Oral health status, salivary physical properties and salivary Mutans Streptococci among a group of mouth breathing patients in comparison to nose breathing

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ABSTRACT

Background: Mouth breathing can lead to introduce cold, dry unprepared air that insults the tissue of oral cavity, nasopharynx and lung, leading in turn to pathological changes in oronasal cavity, nasopharyngeal and other respiratory tissue, mouth breathing associated with nasal obstruction may lead to many health problems, in particular oral health problems such as inflammation of gingiva, oral dryness, change in oral environment that may decrease pH, salivary flow rate and increase bacteria and dental caries.Aims of the present study were to assess the oral health condition among mouth breather associated with nasal obstruction, including dental caries, oral cleanliness and gingival health condition as well as to evaluate the changes in salivary physical characteristics and salivary mutans streptococci counts, and their relation to oral variables in comparison to a control group.

Materials and Methods: Thirty patients with mouth breathing associated with nasal obstruction (15 females and 15 males) were selected as a study group with an age range (18-22) years old, all subjects were examined by ENT specialist to confirm mouth breathing. A 30 gender and age matched healthy looking subjects without nasal obstruction were selected as control. The diagnosis and recording of dental caries was according to severity of dental caries lesion through the application of D_{1_4}MFS(Manji et al., 1989). Plaque index of (Silness and Loe, 1964) was used for plaque assessment; gingival index of (Loe and Silness, 1963) was used for gingival health condition assessment. Stimulated salivary samples were collected according to (Tenovuo and Lagerlof, 1996) and the following variables were recorded: microbiological analysis included the salivary counts of mutans streptococci, salivary flow rate, salivary pH (potential of hydrogen) and then measurement of salivary viscosity by using Ostwald's viscometer.

Results: Results of the present study showed that the mouth breathing group had statistically highly significant, higher plaque and gingival indices than nose breathing group (P<0.01) with a positive highly significant correlation between them in mouth breathing and nose breathing groups (r=0.56, r= 0.64, respectively).The salivary flow rate was lower among mouth breathing with highly significant difference than nose breathing (P<0.01), also salivary pH was lower among mouth breathing but with significant differencecompare to nose breathing (P<0.05); statistically a negative highly significant correlation was recorded among mouth breathing group between salivary flow rate with gingival index (r= -0.56). It has been found that salivary viscosity was not statistically significant difference between mouth breathing group and nose breathing group. The salivary viscosity was found to be inversely significantly correlated with salivary flow rate among mouth breathing group (r= -0.38). While it was positively not significantly correlated with plaque index, gingival index and counts of mutans streptococci among mouth breathing group. Data analysis of the present study showed that salivary mutans streptococci counts among mouth breathing group were higher than that among nose breathing group, difference was statistically highly significant (P<0.01).

Conclusion: Mouth breathing associated with nasal obstruction may have an effect on oral health status, leading to an increase in periodontal disease and changes in dental caries.

Key words: Mouth breathing, nasal breathing, saliva (pH, flow rate, viscosity), salivary mutans streptococcus, oral diseases. (J Bagh Coll Dentistry 2013; 25(Special Issue 1):152-159).

INTRODUCTION

Nasal breathing is the primary mode of air intake for the human, and it is essential for supply of properly cleansed, moistened and warmed air for lung. The mouth is only secondary emergency orifice for assuring an uninterrupted supply of air [(1,2)]. Mouth breathing is an unnatural act of necessity to get air into the lungs when the primary air way is blocked by nasal, nasaopharyngeal such as enlarged adenoids, enlarged tonsils, rhinitis, nasal septal deviation, sinusitis, turbinate hypertrophy and nasal polyp.

The individual which has nasal obstruction is suffering from dryness usually result from open mouth sleeping, the mouth breathing lead to increase lip separation and decrease upper lip coverage at rest were all associated with higher levels of plaque and gingival inflammation [(3-5)].

