

## Orthodontic consequences of airway inadequacy due to adenoids

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### ABSTRACT

The current study was performed to investigate the possible association between nasopharyngeal airway inadequacy due to enlarged adenoid and some dento-alveolar characteristics in subjects 3–17 years old in Mosul City.

Twenty four patients (12 males and 12 females) were randomly selected from patients who admitted to Ear Nose and Throat Department at Al-Zahrawi Teaching Hospital in Mosul City and who indicated for adenoidectomy to relieve severe nasal obstruction. Sixteen variables were recorded and analyzed using Statistical Package for Social Sciences system loaded on Pentium IV computer.

The results proved that a significant correlation existed between nasopharyngeal airway inadequacy due to enlarged adenoid and some dentoalveolar characteristics and females were having high incidence of tonsillar enlargement than males.

**Key Words:** Airway inadequacy, adenoid, malocclusion, nasal obstruction.

### الخلاصة

أجريت الدراسة الحالية للتحري عن العلاقة المحتملة بين عدم كفاية المجرى الأنفي البلعومي الناتج عن تضخم النسيج الغدي في التجويف الأنفي البلعومي وبعض الصفات السنخية السنية لأشخاص تتراوح أعمارهم (3-17) سنة في مدينة الموصل.

اختير أربعة وعشرون مريضاً (12 ذكراً و 12 أنثى) بصورة عشوائية من ضمن المرضى التابعين لقسم الأذن والأنف والحنجرة في مستشفى الزهراوي التعليمي في مدينة الموصل والذين بحاجة لإجراء عملية استئصال النسيج الغدي المتضخم في التجويف الأنفي البلعومي لازالة الانسداد الانفي الشديد. تم تسجيل وتحليل ستة عشر متغيراً باستخدام نظام الحقيبة الاحصائية للعلوم الاجتماعية المحمل على حاسوب نوع "بانتيوم 4".

برهنت النتائج عن وجود علاقة وثيقة بين عدم كفاية المجرى الأنفي البلعومي الناتج عن تضخم النسيج الغدي في التجويف الأنفي البلعومي وبعض الصفات السنخية السنية، وكانت الإناث تمتلك نسبة تضخم الغدة في التجويف الأنفي البلعومي أكثر من الذكور.

### INTRODUCTION

Studies of the contribution of environment to facial development have demonstrated an association between airway obstruction and undesirable variations in facial form. Human investigations have focused on the contribution of enlarged adenoids,<sup>(1-3)</sup> allergic rhinitis,<sup>(4, 5)</sup> choanal atresia,<sup>(6)</sup> enlarged tonsils,<sup>(7)</sup> adenoid tissue in relation to tongue posture<sup>(8)</sup> and such surgical interference with the airway as pharyngoplasty.<sup>(9)</sup>

In animals' experiment, Harvold *et al.*<sup>(10)</sup> and Vargervic *et al.*<sup>(10, 11)</sup> confirmed that environmental impact, such as severe airway obstruction can produce major malocclusion symptoms.

Adenoid is defined as nasopharyngeal tonsil.<sup>(12)</sup> If this lymphoid tissue becomes so hypertrophied that it produces clinical symptoms, it is defined as adenoid vegetation or adenoid.<sup>(13)</sup> Adenoid tissues are located in the nasopharynx above the level of soft palate.<sup>(13)</sup>

The adenoid gland is poorly developed at birth. It is not visible on plain radiography in infant under the age of one month, but it is clinically identifiable by the age of four months. It is radiographically identifiable in 50% of infants under 6 month, and can be seen by x-ray in all of them by the age of 6 months. By the age 2 years, hypertrophy and hyperplasia of the adenoid occur, rapid growth from 3 years to 5 years with subsequent decrease in the nasopharyngeal airway, after that the size of adenoid remains relatively constant while the nasopharynx increase in size, so usually the symptoms of adenoid hypertrophy appears at the age of 3–5 years, involution of the adenoid occur, after puberty, so the problem here is the size of adenoid in relation to nasopharynx.<sup>(14)</sup>

