

Cephalometric Comparison of Pharyngeal Airway in Snoring and Non-Snoring Patients

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ABSTRACT

Objectives: To compare the skeletal and the airway structures of the non-snoring individuals with simple snoring and patients with obstructive sleep apnea (OSA).

Methods: The first group consisted of 20 simple snoring cases (mean age: 37.5±8.05 years; max: 50 years, min: 21 years), the second group consisted of 20 OSA cases (mean age: 40.0±8.28 years; max: 54 years, min: 27 years) and the third group consisted of 20 individuals without any respiration problems (mean age: 29.6±3.20 years; max: 35 years, min: 24 years). In the cephalometric films, 4 skeletal and 14 airway space measurements were done. The control group and the study groups were compared using the Dunnett t test, and the groups with snoring problems were compared using the Bonferroni test.

Results: No statistically significant differences were found between the three groups in skeletal measurements. The OSA and simple snoring groups showed no significant differences in airway measurements. The OSA group showed significantly increased soft palate angulation when compared with the control group ($P<.05$). Soft palate length, soft palate thickness and soft palate height were significantly higher in the OSA samples than in the control group ($P<.001$). Pharyngeal spaces in the soft palate area had the significantly lowest values in the OSA group. Inferior pharyngeal space distances in the control group were greater than in both study groups. The OSA group showed the most inferiorly positioned hyoid bone and the difference between OSA and control groups was significant ($P<.01$).

Conclusions: The decreased airway dimension in the soft palate area due to increased soft palate volume must be taken into consideration in treatment planning of OSA patients. (Eur J Dent 2011;5:84-88)

Key words: Snoring; OSA; Airway.

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INTRODUCTION

Obstructive sleep apnea (OSA) is a condition of partial or complete upper airway obstruction leading to increased resistance to airflow and potential cessation of breathing for 10 seconds or more.¹ Hypopnea, in contrast, is characterized by a reduction, without complete cessation, in airflow or respiratory effort.² Obstructive sleep apnea/hypopnea syndrome (OSAS) is known to be a frequent clinical condition in the general population and can be diagnosed in any age group.¹ Young et al³ reported that a prevalence of 2% existed in the adult female population and 4% existed in the adult male population.

In children, various syndromes can be associated with OSAS, such as Down syndrome, Crouzon and Apert syndromes, Treacher-Collins syndrome, Pierre-Robin syndrome, cerebral palsy and multiple other rare craniofacial disorders. The degree of obstruction in many of these conditions can be so severe that tracheotomy is suggested. The approach to the treatment of these patients is usually a highly individualized surgical approach to correct the craniofacial abnormalities and relieve the airway obstruction to prevent the need for tracheotomy. A variety of surgical techniques have been utilized to correct the airway obstruction; these include maxillomandibular advancement, distraction osteogenesis, septoplasty, and turbinectomy.¹ In addition to tonsillectomy and adenoidectomy, soft tissue procedures can include uvulopalatopharyngoplasty, uvulectomy, epiglottoplasty, and tongue reduction.¹

Obstructive sleep apnea is a disorder that has significant medical and psychosocial consequences and affects both adults and children. Although recognized for centuries, its importance for individuals and society has only recently been appreciated. Because individuals with narrow airways and/or craniofacial anomalies may have increased risk for obstructive sleep apnea/hypopnea syndrome, orthodontics can play an important role in the identification and possible treatment of patients with this syndrome.¹ The purpose of this study, therefore, is to compare the pharyngeal airway in non-snoring, simple snoring and OSA patients.

MATERIALS AND METHODS

The study sample was selected from non-obese patients with no history of orthodontic treatment from the archives of GATA, Military Academy of Medicine, Department of Ear Nose Throat, Ankara. All cases were evaluated with the Apnea-Hypoapnea Index (AHI). Individuals having AHI values under 5 constituted the simple snoring group; AHI values above 5 constituted the OSA group. In the study, Group 1 consisted of simple snoring cases (n=20), Group 2 consisted of OSA cases and the Group 3 served as a control group and consisted of individuals without any history of respiration problem.

Four females and 16 males comprised Group 1 and the mean age was 37.5 ± 8.05 years (max: 50 years min: 21 years). Group 2 consisted of 3 females and 17 males and the mean age was 40.0 ± 8.28 years (max: 54 years, min: 27 years). Group 3 was comprised of 12 females and 8 males and the mean age was 29.6 ± 3.20 years (max: 35 years, min: 24 years).