The vast majority of health care professionals are unaware of the negative impact of upper airway obstruction (mouth breathing) on normal facial growth and physiologic health. Children whose mouth breathing is untreated may develop long, narrow faces, narrow mouths, dental malocclusion, gummy smiles and other oral health problems. These children do not sleep well at night due to obstructed airways; this lack of sleep can adversely affect their growth and academic performance.It is important for the entire health

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care community (including general and pediatric dentists) to screen and diagnose for mouth breathing in adults and in children. If mouth breathing is treated early, its negative effect on facial, dental development, oral health status and the medical and social problems associated with it can be reduced or averted [6,7,8] "The secretions of the salivary glands are of paramount importance for the maintenance of oral health" [9].

The Mutans streptococcal group is considered to be a major etiologic agent in the pathogenesis of dental caries [10-12]. However, saliva helps to control invasion of the mouth by microorganisms, and lack of saliva results in increased numbers of bacteria in the mouth [13].

Salivary flow provides mechanical cleansing of the residues present in the mouth such as non adherent bacteria, cellular and food debris. Thus, lack of mechanical salivary flushing results in accumulation of food debris and dental plaque, thereby promoting an aciduric and acidogenic oral microflora that promotes the development of caries [10,12,14]. Saliva possesses specific rheological properties (viscosity and elasticity) as a result of its chemical, physical and biological characteristics, these properties being essential for maintaining balanced conditions within the oral cavity. There is controversy in relation between salivary viscosity and oral disease such as dental caries and periodontitis [15,16]

The complaint of oral dryness is very common in mouth breathers, and normally this symptom is associated with diminution of salivary flow rates. However, in the specific case of the mouth breathers, the cause of xerostomia may be simply oral desiccation [17,18]. When subject breathe through the mouth, there is loss of saliva and dryness of the mouth and this can increase the risk of tooth decay and inflammation of the gingiva. Also mouth breathing can lead to alterations in the jaw and facial growth [7,19].

MATERIALS AND METHODS

The study group

In the present study, the study group composed of thirty patients (15 females and 15 males) with an age range (18- 22) years according to the last birthday [20]. They were selected from patients attending theConsultation clinical of ear, nose, throat and the Specialized Surgeries Hospital in Baghdad city for their treatment, all selected patients were mouth breathing for at least 2 years.

The control group

The control group composed of thirty subjects (15 females and 15 males) with an age range (18- 22) years, were selected from dental student in Dentistry Collage, University of Baghdad.Those subjects were examined by Simple method used to select nose breathers was demonstrated [21] a small cotton wisp was held in front of each nostril of all the individuals. No movement of cotton wisp when held in front of the nose indicated mouth breathing. Individual showing movement of cotton wisp when held in front of the nose indicated normal nasal breathing; the latter is included in control group.

Clinical examination:

ENT examination

Each individual was examined by an ENT specialist to include or exclude the presence of any nasal obstruction and this was assisted by radiography and nasal endoscope if there is need to diagnose if there is polyp or any septal deviation.

Oral health examination

Oral examination was carried out under standardized conditions according to the basic methods of oral health surveys of World Health Organization [22] that the subject was seated on a straight chair with tall back on which the head was rested. The diagnosis and recording of dental caries was according to severity of dental caries lesion through the application of D_{14} MFS [23]. Plaque index of Silness and Loe [24] was used for plaque assessment; gingival index of Loe and Silness[25] was used for gingival health condition assessment.

Collection of salivary samples and procedure:

The collection of stimulated salivary samples was performed under standard condition following instruction cited by Tenovuo and Lagerlof [26]:

- The patient should not eat or drink except water one hour before collection.
- A pre sampling period one minute is recorded.
- The patient should not smoke or undergo heavy physical stress before collection.
- A fixed collection time (In this study was from 8-11 AM).
- The patient should sit in a relaxed position.
- Samples containing blood should be discarded if chemical analysis of saliva is planned.
- Acute illness or chronic diseases as well as medication should be considered.

