



Effect of allergic rhinitis, asthma and rhinobronchitis on dental malocclusion in adolescents

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RESUMEN

Objetivo: determinar el efecto de la rinitis alérgica (RA), asma y rinobronquitis alérgica (RBA) sobre la oclusión dental en adolescentes.

Método: este es un estudio transversal, observacional, retrospectivo y descriptivo simple de 2556 adolescentes en edades de 14-20 años. RA, asma y la RBA fueron definidos por autorreporte. Mala oclusión fue identificada por exploración física directa. Los datos fueron analizados mediante el programa de estadística SPSS versión 10, se calculó el valor OR ajustado (razón de momios) utilizando un modelo de regresión logística, se calculó la ji cuadrada, se utilizó un intervalo de confianza (IC) de 95%. Los valores de *p* iguales o menores de 0.05 fueron considerados estadísticamente significativos.

Resultados: de la población total, el porcentaje de hombres fue 42.7% y el de mujeres de 57.3%. La prevalencia de RA fue 39.3%, asma 6.9%, RBA 4.5%, y mala oclusión, 37.2%. Un porcentaje mayor de mala oclusión fue encontrado en adolescentes con asma (48.3% vs. 36.3%). Para los grupos de asma (OR ajustado = 1.78; *p* = 0.017) y RA (OR ajustado = 1.20, *p* = 0.032) se infirió que estas patologías favorecer la mala oclusión en adolescentes, esto no ocurrió con el grupo de RBA (OR ajustado = 0.81; *p* = 0.511). La prevalencia de mordida abierta anterior fue mayor en adolescentes con asma (44.3% vs 31.3%). Para el grupo de asma (OR ajustado = 1.66; *p* = 0.037) se infirió que se favorece el desarrollo de la mordida abierta anterior, esto no fue así para los grupos de RBA (OR ajustado = 1.01; *p* = 0.956) y RA (OR ajustado = 1.17; *p* = 0.071). La enfermedad alérgica nasal, bronquial ó la asociación de ambas no son causa de mordida abierta posterior.

Conclusión: asma esta relacionada con la mala oclusión en adolescentes, particularmente a la mordida abierta anterior. RA y la RBA no favorecen el desarrollo de mala oclusión.

Palabras clave: rinitis, asma, rinobronquitis alérgica, mala oclusión.

ABSTRACT

Objective: To determine the effect of allergic rhinitis (AR), asthma, rhinobronchitis (ARB) on dental malocclusion in adolescents.

Method: This is a cross-sectional, observational, retrospective and sample descriptive study of 2556 adolescents aged 14-20 years. AR, asthma and ARB were defined by self-reported. Malocclusion was identified by direct physical examination. Data were analyzed by the SPSS 10.0 version statistical program, adjusted OR value (Odds Ratio) using a logistic regression model was determined, ji square was calculated, an 95% Confidence Intervals was used. Equal or smaller values of *p* < 0.05 were considered statistically significant.

Results: Percentage of male sex was 42.7% and female 57.3%. Prevalence of AR was 39.3%, asthma 6.9%, ARB 4.5%, and malocclusion, 37.2%. A higher percentage of malocclusion was found in adolescents with asthma (48.3% vs 36.3%). For the groups of asthma (adjusted OR = 1.78; *p* = 0.017) and RA (fit OR = 1.20, *p* = 0.032) were inferred that these pathologies to favor the malocclusion in adolescents, this did not happen with the group of RBA (OR fit = 0.81; *p* = 0.511). The prevalence of open bite was greater in adolescents with asthma (44.3% vs 31.3%). For the asthma group (OR fit = 1.66; *p* = 0.037) we deduced that the development of anterior open bite is favored, this was not thus for the groups of RBA (OR fit = 1.01; *p* = 0.956) and RA (OR fit = 1.17; *p* = 0.071). Nor AR, asthma or ARB have any effect on posterior open bite.

Conclusions: Asthma is related to malocclusion in adolescents, particularly to anterior open bite. AR and ARB do not favor the development of malocclusion.

Key words: Rhinitis, asthma, allergic-rhinobronchitis, malocclusion.

