

# Oral findings as predictors of obstructive sleep apnea- A case-control study

Asifa Ashraf, Ipseeta Menon, Ritu Gupta, Vikram Arora, Iram Ahsan, Dipshikha Das

Department of Public Health Dentistry, I.T.S Centre for Dental Studies and Research, Ghaziabad, Uttar Pradesh, India

## ABSTRACT

**Objective:** To evaluate the role of dental parameters that may contribute to increasing apneic activity in patients with or without obstructive sleep apnea (OSA). **Materials and Method:** The study comprises a total of 120 patients (60 diagnosed with sleep apnea visiting a sleep center at Delhi and 60 controls). Patients were assessed based on body mass index, age, neck circumference, and gender (BANG), which were recorded for both the patients and controls. Oral and general examination was carried out using predetermined criteria for Angle's class of malocclusion, maxillary arch constriction, facial profile, Mallampati score for uvula, tongue size, depth of palatal vault, mouth breathing, and periodontitis. **Results:** Among 120 study subjects, 92 were males and 28 females, with a mean age of 49.08 + 13.13 years in the study group and 45.28 + 14.78 years in the control group. All the variables except Angle's class of malocclusion, periodontitis, mouth breathing, and hypertension showed significant differences in the study group. Multivariate analysis for patients with OSA revealed that obese patients were almost 1.5 times more possibly to report OSA symptoms than their non-obese counterparts. It was also found that patients with OSA were 4.12 times more likely to have neck circumference >40 cm, 2.25 times more likely to have maxillary arch constriction, 1.43 times deeper palatal vault, 8.7 times macroglossia, and 1.7 times class III & IV Mallampati score for uvula. **Conclusion:** The oral structural findings appear to be more closely related with OSA.

**Keywords:** Neck circumference, obstructive sleep apnea, polysomnography, sleep-disordered breathing, tongue size

## Introduction

Dental sleep medicine plays a vital role in encountering sleep disorders and helps in treating this under-diagnosed epidemic that comprises many aspects of human health.<sup>[1]</sup> Sleep disorder breathing (SDB) encloses a heterogeneous group of sleep disorders that are distinguished by abnormal pauses while breathing during sleep. There are two major types of SDB: obstructive sleep apnea (OSA), and central sleep apnea (CSA).<sup>[2]</sup>

OSA is a sleep disorder in which breathing is interrupted during sleep. The term "apnea" refers to a breathing pause that lasts for 10 s. OSA occurs when the muscles that support the soft tissues in the back of the throat, such as the tongue and soft palate, relax and fail to keep the airway open, despite efforts to breathe. CSA is another form of sleep apnea in which the brain fails to properly control breathing during sleep. OSA can cause fragmented sleep and low blood oxygen levels.<sup>[3]</sup>

**Address for correspondence:** Dr. Asifa Ashraf,  
Department of Public Health Dentistry, I.T.S Centre for Dental  
Studies and Research, Delhi-Meerut Road, Muradnagar,  
Ghaziabad - 201206, Uttar Pradesh, India.  
E-mail: asifaashraf515@gmail.com

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Dental sleep medicine has become more apparent and deals with these sleep disorders by providing treatment with oral appliances.<sup>[4]</sup> There are a number of factors that increase risk, including having a small upper airway, being overweight, having a recessed chin, small jaw, or a large overbite.<sup>[5]</sup>

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From an anatomic perspective, there are some risk factors correlated with OSA, which include macroglossia, micrognathia,<sup>[6]</sup> increased soft palate size,<sup>[6-8]</sup> retropositioned mandible,<sup>[6]</sup> and increased uvula size<sup>[6,8,9]</sup>

Dentists play an important part in the identification of the signs and symptoms of OSA and its management. Thus, the study aims to determine the oral findings in patients with OSA and investigate the factors associated with the risk of OSA and compare their oral findings with matched controls, that is, patients without OSA.