Each individual was asked to chew apiece of Arabic gum (0.5-0.7) gm for one minute, then removed all saliva by expectoration, after that chewing was continued for ten minutes with the same piece of gum and saliva collected in a sterile screw capped bottle. Salivary volume was estimated and rate of secretion was expressed as milliliter per minute (ml/min). After collection and disappearance of salivary foam, 0.1 ml of saliva was transferred to 9.9 ml of sterile normal

saline (pH 7.0).Tenfold serial dilutions were prepared usingnormal saline. Two dilutions were selected for each microbial type and inoculated on the following culture media: MSB Agar (The selective media formutans streptococci) 0.1ml was withdrawn fromdilutions (10^{-2}, 10^{-4}) and then spread in duplicate by using sterile microbiological spreader on the plates of MSB agar then the plates wereincubated anaerobically using a gas pack for 48 hr. at 37°C then incubated aerobically for 24 hr. at room temperature[27]. Following incubation, colonies were identified andcounted by the use of the colony counter. The number of colonies was recorded taking in consideration the dilutions factor, and expressed as colony forming unit per ml saliva i.e. CFU/ml saliva [12].Also within less than 15 minutes, the pH of the saliva was measured using a digital pH meter.

Then measure the viscosity of saliva by Ostwald viscometer[28,29](Figure1). The Ostwald method is a simple and available method for the measurement of viscosity, in which viscosity of liquid is measured by comparing the viscosity of an unknown liquid with that of liquid whose viscosity is known. In this method viscosity of liquid is measured by comparing the flow times of two liquids of equal volumes using same viscometer. Consider two liquids are passing through a capillary of same viscometer. Then the coefficient of viscosity of liquid (η_2) is given by equation:

$\eta_1 / \eta_2 = \rho_1 t_1 / \rho_2 t_2$ *(unit of viscosity is poise)*

η_1 = coefficient of viscosity water equal 0.008904 poise at 25 C^{0}[30].

η_2 = viscosity of saliva.

ρ_1 =density of distilled water gm/cm^3 .

t_1 = time to pass the distilled water in second.

ρ_2 = density of saliva sample.

t_2 = time to pass the saliva in second.

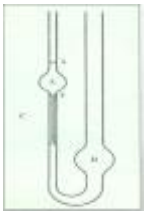

Figure 1

RESULTS

Table 1 illustrates the mean values in addition to standard deviations of plaque and gingival indices among the mouth breathing and nose breathing groups. Clinical oral examination revealed highest mean values of Plaque Index among the mouth breathing group compared to nose breathing group with statistically high significance difference (t= 7.72, P<0.01, df= 58).

Values grades of DS (D_1, D_2, D_3, D_4) (Mean and Standard Deviation) among mouth breathing and nose breathing groups are presented in Table 2. For both mouth breathing and nose breathing groups including males and females. It was found that presence of higher**D_1**mean values among nose breathing group compared with mouth breathing group with no statistically significant difference between them (t= 0.58, P>0.05, df=58) while for **D_2**, **D_3**, **D_4**mean values, it was found higher in mouth breathing group in comparing to nose breathing group with also no significant difference between them (P>0.05, df=58). Clinical oral examination revealed higher mean values of **DS** among the mouth breathing group compared to nose breathing group with statistically no significant difference (t=1.80, P>0.05, df=58).

Table 3 illustrates the mean values in addition to standard deviations of Salivary Flow Rate and Salivary pH among the mouth breathing and nose breathing groups. The mean values of salivary flow rate was found lowest in mouth breathing group with statistically highly significant difference in compared to nose breathing group (t= 4.06, P<0.01, df=58). Salivary pH mean values was found lower in mouth breathing group with significant difference in compared to mouth breathing group (t= 2.40, P<0.05, df=58). Table 4 illustrates the mean values in addition to standard deviations of salivary viscosity among the mouth breathing and nose breathing groups. Result showed that no statistically significant difference in salivary viscosity between both groups (t=0.57, P>0.05, df= 58).