The association between certain airway obstructing disorders and the abnormal development of the cranial-facial complex has been discussed in the medical literature for some time now.¹⁻³ Allergic rhinitis

(AR) and asthma are common and frequent diseases that obstruct airways, affecting 17.9%⁴ and 12.6%⁵ of adolescents, respectively. Dental malocclusion is one of the most frequent disorders that occurs during cranial-facial development.⁶⁻⁸ The

prevalence quoted in the literature states that dental malocclusion ranges between 16.5% and 93% of adolescents.^{6,7,9-11}

The effect of AR and asthma on dental occlusion has been a widely discussed topic among researchers.¹²⁻¹⁶ The results found have caused differences of opinion and discussion on the subject. To this controversy, one must add a new element. Many researchers, while conducting their studies have found in their populations an important number of persons that simultaneous have AR and asthma.^{17,18} This has recently caused the introduction of a new concept "one airway, one disease"¹⁹ called, although not generally speaking, "allergic rhinobronchitis".²⁰ This condition has lead to new research studies to determine the effect of disorders that obstruct airways (AR, asthma, allergic rhinobronchitis) on cranial-facial development.

Traditionally, anatomical and functional respiratory tract differences have been useful for identifying the airways as either upper or lower. This has caused for the epidemiology and the complications that AR and asthma generate to be closely studied, until not too long ago, as conditions exclusively of the lower.^{21,22} and upper^{23,24} respiratory tract, respectively. A connection between upper respiratory tract disorders and those that affect the lower tract has been suspected for quite some time. Only in the last two decades has epidemiological, patho-

physiological and therapeutic evidence shown that nasal and bronchial mucosa are similar and that AR and asthma co-exist in patients.^{18-20,25-27} Bugiani et al.²⁸ in their study with a sample population of 17,666 subjects found that 60% of those subjects with asthma, also have AR, while 51.5% of patients with AR have asthma. The results obtained by Yawn and col.²⁹ among other authors, show a particularly strong association between rhinitis and asthma in teenagers under 25 years of age.^{30,31}

The increased acceptance that AR and asthma are manifestations of the same disease has made it evident for the need to conduct new studies to assess the effect of AR, asthma or the simultaneous presence of both disorders in an individual on dental occlusion.^{23,25,26}

As a consequence, this study was designed to assess the effect of allergic rhinitis, asthma and allergic rhinobronchitis on the development of malocclusion in adolescents.

MATERIAL AND METHOD

This study was a population-based a case-control study. Both healthy teenagers and adolescents with allergic rhinitis, allergic rhinobronchitis, and dental malocclusion, with ages ranging from 14 to 20 years old, currently in junior high and senior high school in an urban zone of Northeastern Mexico were enrolled in the study. This zone is situated in the Southern part of the state of Tamaulipas, on the coast of the Gulf of Mexico, about 542 km Northeast of Mexico City and comprises the cities of Tampico, Ciudad Madero and Altamira. The cities share an area of 1,492.7 km² and have a population of 605,431 inhabitants.

The Ethics Committee of the General Hospital No. 6 of the Mexican Institute of Social Security. Tamaulipas, Mexico and the Autonomous University of Tamaulipas Medical School reviewed and approved the clinical trial protocol. The participating teenagers were recruited from one of the programs conducted by the Medical School in the community. The healthcare team working in and for the community was comprised by general practitioners, specialists

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(allergy specialists, epidemiologists), dentists, and medical school students.

Permission from the proper education authorities was obtained. The schools and participating students were selected using a simple random technique. A list of students enrolled at each school selected was solicited. The students were selected from a random numbers list. A questionnaire was given to students in the classroom in presence of their professors. Physical exams were done in a private room. The data were collected from June 2005 to March 2006.

For the registration of information, a self-reported questionnaire was used comprised by 24 closed, binomial, multiple choice questions. Through this instrument, information concerning the participants was obtained, such as age, gender, personal and family history of allergic conditions, as well as their sociodemographic data. The application of the questionnaire was done by trained personnel for the correct recording of the information.

The questions relating to asthma and allergic rhinitis were taken from the ISAAC questionnaire.³³ The data were recorded as: 1.- Allergic rhinitis; 2.- Current asthma; 3.- Allergic rhinobronchitis.

The teenagers were diagnosed with allergic rhinitis when they responded affirmatively and simultaneously to the following two questions: 1.- Have you ever sneezed, had an itching sensation or congested nose without having the flu or a cold? 2.- In the last year, have you sneezed, had an itching sensation or congested nose without having the flu or a cold? The physical examination of the nasal openings was done by a specialist in allergic conditions using a Welch Allen rhinoscope, to determine the characteristics of the nasal mucosa and turbinate.