The acute infection of adenoid usually follows the upper respiratory tract infection, which result in hyperplasia with multiplication of lymphoid follicles, usually it is associated with acute tonsillitis.<sup>(15)</sup> There is no doubt that large adenoid can partially or totally obstruct nasal respiration causing snoring, hyponasal speech forcing the child for mouth breathing and nasal discharge and postnasal drip due to sinusitis.<sup>(16)</sup>

Some authors have stressed the importance of adenoidal enlargement as a primary cause of mouth breathing.<sup>(17–19)</sup> Many studies reported that there is a significant correlation between adenoids and mouth breathing due to the fact that the hypertrophied adenoids occlude the posterior nasopharyngeal breathing space leading to mouth breathing.<sup>(20–22)</sup> Other studies demonstrated a possible association between airway obstruction and subsequently mouth breathing to undesirable variations in dentofacial form.<sup>(23–33)</sup>

On the other hand, Wenzel *et al.*<sup>(34)</sup> noticed no association between mouth breathing and occlusal abnormalities and suggest that such abnormalities have many reasons beyond this habit.

The objective of the present study is to investigate the possible association between nasopharyngeal airway inadequacy due to enlarged adenoid and dentoalveolar characteristics in subjects 3–17 years old in Mosul City.

## MATERIALS AND METHODS

The study subjects were randomly selected from a group of patients who admitted to Ear, Nose and Throat (ENT) Department at Al-Zahrawi Teaching Hospital in Mosul City and indicated for adenoidectomy to relieve severe nasal obstruction; 24 patients (12 males and 12 females) aged 3–17 years.

The sample was assessed by otolaryngologist and oral surgeon. None underwent orthopedic, orthodontic treatment or orthognathic surgery.

Information obtained from the patients included list of questionnaires, sex, age, ENT section (which include: attack of tonsillitis/ year, history of snoring, oral breathing, difficulty in eating or swallowing, grade of obstruction, enlargement of tonsils, nasal mucoal swelling, asthma and perenial rhinitis), dental section (which include: information about the presence or absence of anterior open bite, posterior cross bite, anterior teeth crowding, lip incompetence, in addition to Angle's classification of malocclusion).

Also an assessment of the size of adenoids (post-nasal space) on lateral cephalometric radiograph with a 5-feet focal spot film with neutral position of the head was taken.<sup>(35)</sup> The clinical impression on the radiography was scored by assessing the adenoid shadow used by Jorma<sup>(36)</sup> in his study for adenoid in children. He divided the size of adenoid as follows:

**I (small):** If adenoid shadow obstructing less than 1/3 of the postnasal airway.

**II (medium):** Less than 2/3 of postnasal airway obstructed by adenoid shadow.

**III (large):** If the adenoid shadow obstructing more than 2/3 of post-nasal airway.

Descriptive statistics including mean and standard deviation of variables for total sample with comparison between males and females were calculated. Pearson correlation coefficient (*r*) of variables for total sample with comparison between males and females was carried out to show any statistically significant association between the tested variables. The value of “*r*” is described as significant at the level  $p \leq 0.05$ , and highly significant at the level  $p \leq 0.01$ .

**RESULTS**

The mean and standard deviation of variables for total sample with comparison between males and females were presented in Table (1) and the Figure. For the ENT section, there was a significant sex difference (at  $p \leq 0.05$ ) with the males having higher incidence of difficulty in eating, nasal mucosal swelling and size of adenoids (x-ray). While the females having higher incidence of attack of tonsillitis/year, snoring, oral breathing, tonsillar enlargement and history of asthma.

Considering the dental section, a significant sex difference was found (at  $p \leq 0.05$ ) with the males having higher incidence of anterior deep bite and anterior crowding. While the females having higher incidence of posterior cross bite, lip incompetence and Angle's classification of malocclusion.