Table 5 shows the mean and standard deviation counts of salivary mutans streptococci among the mouth breathing and nose breathing groups. Mean counts of salivary mutans streptococci was found highest in mouth breathing group with statistically highly significant difference in compared to nose breathing group (t= 7.099, P<0.01, df=58).

Table 6 illustrates the correlation coefficient of Plaque Index in relation to Gingival Index among mouth breathing and nose breathing groups. Results revealed that there is a positive highly significant relation found between Plaque Index with gingival inflammation in the mouth breathing group also there is a positive highly significant correlation was found between them in the nose breathing group.

Table 7 illustrates the correlation coefficient of gingival index in relation to salivary flow rate among mouth breathing and nose breathing groups. Among the mouth breathing group, statistical results revealed that there is a negative highly significant relation found between gingival inflammation with salivary flow rate.

Table 8 demonstrates the correlation coefficient of salivary viscosity in relation to salivary flow rate among mouth breathing and nose breathing groups. Among the mouth breathing group, statistical results revealed that there is a negative significant relation found between salivary viscosity with salivary flow rate. Regarding data analysis in each gender, revealed that no significant difference in salivary viscosity between two gender among both groups ($P > 0.05$, df= 28).

DISCUSSION

Dental plaque was reported to be the main etiological factor for periodontal diseases [31,32]. In order to provide precise evidence of the relationship between the amount of plaque and gingival inflammation the gingival index of Löe and Silness[25] was used to assess the gingival condition together with plaque index of Silness and Löe[24]. These two are widely used in both epidemiological and controlled studies due to their ease, validity and feasibility, as well as they allow the assessment of the state by severity [33].In present study, the higher mean values of Gingival Index among mouth breathing group may be attributed to the higher mean values of Plaque Index (1.15 ± 0.36) that recorded among mouth breathing group with high significance difference compared to nose breathing group (0.52 ± 0.26) this finding is in agreement with other studies that found increase gingivitis among mouth breathing [5,34-37] .The present study revealed that higher plI and GI with mouth breathing than control this may be attributed to **l**ower salivary flow rate among mouth breathing group with statistically highly significant, the result can be explained by that the salivary flow rate may play an important role in relation to plaque accumulation since decrease of salivary flow rate lead to decrease of washing action of saliva and oral dryness as well as protective constituents decreased with decreased flow rate [38] so the plaque accumulation increased and this confirmed by the result of the present study which showed negative not significant correlation of salivary flow rate with plaque index and highly significant in negative direction with gingival index among mouth breathinggroup. In the group of mouth breathers may retain a greater amount of bacteria in their oral cavities due to evaporation of water from the saliva constant mouth breathers that can reach 0.24 ml/min [39] .This can make the clearance and bacterial aggregation product by mucin MG2 more difficult [40].

In the present study revealed that mean values caries experience represented DS components among mouth breathing group was higher than control group with no significant difference. Further data analysis concerning grades of DS showed that the caries lesion severity represented by D_2, D_3 and D_4 were higher among mouth breathing group than control group with no significant difference. This may be attributed to many findings that illustrated by the data of the present study, these include: higher mutans streptococci among mouth breathing than nose breathing with highly significant differences. Streptococcus mutans is considered a major cariogenic bacterium[10,12]. ; Lower pH mean value among mouth breathing than nose breathing with significant differences. Saliva with a low PH provides a suitable environment for acidogenic bacteria, cariogenic bacteria tolerate very low PH by producing lactic acid as a byproduct of carbohydrate metabolism[41], during low PH calcium and phosphorus are liberated from the enamel to the biofilm. ; Lower flow rate among mouth breathing than nose breathing with highly significant difference between them. Saliva flow rate has an important role to protective teeth against dental caries. There are previous studies reported that increase levels of dental caries due to related to decrease flow rate [16].