Current asthma was defined as a case when youngsters reported having been diagnosed with asthma by a physician (using spirometry and laboratory assessment) together with any of the following options: having had wheezing or been awoken by an episode of dry cough without having a cold or a chest infection, in the last 12 months or having taken medication for asthma in the last month.

Adolescents were considered to have allergic rhinobronchitis when they simultaneously had allergic rhinitis and current asthma.

The diagnoses of the different types of malocclusions were done by direct examination of the oral cavity by dentists using disposable gloves, a tongue depressor and a millimetric scaled measuring device. Overjet (horizontal open bite) was measured from the border of the lip-incisors to the upper central incisor to the lip surface of the inferior central incisors parallel to the occlusal plane. The measurements were classified as abnormal if the horizontal open bite exceeded 3 mm, while an horizontal open bite equal to or less than 3 mm was considered normal.³⁴

Overbite (vertical open bite) was registered when there was loss of vertical contact between the upper and lower teeth, that is to say, based on the distance between the top of the superior central incisor overlapping the top of the inferior central incisor.^{35,36}

Anterior open bite was diagnosed when teenagers had an open horizontal or vertical bite or both types of malocclusion.

Posterior open bite was diagnosed when the inverse conditions were found, in premolar and/or molars, of one or several teeth on both sides of the jaw.^{35,36}

Referent to malocclusion an test intraexaminer reliability was made, 50 adolescents were reexamined at least 15 days later. There was a complete agreement ($k = 1$) in the repeated recording of malocclusion.

The data were analyzed using the SPSS 10.0 version statistical program. Dichotomic variables (yes or no) were used for indicating the presence or absence of a condition. Simple frequencies and central tendency measures were estimated. A 2 x 2 contingency table was used (Chi square, Odds Ratio and 95% Confidence Intervals) to estimate the risk of malocclusion due to allergic rhinitis, current asthma and allergic rhinobronchitis comparing a group with malocclusion to another without occlusion problems. The adjusted OR was estimated using a logistic regression model to determine the effect of a variable having adjusted the others. All p values ≤ 0.05 were considered statistically significant.

Oral and written informed consent was obtained from both parents, as well as from the participating teenagers. The researchers, parents and participating alumni were blind to the specific aims of the study.

RESULTS

We studied 2556 adolescents, 42.6% were males. The average age was 15.74 ± 2.41 . Of the total population, 950 (37.2%) youngsters had some kind of dental malocclusion. The prevalence of allergic rhinitis was 39.3%, asthma diagnosed 6.9%, and allergic rhinobronchitis, 4.5%. Table 1 shows the personal and clinical characteristics of the study population by gender.

A slightly greater percentage of teenagers with

malocclusion (Table 2) were found in the group of young asthmatics (48.3% *vs* 36.3%). Based on the results, asthma (OR = 1.63; 95% CI 1.20-2.22, $p = 0.001$), allergic rhinitis (40.0% *vs* 35.3%; OR = 1.22; 95% CI 1.03-1.43; $p = 0.010$) and allergic rhinobronchitis (48.1% *vs* 36.7%; OR= 1.59; 95% IC 1.07-2.36; $p = 0.013$) are related to malocclusion. Gender is not related to malocclusion.

As determined using a logistic regression model, including all the adolescents in the study, and adjusting for the other variables, asthma and allergic rhinitis has an effect on malocclusion. Allergic rhinobronchitis was not associated with dental malocclusion in teenagers (Table 2).

The prevalence of the anterior open bite was greater in teenagers with allergic rhinobronchitis (46.1% *vs* 31.6%) (Table 3). The analysis shows that

Table 1. Personal and clinical characteristics of the study population, by gender

	Males		Females	
	No	%	No	%
Allergic rhinitis	392	35.9	613	41.9
Diagnosed asthma	68	6.2	108	7.4
Allergic rhinobronchitis	38	3.5	66	4.5
Malocclusion	403	36.9	547	37.4
Anterior open bite	347	31.8	476	32.4
Posterior open bite	60	5.5	98	6.7
Age	(mean $\pm$ -SD)		15.88 $\pm$ -2.32	
	15.63 $\pm$ -2.46			

Data are expressed as mean (SD) or absolute number (%).

