



THE RELATIONSHIP BETWEEN EPIGLOTTIS AND SEVERITY OF OBSTRUCTIVE SLEEP APNEA

Ismet Emrah Emre,MD; Elif Aksoy,MD; Gediz Murat Serin,MD; Şenol Polat,MD; Ömer Faruk Ünal,MD ; Hasan Tanyeri,MD
Acibadem University, School Of Medicine, Department of Otolaryngology Head and Neck Surgery, Istanbul, Turkey

ABSTRACT

Objective:

The aim of this study was to define epiglottis morphologies and to investigate the relationship between the angle of the laryngeal surface of the epiglottis (ALSE) and the severity of obstructive sleep apnea (OSA) using flexible optic laryngoscopy (FOL) images.

Subjects And Methods:

This is a retrospective case-control study conducted at a university affiliated clinic. Eighty-three patients with OSA (Group 1) and 87 patients with no complaints of OSA (Group 2) who attended between May 2012 and Januaray 2013 were evaluated. The ALSE was measured using ImageJ through FOL images. ALSE measurements were compared between the two groups. The correlation of ALSE measurements to the respiratory disturbance index (RDI) was analyzed.

Results:

Group 1 comprised 79 male and 4 female patients with a mean age of 43 years. Group 2 comprised 72 male and 15 female patients with a mean age of 39 years. The mean ALSE measurement was 139,7° in Group 1 and 140.08° in Group 2 and was not significantly different between the two groups (P > 0.05). The mean RDI in Group 1 was 28.83 showing evidence of a low correlation between ALSE measurements and RDI. Epiglottis morphology revealed three different shape; concave epiglottis and slightly observed petiole, minimally concave epiglottis with petiole dominancy, severe concave epiglottis (omega epiglottis).

Conclusions:

Epiglottis morphology and ALSE cannot be used as predictive factors in OSA pathophysiology.

CONTACT

Ismet Emrah Emre, MD

Acibadem Kadikoy Hospital, Istanbul,
Turkey

Email: dremrahemre@hotmail.com

Phone: +90 532 5402662

INTRODUCTION

Partial collapse or total obstruction of the upper airway in obstructive sleep apnea (OSA) may occur at any level of the upper airway. Evaluating the site of obstruction is vital when forming a strategy for surgical intervention^{1,2}. Multiple sites of obstruction are frequently encountered in patients with OSA and surgery towards a single site of the upper airway often results in unsatisfactory results³⁻⁵. Polysomnography (PSG) is the excepted gold standard technique in diagnosing OSA but lacks in its' ability to point to the site of obstruction which can only be overcome with direct visualization techniques including flexible optic laryngoscopy (FOL), dynamic computed tomography imaging (dCT) and magnetic resonance imaging (MRI) and video endoscopy^{6,7}. Many physicians today turn to the FOL for assessment of both the static anatomy and dynamic changes observed with utilization of the Mueller's maneuver^{8,9} and mostly concentrate on the retroglossal and retropalatal areas and quantify the amount of obstruction observed on the basis of collapse seen during FOL¹⁰. Less focus has been placed on laryngeal structures or the impact of the epiglottis on obstruction in adult patients with OSA¹¹.

The epiglottis has a concave appearance on its' laryngeal surface. In our study we decided to quantify this concavity by means of the ALSE. We defined the ALSE as the angle measured between 2 intersecting lines drawn from the exact center of the superior free edge of the epiglottis that are each tangential to one free lateral edge of the epiglottis (figure 1).

METHODS AND MATERIALS

This study was a retrospectively performed study at a university affiliated clinic between May 2012-January 2013. A total of 170 patient FOL videos from our database were evaluated, and divided in to 2 groups. All patients underwent a complete otolaryngologic examination with FOL and an additional overnight attended PSG as specified per norm for OSA patients⁸ was performed for patients with OSA symptoms. Group 1 composed of 83 patients that had applied to our clinic with symptoms pertaining to OSA. The second group contained individuals that had applied to our clinic with symptoms unrelated to OSA such as sore throat, dysphagia and dysphonia. Patients with craniofacial abnormalities such as retrognathia or mandibular dysplasia and who previously had soft palate, tonsil, or tongue surgery were excluded from both groups. Study approval was obtained from the university institutional review board.