The decrease pH level among mouth breathing group may be attributed to the results of the present study showed that: Higher mean of mutans streptococcus counts with highly significant differences among mouth breathing group than nose breathing, A negative correlation between pH and mutans streptococcus counts among mouth breathing group, the results can be explained by that the mutans streptococcus may play an important role in acid production this lead to decrease in pH. And decrease pH among mouth breathing due to the decrease salivary flow rate among mouth breathing, this can be explained by salivary pH varies in accordance with the SFR, from 5.3 low SFR to 7.8 (peak SFR), at low SFR lead to lower bicarbonate, thus decrease pH[42,43,44].The lower in the salivary pH within mouth breathing may be attributed to other factors conducted by other studies: Weiler et al. [19] found higher level of free sliaic acid among mouth breathing group is indicative of an increase number of bacteria in saliva this will lead to decrease of pH as in the present study. Flutter, [45] found that relation between reduce CO_2 among mouth breathing group with pH. Mouth breathing lead to reduce CO_2 content in alveoli of the lungs (hypocapnia). CO_2 is the most important factor in controlling pH by buffering with bicarbonate or carbonic acid.

The present study showed a lowest mean salivary flow rate among mouth breathing compared to nose breathing group with highly significant difference this finding is in agreement with Lida et al, while it is disagreement with others [47,48,19]. The decrease flow rate among mouth breathing may be due to the complaint of oral dryness is very common in mouth breathers, and normally this symptom is associated with diminution of salivary flow rates, also lower salivary clearance in mouth breathers due to great evaporation of saliva[17,18].

The present study results showed that statistically no significant difference regarding salivary viscosity between mouth breathing and nose breathing. This may be attributed to viscosity of saliva depended greatly on the method of stimulation (acid or mechanical) [49], so Van der Reijden et al. [50,51]have observed different viscoelastic properties for the saliva excreted from different glands within the oral cavity, since submandibular/sublingual saliva contains much higher concentrations of mucins and glycoproteins than does parotid saliva, also saliva containing mucins of different conformation, molecular weight and concentration.Concerning gender differences in the current study, results revealed no significant differences between gender among both groups this is in accordance with Briedis et al. and Rantonen,[52,53] who found that no statistically significant differences between genders in salivary viscosities, and gender did not affect the within-subject variation of salivary viscosities.

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Table 1: Plaque Index and Gingival Index (Mean and Standard Deviation) among Mouth breathing and Nose breathing groups.

Variable	Gender	Mouth breathing	Nose breathing	Statistic test	
		Mean ± SD	Mean ± SD	t-test	P-value
PlI	M	1.26 ± 0.45	0.58 ± 0.24	5.27**	0.000
	F	1.03 ± 0.22	0.47 ± 0.27	6.31**	0.000
	T	1.15 ± 0.36	0.52 ± 0.26	7.72**	0.000
GI	M	1.06 ± 0.27	0.32 ± 0.098	10.19**	0.000
	F	0.98 ± 0.25	0.40 ± 0.33	5.50**	0.000
	T	1.02 ± 0.26	0.36 ± 0.24	10.36**	0.000

**** Highly significant P < 0.01**

Table 2: Grades of DS (D_1, D_2, D_3, D_4) (Mean and Standard Deviation) among Mouth breathing and Nose breathing groups.