Table (2) showed the correlation matrix of all the variables for total sample with comparison between the two sexes. Correlation is considered significant at  $p \leq 0.05$  and highly significant at  $p \leq 0.01$ .

Table (1): Mean and standard deviation of variables for total sample with comparison between males and females

	Variable	Mean	± SD	Sex	Mean	± SD	t-value	Significance
Ear, Nose and Throat Section	Age	8.875	4.384	M	7.6667	3.359	7.351	S
				F	10.083	5.072		
	Attack of Tonsillitis	11.916	6.626	M	11.083	6.515	14.300	S
				F	12.750	6.917		
	Snoring	0.75	0.442	M	0.667	0.492	9.004	S
				F	0.833	0.389		
	Oral Breathing	0.708	0.464	M	0.750	0.452	17.07	S
				F	0.667	0.492		
	Grade of Obstruction	1.333	0.482	M	1.333	0.492	0.000	NS
				F	1.333	0.492		
	Difficulty in Eating	0.625	0.495	M	0.750	0.452	5.000	S
F				0.500	0.522			
Tonsillar Enlargement	0.833	0.381	M	0.750	0.452	9.998	S	
			F	0.917	0.289			
Nasal Mucosal Swelling	0.375	0.495	M	0.500	0.532	3.000	S	
			F	0.250	0.452			
Asthma	0.125	0.338	M	0.167	0.389	1.041	S	
			F	0.083	0.289			
Adenoids (x-ray)	0.375	0.495	M	0.417	0.515	8.993	S	
			F	0.333	0.492			
Dental Section	Anterior Deep Bite	4.167	0.204	M	8.333	0.289	1.000	S
				F	0.000	0.000 <sup>(a)</sup>		
	Anterior Open Bite	0.5	0.511	M	0.500	0.522	0.000	NS
				F	0.500	0.522		
	Posterior Cross Bite	0.333	0.482	M	0.250	0.452	3.999	S
				F	0.417	0.515		
	Anterior Crowding	0.375	0.495	M	0.417	0.515	8.993	S
F				0.333	0.492			
Lip Incompetence	0.583	0.504	M	0.500	0.522	6.999	S	
			F	0.667	0.492			
Angle's Classification	1.25	0.442	M	1.083	0.289	7.499	S	
			F	1.417	0.515			

M: Males (n=12); F: Females (n=12); SD: Standard deviation.

NS= Not significant; S= Significant at  $p \leq 0.05$ .

(a) Can not be computed because the standard deviation is zero.

