Revista Portuguesa de Estomatologia, Medicina Dentária e Cirurgia Maxilofacial

REV PORT ESTOMATOL MED DENT CIR MAXILOFAC. 2017;58(4):199-204

Original research

Prevalence of malocclusion in children with upper airway obstruction

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ARTICLE INFO

Article history:
Received 3 June 2017
Accepted 8 January 2018
Available online 2 February 2018

Keywords:
Adenoids
Allergic rhinitis
Malocclusion
Mouth breathing
Prevalence
Tonsils

ABSTRACT

Objectives: To report epidemiological data on the prevalence of malocclusion in a group of children admitted to a referral mouth-breathing otorhinolaryngological hospital center, and to evaluate the association between upper airway obstruction and different dental malocclusions.
Methods: One thousand and two oral breathing children, with a mean age of 6.7 ± 2.7, were evaluated by a multidisciplinary team. The inter-arch relation was recorded in the sagittal, vertical and transversal planes and the chi-square test was performed to evaluate associations between malocclusion and mouth breathing (airway obstruction due to enlarged tonsils or adenoids and/or allergic rhinitis).
Results: Tonsillar hypertrophy causing significant airway obstruction was detected in 41.3% of this sample, adenoid hypertrophy in 54.1%, and allergic rhinitis in 68.1%. Open bite and class II malocclusions were detected in approximately 30% of the children, and posterior crossbite in 25%. More than half of the mouth-breathing children had a normal inter-arch relationship in the sagittal (59.3%), vertical (53.0%) and transversal planes (75.1%). The chi-square analysis detected a non-significant association between oral breathing and malocclusion.
Conclusions: Most of the evaluated oral breathing children presented a normal dental relationship in the vertical, transverse and sagittal planes. The association between Angle class II, open bite and crossbite and type of nasal obstruction was not significant. (Rev Port Estomatol Med Dent Cir Maxilofac. 2017;58(4):199-204)

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http://doi.org/10.24873/j.rpemd.2017.12.209

Prevalência de má-oclusão em crianças com obstrução das vias aéreas superiores

Palavras-chave:
Adenóides
Rinite alérgica
Má-oclusão
Respiração oral
Prevalência
Amígdalas

RESUMO

Objetivos: Determinar a prevalência das má-oclusões dentárias em crianças respiradoras orais, bem como a sua associação com o tipo de obstrução das vias aéreas superiores.
Métodos: 1002 crianças respiradoras orais, com idade média de 6,7 ± 2,7, foram avaliadas num centro hospitalar por uma equipa multidisciplinar. A relação das arcadas dentárias no sentido vertical, sagital e tranversal foi registada e o teste do qui-quadrado foi utilizada para determinar a associação entre obstrução das vias aéreas superiores (por hipertrofia das amígdalas ou dos adenóides e/ou por rinite alérgica), e as más-oclusões.
Resultados: A hipertrofia das amígdalas esteve presente em 41,3%, a hipertrofia dos adenóides em 54,1% e a rinite alérgica em 68,0% das crianças avaliadas. As má-oclusões com mordida aberta e classe II de Angle foram encontradas em aproximadamente 30% da amostra, enquanto que a mordida cruzada posterior esteve presente em 25% das crianças. Mais da metade das crianças respiradoras orais tinham uma relação inter-arcadas normal no plano sagital (59,3%), vertical (53,0%) e transversal (75,1%). A análise estatística não demonstrou nenhuma associação significativa entre o tipo de obstrução respiratória e as má-oclusões dentárias.
Conclusões: A maioria das crianças com respiração oral apresentaram oclusão dentária normal nos três planos do espaço avaliados. A associação entre classe II de Angle, mordida aberta e mordida cruzada posterior e o tipo de obstrução respiratória não foi significativa.
(Rev Port Estomatol Med Dent Cir Maxilofac. 2017;58(4):199-204)

Introduction

For normal craniofacial growth to occur, a fine balance between stomatognathic functions, according to the genetic and morphological patterns of each person, is essential. Breathing is a vital function that occurs permanently, and therefore oral breathing could have a deep impact on dentofacial development.[1] Upper airway obstructions can change the normal naso-respiratory function by restricting the air flow passage, thus making oral breathing required for air to reach the lungs.[2] Tonsils and adenoids hypertrophy, polyps, allergies, recurrent infections and nasal deformities can cause oral breathing, which in turn may lead to muscular, postural and dentofacial changes. The association between dentofacial abnormalities and breathing has been studied since the mid-nineteenth century and is a subject of great interest for pediatricians, otorhinolaryngologists, allergists, orthodontists, speech therapists, physiotherapists and other health professionals dealing with patients' growth.[3-7]