## Materials and Methods

The comparative study was conducted among the patients with or without OSA visiting a sleep center in Delhi to assess the role of dental variables that may contribute to increasing the apneic issues. The study protocol was approved by the institutional ethical and review committee board. Written informed consent was obtained from all the study participants after explaining the purpose of the research.

A total of 120 dentate individuals without any acute oral infections were included in the study. Among these 120 patients, 60 were included in the study group (i.e., patients with OSA) who were diagnosed through a clinical examination by a qualified doctor and confirmed by polysomnography. An equal number (60) of age- and gender-matched controls without OSA accompanying the OSA patients were also included in the study.

## Questionnaire

A specifically prepared structured questionnaire was interviewer-administered to both study and control group participants. All the questions were explained in the regional language, and the answers were recorded by the examiner.

The questionnaire was divided into three sections. Section A consisted of questions assessing sociodemographic variables, medical history, and habitual smoking. Socioeconomic status was assessed using the Kuppusswamy scale (2019).<sup>[10]</sup> Section B included questions to assess sleep quality using snoring, tiredness, observed apnea, blood pressure, BMI, age, neck circumference, and gender (STOP-Bang).<sup>[11]</sup>

Section C consisted of questions for assessing Epworth Sleepiness Scale (ESS) to measure daytime sleepiness. The ESS is an 8-item questionnaire that helps to assess the frequency of dozing during different activities and can range from 0 (does not doze) to 3 (high dozing possibility). The total ESS score ranges from 0 to 24, and a score of >10 indicates excessive sleepiness during the daytime.<sup>[12]</sup>

## Clinical examination

Clinical examination was done to assess temporomandibular disorders (TMDs present or absent) adopted by Sanders *et al.*,<sup>[13]</sup> facial profile (concave, straight, or convex) by Bhalajhi,<sup>[14]</sup> uvula for Mallampati score (classes 1, 2, 3, and 4) by Rodrigues *et al.*,<sup>[9]</sup>

tongue for lateral indentations (large or normal tongue size) by Weiss *et al.*,<sup>[15]</sup> maxillary arch constriction (present or absent) by using Chadda's index,<sup>[16]</sup> dental attrition was examined in sleep apnea patients as grinding is just one oral health sign of sleep apnea. Molar relation along with small jaw and overjet, constructed and deep palatal vault which is another symptom of sleep apnea) are also signs. That is the reason why all those oral conditions we assessed by Ruangsri *et al.*,<sup>[8]</sup> mouth breathing by Gunaratnam *et al.*,<sup>[17]</sup> and periodontal status (CPI-modified) and loss of attachment were assessed using WHO criteria 2013.<sup>[18]</sup>

## Statistical analysis

Data were analyzed using SPSS 20.0 software package. Descriptive statistics were addressed by using mean, standard deviation, and percentage. Following this, multivariate logistic regression was performed on SPSS 21 by including variables in the model, which showed statistically significant differences by Chi-square test. The level of significance was fixed at  $P < 0.05$ .

## Results

### Demographic profile

Among 120 patients (60 with OSA and 60 without OSA) aged above 18 years with a mean age of 49.08 + 13.13 years in the study group and 45.28 + 14.78 years in the control group, 92 were males and 28 were females. The majority of study subjects (60.0%) and controls (55.0%) were from urban areas, and the majority of study groups (61.7%) and controls (53.3%) belonged to the upper socioeconomic class [Table 1].

### General findings

Prevalence of obesity and risk of overweight was significantly higher among cases (36.7%) when compared to the study group;

**Table 1: Demographic profile of the study subjects attending the sleep center**

Demographic Details	Values	
	Study Group n (%)	Control Group n (%)
Age		
18-37	10 (16.7%)	8 (13.3%)
38-57	34 (56.7%)	34 (56.6%)
58-77	16 (26.6%)	18 (30.1%)
Gender		
Male	47 (78.3%)	45 (75.0%)
Female	13 (21.7%)	15 (25.0%)
Address		
Urban	36 (60.0%)	33 (55.0%)
Semi-urban	15 (25.0%)	20 (33.3%)
Rural	9 (15.0%)	7 (11.7%)
Socio-economic status		
Upper (I)	37 (61.7%)	32 (53.3%)
Upper Middle (II)	12 (20.0%)	14 (23.3%)
Lower Middle (III)	7 (11.7%)	9 (15.1%)
Upper Lower (IV)	4 (6.6%)	3 (5.0%)
Lower (V)	0 (0%)	2 (3.3%)

73.3% were more likely to have neck circumference >40 cm, and 55.0% had hypertension.