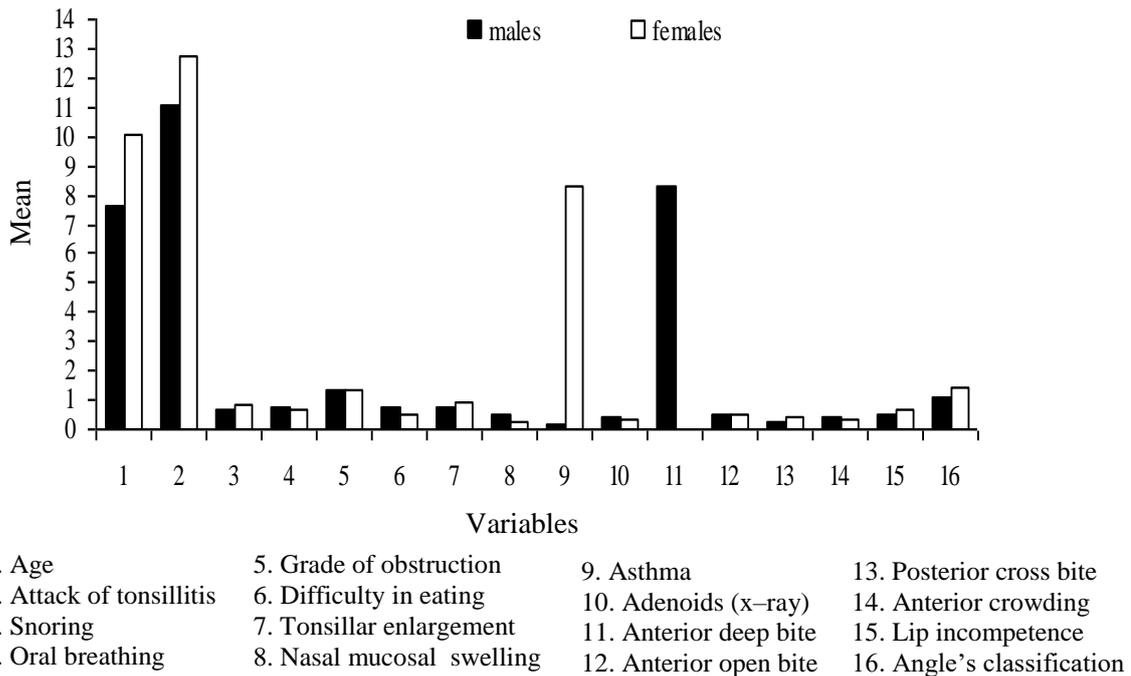


Figure: The comparison of the mean between males and females for different variables

**DISCUSSION**

The results of this study must be interpreted with the realization that this sample comprises a wide spectrum of developmental stages of dental occlusion (3–17years).

In view of the difference between girls and boys, a significant sex difference has been found for the following variables: Difficulty in eating, nasal mucosal swelling and size of adenoids (x-ray), with the males having higher value. Whereas the females having higher incidence of attack of tonsillitis/year, snoring, oral breathing, tonsillar enlargement and history of asthma.

For dental parameters, the males have significant higher incidence of anterior deep bite and anterior crowding. While the females having significant higher incidence of posterior cross bite, lip incompetence and more tendencies toward Class II Angle's classification of malocclusion. Mouth breathing is believed to be primary factor in developing Class II division 1 malocclusion.<sup>(23)</sup> Ung *et al.*<sup>(24)</sup> Found weak tendency among mouth breathers towards Class II division 1 malocclusion. Linder-Aronson<sup>(37)</sup> stated that there is a normal

anteroposterior relationship between upper and lower jaws in adenoid children.

The females having significant higher incidence of posterior cross bite. This is in accordance with Limme<sup>(27)</sup> and Oulis *et al.*<sup>(31)</sup>

Many investigators<sup>(4, 34)</sup> have demonstrated relationships between atopy and dentofacial growth.

Regarding the relation between nasopharyngeal airway inadequacy and dentofacial growth, including development of occlusion, there is a positive correlation between attack of tonsillitis and difficulty in eating; snoring and oral breathing and tonsillar enlargement. Several authors have stressed the importance of adenoidal enlargement as a primary cause of mouth breathing.<sup>(17–19)</sup> Many studies<sup>(20–22)</sup> reported that there is a significant correlation between adenoids and mouth breathing due to the fact that the hypertrophied adenoids occlude the posterior nasopharyngeal breathing space leading to mouth breathing. There is no doubt that large adenoid partially or totally obstruct the nasal respiration causing snoring, hyponasal speech forcing the child for mouth breathing, nasal discharge and post-nasal drip due to sinusitis.<sup>(16)</sup>

Table (2): Pearson correlation coefficient of variables for total sample with comparison between males and females

Variable	Sex	1	2	3	4	5	6	7	8
1	M								.811**
	F			-.729**				-.74**	
	T			-.465*					
2	M								
	F						-.843**		
	T						-.448*		
3	M				.816**				
	F	-.729**							
	T	-.465*			.476*			.672*	
4	M			.816**					-.557*
	F								
	T			.476*					
5	M								
	F								
	T								
6	M								
	F		-.843**						
	T		.448*						
7	M								.577*
	F	-.74**		.674*					
	T								
8	M				-.557*			.577*	
	F								
	T								
9	M	.811**		-.632*					
	F								
	T								.467*
10	M								.674*
	F								
	T								
11	M	.781*							
	F								
	T							-.466*	
12	M								
	F	.051**							
	T								
13	M								
	F								
	T						-.548**		
14	M								
	F	.666*				.625*			
	T								
15	M								
	F								
	T								
16	M								
	F								
	T								

To be continued.....