A positive association has been found between upper airway obstruction and various forms of malocclusion or skeletal problems.[8] Moss's functional matrix theory[9] can be applied to oral breathers based on the form-function relationship, since nasal breathing impairments may change facial form, oral musculature and soft tissues. In 1872, Tomes introduced the concept of "adenoid facies" or long face syndrome to describe typical dentofacial characteristics in oral breathers, such as mouth opened without labial sealing at rest, short and hypotonic upper lip, everted lower lip, short and underdeveloped nose, more inferiorly and anteriorly positioned tongue, labially inclined upper incisors and allergic shiners.[10]

Chronic oral breathers are expected to have maxillary atresia, posterior crossbite, excessive vertical growth pattern, anterior open bite and class II malocclusion.[11] Although these classic features of oral breathers are fully described in the literature, epidemiological studies have shown that typical "adenoid facies" are not common in mouth-breathing children, in whom, moreover, normal occlusal relationships are frequently found.[12-14] Some authors have even questioned the association between the respiratory pattern and the dentofacial morphology. Isolated skeletal features such as increased lower anterior facial height and maxillary constriction have a higher prevalence in oral breathers; however, contrary to what would be expected, Angle class I is the most common occlusion type, and not Angle class II.[15,16]

The objective of this study was to report epidemiological data on malocclusion prevalence among a group of children consecutively referred to the mouth-breathing Ear Nose and Throat Center in the Faculty of Medicine of the Federal University of Minas Gerais, Brazil. The hypothesis tested is that there is an association between upper airway obstructions caused by enlarged tonsils or adenoids and/or by allergic rhinitis and the presence of sagittal, transversal and vertical malocclusions.

Materials and methods

The present cross-sectional observational study was developed at the Oral Respiratory Outpatient Center of the Hospital das Clínicas in the Federal University of Minas Gerais, Brazil, and was approved by its Ethics Committee. One thousand and two patients consecutively admitted to the Center from November 2002 to December 2015 enrolled the study. All patients had been referred by pediatricians and primary care physicians due to a mouth-breathing problem and were evaluated by a multidisciplinary team (otorhinolaryngologists, pediatric allergists, orthodontists, speech therapists and physiotherapists) in the same day. The patients' clinical history included oral breathing complaints for at least three months, an open-mouth posture during the day and/or the night, and snoring and sleep apnea in some cases. Oral breathing was confirmed in the presence of at least one of the following airway pathologies: obstructive tonsillar hyperplasia, obstructive adenoidal hyperplasia and allergic rhinitis. The children who were not diagnosed with obstruction caused by one of these conditions were classified as functional mouth breathers.[13]

The clinical examination was complemented with a fiber nasopharyngoscopy using a 3.2-mm flexible nasopharyngo-laryngoscope (Machida ENT-30PIII). Through clinical examination and fiber nasopharyngoscopy, the patients' upper airways were classified as non-obstructed or obstructed. Upper airway obstruction was diagnosed when 75% or more of the nasopharynx was occupied by adenoids and/or when tonsils were classified with grades III or IV according to the criteria of Brodsky and Kock.[17] The diagnosis of allergic rhinitis was performed by allergological assessment, which included a structured medical interview and a physical examination using the standard volar forearm skin prick method for the common aeroallergens.[18]

A team of orthodontists, who were previously calibrated, performed the dental clinical examination. Vertical relationships were classified as normal, as anterior deep bite when more than half of the lower incisors were overlapped by the incisal edges of the upper incisors or as anterior open bite when no overbite was observed, regardless of the amount can be removed. In the transversal plane, the relationship was classified as normal, as posterior crossbite without a mandibular functional shift or as posterior crossbite with a mandibular functional shift. In the sagittal plane, the occlusion was classified as normal, as class I malocclusion, as class II malocclusion or as class III malocclusion. In deciduous and mixed dentitions, a class I dental relationship was considered when the upper deciduous canine cuspid was set between the lower deciduous canine and the first deciduous molar. Syndromic children and children with permanent dentition were excluded.

