Original Article

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Adenoid hypertrophy and open bite

Ana de Lourdes Sá de Lira[1], Antonio de Moraes Izquierdo[1], Sávio Prado[1], Margareth Maria Gomes Souza[2], Sandra Regina Torres[3]

[1]DDS, MS, PhD student, Department of Pediatric Dentistry and Orthodontics, Dental School, Federal University of Rio de Janeiro, Brazil
[2]DDS, PhD, Professor, Department of Pediatric Dentistry and Orthodontics, Dental School, Federal University of Rio de Janeiro, Brazil
[3]DDS, PhD, Professor, Department of Oral Pathology and Diagnosis, Dental School, Federal University of Rio de Janeiro, Brazil

Abstract

Aim: To evaluate if the constricted airway passage, measured by the nasopharyngeal (NP) and oropharyngeal (OP) width, has a correlation to anterior open bite. **Methods:** Lateral cephalometric radiographs of 43 patients with anterior open bite (26 with mixed dentition and 17 with permanent dentition) and 30 patients with overbite (15 with mixed dentition and 15 with permanent dentition) were obtained from de Department of Pediatric Dentistry and Orthodontics of the Federal University of Rio de Janeiro for examination. Eight patients with syndromes were excluded from study. Cephalometric measurements were carried out using Dolphin Imaging &Management Solutions™ software (Chatsworth, CA, USA). Measures of NP and OP were evaluated according to the McNamara's soft tissue analysis and were correlated with the presence of open bite or overbite. Student's *t* test and chi-square were used to assess statistical differences in continuous and dichotomic variables, respectively. Kruskal-Wallis test was employed to compare multiple variables. **Results:** Open bite patients showed significant decreased mean NP and OP values compared to overbite patients. Lack of labial seal was observed in all open bite patients. When patients with mixed and permanent dentitions were analyzed separately, the mean NP value was still significantly smaller in the open bite group. However, the mean OP values were smaller in the open bite group in both dentitions analysis, but were not statistically different. **Conclusions:** All patients with anterior open bite had reduced NP and OP measures compared to overbite patients, in spite of dentition.

Keywords: anterior open bite, adenoid hypertrophy; nasopharyngeal width; oropharyngeal width.

Introduction

In the child normal growing process, there is an increase in the nasopharyngeal lymphoid tissue and a downward and forward shift of the face to allow airflow passage[1]. This area is crucial for determining the nasal respiratory strength because of the presence of adenoids[2]. In general, lymphoid tissues are hypertrophic during childhood, becoming less hypertrophic following puberty and atrophic by adulthood[2]. However, when lymphoid tissues increase in size, a mechanical obstruction of the airflow passage may be expected, and the child may develop a compensatory mouth-breathing habit[3].This may interfere with both growth and development of the face, which eventually results in skeletal open bite[1-2].

Adenoid hypertrophy decreases the nasopharyngeal width, which favors the backward and upward positioning of the head in relation to cervical column, thus increasing the facial height[3]. Posterior rotation or inclination of the mandible and consequent increase in the angle between anterior maxillary/mandibular parts and nasion point (ANB) may occur, as well as flaccidity and shortening of upper lip

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Correspondence to:
Ana de Lourdes Sá de Lira.
Departamento de Ortodontia,
Faculdade de Odontologia
University Federal fo Rio de Janeiro (UFRJ),
Av. Brigadeiro Trompowsky s/n - Ilha do
Fundão Rio de Janeiro,
CEP: 21941-590, Rio de Janeiro, RJ, Brasil
E-mail: anadelourdessl@hotmail.com

associated with flaccid perioral muscles[3]. Alterations in the oral structures such as protrusion and lowering of the tongue, high-vaulted arch, V-shaped constriction of upper arch, and anterior open might be observed particularly in those patients with vertical growth pattern[4]. Though anterior open bite is more frequently observed, adenoid hypertrophy may also cause posterior open bite when lingual interposition occurs in the premolar and molar regions[1-4].

It has been reported that mouth breathing and open bite cause changes in muscular balance, tongue and head posture in addition to obstructive sleep apnoea[5]. Breathing difficulty during sleep also decreases nocturnal secretion of growth hormone, resulting in poor development of the ramus and lower edge of the mandible[6-7].

