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Research Article

Examining Tongue Size in OSA Patients with Lateral Cephalometric Radiography

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Abstract

Aim: This article aims to investigate tongue dimensions in patients using lateral cephalometric radiography, examining the potential impact of differences in tongue size on Obstructive Sleep Apnea Syndrome (OSAS).

Methods: This study included 80 patients, with 34 females and 46 males. Among these patients, 48 were in the patient group with OSA, and 32 were in the control group Apne-Hypopnea Index (AHI)<5. Tongue dimensions were measured in lateral cephalometric radiographs of the patients, and these measurements were compared between the groups.

Results: In our study, a statistically significant increase was observed in tongue length and tongue area in OSA patients ($p < 0.05$). However, the increase in tongue thickness was not statistically significant.

Conclusion: Our study shows that obstructive sleep apnea (OSA) patients tend to have larger tongues. A larger tongue may contribute to airway obstruction during sleep, leading to increased OSA severity. This information could aid clinicians in tailoring treatment strategies for OSA patients, potentially improving therapeutic outcomes.

Keywords: obstructive sleep apnea syndrome, tongue, fat, soft tissue

OUAS'lı Hastalarda Dil Boyutlarının Lateral Kafa Grafisi ile İncelenmesi

Öz

Amaç: Bu makalede, lateral sefalometrik radyografi kullanarak hastalarda dil boyutlarını inceleyerek, dil boyutlarındaki farklılıkların Obstrüktif Uyku Apnesi Sendromuna (OUAS) potansiyel etkisini araştırmak amaçlanmıştır.

Yöntemler: Bu çalışmaya 34 kadın 46 erkekten oluşan 80 hasta dahil edildi. Bu hastalardan OUAS'ı olan 48'i hasta grubunu, 32' si ise apne hipopne indeksi (AHİ)<5 olan kontrol grubunu oluşturmaktaydı. Hastalara ait lateral sefalometrik radyografilerde dil boyutları ölçüldü ve gruplar arasında bu değerler karşılaştırıldı.

Bulgular: Çalışmamızda obstrüktif uyku apnesi (OUA) hastalarında dil boyunda ve dil alanında istatistiksel olarak anlamlı bir artış gözlenmiştir ($p <0.05$). Fakat dil kalınlığındaki artış anlamlı derecede değildir.

Sonuç: Çalışmamız, OUA hastalarının genellikle daha büyük bir dile sahip olduğunu göstermektedir. Daha büyük bir dil, uyku sırasında hava yolunun tıkanmasına katkıda bulunabilir, bu da OUAS şiddetinin artmasına yol açabilir. Bu bilgi, klinisyenlere OUA hastaları için tedavi stratejilerini uyarlamada yardımcı olabilir ve tedavi sonuçlarını potansiyel olarak iyileştirebilir.

Anahtar Kelimeler: obstrüktif uyku apnesi sendromu, dil, yağ, yumuşak doku

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1. Introduction

Obstructive Sleep Apnea Syndrome (OSAS) is a sleep disorder with a high prevalence that continues to increase [1], characterized by repeated interruptions of breathing and/or a significant reduction in airflow during sleep [2]. The prevalence of OSA is increasing in the population, making it a significant public health issue that adversely affects both individuals' and society's well-being and increases susceptibility to many serious diseases [3]. Complications such as obesity and smoking ,hypertension, hyperlipidemia, metabolic syndrome, diabetes mellitus and insulin resistance are more common in OSAS patients compared with the general population [4].

The etiology of OSA is complex, involving the interplay of numerous factors. These factors include genetic predisposition, age, gender, obesity, and anatomical features such as neck circumference [5]. The upper airway consists of structures such as the nose, mouth, throat, and pharynx, and the anatomical characteristics of this region can influence the risk of OSA [6].

Untreated or poorly managed obstructive sleep apnea (OSA) can lead to serious consequences, including cardiovascular diseases, hearing loss, diabetes, mental and emotional problems, as well as accidents and injuries [7]. Therefore, it is crucial to seek professional medical evaluation and appropriate treatment when OSA is diagnosed, or its symptoms are recognized. Treatment options may include lifestyle modifications, positive airway pressure devices (such as continuous positive airway pressure), oral appliances, and, in some cases, surgical interventions. With proper treatment, the adverse effects of OSA can be reduced or prevented [8–10].