Four skeletal (SNA, SNB, ANB and SN/GoGn) (Figure 1) and 14 airway space measurements (ANS.PNS.SPT, PNS-SPT, SPC-SPD, SPT-SPpp, PNS-PPW1, SPT-PPW2, SPL/SPS, SPL/IPS, Psp-Phws, Sbtn-Phwn, Sbti-Phwl, Pns-Eb, Eb-Tt and Ml-Hy) (Figure 2) were done on the cephalometric films.

Statistical analysis

Control group (Group 3) and the groups with snoring individuals (Groups 1 and 2) were compared using the Dunnett t test, and the groups with snoring problems were compared with the Bonferroni test.

Two weeks after the first measurements, 20 randomly selected cephalometric films were re-measured. A paired-samples t-test was applied to the measurements. The difference between the first and second measurements of the 20 films was insignificant. The values ranged between 0.82 and 0.92, which were in acceptable limits.

RESULTS

Skeletal measurements

No statistically significant differences were found between the three groups in the skeletal measurements (Table 1).

Airway measurements

The OSA group showed the greatest soft palate angulation (ANS.PNS.SPT), and the difference between it and the control group was significant ($P<.05$). Soft palate length (simple snoring group-control group: $P<.01$ and for the OSA-control group: $P<.001$), soft palate thickness and soft palate height were significantly higher in both the OSA and simple snoring groups than in the control group ($P<.001$). The ratio between soft palate length and superior pharyngeal space SPL/SPS was significantly higher in Group 1 ($P<.01$) and Group 2 ($P<.001$) than in the control group due to increased soft palate length. The inferior pharyngeal space (SPT-PPW2) distance in the control group was greater than in the study groups and the difference between the simple snoring group was significant ($P<.05$). Pharyngeal spaces (psp-phws and sbtn-phwn) in the soft palate area had the significantly lowest values in the OSA group. The lower positioning of the epiglottis (pns-eb) was significant in the study groups compared to the control group ($P<.001$). The length between tongue tip and epiglottis (eb-Tt) had the highest value in the OSA group among the groups, The measurements in

the OSA-control group ($P<.001$) and the simple snoring-control group ($P<.05$) differences were statistically significant. The OSA group exhibited more inferiorly positioned hyoid bone than other groups and the difference between OSA and control groups was significant ($P<.01$) (Table 1).

DISCUSSION

This study was conducted to investigate the possible abnormalities in the upper airway structures of OSA in non-obese subjects with lateral cephalometric films. Tsai et al⁴ investigated the lateral cephalometric films to identify indicators for the diagnosis of OSA and simple snoring patients. Lowe et al⁵ compared the craniofacial and upper airway structures of an OSA group with a control group by means of cephalometric measurements. In our study, the OSA group was compared with both a simple snoring group and a control group.

Many etiological factors have been shown for OSA. It can result from various combinations of anatomical and pathophysiological features, some of which may be influenced by genetic factors.⁶ Relaxation of the upper airway musculature has

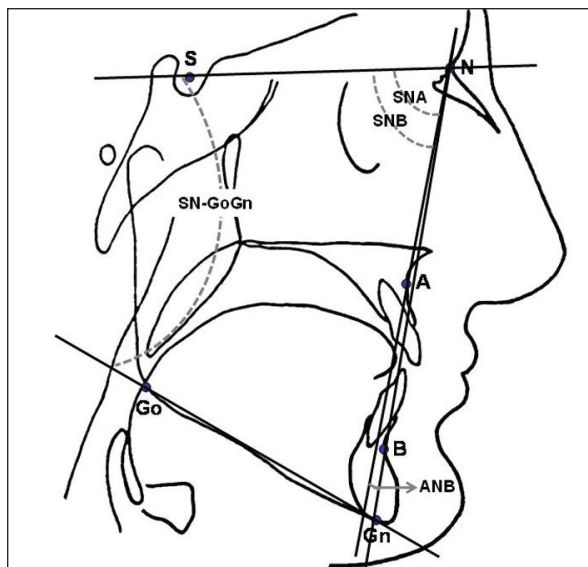


Figure 1. Skeletal measurements; SNA°, SNB°, ANB° and SN/GoGn°.