Nasopharyngeal width tends to decrease if adenoids are hypertrophic[8]. On the other hand, there has been reported an increasing OP width related to adenoid hypertrophy, which could be explained by a compensatory anterior lingual posture when hypertrophy of adenoids are present[6-7].

Our hypothesis was that patients with smaller NP and OP measurement develop open bite as a compensating mechanism for breathing. The aim of the present study was to evaluate if the constricted airway passage, as measured by the NP and OP width, has a correlation to anterior open bite.

Material and methods

This study was approved by the local Ethics research Committee (CAAE number: 131/2009.0049.0.239.000-09).

From 81 patients that started the treatment between March 2004 and March 2008, 8 were excluded for being syndromic patients. After obtaining written informed consent, the sample consisted of 73 patients who had undergone total corrective orthodontic treatment through edgewise system in the orthodontic clinic of the Department of Pediatric Dentistry and Orthodontics, Dental School, Federal University of Rio de Janeiro (Rio de Janeiro, Rio de Janeiro, Brazil). The study group consisted of 43 patients with anterior open bite, whereas the control group consisted of 30 patients with overbite. Demographic and clinical data regarding all patients were obtained from clinical records, study models and baseline cephalometric x-rays.

Cephalometric measurements were carried out using Dolphin Imaging &Management Solutions™ software (Chatsworth, CA, USA). The distance between incisal edges was measured from the lower incisal edge to a parallel line traced along the upper incisor axis. Anterior open bite was defined as being the lack of vertical trespass between upper and lower central incisors. Overbite was defined by the presence of a vertical trespass. Negative values were attributed to anterior open bite, whereas positive values were attributed to overbite.

The nasopharyngeal (NP) width was obtained by measuring the smallest distance between the posterior wall of soft palate and the posterior wall of the pharynx. The NP values greater than 12 mm and 17.4 mm were considered normal for individuals with mixed and permanent dentition, respectively[5].

The oropharyngeal (OP) width was obtained by measuring the smallest distance between the intersection of lingual posterior edge with mandibular lower edge and the posterior wall of the pharynx. Normal OP values ranging from 10 to 12 mm were considered normal[5].

In order to determine the consistency of the method, two examiners were calibrated by repetition of the process until the method was considered adequate by a third examiner. Random errors in landmark localization were decreased by tracing each lateral cephalogram twice and using the medium values of each measurement. The intraexaminer consistency (ICC) was calculated for reliability of tracing, landmark identification and analytical measurement showing a correlation coefficient always greater than 0.94.

Data were collected and analyzed by using the statistical software SPSS v.10.0 for Windows© (Chicago, IL, USA). Student's t test and chi-square test were used for assessing the possible differences regarding continuous and dichotomic variables, respectively. Kruskal-Wallis test was employed for comparing multiples variables. A significant level of 5% was established.

Results

Demographic and clinical characteristics of the 73 studied patients were shown in Table 1 and Figure 1. No statistically significant differences were observed between open bite and overbite groups regarding demographic data, dentition and malocclusion.

Labial seal was absent in 100% of open bite group and in only 6% of overbite patients (Table 1).

The mean value for NP measurements of patients with open bite (6.8 mm) was significantly smaller than that of the patients with overbite (11.43 mm) ($p < 0.001$). (Table 1).

Patients in the open bite group had a mean value of the OP measurements significantly smaller than that of patients in the overbite group (10.69 mm vs. 11.88 mm) ($p = 0.044$). (Table 1) The mean values for NP and OP in both groups

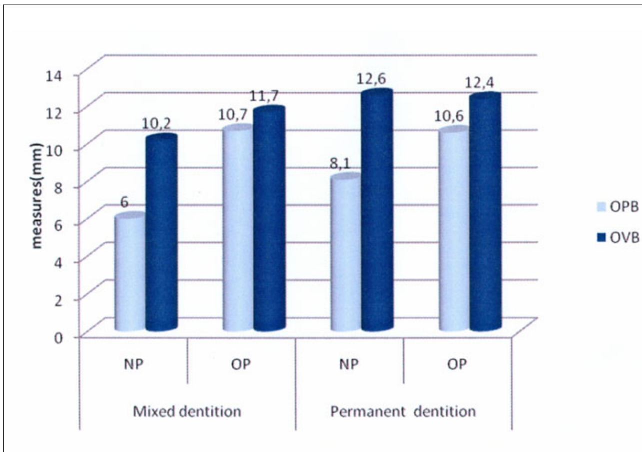

Fig. 1. Mean NP and OP values for overbite and open bite groups regarding mixed and permanent dentitions. Footnote: NF- nasopharynge. OF- oropharynge. OPB- open bite. OVB- overbite.