*Orthodontic consequences of adenoids*

Variable	Sex	9	10	11	12	13	14	15	16
1	M	.811**		.781**			.666*		
	F				.051**				
	T								
2	M								
	F								
	T								
3	M	-.632*							
	F								
	T								
4	M								
	F								
	T								
5	M						.625*		
	F								
	T								
6	M								
	F								
	T					-.548**			
7	M								
	F								
	T				-.466*				
8	M				.674*				
	F								
	T		.467*						
9	M				.607*				
	F								
	T				.552**				
10	M						.666*		
	F								
	T					-.598*			
11	M	.607*							
	F								
	T	.552**							
12	M								
	F								
	T								
13	M								
	F								
	T		-.598*						
14	M								
	F								
	T								
15	M								
	F								.598*
	T								.488*
16	M								
	F							.598*	
	T							.488*	

M: Males (n=12); F: Females (n=12).

\*Correlation is significant at the level  $p \leq 0.05$ .

\*\* Correlation is highly significant at the level  $p \leq 0.01$ .

- |                          |                           |                        |                            |
|--------------------------|---------------------------|------------------------|----------------------------|
| 1. Age                   | 5. Grade of obstruction   | 9. Asthma              | 13. Posterior cross bite   |
| 2. Attack of tonsillitis | 6. Difficulty in eating   | 10. Adenoids (x-ray)   | 14. Anterior crowding      |
| 3. Snoring               | 7. Tonsillar enlargement  | 11. Anterior deep bite | 15. Lip incompetence       |
| 4. Oral breathing        | 8. Nasal mucosal swelling | 12. Anterior open bite | 16. Angle's classification |

The most important finding of this study is that a significant positive correlation (at 0.05 level) existed between the grade of obstruction, adenoid in x-ray and the anterior dental crowding. This is in accordance with Linder-Aronson *et al.*,<sup>(2)</sup> and Woodside *et al.*<sup>(3)</sup> Several investigators<sup>(39)</sup> found that adenoidectomy and changed mode of breathing are associated with significant labial positioning of incisor teeth in both jaws during 5 years after surgery. Linder-Aronson<sup>(40)</sup> reported that maxillary and mandibular incisors changed from retroclined to a proclined position during the first year after adenoidectomy, implying an environmental changes in tooth position. Woodside *et al.*<sup>(3)</sup> found that mandibular incisors were statistically very significant and more crowded in group with nasal airway obstruction than in controls.

In contrast, Hannuksela and Vaananen<sup>(38)</sup> reported no significant mandibular incisor crowding.

A negative correlation was found between tonsillar enlargement and anterior deep bite, a positive significant correlation was found between nasal mucosal swelling and anterior deep bite and a positive correlation was found between asthma, perennial rhinitis and anterior deep bite. This comes in agreement with Bauman and Plinkert,<sup>(22)</sup> Shapira<sup>(41)</sup> who showed a correlation between obstructed nasal breathing, large adenoids and vertical growth pattern of the face. Also other authors<sup>(4, 24, 26-29)</sup> found that mouth breathing is associated with increased anterior facial height. The increase in anterior facial height in adenoid children is due to dorsal rotation of mandible caused by soft tissue stretching.<sup>(17)</sup> Principato<sup>(30)</sup> found that the increase in anterior facial height is due to excessive molar tooth eruption and consequently a clockwise rotation of the growing mandible. Takashi and Ishiwata,<sup>(42)</sup> in their experimental study, suggested that the elevator muscle, masseter, electromyographic activity is inhibited during oral respiration.

### CONCLUSIONS

A significant correlation existed between nasopharyngeal airway inadequa-

cy due to enlarged adenoid and some dental-alveolar characteristics.

Females had high incidence of tonsillar enlargement than males.

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