Statistical analysis was performed with the SPSS software, version 12.0. The independent ear nose and throat (ENT) variables were the grade of tonsils and adenoids obstruction and the presence of allergic rhinitis. The dependent variables were class II, anterior open bite and posterior crossbite. Descriptive statistics and bivariate analysis were performed with the chi-square test, with a significance level of $p < 0.05$.

Results

The mean age of the 1002 children enrolled in the study was 6.7 ± 2.7 years, ranging from 1.4 to 12.9 years. The original sample lacked some data, which lead to a final number different from the total number of observed subjects. Table 1 shows the prevalence of the studied variables according to gender. There were no statistically significant differences between boys and girls. According to Table 1, 58.3% (n=516) of children were in the mixed dentition, and 41.7% (n=369) were in the deciduous dentition. In the sagittal plane, class I malocclusion was the most frequently found condition in boys (46.7%) and girls (48.5%), followed by class II malocclusion (30.8% in the entire sample). More than half of the oral breathing sample presented a normal relationship between upper and lower jaws in the sagittal (59.3%, n=548), transversal (75.1%, n=699) and vertical (53.0%, n=488) planes. Tonsil obstruction grades III and IV were found in 41.3% of the children, adenoid obstruction equal to or higher than 75% was found in 54.1%, and allergic rhinitis was found in 68.0%.

Table 2 shows the prevalence of different variables studied, according to deciduous or mixed dentition. Tonsillar hy-

Table 1. Prevalence of dental and ear nose and throat findings according to gender

Variables	Males		Females		Total	
	n	%	n	%	n	%
Stage of development (n=885)						
Deciduous dentition	219	43.2	150	39.7	369	41.7
Mixed dentition	288	56.8	228	60.3	516	58.3
Total	507	100.0	378	100.0	885	100.0
Sagittal relationship (n=923)						
Normal	63	11.9	47	11.9	110	11.9
Class I malocclusion	247	46.7	191	48.5	438	47.4
Class II malocclusion	163	30.8	121	30.7	284	30.8
Class III malocclusion	56	10.6	35	8.9	91	9.9
Total	529	100.0	394	100.0	923	100.0
Vertical relationship (n=921)						
Normal	281	52.9	207	53.1	488	53.0
Deep bite	82	15.5	55	14.1	137	14.9
Open bite	168	31.6	128	32.8	296	32.1
Total	531	100.0	390	100.0	921	100.0
Transversal relationship (n=931)						
Normal	416	78.0	283	71.1	699	75.1
Posterior crossbite w/o shift	76	14.3	67	16.8	143	15.4
Posterior crossbite w/ shift	41	7.7	48	12.1	89	9.5
Total	533	100.0	398	100.0	931	100.0
Tonsils status (n=990)						
Grades 0, I, II	348	61.5	233	55.0	581	58.7
Grades III, IV	218	38.5	191	45.0	409	41.3
Total	566	100.0	424	100.0	990	100.0
Adenoid obstruction status (n=942)						
<75%	269	49.6	163	40.8	432	45.9
≥75%	273	50.4	237	59.2	510	54.1
Total	542	100.0	400	100.0	942	100.0
Rhinitis (n=870)						
Yes	349	70.4	243	65.0	592	68.0
No	147	29.6	131	35.0	278	32.0
Total	496	100.0	374	100.0	870	100.0

Number of children (n) and prevalence given in percentage (n/N X100)

Table 2. Prevalence of dental and ear nose and throat findings by deciduous and mixed dentition

Variables	Deciduous		Mixed	
	n	%	n	%
Sagittal relationship (n=867)				
Normal	58	16.3	50	9.8
Class I malocclusion	159	44.7	250	48.9
Class II malocclusion	110	43.0	159	31.1
Class III malocclusion	29	8.1	52	10.2
Vertical relationship (n=864)				
Normal	172	47.5	283	56.4
Deep bite	59	16.3	69	13.7
Open bite	131	36.2	150	29.9
Transversal relationship (n=874)				
Normal	283	78.4	382	74.5
Posterior crossbite w/o shift	40	11.1	88	17.1
Posterior crossbite w/ shift	38	10.5	43	8.4
Tonsils status (n=874)				
Grades 0, I, II	172	46.6	330	65.3
Grades III, IV	197	53.4	175	34.7
Adenoid obstruction status (n=832)				
<75%	111	32.0	257	53.0
≥75%	236	68.0	228	47.0
Rhinitis (n=778)				
Yes	187	57.0	333	74.0
No	141	43.0	117	26.0