**Oral findings**

For the oral findings, it was observed that the prevalence of narrow dental arch, Mallampati III and IV, macroglossia, and high vaulted palate was significantly higher among study subjects when compared to controls ( $P < 0.05$ ) [Table 2].

A multivariate binary logistic regression was performed; the variables showing significant differences were included in the logistic regression model, and the odds ratio (B exp) was obtained. It was found that patients with OSA had 2.259 times greater odds (95% CI) for maxillary arch constriction, 1.7 times greater odds for class III and IV Mallampati score of the uvula, 8.7 times greater odds for macroglossia, 1.448 times deeper palatal vault, and 1.5 times obesity, respectively. Patients with neck circumference >40 cm were almost four times more likely to report with OSA symptoms. A significant positive association was observed with periodontitis ( $P = 0.029$ ) and dry mouth ( $P = 0.058$ ) [Table 3].

**Discussion**

Sleep plays a vital role in good health throughout life. Many people encounter difficulty in sleeping, which may be due to stress or other factors, but becomes a concern when it takes place repeatedly and thus indicating a sleep disorder.<sup>[19]</sup> Oral findings have been proposed as some risk factors correlated with OSA, which include macroglossia, micrognathia, increased soft palate size, repositioned mandible, increased uvula size,<sup>[6]</sup> Bruxism, and type of breathing.<sup>[17]</sup>

The present age- and gender-matched study was conducted to evaluate the role of dental parameters that may contribute to increasing apneic activity in patients with or without OSA. In the present study, 45 males and 15 females were identified with OSA. The results were similar to previous studies<sup>[19,20]</sup> indicating males at higher risk for OSA as compared to females.

Obesity is the main risk factor for OSA.<sup>[21]</sup> In this study, we found that for each 1 kg/m<sup>2</sup> BMI increase, the risk factor for OSA increases by 1.5 times, and neck circumference of >40 cm was highly significant for study subjects. Following all other variables, the difference was significant for BMI and neck circumference, which acts as an accurate predictor for OSA. Comparable results were reported by Nuckton *et al.*,<sup>[20]</sup> while Ruangsri *et al.*<sup>[8]</sup> reported contrasting results.

Angles class II malocclusion, facial profile, and narrow maxillary arch are related with each other. In the present study, Angle’s class II malocclusion was absent among OSA patients, indicating that this type of malocclusion is not a risk factor for OSA. The results were indistinguishable from the study done by Kale.<sup>[19]</sup> Comparable results were mentioned by Al-Madani *et al.*<sup>[22]</sup> and Seto *et al.*<sup>[23]</sup> which did not find Angle’s class II malocclusion to

