help with the comprehension of our findings.

Sagital dental inter-arch relationship is mostly determined by heredity [27] and therefore mouth breathing is only a secondary etiological factor to class II development. Most likely, the power of the unbalanced muscular activities, due to mouth breathing, is not enough to shift a solid class I or III patterns into a class II. Maybe those children with a tendency toward a class II, who could growth into class I, depending on environmental factors, are the population candidates who develop class II, when exposed to mouth breathing. Therefore, in an epidemiological analysis, as we did, the prevalence of class II is higher than in the general population, especially in older children.

Vertical dental relationship also has heredity as the major determinant, but environmental factors such as non-nutritious sucking habits and mouth breathing work as secondary causes of anterior open bite [42]. During deciduous dentition, when sucking habits are highly prevalent in Brazil [43], the prevalence of anterior open bite found in our sample of nasal impaired children was within the range cited in previous Brazilian studies [40–42]. However, during mixed and permanent dentitions, as these sucking habits decline in the general population, the difference with our data gets bigger.

The transversal dental relationship, although governed by individual facial genotype [47], suffers greatly from environmental perverse factors [40]. Mocellin et al. [48], found 63.3% of palatal constriction in mouth breathers and 5% in nasal breathers. This fact explains why the discrepancy in the prevalence of posterior crossbite was so significant between the mouth breathers and the general population. As ethnic difference does not influence posterior crossbite [25], the comparison with data from other studies is feasible.

The triad of class II malocclusion, anterior open bite and posterior crossbite, despite showing a higher prevalence in a mouth breather sample than in the general population, is not the most prevalent inter-arch relationship among the studied nasal impaired children. In fact, a significant number of children showed a normal occlusion, even growing with this perverse habit.

It is clear that mouth breathing is capable of adding an environmental weight to the etiology of such malocclusions. However, since heredity plays a more important rule on facial growth and development, we should not expect to find, on an individual basis, many of these dental anomalies. It is not possible, therefore, to predict with any certainty whether or not a mouth breathing child will develop malocclusion, despite the fact that on an epidemiological level, mouth breathers have a higher risk of developing class II, anterior open bite and posterior crossbite than a general population, as shown in other studies [10].

The results of this study suggest that older mouth breathing children (mixed and permanent dentitions) have a tendency toward increasing the prevalence of class II malocclusion and open bite. If this assumption is true, normalizing nasal airflow passage in younger children, instead of postponing ENT treatments, would be beneficial from an orthodontic point of view. This hypothesis needs to be tested in a longitudinal design study.

Our data did not show any association between the prevalence of malocclusion and an obstructive pattern of the tonsils and/or adenoid, nor with the presence of allergic rhinitis. This is a controversial field in which previous studies have shown discordant findings [2,7,49–54].

An explanation of this finding is based on morphogenetic sensitivity in the development of malocclusion. If the child facial type is prone to the development of one or more of the studied inter-arch abnormalities, mouth breathing will only add an additional etiological "push", regardless of the severity or the type of the obstruction. Similarly, when a child has a low susceptibility to the development of malocclusion, even in the presence of a greater airflow obstruction, no dento-facial sequela will occur.

If this explanation represents the truth, the risk of developing malocclusion may be proportional to its morphogenetic susceptibility, but not with the severity of the obstruction. In this research, no evaluation of the skeletal pattern was done, which would allow the identification and stratification of the susceptibility. Therefore, it is only possible to speculate that a full spectrum of malocclusion was present. This balanced distribution contributed to the interesting results of no association between malocclusion and the grade of airflow blockage.

Secondly, another point which must be considered is the time lapse between the initiation of mouth breathing and the malocclusion outcome. If we theorize that, over time, children with greater obstruction could develop more malocclusion than children with less severity, using a young sample may explain the lack of association between the tested variables.

One more explanation to our results could be the chosen cut point which classified the tonsils and adenoids hyperplasia as being obstructive or not. As no validation of these clinical criteria was done yet, anyone can argue that a bias on the obstruction classification interfered with the results.

As it was expected, the younger children had more tonsils and adenoids obstruction than older ones [55]. The prevalence of rhinitis, however, was much higher in older children. The reason is linked to Waldeyer's ring involution with aging, consequently reducing the number of older subjects with adenoid or tonsil hyperplasia referred to the hospital. Thus the respiratory ENT complaint of older children tends to be rhinitis.

The findings of this study suggest that, based on the orthodontic point of view, ENT doctors should consider treating all mouth breathing children, regardless of the etiological factor, since it is not possible to identify the risk of developing malocclusion based solely on routinely used criteria.

Further research, with a longitudinal design and using methods that can help in the identification of morphogenetic sensitivity such as lateral cephalometric radiograph, and better evaluation of the severity of airway obstruction could add important information to this topic.

In conclusion, our study showed that the investigated nasal impaired children had a higher prevalence of posterior crossbite than general population at the same stage of development. During mixed and permanent dentitions, anterior open bite and class II malocclusion were more likely to be present in mouth breathers. However, the majority of the children did not match the expected ''mouth breathing dental stereotype''. We have also showed that, in this sample of mouth breathers, adenoids/tonsils hyperplasia or the presence of rhinitis, have no association with the prevalence of class II malocclusion, anterior open bite and posterior crossbite.

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