Flexible optic laryngoscopy

After the administration of topical anesthesia with 4% pantocaine and 1:100,000 epinephrine, flexible endoscopy (3.4-mmwide ENF-P4 fiberoptic nasolaryngoscope; Olympus, Hamburg, Germany) was performed through the nose during quiet inspiration in a sitting position. All examinations were done by the same otolaryngologist (H.T.). The fiberoptic endoscope was connected to a camera (telecamera; Karl Storz, Tuttlingen, Germany), and videos were transferred to a desktop computer (ArcSoft Totalmedia 3, Arc-Soft, Fremont, CA) via a video creator (Snazzi* video creator 300; Kampong Ubi Industrial Estate, Ubi, Singapore). The endoscope was advanced through 1 nasal passage and aimed inferiorly at the nasopharynx and passed towards the level of the tongue base. The entire epiglottis was visualized in situation with the tongue base and posterior pharyngeal wall. A screen shot was obtained and the ALSE was measured for each capture.

Image editing

The recorded videos were collected in a computer and reexamined. The videos were replayed in slow motion at a frequency of 0.4 second in order not to skew the targeted area. Multiple photographic images were captured at the level of tongue base. A single photographic image was selected from a series of multiple images that were retrieved from the video image. This single image was used to calculate the ALSE which was subsequently measured for each cohort using imageJ (National Institute of Health, Public domain)

Statistical analysis

The ALSE was measured for every patient and the mean value of each group for angle of ALSE was compared between the 2 groups using the Wilcoxon Rank test.

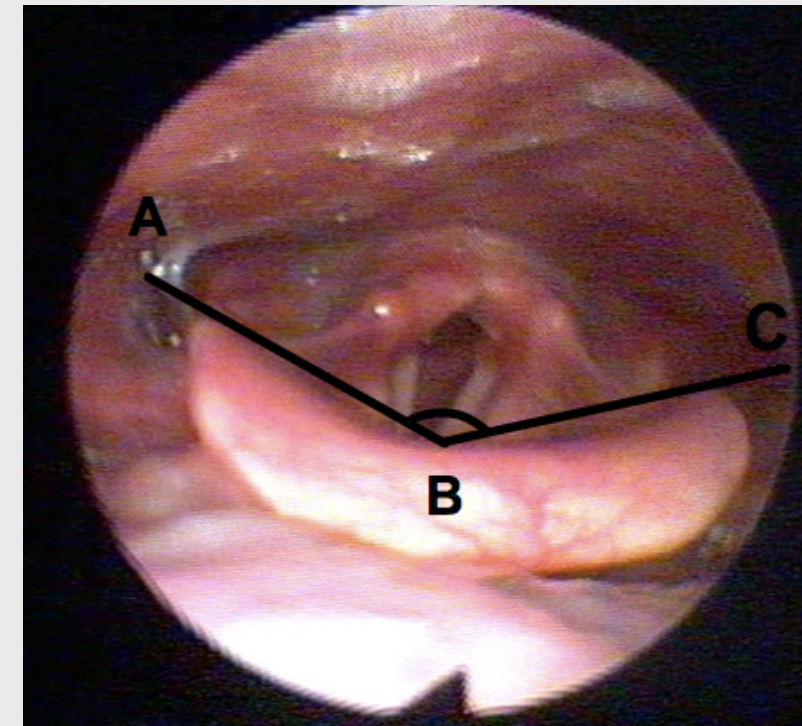


Figure 1. Measurement of the ALSE. The ALSE is the angle formed by the intersection of line AB and Line BC. Point B is the exact center of the superior edge of the epiglottis. Points A and C depict where the lines touch the free edge of the right and left free lateral borders respectively.