**Table 2: General and oral findings in patients with and without OSA**

Clinical Findings	Patients with OSA (n %)		P
	Present	Absent	
BMI			0.000
<35 kg/m <sup>2</sup>	20 (33.3%)	39 (65.0%)	
>35 kg/m <sup>2</sup>	22 (36.7%)	12 (20.0%)	
Neck circumference			0.000
<40 cm	16 (26.7%)	36 (60.0%)	
>40 cm	44 (73.3%)	24 (40.0%)	
Hypertension	33 (55.0%)	29 (48.3%)	0.251
Facial profile			0.175
Convex	23 (38.3%)	17 (28.4%)	
Concave	19 (31.7%)	29 (48.3%)	
Maxillary arch constriction			0.028
Normal	22 (36.7%)	34 (56.7%)	
Narrow dental arch	38 (63.3%)	26 (43.3%)	
Mallampati score for uvula			0.000
Class I	4 (6.7%)	15 (25.0%)	
Class II	9 (15.0%)	31 (51.7%)	
Class III	26 (43.3%)	8 (13.3%)	
Class IV	21 (35.0%)	6 (10.0%)	
Tongue Size			0.000
Normal	10 (16.7%)	24 (40.0%)	
Microglossia	4 (6.7%)	22 (36.7%)	
Macroglossia	46 (76.6%)	14 (23.3%)	
Depth of palate vault			0.005
Class I	23 (38.3%)	34 (56.7%)	
Class II	33 (55.0%)	16 (26.6%)	
Class III	4 (6.7%)	10 (16.7%)	
Periodontal Status			0.029
Present	40 (66.6%)	26 (43.33%)	
Absent	20 (33.3%)	34 (56.7%)	
Mouth Breathing			0.058
Present	27 (45.0%)	17 (28.3%)	
Absent	33 (55.0%)	43 (71.7%)	

**Table 3: Multivariate logistic regression of the patients with OSA**

Variable	Exp (B)	Sig	95% CI for Exp (B)	
			Lower bound	Upper bound
Maxillary arch constriction	2.259	0.029	1.086	4.698
Mallampati score (Uvula)	1.7	0.000	0.026	0.318
Tongue size	8.7	0.007	0.030	0.572
Depth of Palatal vault	1.437	0.575	0.405	5.108
BMI	1.5	0.000	0.022	0.325
Neck Circumference	4.125	0.000	1.908	8.916

be associated with OSA. The narrow maxillary arch may reduce the upper airway space, leading to increased risk of difficulty in breathing due to collapsed tongue along with reduced tongue space, which further contributes to the risk of developing OSA.

In the present study, subjects were found with unusual large uvula and sometimes with a large base, and the edge of the uvula was not visible during phonation as it came into contact

with the base of the tongue. In study subjects with OSA, mostly class III in (43.3%), and class IV in (35.0%) Mallampati score of uvula was found. In control groups, mostly class 1 (25.0%) and class II (51.7%) Mallampati score of uvula was found, which is similar to the findings of OSA patients done by Amerikanon *et al.*,<sup>[24]</sup> Rodrigues *et al.*,<sup>[9]</sup> and Ruangsi *et al.*<sup>[8]</sup> which concluded that in patients with OSA, the uvula contains more muscle and fat than the uvula in healthy control groups.

Similarly, in the present study, the number of subjects (76.6%) with large tongues was more in the study group as compared to controls (23.3%). Similar results were found in the study done by Crumley *et al.*,<sup>[25]</sup> Amerikanon *et al.*,<sup>[24]</sup> Ruangsi *et al.*,<sup>[9]</sup> and Weiss *et al.*,<sup>[15]</sup> which with the help of rapid cine-computed tomography scans, showed that the base of the tongue and the soft palate commonly contribute to the obstructive process. A long palate is considered one that descends below the base of the tongue and cannot be directly seen, such as a palate that may be related to macroglossia. It is well documented by various studies that sleep-disordered breathing and OSA have many health-related consequences.<sup>[26]</sup> Untreated OSA is characterized by a collapsing of the tongue back on the pharynx during sleep.<sup>[27]</sup> Typically, this is because of a large tongue, small air pathway, or abnormal throat anatomy. This blockage restricts breathing, lowering the concentration of oxygen in the blood until receptors in the carotid sinus are altered to higher CO levels in the body, causing the patient to wake up and normal breathing is restored. When the patient falls into deep sleep, the tongue collapses again and another apneic episode takes place.<sup>[28]</sup>

Cases had a lesser proportion of patients with square or gently round palate compared with the control group, as shown in Table 2. This indicated that narrow palatal vault may be more common in patients with OSA, as previously reported.<sup>[29]</sup> This is comparable to the study done by Raungsri *et al.*<sup>[8]</sup> and Kale.<sup>[19]</sup> This might be due to the continuous airflow through the nasal passage during breathing inducing a constant stimulus for the lateral growth of the maxilla and for lowering of the palatal vault.