Table 1: Demographic and clinical characteristics of patients presenting overbite and open-bite[a]

	Overbite Group N = 30	Open-bite Group N=43	Significance
Age			NS
mean + S.D.	16.5 ± 6.30	14.7 ± 5.86	
Gender			
Male	15	18	NS
Female	15	25	
Dentition			
Mixed	15	26	NS
Permanent	15	17	
Malocclusion			
Class I	15	23	NS
Class II	9	8	
Class III	6	12	
Labial seal			
Present	28	0	***
Absent	2	43	
Overbite (mean + S.D. mm)	4.5 ± 1.42	-2.48 ± 2.21	***
NP measurement (mean + S.D. mm)	11.43 ± 3.02	6.88 ± 2.09	***
OP measurement (mean + S.D. mm)	11.88 ± 2.95	10.69 ± 1.99	*

[a] NP indicates nasopharyngeal width; OP, oropharyngeal width; SD, standard deviation; N, number of patients; and NS, not significant.
*, $P \leq .05$; ***, $P \leq .001$.

regarding mixed and permanent dentitions were shown in Figure 1.

When patients with mixed dentition were analyzed, the mean NP value was found to be significantly smaller in the open bite group (6.03 mm) than in the overbite group (10.2 mm) ($p < 0.001$) (Table 2). There was no statistically significant difference between the open bite (10.71 mm) and overbite (11.33 mm) groups regarding the mean OP values for mixed dentition (Table 2).

When the permanent dentition was analyzed separately, the mean NP value was found to be significantly smaller in the open bite group (8.17 mm) than in the overbite group (12.6 mm) ($p < 0.001$) (Table 3).

There was no statistically significant difference between the open bite (10.67 mm) and overbite (12.43 mm) groups regarding the mean OP values for permanent dentition (Table 3). No statistically significant differences were found between

Table 2: Measurements of patients with mixed dentition

	Overbite Group	Open-bite Group	Significance
NP (mean + S.D. mm)	10.2 ± 3.04	6.03 ± 1.52	***
OP (mean + S.D. mm)	11.33 ± 2.85	10.71 ± 2.06	NS

NP indicates nasopharyngeal width; OP, oropharyngeal width; SD, standard deviation; and NS, not significant.*** $P \leq .001$

Table 3: Measurements of patients with permanent dentition[a]

	Overbite Group	Open-bite Group	Significance
NP (mean + S.D. mm)	12.6 ± 2.60	8.17 ± 2.21	***
OP (mean + S.D. mm)	12.43 ± 3.05	10.67 ± 2.06	NS

[a] NP indicates nasopharyngeal width; OP, oropharyngeal width; SD, standard deviation;and NS, not significant.*** $P \leq .001$

NP and OP measurements of mixed and permanent dentitions regarding age and gender in both groups (Figure 2).

When these values were compared to McNamara's normal parameters[5], the mean value for NP measurement for both groups were below of which is considered normal and OP mean values from both groups were within the considered normal range. When mixed and permanent dentitions were analyzed separately, both groups had a mean NP value below to the normal and OP mean values within the normal parameters.

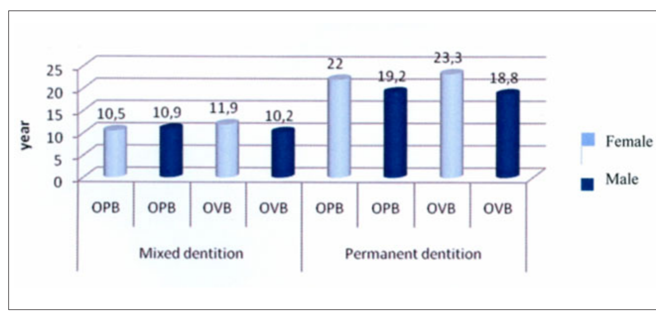

Fig. 2. Profile of patients with open bite and overbite regarding gender and age. Footnote: OPB- open bite. OVB- overbite.