Number of children (n) and prevalence given in percentage (n/N X100%)

perplasia was more prevalent (53.4%) in the children in deciduous dentition than in the ones in mixed dentition (34.7%). The opposite was verified for rhinitis, with more cases in mixed (74.0%) than in deciduous dentition (57.0%). Posterior crossbite with and without a functional shift, anterior open bite and class II malocclusion were found in similar percentages in children in deciduous and mixed dentitions.

The chi-square test (Table 3) showed no association between type of obstruction (tonsils, adenoids and rhinitis) and the different types of malocclusion – class II, open bite and crossbite (p>0.05).

Discussion

Although the literature has been showing interest on the impact of oral breathing in growth and dentofacial development for many years, many questions remain unanswered regarding the real meaning of nasal obstruction as an etiological factor for malocclusion. Classic cephalometric studies have associated upper airway obstruction with skeletal and dentofacial deviations from the norm, but there are few clinical evaluations on these patients' occlusion.[19-22]

Cross-sectional studies, even the ones with a large sample as this here presented, have some limitations that need to be addressed. In this study, although children were supposed to be submitted to evaluation by the whole professional team at the first appointment, sometimes that was not possible. For example, the diagnosis of allergic rhinitis was not made in the first appointment in some cases due to antihistamine use or airway infections, and patients did not show up on recall. Therefore, some data was missing from the original 1002 patients. All non-syndromic children, in both deciduous and mixed dentition, who were consecutively referred and diagnosed as mouth breathers enrolled the present study and, therefore, the age range was wide. There was no information available on the onset of oral respiration, sucking habits, and, due to radiation issues, lateral x-rays were not available to differentiate skeletal from dental malocclusions.

Some studies representing the general population, and not only the mouth breathers, can be found in the literature. In the present sample with nasal obstruction, the prevalence of class II malocclusion was 43.0% in the children in deciduous dentition and 31.1% in the ones in mixed dentition. These numbers differ from other studies made in Brazil by Tomita et al.[23] and Sadakyio et al.,[24] which showed a class II prevalence between 6% and 20% in pre-school children. The higher prevalence of class II malocclusion in the mouth breathers in mixed dentition comparing to those in deciduous dentition can be explained either by the longer influence of the mouth-breathing problem or simply by the transition to mixed dentition, which could naturally result in class II canine in some cases. More epidemiological studies on the sagittal relationship during the

Table 3. Bivariate analyses, using the chi-square test, between the obstructive causes for mouth breathing (independent variables) and class II, anterior open bite and posterior crossbite (dependent variables)

Variables	Class II malocclusion (n=290)	Anterior open bite (n=282)	Posterior crossbite (n=230)
Tonsil and/or adenoid obstruction			
Yes (n=602)	197 (32.7%)	189 (31.4%)	153 (25.4%)
No	314	320	364
	p=0.824	p=0.264	p=0.751
Only rhinitis			
Yes (n=520)	70 (13.5%)	71 (13.6%)	65 (12.5%)
No	161	162	170
	p=0.719	p=0.574	p=0.322
No obstruction cause diagnosed			
Yes (n=69)	23 (33.3%)	22 (31.9%)	12 (17.4%)
No	42	44	43
	p=0.800	p=0.604	p= 0.800

Number of children (n) and prevalence given in percentage (n/N X100%)

transition to mixed dentition stages would be helpful in testing these hypotheses.

The prevalence of open bite in the mouth-breathing sample, including children both in the deciduous and mixed dentitions, was 32.5% (Table 2). This percentage is in agreement with the prevalence of open bite in the general Brazilian children population, described as between 20.6% and 46.3%.[23,25-27] On the other hand, the prevalence of open bite reported in some reference articles that analyzed only children in mixed dentition was lower than in our study (12.0% and 20.1%).[28-30] Environmental factors such as non-nutritious sucking habits and mouth breathing act as secondary causes of anterior open bite. However, during mixed and permanent dentitions, these sucking habits decline in the general population, and this fact could explain the discrepant results.