In the present study, the prevalence of periodontal disease was high in the study subjects with OSA (35.0%) as compared to the control group (26.7%). The present study suggests that mild to moderate periodontitis was elevated among patients with OSA. The high prevalence of periodontal disease along with loss of attachment in the present study is comparable to the study done by Gunaratnam *et al.*<sup>[17]</sup> who suggested that the increased prevalence of periodontitis in OSA patients may be due to a true association between OSA and periodontitis. OSA may act as an inflammatory mediator for periodontitis or vice versa.

The dryness of the mucous membrane produced by oral respiration is frequently observed in individuals with OSA (due to oral breathing), which enables the greater colonization of the periodontal microbiota. Systemic inflammation occurs both in OSA and periodontitis.

In the present study, it was found that 45.0% of cases were associated with mouth breathing as compared to 28.3% of controls. However, in the present study, there was no association between the presence of dry mouth and periodontitis. The present finding is comparable to the study done by Gunaratnam *et al.*<sup>[17]</sup>

The findings of this study shed light on the role a dentist can play to identify the signaling oral findings of OSA patients to sleep physicians. Dentists can provide a valuable service to their patients by incorporating sleep apnea screening and treatment into their practice.

OSA has a notable life-threatening effect. This condition needs an early multispecialty treatment approach. There is a need of identifying new therapeutics and development of simplified phenotyping tools to be used in the clinic to inform targeted therapies for OSA. Given the potential short- and long-term benefits and the low risk of the intervention, early evaluation and primary care in managing OSA in the population seems easily justified.<sup>[30]</sup>

In conclusion, the prevalence of OSA symptoms was 78.3% in male and 21.7% in female adult patients. Obesity, neck circumference >40, narrow maxillary arch, Mallampati III and IV scores for the uvula, tongue size (macroglossia), and depth of palatal vault are the independent predictors for OSA.

A dentist may be the first health care provider to identify a person with OSA because its signs and symptoms often are recognizable in the dental office. Therefore, much can be done to increase lay awareness of the disease so that many sufferers can find help by being directed to sleep laboratories through medical referral.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

### Conflicts of interest

There are no conflicts of interest.