The role of soft tissues is more significant than that of hard tissues in shaping the upper airway. Among these soft tissues, the importance of the tongue and soft palate is greater. OSAS is a disease that generally occurs more frequently in the supine position. Probable factors contributing to increased obstruction in the supine position include the gravitational pull and changes in muscle tone leading to the repositioning of the soft palate or tongue backward. Therefore, the most common sites of obstruction are the retroglossal and retropalatal areas. Surgical procedures commonly used in the treatment of OSAS are also typically performed in these areas [11]. In addition to positional changes in soft tissues, volumetric increases, particularly in the tongue and other soft tissues due to fat accumulation, also play a significant role in upper airway obstruction [12]. Because of the importance of the role of tongue size in obstruction, it has been frequently studied by researchers. Lateral cephalometric radiography allows for an objective measurement of tongue size and offers the opportunity to investigate its relationship with the severity of OSA [13].

This article aims to investigate tongue size in OSA patients using lateral cephalometric radiography and evaluate the potential impact of these measurements on the severity of OSA. The results of our study may contribute to a deeper understanding of the pathophysiology and risk factors associated with OSA, potentially leading to improved treatment strategies.

2. Material and Methods

This study included 80 patients aged 18-65 years who presented to the Chest Diseases Clinic of Erzincan Binali Yildirim University Mengucek Gazi Training and Research Hospital between 2021 and 2022 with complaints of sleep-disordered breathing. Patients with craniofacial abnormalities, a history of tongue surgery, or any medical conditions affecting tongue size were excluded from the study.

Polysomnography

All patients were evaluated with nocturnal polysomnography (PSG) in the clinic's sleep department (55-channel polysomnography-Alice Sleepware; Philips Respironics, Pennsylvania, USA), and 48 of them were diagnosed with OSA according to the American Academy of Sleep Medicine (AASM) criteria. In 32 patients, the AHI value was below 5 according to PSG evaluation, and simple snoring was diagnosed. Apnea is defined as a reduction of at least 90% in airflow amplitude lasting less than 10 seconds and hypopnea is defined as a reduction of at least 30% in airflow amplitude lasting at least 10 seconds and associated with a 4% or greater oxygen desaturation. In patients with OSAS, the number of AHI episodes, including apnea and hypopnea episodes per hour of sleep, was calculated.

Cephalometric analysis

All X-rays were obtained with the DRGEM Diamond-6A (Korea) X-ray machine in a repeatable natural head position, where all teeth were in centric occlusion, with slight contact or at rest without contraction of the upper and lower lips. During the acquisition of lateral cephalograms, the patient-source distance was standardized at 152 cm, and the mid-sagittal plane film cassette distance was 13 cm (80 kV, 320 mA, 51.2 mAs). All X-ray films were taken by the radiologic technician.

While the radiographic images were captured by technicians, cephalometric images were transferred to the Corel-Draw program, and measurements were performed by our team. In terms of reliability, the measurements were repeated 25 days later.

Cephalometric Landmarks

TT: The most anterior point of the tongue seen in cephalometry.

Eb: The deepest point in front of the epiglottis.

Hy: anterosuperior point of the hyoid bone.

G: genial tubercle

Tongue Size Measurements:

TA, Tongue Area: A line connecting the Eb, Hy, and G points, along with a line drawn from the G point to the TT point following the inner contour of the mandible and continuing along the dorsum of the tongue back to the Eb point, defines the area referred to as the tongue area.

TL, Tongue length: The distance between Eb and TT.

TH, tongue height: The length of the line perpendicular to the line between Eb and TT from the top of the curvature of the tongue dorsum.