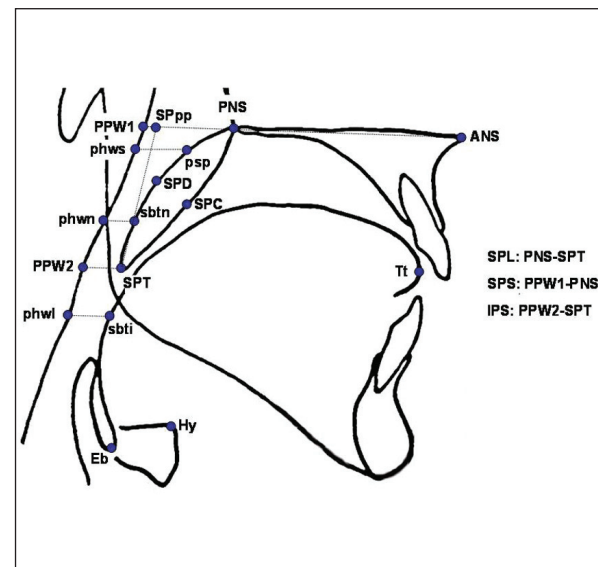


Figure 2. Soft palate and nasopharyngeal airway measurements: ANS.PNS.SPT (soft palate angulation); PNS-SPT (SPL-soft palate length); SPC-SPD (soft palate thickness); SPT-SPpp (soft palate height); PNS-PPW1 (SPS-superior pharyngeal space); SPT-PPW2 (IPS-inferior pharyngeal space); SPL/SPS (ratio between soft palate length and superior pharyngeal space); SPL/IPS (ratio between soft palate length and inferior pharyngeal space); Psp-Phws (superior pharyngeal space in the soft palate area); Sbtn-Phwn (the most narrowest pharyngeal space in the soft palate area); Sbti-Phwl (the most inferior pharyngeal space); Pns-Eb (the distance between posterior nasal spine and tip of the epiglottis); Eb-Tt (the distance between the tip of the epiglottis and the tip of the tongue); and MI-Hy (the distance between Go-Gn line and the tip of the hyoid bone).

been studied in relation to OSAS.⁷ Anatomic narrowing of the upper airway as a result of alterations in the craniofacial morphology or soft tissue enlargement, sleep posture, age, male gender, nasal obstruction, and adipose tissue in the pharynx have been suggested as etiologies of OSA.^{4,8,9}

The laboratory recording technique for OSAS is called polysomnography (PSG), and was described by Holland et al¹⁰ in 1974 to describe the recording, analysis and interpretation of multiple, simultaneous physiologic parameters. PSG has been an available tool for the diagnosis of sleep-disordered patients and in the evaluation of both normal sleep and sleep disorders.¹⁰

The major polysomnographic measurement used to determine whether a patient is clinically diagnosed with sleep-disordered breathing has been the frequency of the respiratory events per hour of sleep. This measure provides the major

index of severity of the disorder and, generally, the combination is the number of the apneas and hypopneas per hour of sleep. The apnea-hypopnea index (AHI) has been shown to be a reproducible measure as well as a predictor of associated cardiovascular disease.^{1,11}

In our study, the AHI was used as a diagnostic tool for constructing the study groups, so all patients were evaluated utilizing the AHI. Individuals having AHI values under 5 constituted the simple snoring group, and those with AHI values above 5 constituted the OSA group.

Lowe et al¹² documented several alterations in the craniofacial structure of 25 male patients with OSA, including posteriorly positioned maxilla and mandible, a steep mandibular plane, high upper and lower facial heights, overerupted maxillary and mandibular teeth, and proclined incisors. Our study focused on the soft palate characteristics

Table 1. Comparison of cephalometric and pharyngeal airway measurements in simple snorer, osa and control groups.