Posterior crossbite was more prevalent in the children in mixed dentition (25.5%) than deciduous dentition (21.6%). Transversal dental relationships, although guided by individual facial genotype, can be greatly changed by deleterious environmental factors, and one can expect a higher prevalence of transversal problems as growth occurs. In general, our sample showed 23.9% of crossbite malocclusion. Previous studies showed a wide variation (8% to 22%) in the presence of crossbite in the general population.[31]

Although class II malocclusions (30.8%), anterior open bites (32.1%) and posterior crossbites (24.9%) in the present sample of mouth breathers were high, more than half of children showed a normal inter-arch relationship on the sagittal (59.3%), transversal (75.1%) and vertical (53.0%) planes (Table 1). Epigenetic factors such as oral habits or mouth breathing can act as contributive agents but other determinant factors, like heredity, should be involved in malocclusion development.

There were no associations between different types of malocclusion and adenoid or tonsil obstruction, with or without allergic rhinitis, in the mouth breathers studied. Malocclusion development is probably related to individual genetic susceptibility, even though some authors have reached different conclusions.[19,32-34] One limitation of this study was the absence of a cephalometric analysis, thus not allowing the evaluation of skeletal problems. On the other hand, a strong point of the present study was the large number of mouth-breathing patients evaluated, which helped obtain valid epidemiological data. Since no associations were found between upper airway obstruction or allergic rhinitis and dental malocclusions, within the limitations of this study, mouth-breathing problems cannot be considered as determinant factors in the development of dental problems.

Conclusions

In the present sample, 30.8% of the mouth-breathing children presented class II malocclusion, 32.1% presented anterior open bite and 24.9% posterior crossbite. No association was found between the type of obstruction (tonsils, adenoids and rhinitis) and the different malocclusions. More than half of the children presented a normal inter-arch relationship in the sagittal, transversal and vertical dimensions.

Ethical disclosures

Protection of human and animal subjects. The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

Conflict of interest

The authors have no conflicts of interest to declare.

REFERENCES

1. Enlow DH. Facial growth. 3rd ed. Philadelphia: Saunders, 1990.
2. Kenna MA. Nelson textbook of pediatrics, 16th ed. Philadelphia, PA: WB Saunders, 2000.
3. O'Ryan FS, Gallagher DM, LaBanc JP, Epker BN. The relation between nasorespiratory function and dentofacial morphology: a review. Am J Orthod.1982;82:403-10.
4. Subtelny JD. Oral respiration: facial maldevelopment and corrective dentofacial orthopedics. Angle Orthod. 1980;50;147-64.
5. Hultcrantz, E Larson M, Hellquist T, Ahqvist-Rastad J, Svanholm H, Jakobsson OP. The influence of tonsillar obstruction and tonsillectomy on facial growth and dental arch morphology. Int J Pediatr Otorhinol. 1991;22:125-34.
6. Moyers RE, Bookstein FL, Guire KE. The concept of pattern in craniofacial growth. Am J Orthod.1979;76:136-48.
7. McNamara, JA. Influence of respiratory pattern on craniofacial growth. Angle Orthod.1981;51:269-300.
8. Woodside D, Linder-Aronson S, Lundstrom, A. Mandibular and maxillary growth after changed mode of breathing. Am J Orthod Dent Orthop.1991;100:1-18.
9. Moss ML. The functional matrix: functional cranial components. In: Kraus BS, editors. Vistas in orthodontics. Philadelphia: Lea and Febiger.1962; 85-90.
10. Tomes CS. On the development origin of the V-shaped contracted maxilla (1872) *in* Rubin RM. Mode of respiration and facial growth. Am J Orthod. 1980;78:504-10.
11. Ricketts RM. Respiratory obstruction syndrome. Am J Orthod. 1968;54:495-507.
12. Souki BQ, Lopes PB, Pereira TBJ, Franco LP, Becker HMG, Oliveira DD. Mouth breathing children and cephalometric pattern: Does the stage of dental development matter? Int J Pediatr Otorhinol. 2012;76:837-41.
13. Souki BQ, Pimenta GB, Souki MQ, Franco LP, Becker HM, Pinto JA. Prevalence of malocclusion among mouth breathing children: Do expectations meet reality? Int J Pediatr Otorhinolaryngol. 2009;73:767-73.
14. Souki MQ, Souki BQ, Franco LP, Becker HMG, Araújo EA. Reliability of subjective linear, ratio and area cephalometric measurements in assessing adenoid hypertrophy among different age groups. Angle Orthod.2012;82:1001-7.