Table 2. Effect of allergic rhinitis, current asthma and allergic rhinobronchitis on dental malocclusion

Group of adolescents	Malocclusion				Crude OR (95% CI)	P value	Logistic Regression OR (95% CI)	p value
	Yes	%	No	%				
Male	403	36.9	689	63.1	0.98 (0.83-1.15)	0.423	1.00 (0.85-1.18)	0.498
Female	547	37.4	917	62.6				
Allergic rhinitis (+)	402	40	603	60.0	1.22 (1.03-1.43)	0.010	1.20 (1.01-1.43)	0.032
Allergic rhinitis (-)	548	35.3	1003	64.7				
Diagnosed asthma (+)	85	48.3	91	51.7	1.63 (1.20-2.22)	0.001	1.78 (1.10-2.86)	0.017
Diagnosed asthma (-)	865	36.3	1515	63.7				
Allergic rhinobronchitis (+)	50	48.1	54	51.9	1.59 (1.07-2.36)	0.013	0.81 (0.43-1.51)	0.511
Allergic rhinobronchitis (-)	900	36.7	1552	63.3				

(+) Adolescents with the condition, (-) adolescents without the condition.

Table 3. Effect of allergic rhinitis, current asthma and allergic rhinobronchitis rhinitis on anterior open bite

Group of adolescents	Anterior Open Bite				Crude OR (95% CI)	P value	Logistic Regression OR (95% CI)	p value
	Yes	%	No	%				
Male	347	31.8	745	68.2	0.96 (0.81-1.14)	0.363	1.01 (0.86-1.20)	0.838
Female	476	32.5	988	67.5				
Allergic rhinitis (+)	350	34.8	655	65.2	1.22 (1.02-1.44)	0.013	1.17 (0.98-1.40)	0.071
Allergic rhinitis (-)	473	30.5	1078	69.5				
Diagnosed asthma (+)	78	44.3	98	55.7	1.74 (1.28-2.38)	0.000	1.66 (1.03-2.70)	0.037
Diagnosed asthma (-)	745	31.3	1635	68.7				
Allergic rhinobronchitis (+)	45	46.2	56	53.8	1.85 (1.25-2.75)	0.002	1.01 (0.54-1.91)	0.956
Allergic rhinobronchitis (-)	775	31.6	1677	68.4				

(+) Adolescents with the condition, (-) adolescents without the condition.

Table 4. Effect of allergic rhinitis, current asthma and allergic rhinobronchitis on posterior open bite

Group of adolescents	Posterior Open Bite				Crude OR (95% CI)	P value	Logistic Regression OR (95% CI)	p value
	Yes	%	No	%				
Male	60	5.5	1032	94.5	0.81 (0.58-1.12)	0.122	1.23 (0.88-1.71)	0.217
Female	98	6.7	1366	93.3				
Allergic rhinitis (+)	65	6.5	940	93.5	1.08 (0.78-1.50)	0.343	1.08 (0.77-1.52)	0.627
Allergic rhinitis (-)	93	6.0	1458	94.0				
Diagnosed asthma (+)	8	4.5	168	95.5	0.70 (0.34-1.46)	0.225	0.66 (0.20-2.15)	0.498
Diagnosed asthma (-)	150	6.3	2230	93.7				
Allergic rhinobronchitis (+)	5	4.8	99	95.2	0.75 (0.30-1.89)	0.368	1.05 (0.235-4.75)	0.942
Allergic rhinobronchitis (-)	153	6.2	2299	93.8				

(+) Adolescents with the condition, (-) adolescents without the condition.

allergic rhinobronchitis (OR=1.85; 95% IC 1.25-2.75; $p = 0.002$); asthma (44.3% *vs* 31.3%; OR = 1.74; 95% CI 1.28-2.38; $p = 0.000$), and allergic rhinitis (34.8% *vs* 30.5%; OR=1.21; 95% IC 1.02-1.44; $p = 0.013$) has an effect on the anterior open bite. Gender has not effect on anterior open bite.

Asthma was associated with the anterior open bite as determined by a logistic regression model when adjusting for other variables (Table 3).

Gender (males 5.5% females 6.7%; OR=0.81; 95% IC 0.81; 95% IC 0.58-1.12; $p = 0.122$), allergic rhinitis (6.5% *vs* 6.0%; OR = 1.08; 95% CI 0.78 – 1.50; $p = 0.343$); asthma (4.5% *vs* 6.3; OR = 0.70; 95% CI 0.34-1.46; $p = 0.225$) and allergic rhinobronchitis (4.8% *vs* 6.2%; OR = 0.75; 95% CI 0.30 to 1.89; $p = 0.368$) has no effect on the posterior open bite.