DS Grades	Gender	Mouth breathing	Nose breathing	Statistic test	
		Mean ± SD	Mean ± SD	t-test	p-value
D_1	M	1.40 ± 1.595	1.73 ± 1.34	0.62	0.54
	F	1.60 ± 1.24	1.67 ± 1.23	0.15	0.88
	T	1.50 ± 1.41	1.70 ± 1.26	0.58	o.57
D_2	M	3.87 ± 2.997	2.60 ± 2.098	1.34	0.19
	F	4.67 ± 3.44	3.87 ± 2.59	0.72	0.48
	T	4.27 ± 3.19	3.23 ± 2.40	1.42	0.16
D_3	M	0.47 ± 0.83	0.20 ± 0.56	1.03	0.31
	F	0.73 ± 1.44	0.20 ± 0.41	1.38	0.18
	T	0.60 ± 1.16	0.20 ± 0.48	1.74	0.08
D_4	M	0.33 ± 1.29	0.00 ± 0.00	1.00	0.33
	F	0.00 ± 0.00	0.00 ± 0.00	-------	-------
	T	0.17 ± 0.91	0.00 ± 0.00	1.00	0.32
DS	M	6.07 ± 3.41	4.53 ± 2.59	1.39	0.18
	F	7.00 ± 3.27	5.73 ± 2.69	1.16	0.26
	T	6.53 ± 3.32	5.13 ± 2.66	1.80	0.07

Table 3: The Salivary Flow Rate (ml\min) and Salivary pH (Mean and Standard Deviation) among Mouth breathing and Nose breathing groups.

Variables	Gender	Mouth breathing	Nose breathing	Statistic test	
		Mean ± SD	Mean ± SD	t-test	p-value
Salivary flow rate	M	0.77 ± 0.42	1.47 ± 1.22	2.12*	0.04
	F	0.65 ± 0.41	1.43 ± 0.46	4.88**	0.000
	T	0.71 ± 0.41	1.45 ± 0.91	4.06**	0.000
Salivary pH	M	6.94 ± 0.57	7.34 ± 0.34	2.31*	0.03
	F	6.42 ± 1.65	7.17 ± 0.41	1.699	0.10
	T	6.68 ± 1.24	7.25 ± 0.38	2.40*	0.02

***Significant P<0.05 ** Highly significant P < 0.01**

Table 4: The Salivary Viscosity (poise) (Mean and Standard Deviation 10^{-3}) among Mouth breathing and Nose breathing groups.

Variable	Gender	Mouth breathing	Nose breathing	Statistic test	
		Mean ± SD	Mean ± SD	t-test	p-value
#Salivary viscosity	M	13.07 ± 1.75	12.87 ± 1.72	0.32	0.76
	F	13.93 ± 2.46	14.93 ± 3.97	0.83	0.41
	T	13.50 ± 2.15	13.90 ± 3.19	0.57	0.57

#The values expressed by 10^{-3}

Table 5: Count of Salivary Mutans Streptococci (Mean and Standard Deviation) among Mouth breathing and Nose breathing groups.

Variable	Gender	Mouth breathing	Nose breathing	Statistic test	
		Mean ± SD	Mean ± SD	t-test	p-value
#Mutans Strep.	M	20.81 ± 13.03	4.98 ± 2.45	4.62**	0.000
	F	18.53 ± 7.74	5.05 ± 5.11	5.63**	0.000
	T	19.67 ± 10.60	5.02 ± 3.94	7.099**	0.000

#The values expressed by 10^7 CFU/ml of saliva. ** Highly significant P < 0.01

Table 6: Correlation Coefficient between Plaque Index with Gingival Index among Mouth breathing and Nose breathing groups.

Groups	Variable	GI	
		R	P
Mouth breathing	PlI	0.56**	0.001
Nose breathing	PlI	0.64**	0.000

**** Highly significant P < 0.01**

Table 7: Correlation Coefficient between Gingival Index with Salivary Flow Rate among Mouth breathing and Nose breathing groups.

Groups	Variable	SFR	
		R	P
Mouth breathing	GI	-0.56**	0.001
Nose breathing	GI	-0.06	0.75

** Highly significant P < 0.01

Table 8: Correlation Coefficient between Salivary Viscosity with Salivary Flow Rate among Mouth breathing and Nose breathing groups.

Groups	Variable	SFR	
		r	P
Mouth breathing	Viscosity	-0.38*	0.04
Nose breathing	Viscosity	-0.20	0.29

* Significant P<0.05