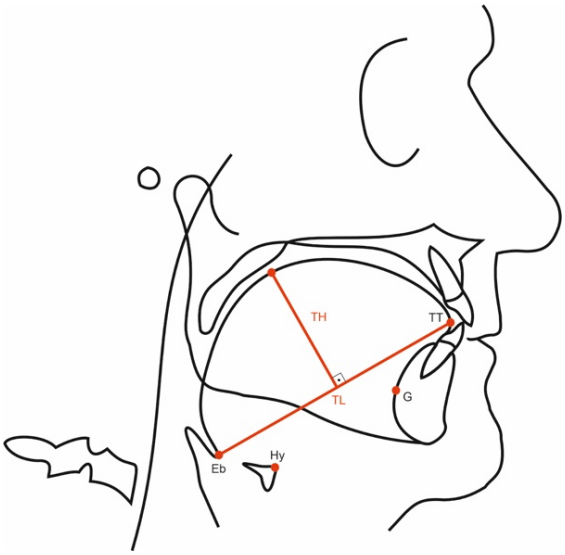

Figure 1: Anatomic Landmarks and Measurements

TL: Tongue length, TH: tongue height, Eb: Base of epiglottis, Hy: Hyoid bone, G: Genial tubercle, TT: Tip of tongue

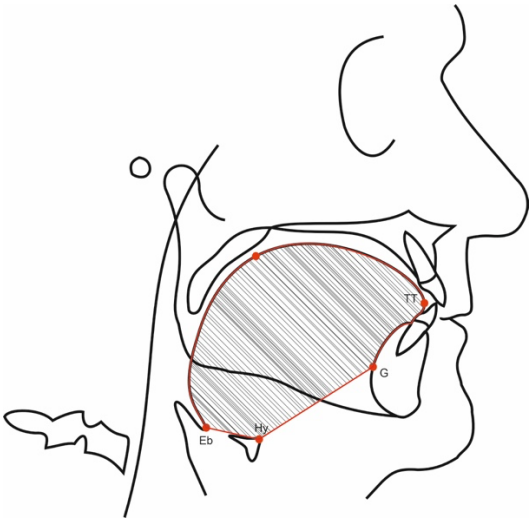

Figure 2: Borders of the Area of the Tongue

Eb: Base of the epiglottis, Hy: Hyoid bone, G: Genial tubercle, TT: Tip of tongue

Patients' cephalometric records and clinical data, including age, sex, and AHI values were collected from the hospital's medical records.

Statistical Analysis:

Statistical analysis was conducted using SPSS-22 software. The normal distribution of the data was assessed using the Kolmogorov-Smirnov test. Since the data followed a normal

distribution, they were compared using the T-test, and values with $P<0.05$ were considered statistically significant.

3. Results and Discussion

In a study conducted by Horner et al. tongue sizes were compared between patients with OSAS (AHI>5) and a control group (AHI<5) using magnetic resonance imaging (MRI). The study found that OSAS patients had a higher prevalence of tongue enlargement due to fat deposition in comparison to the control group [14].

In an MRI study conducted by Kim et al., they measured tongue volume and fat volume in apneic and non-apneic patients. They observed a statistically significant increase in both tongue and fat volumes in apnea patients compared to the control group ($P < 0.05$) [12].

In a study conducted by Wang et al. investigating the impact of weight factors on OSAS, they compared certain anatomical structures affecting upper airway dimensions between patients who lost weight and those who could not lose weight. In their research, they noted a statistically significant reduction in AHI values among patients who experienced weight loss ($P=0.0004$). The point of interest highlighted in their study was the significant reduction in tongue fat content observed in the group of patients who lost weight ($P<0.0001$) [15].

Kim TH et al. conducted a study using cephalograms obtained from obese and non-obese OSA patients. In their study, they attributed increased tongue volume in obese patients to the accumulation of fat and soft tissue in the tongue and pointed to the downward displacement of the hyoid bone as the cause of this condition [16].

Schwab and colleagues confirmed increased tongue volume in patients with OSA through their MRI study [17].

Lu et al. conducted a prospective study on patients with severe sleep apnea who underwent multilevel surgery, comparing their AHI values and tongue dimensions based on head and neck computerized tomography (CT) scans. As a result, it was determined that tongue length is associated with disease severity, and tongue volume significantly decreased after surgery [18].

In a magnetic resonance imaging study conducted by Do et al. and a CT scan study conducted by Ogawa et al., increased tongue sizes were observed in OSA patients compared to control groups, supporting findings from other studies [19,20]. Similarly, in MRI studies by Kando et al. and CT studies by Shigeta et al., the volumetric calculations of the tongue and oral cavity were performed, and in OSA patients, this ratio was found to be larger. These studies concluded that the increase in tongue size was negatively correlated with airway volume [20,21].