The final analysis using a logistic regression model and adjusting for other variables shows that neither gender, allergic rhinitis, asthma nor allergic rhinobronchitis, are associated with the development of the posterior open bite (Table 4).

DISCUSSION

After more than a century, the association between the obstruction of airways and dental malocclusion is still under discussion.^{2,12} Several research studies show that AR and asthma play important roles in the development of altered dental occlusion,¹² while others do not find any association between AR, asthma and malocclusion.² Undoubtedly, the more convincing information of the association between

breathing through the mouth and the modification of cranial facial growth has been achieved in animal models.^{37,38} On the other hand, this evidence cannot be extrapolated to explain the phenomenon in humans since induced total nasal obstruction in animal models barely seems to be equivalent to what happens in humans. RA and asthma are the disorders that cause the greatest frequency of airway obstruction in humans and potentially, due to the functional changes of the oral-maxillary muscles that these conditions cause, can alter the normal development of dental occlusion.

Lopatiéné et al.¹² found that 12.2% of their patients with orthodontic anomalies had allergic rhinitis. On the other hand, Martins et al., in their sample of 61 subjects with asthma, found that 42.5% had cross bite, 40% overbite and 47.5% overjet.¹⁷ In our study, 42.3% adolescents with malocclusion had AR, 8.9% had asthma and 5.3% ARB (data not shown). Inversely speaking and according to the data, 40.0% of teenagers with AR, 48.3% of those with asthma and 48.1% as carriers of ARB had dental malocclusion.

This study has several methodological limitations that must be taken into account when interpreting the results. Firstly, this is a case-control study based on a transversal design. Secondly, the teenagers included in the study are students attending junior and senior high school. Thirdly, no objective tests were used to diagnose AR, asthma and allergic rhinobronchitis. Lastly, a self-reported questionnaire was used to diagnose AR, asthma and allergic rhinobronchitis. Due to the probability of over-reporting or under-reporting of AR, asthma and allergic rhinobronchitis, they could not be adequately estimated.

The strengths of our study are based on: 1.- for the diagnosis of AR, asthma and allergic rhinobronchitis, we used the questions included in ISAAC, previously validated and their usefulness demonstrated through several studies;^{33,34} 2.- the physical examination of airways, oral cavity and dental arches was done by expert personnel on the subject; 3.- the application of the questionnaire was done in the classroom, with the professor present, by personnel specialized and trained in insuring the correct collecting of data.

Based on the study of 2556 teenagers, asthma and allergic rhinitis seems to be important obstructive respiratory conditions for the development of dental malocclusion. The analysis shows a greater prevalence of altered occlusion in adolescents with a history of asthma (48.3% *vs.* 36.3%). Adolescents with asthma or allergic rhinitis have 1.78 and 1.20 times, respectively, the risk of developing malocclusion in comparison with those without asthma and allergic rhinitis. On the other hand, rhinobronchitis was not associated with malocclusion, determined by logistic regression model with adjustment for another variable.

Recent studies point to the prevalence of the anterior open bite reaching figures up to 66%.¹¹ In this study, 32.2% of the adolescents had anterior open bite, and more so, the percentage of teenagers with anterior open bite was greater in those with allergic rhinobronchitis and asthma. Determined by logistic regression model, asthmatic teenagers have 1.66 times more at risk for developing anterior open bite and AR and ARB have no effect on anterior open bite. Previous studies have been controversial when finding an association¹⁵⁻¹⁷ or not association² among AR, asthma and anterior open bite.

Posterior open bite is other frequent form of malocclusion. The prevalence reported of posterior open bite ranges between 24.5% and 42.5%.^{12,17} Some authors have found that allergic rhinitis and asthma favor the development of posterior open bite.^{16,17} On the other hand, authors such as Lopatiéné et al.¹² did not find an association between airway obstruction and posterior open bite. In this study, 6.2% of the teenagers presented posterior open bite. Based on the analysis conducted, neither AR, asthma nor rhinobronchitis have an effect on posterior open bite in adolescents.

CONCLUSION

In conclusion, based on the results, asthma and allergic rhinitis seems to favor the development of anterior open bites in adolescents. Adjustment for another variable in a logistic regression model allergic rhinitis and rhinobronchitis have no effect

on any form of dental malocclusion in youngsters. There is a clear need to establish health programs for the diagnosis and management of airway obstructive disorders and therefore avoid certain complications they may cause such as the changes in the development of the cranial-facial complex. Additionally it is necessary to develop more research to determine the prevalence and negative effects of rhinobronchitis.

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