When patients with open bite were analyzed, no statistically significant difference was found between number of patients and type of dentition ($p = 0.29$). However, a significantly larger number of patients with Class I malocclusion was observed ($p = 0.003$).

By associating the NP measurement with the type of malocclusion, no statistically significant difference was found for patients with open bite ($p = 0.05$). On the other hand, a significant reduction in OP measurement was observed in patients with open bite with Class II malocclusion ($p = 0.05$).

Discussion

Adenoid hypertrophy causes obstruction of the airflow through NP possibly favouring mouth-breathing habit and open bite[7]. The present study measured the NP and OP dimensions in 73 orthodontic patients ranging from 10 to 24 years of age. These measures were compared between patients presenting open bite and overbite. Confirming our hypothesis, the mean NP and OP values were significantly smaller among patients presenting open bite, than in those presenting overbite. In a similar study, McNamara[5] found equivalent results for NP measurement only. The results of the present study seem to confirm our hypothesis of the development of an open bite as a compensatory breathing mechanism for the narrowing of the airflow passage.

Patients with open bite had a decreased mean NP value compared to patients with overbite in both dentitions, regardless of the type of malocclusion. The marked NP constriction before and during the growth spurt, which occurs in the mixed and permanent dentitions, predisposes the development of anterior open bite[6-8]. Moreover, this NP constriction makes nasal breathing difficulty, consequently favoring mouth breathing, posterior teeth extrusion, narrowing of dental arches, and vertical growth of the anterior face[8-10]. Other factors like genetic characteristics, infections or recurrent adenoid inflammations may also be involved in this process[1, 6-11].

The decreased mean OP value observed in the patients with open bite may be explained by the anterior positioning of the tongue as compensatory respiratory mechanism. Consequently, there is a greater predisposition to a vertical facial growth[8,12]. In the same group, the significant reduction of mean OP value in patients with Class II malocclusion is possibly due to the more posterior positioning of the mandible in relation to the skull base[13,14].

Lack of labial sealing was observed in all patients with anterior open bite. This result has been found by other authors, correlating adenoid hypertrophy with mouth breathing and vertical growth pattern of the face[5,15-20].

When patients were analyzed separately by type of dentition, the mean NP value was small in open bite patients regarding mixed and permanent dentition. When adenoid hypertrophy persists until permanent dentition, the resulting NP narrowing may influence the vertical facial growth and anterior open bite[19-20].

In both dentitions, the OP measurement was also small in the open bite group, but the results were not statistically significant. Other authors have shown opposite findings, reporting an increase in OP measurement associated with open bite[5,15]. Other studies should be conducted in order to confirm if OP measurements have a correlation to open bite.

In the present study, anterior open bite was more predominantly found in patients with Class I malocclusion, although some authors[13-14,21-22] have reported a higher frequency in cases of Class II malocclusion. Those authors[13-14,21-22] also observed that patients with Class I or Class II malocclusion who had a predominance of vertical facial growth, showed greater nasopharyngeal narrowing compared to those patients with horizontal facial growth. It suggests that the type of malocclusion and growth pattern have no influence on NP width, despite predisposing to vertical growth of the face and anterior open bite[23].

All patients with open bite and Class III malocclusion showed a significant decrease in the nasopharyngeal width. According to some authors, anterior open bite seems to be established by mandibular vertical growth and extrusion of posterior teeth, as a result of mouth breathing[9-11].

The present study also contributes with epidemiologic data for NP and OP measures. The mean NP values for patients with either overbite or open bite were below the normal range established by McNamara[5]. The results of the present study suggested that the parameters used by the author[5] may not be applicable to the patterns of normality of the Brazilian population.

The findings of this study may have implications in the clinical practice. Adenoid hypertrophy is a problem that should be investigated as an etiologic factor of anterior open bite. Further studies correlating NP to the growth of facial structures and other measurable parameters of mouth breathing, should be conducted in order to determine the relationship between soft and hard tissues of the face.