In a study conducted by Johal et al., they highlighted a significantly reduced intermaxillary space in patients with OSAS. This implies a restriction in the area where the tongue is positioned in individuals with OSAS [22].

Stipa et al. conducted a retrospective study on the cephalometric images of 253 OSA patients and evaluated tongue size and tongue length parameters about AHI values. However, no statistically significant relationship was found between disease severity and these parameters [23].

In a study conducted by Battagel et al. on cephalograms of 35 OSA patients and 24 healthy individuals from a total of 59 patients, they did not observe any difference in the tongue area among OSA patients [24].

Various advanced technologies such as CT and MRI are used to assess the anatomical characteristics of the upper airway and craniofacial structures and to identify areas of obstruction. However, the traditional cephalometric method has remained the most practical and widely used approach. Although cephalometry provides a static, two-dimensional assessment of the dynamic three-dimensional anatomical structures of the head and neck, it has proven to be useful because it reveals significant differences between asymptomatic controls and OSA patients. The main advantages of cephalometry include easy accessibility, low cost, and minimal radiation exposure [25].

We studied cephalograms from a group of 46 OSA patients and a control group consisting of 34 simple snoring patients (AHİ<5). 34 of the patients were female, and 46 were male. In our study, no significant differences were noted between the groups in terms of age and gender (Table 1).

Table 1: The Distribution of Age and Gender in the Groups

	OSA Positive (n: 48)	Control Group (n: 32)
Age (years)		
Mean ± SD	46.78 ± 13.30	45.94 ± 11.31
Median (minimum-maximum)	47 (20 – 73)	48 (20 – 67)
Sex		
Female	18/48 (37.5%)	16/32 (50%)
Male	30/48 (62.5%)	16/32 (50%)

This study demonstrates the presence of tongue enlargement in OSA patients. We observed a significant difference in tongue length between the two groups ($p=0.01$). The tongue area also showed a significant difference between the two groups ($p<0.01$). However, despite a slight increase in tongue height, this increase was not statistically significant (Table 2).

Despite the tongue being surrounded by hard tissues in the intermaxillary area, there is no limiting hard tissue in the oropharyngeal direction. Therefore, tongue enlargement may manifest as an increase in length rather than an increase in height, possibly leading to narrowing of the pharyngeal airway at the retroglossal level and exacerbating OSAS.

Table 2: Comparison of Data Between the Groups

	OSA Positive	Control Group	P
Tongue Length(mm)	81.11 ± 8.35	76.96 ± 7.52	0.01*
Tongue Height(mm)	32.56 ± 4.09	31.48 ± 6.99	0.436
Tongue Area(cm^2)	34.29 ± 3.74	31.92 ± 4.05	0.009*

Cephalometric examination is the most preferred method for evaluating the soft tissues in the upper airway in patients with OSA due to its cost-effectiveness and ease of application. However, like any procedure, there are certain limitations associated with cephalometric analysis. These limitations include the inability to obtain three-dimensional images, challenges in standardizing patient positioning, and the inability to assess the fat content in the tongue.

4. Conclusion

The increase in tongue size in OSA patients is believed to be due to fat accumulation in the tongue, which is associated with obesity, the primary etiological factor of OSA [12,15]. Studies can be supported by the STOP-Bang questionnaire [26], which includes questions about the patient's snoring habits and frequency, how tired they feel in daily life, whether they have experienced breathing pauses during sleep, the presence of hypertension, their age, gender, as well as the calculation of the patient's body mass index (BMI) and measurement of neck circumference. Furthermore, to determine the localization of fat accumulation in the tongue, it would be more accurate to supplement the study with an MRI investigation.

In patients with OSA, the role of the tongue is crucial in the detection and treatment of upper airway obstruction. Guidance results for clinicians can be obtained in future studies by implementing recommended practices and utilizing a broader patient population.

Ethics in Publishing

The ethical approval has been obtained with decision number 15/04 at the meeting of the Erzincan Binali Yıldırım University Clinical Research Ethics Committee on February 21, 2022, and documented as the 15th decision.

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