15. Leech H. A clinical analysis of orofacial morphology and behavior of 500 patients attending an upper respiratory research clinic. Dent Pract. 1958;9:57-68.
16. Fields HW, Donald WW, Black K, Phillips CL. Relationship between vertical dentofacial morphology and respiration in adolescents. Am J Orthod Dentofacial Orthop. 1991;99:147-54.
17. Brodsky L, Koch RJ. Anatomic correlates of normal and diseased adenoids in children. aryngoscope.1992;102:1268-74.
18. Barros JR, Becker HM, Pinto JA. Evaluation of atopy among mouth-breathing pediatric patients referred for treatment to a tertiary care center. J Pediatr. 2006;82:458-64.
19. Behlfelt K, Linder-Aronson S, Mc William J, Neader P, Laage-Hellman J. Dentition in children with enlarged tonsils compared to control children. Eur J Orthod.1989;11:416-29.
20. Características da dentadura mista em crianças brasileiras. Tese Mestrado, Bauru. 2003, Universidade de São Paulo.
21. Woodside DG, Linder-Aronson S. The channelization of upper and lower anterior face heights compared to population standard in males between ages 6 to 20 years. Eur J Orthod.1979;1:25-40.
22. Solow B, Siersbaek-Nielsen S, Greve E. Airway adequacy, head posture and craniofacial morphology. Am J Orthod. 1984;86:214-23.
23. Tomita NE, Bijella FTB, Silva SMD, Bijella VT, Lopes ES, Novo NF et al. Prevallence of malloclusion in preschoolchildren in Bauru-SP-Brazil. J. Apply Oral Sci. 1998;6:35-44.
24. Sadakyio CA, Degan VV, Pignataro Neto G, Rontani MRP. Malocclusion prevalence in Brazilian preschoolers from Piracicaba-SP. Cienc Odontol Bras. 2004;7:92-9.
25. Sousa RLS, Lima RB, Florêncio Filho C, Lima KC, Diógenes AMN. Prevalence and risk factors of anterior open bite in the complete deciduous dentition in prescholars' children who live in the city of Natal/RN. Rev Dental Press Ortodon Ortop Facial. 2007;12:129-38.
26. Peres KG, Lattore MRDO, Sheiham A, Peres MA, Victora CG, Barros FC. Social and biological early life influence on the prevalence of open bite in Brazilian 6 year-olds. Int J Paediatr Dent. 2007;17:41-9.
27. Katz CR, Rosenblatt A, Gondim PP. Nonnutritive sucking habits in Brazilian children: effects on deciduous dentition and relationship with facial morphology. Am J Orthod Dentofac Orthop. 2004;126:53-7.
28. Thomazine GDPA, Imparato JCP. Prevalence of open bite and cross bite in students of public schools of Campinas. J Bras Odontopediatr Odontol Bebe. 2000;3:29-37.
29. Clemens C, Sanchez MF. Prevalência de mordida aberta anterior em escolares de Porto Alegre. Rev Fac Odontol. 1982;21:139-52.
30. Gandini MREAS et al. Estudo da oclusão dentária de secolares da cidade de Araraquara, a fase da dentadura mista. Relação inter-arcos, Região anterior (Overjet e Overbite). Ortodontia. 2000;33:44-9.
31. Petren S, Bondemark L, Soderfeldt B. A systematic review concerning early orthodontic treatment of unilateral posterior crossbite. Angle Orthod. 2003;73:588-96.
32. Linder- Aroson S. Adenoids: Their effect on mode of breathing and nasal airflow and their relationship to characteristics of the facial skeleton and the dentition. Acta Otolaryngol Suppl.1970;265:1-132.
33. Morrison WW. Interrelationship between nasal obstruction and oral deformities. Int J Orthod.1931;17:453-8.
34. Oulis CJ et al. The effect of hyperthophic adenoids and tonsils on the development of posterior crossbite and oral habits. J Clin Pediatric Dent. 1994;18:197-201.