In conclusion, all patients with anterior open bite showed reduced nasopharyngeal and oropharyngeal measurements compared to those with overbite in both mixed and permanent dentitions.

References

1. Linder-Aronson S, Woodside DG, Lundstrom A. Mandibular growth direction following adenoidectomy. Am J Orthod Dentofacial Orthop. 1986; 89: 273-84.
2. Trask GM SG, Shapiro PA. The effects of perennial allergic rhinitis on dental and skeletal development: A comparison of sibling pairs. Am J Orthod Dentofacial Orthop. 1987; 92: 286-93.
3. Jones AG, Bhatia S. A study of nasal respiratory resistance and craniofacial dimensions in white and West Indian black children. Am J Orthod Dentofacial Orthop. 1994; 106: 34-9.
4. Ung N, Koenig J, Shapiro PA, Shapiro G, Trask G. A quantitative assessment of respiratory patterns and their effects on dentofacial development. Am J Orthod Dentofacial Orthop. 1990; 98: 523-32.
5. McNamara JA. Influence of respiratory pattern on craniofacial growth. Angle Orthod. 1981; 51: 269-300.
6. Behlfelt K, Linder-Aronson S, McWilliam J, Neander P, Laage-Hellman J. Cranio-facial morphology in children with and without enlarged tonsils. Eur J Orthod. 1990; 12: 233-43.
7. Subtelny JD. Oral respiration: facial maldevelopment and corrective dentofacial orthopedics. Angle Orthod. 1980; 50: 147-64.
8. Linder-Aronson S, Leighton BC. A longitudinal study of the development of the posterior nasopharyngeal wall between 3 and 16 years of age. Eur J Orthod. 1983; 5: 47-58.
9. McNamara Jr JA. An orthopedic approach to the treatment of Class III malocclusion in young patients. J Clin Orthod. 1987; 21: 598-608.
10. Sugawara J, Mitani H. Facial growth of skeletal Class III malocclusion and the effects, limitations, and long-term dentofacial adaptations to chincap therapy. Sem Orthod. 1997; 3: 244-54.
11. Buschang PH, Martins J. Childhood and adolescent changes of skeletal relationships. Angle Orthod. 1998; 68: 199-206.
12. Vig KW. Nasal obstruction and facial growth: the strength of evidence for clinical assumptions. Am J Orthod Dentofacial Orthop. 1998; 113: 603-11.
13. Paul JL, Nanda RS. Effect of mouth breathing on dental occlusion. Angle Orthod. 1973; 43: 201-6.
14. Mergen DC, Jacobs RM. The size of nasopharynx associated with normal occlusion and Class II malocclusion. Angle Orthod. 1970; 40: 342-6.
15. Cuccia AM, Lotti M, Caradonna D. Oral breathing and head posture. Angle Orthod. 2008; 78: 77-82.
16. Cheng MC, Enlow DH, Papsidero M, Broadbent Jr BH, Oyen O, Sabat M. Developmental effects of impaired breathing in the face of the growing child. Angle Orthod. 1988; 58: 309-20.

17. Tourne LP. The long face syndrome and impairment of the nasopharyngeal airway. Angle Orthod. 1990; 60: 167-76.
18. Tourne LP. Growth of the pharynx and its physiologic implications. Am J Orthod Dentofacial Orthop. 1991; 99: 129-39.
19. Yamada T TK, Miyamoto K, Yamauchi K. Influences of nasal respiratory obstruction on craniofacial growth in young Macaca fuscata monkeys. Am J Orthod Dentofacial Orthop. 1997; 111: 38-43.
20. Martin O, Muelas L, Vinas MJ. Nasopharyngeal cephalometric study of ideal occlusions. Am J Orthod Dentofacial Orthop. 2006; 130: 431-9.
21. Kerr WJ. The nasopharynx, face height, and overbite. Angle Orthod. 1985; 55: 31-6.
22. Subtelny JD. Malocclusions, orthodontic corrections and orofacial muscle adaptation. Angle Orthod. 1970; 3: 170-201.
23. de Freitas MR, Alcazar NM, Janson G, de Freitas KM, Henriques JF. Upper and lower pharyngeal airways in subjects with Class I and Class II malocclusions and different growth patterns. Am J Orthod Dentofacial Orthop. 2006; 130: 742-5.