Parameters	Group 1				Group 2				Group 3				test		
	mean	sd	max	min	mean	sd	max	min	mean	sd	max	min	1-2	1-3	2-3
Cephalometric measurements															
sna	80.93	3.59	88.00	74.80	80.48	3.98	88.20	72.00	79.79	4.43	88.00	70.50			
snb	78.36	3.73	87.00	72.00	78.49	4.40	86.50	69.50	76.82	4.36	87.50	71.50			
anb	2.57	2.65	7.40	-3.00	1.99	2.86	7.00	-3.00	2.97	2.96	8.90	-3.30			
s-n/go-gn	30.59	6.88	45.00	16.50	29.39	5.85	40.50	20.00	32.80	5.30	40.00	22.00			
Airway measurements															
ANS.PNS.SPT	126.05	5.96	140.00	115.00	125.30	6.50	140.00	116.00	129.92	4.87	139.00	120.00			*
PNS-SPT	43.04	5.96	54.50	28.80	45.39	6.13	54.00	32.50	37.02	4.26	43.50	30.50		**	***
SPC-SPD	9.98	2.02	14.40	6.50	10.49	1.93	13.50	7.00	6.96	1.86	12.50	5.00		***	***
SPT-SPpp	35.94	5.63	48.90	26.00	37.06	6.80	44.50	17.90	28.39	3.91	33.20	17.00		***	***
PNS-PPW1	26.61	2.96	30.80	19.20	25.77	3.53	31.00	19.70	27.99	3.62	34.90	21.00			
SPT-PPW2	8.45	3.02	15.50	0.92	9.83	4.21	18.80	1.21	11.99	5.45	25.50	4.00		*	
SPL/SPS	1.64	0.33	2.30	0.95	1.79	0.32	2.29	1.23	1.35	0.27	2.04	0.87		**	***
SPL/IPS	6.89	7.69	39.13	2.84	6.15	5.19	26.86	1.91	3.83	2.13	10.73	1.22			
psp-phws	16.20	2.33	21.00	12.00	14.85	3.13	21.50	9.30	18.68	3.84	26.10	12.10		*	***
sbtn-phwn	6.66	2.14	11.00	3.50	5.17	2.48	11.50	2.00	11.63	4.66	21.50	4.00		***	***
sbti-phwl	11.06	2.71	18.00	8.00	11.28	2.79	19.60	7.00	13.26	5.91	26.10	4.00			
pns-eb	78.12	4.10	84.50	68.70	77.96	9.07	90.00	57.00	69.99	6.23	78.70	59.00		***	***
eb-Tt	85.49	7.01	94.00	67.50	89.76	7.29	99.90	76.00	80.01	6.05	92.50	69.50		*	***
ml-hy	19.77	4.23	26.50	12.00	22.67	3.95	29.00	15.00	17.97	4.74	26.50	11.50			**

sd: Standard Deviation; max: maximum; min: minimum; *: P<.05; **: P<.01; ***: P<.001.

and upper air way dimensions of the OSA samples, so only four skeletal variables were measured. Contrary to the findings of Lowe et al,¹² the mandibular plane showed a hypodivergent tendency in the OSA group ($29.39^{\circ} \pm 5.85$). The maximum age in the OSA group was 54 years and the mean age was 40.0 ± 8.28 years. The small mandibular plane angle in the OSA sample may be due to a decrease of the vertical dimensions in mature or old patients with teeth loss and aging.

Soft palate length, soft palate thickness and soft palate height were significantly higher in both the OSA and simple snoring groups than in the control group. Tsai et al⁴ also observed a longer soft palate in non-obese patients with severe OSAS compared with simple snorers. Pharyngeal spaces (psp-phws and sbtn-phwn) in the soft palate area have the significantly lowest values in the OSA group. The OSA group also showed the greatest soft palate angulation. This three-dimensional increased mass and angulation of the soft palate can be one of the reasons for obstruction of the upper way in OSA cases. The results of our study confirm the findings of Tsai et al⁴ that showed no statistically significant difference in any portion of the upper pharyngeal airway space between severe OSAS patients and simple snorers.

The OSA group had the longest tongue tip-epiglottis length (eb-Tt) among the groups; the OSA-control group ($P < .001$) and the simple snoring-control group ($P < .05$) differences were statistically significant. The OSA group exhibited more inferiorly-positioned hyoid bone than the other groups. Jamieson et al¹³ found a low hyoid bone position in conjunction with a constricted posterior upper airway (UA) space in 30 OSA patients. Tsai et al⁴ found greater tongue thickness and an inferiorly positioned hyoid bone in OSA subjects.

CONCLUSIONS

Narrow posterior airway space, elongated tongue, enlarged soft palate, and an inferiorly located hyoid may be variables that can be significant determinants of apnea severity. Increase in soft palate mass is an important factor in the structural narrowing of the upper airway. Therefore, evaluation of these structures in OSA patients can be beneficial for developing future treatment plans.

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