## References

- Huynh NT, Emami E, Helman JI, Chervin RD. Interactions between sleep disorders and oral diseases. *Oral Dis* 2014;20:236-45.
- Morgenthaler TI, Kagramanov V, Hanak V, Decker PA. Complex sleep apnea syndrome: Is it a unique clinical syndrome? *Sleep* 2006;29:1203-9.
- Available from: <https://www.sleepfoundation.org>. [Last accessed on 2019 May 15].
- Arora SA, Kochhar R, Narang S, Saurav K. Sleep related breathing disorders. What and why a dentist should know? An overview of dental sleep medicine. *Natl J Integr Res Med* 2015;6:94-102.
- Sleep apnea. Available from: <https://drhusari.com>. [Last accessed on 2019 Jul 13].
- Hans MG, Goldbbreg J. Cephalometric sleep apnea. *Oral Maxillofac Surg Clin North Am* 1995;7:269-81.
- Schellenberg JB, Maislin G, Schwab R. Physical findings and the risk for obstructive sleep apnea. The importance of Oropharyngeal structures. *Am J Respir Crit Care Med* 2000;162:740-8.
- Ruangsri S, Jorns TP, Puasiri S, Lurcha T, Chaithap C, Sawanyawisuth K. Which oropharyngeal factors are significant risk factors for obstructive sleep apnea? An age matched study and dentist perspectives. *Nat Sci Sleep* 2016;8:215-9.
- Rodrigues MM, Dibbern RS, Gonlart CW. Nasal obstruction and high Mallampati score as risk factors for obstructive sleep apnea. *Braz J Otorhinolaryngol* 2010;76:596-9.
- Sharma R. Revised Kuppuswamy's socioeconomic status scale: Explained and updated. *Indian Pediatr* 2017 Oct; 54:867-80.
- Chung F, Yegneswaran B, Liao P, Chung SA, Vairavanathan S, Islam S. Stop questionnaire: A tool to screen patients for obstructive sleep apnea. *Anesthesiology* 2008;108:812-21.
- Johns EM. A new method of measuring daytime sleepiness: The Epworth sleepiness scale. *Sleep* 1991;14:540-5.
- Sanders AE, Essick GK, Fillingim R, Knott C, Ohrbach R, Greenspan JD, *et al.* Sleep apnea symptoms and risk of temporomandibular disorder. OPPERA Cohort. *J Dent Res* 2013;92 (7 Suppl):70s-7s.
- Bhalaji SI. Orthodontic diagnosis. In: Bhalaji SI, editor. *Textbook of Orthodontics. The Art and Science* 4<sup>th</sup> ed. New Delhi: Arya; 2009. p. 129-58.
- Weiss TM, Atanasov S, Calhoun KH. The association of tongue scalloping with obstructive sleep apnea and related sleep pathology. *Otolaryngol Head Neck Surg* 2005;133:966-71.
- Indian Dental Academy. Model analysis. Available from: <https://www.slideshare.net/indiadentalacademy/model-analysis-1>. [Last accessed on 2019 Jul 13].
- Guneratnam K, Taylor B, Curtis B, Cistulli P. Obstructive sleep apnea and periodontitis: A novel association? *Sleep* 2009;13:233-9.
- World Health Organization (WHO). *Oral Health Surveys: Basic Methods*. 5<sup>th</sup> ed. Geneva: WHO; 2013.
- Kale SS, Kakodkar P, Shetiya SH. Assessment of oral findings of dental patients who screen high and no risk for obstructive sleep apnea (OSA) reporting to a dental college - A cross sectional study. *Sleep Sci* 2018;11:112-7.
- Nuckton TJ, Glidden DV, Browner WS, Claman DM. Physical Examination: Mallampati score as an independent predictor of obstructive sleep apnea. *Sleep* 2006;29:903-8.
- Victor LD. Obstructive sleep apnea. *Am Fam Physician* 1999;60:2279-86.
- Al-Madani GH, Banabilh SM, El-Sakhawy MM. Prevalence of snoring and facial profile type, malocclusion class and dental arch morphology among snorer and non snorer university population. *Orthod Sci* 2015;4:108-12.
- Seto BH, Gotsopoulos H, Sinus MK, Cistulli PA. Maxillary morphology in obstructive sleep apnea syndrome. *Eur J Orthod* 2001;23:703-14.
- Amerikanou CP, Belazi MA, Daskalopoulou E, Vlachoyiannis E, Daniilidou NV, Papanayiotou PC. Oral findings in patients with obstructive sleep apnea syndrome. *Quintessence Int* 2005;36:293-8.
- Crumley PL, Stein M, Gamsn G. Determination of obstructive site in obstructive sleep apnea. *Laryngoscope* 1987;97:301-4.
- Waller PC, Bhopal RS. Is snoring a cause of vascular disease: An epidemiological review. *Lancet* 1989;1:143-6.
- Wilms D, Popovitch J, Conway W, Fujita S, Roth T. Anatomic abnormalities in obstructive sleep apnea. *Ann Otol Rhinol Laryngol* 1982;91:595-6.
- Javaheri S, Dempsey JA. Central Sleep apnea. *Compr Physiol* 2013;3:141-63.
- Patel M. A study of the hard palate in the skulls of central Indian population. *Int J pharm Bio Sci* 2012;3:527-33.
- Belkhode V, Godbole S, Nimonkar S, Parhad S, Nimonkar P. Oral appliances for obstructive sleep apnea. *J Family Med Prim Care* 2021;10:3172-75.