RESULTS

Group 1 comprised 79 male and 4 female patients with a mean age of 43 years. Group 2 comprised 72 male and 15 female patients with a mean age of 39 years. The mean ALSE measurement was 139,7° in Group 1 with a range between 60.3°-174.85°. Group 2 had a range between 61.2°-179.67 with the mean ALSE being 140.08°. There was no statistically significant different between the two groups (P > 0.05) (figure2) The mean RDI in Group 1 was 28.83 showing evidence of a low correlation between ALSE measurements and RDI. Epiglottis morphology revealed three different shapes when viewed in a superior to inferior axis during FOL; the concave epiglottis and slightly observed petiole, the minimally concave epiglottis with petiole dominancy, the severely concave epiglottis (omega epiglottis) (figures 3-5). The distribution of epiglottic morphological shape for patients in group one are depicted in figure 6, group 2 in figure 7 and figure 8 shows a comparison between the two groups. (Figures 6-8).

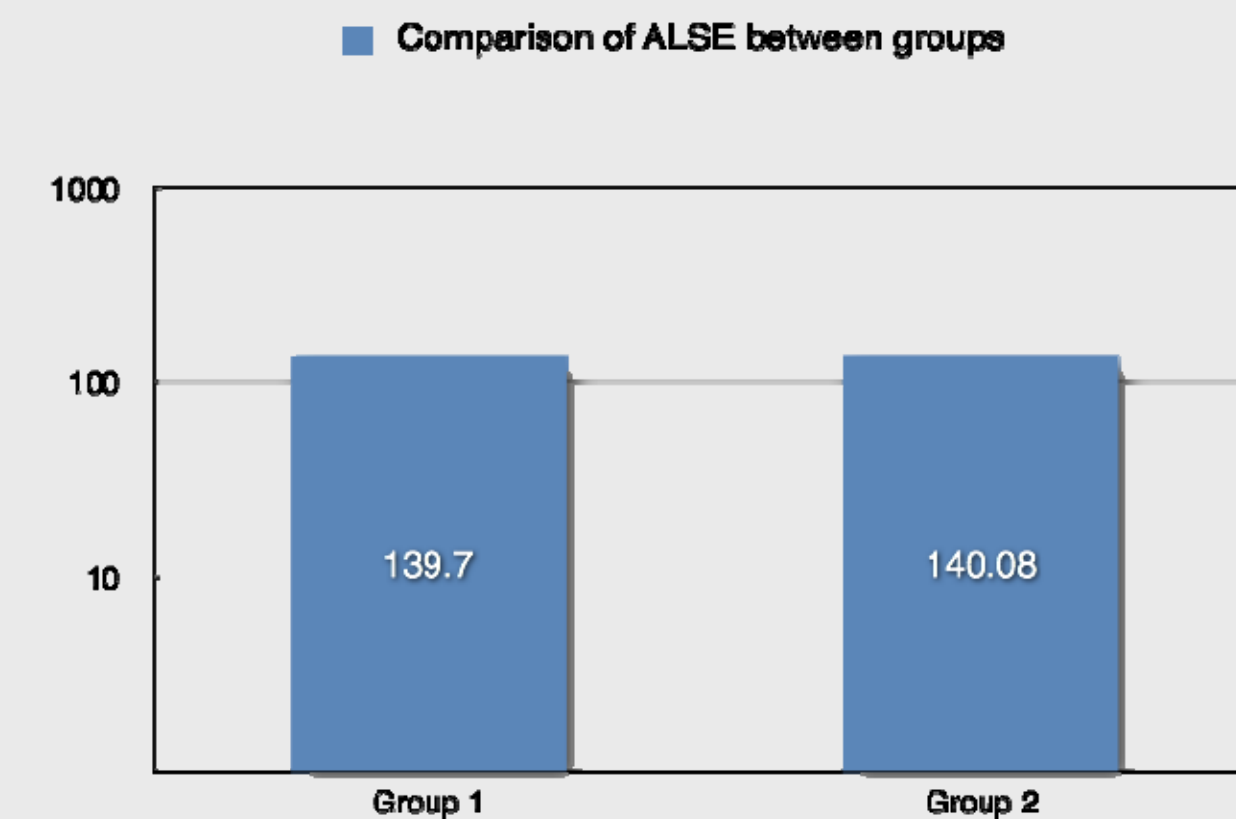


Figure 2. The comparison of ALSE measurements between the two groups

DISCUSSION

The use of FOL coupled with the Mueller maneuver allows the surgeon to observe dynamic changes that occur in the upper airway and correctly place the site of obstruction which is vital in ensuring a positive outcome after surgery^{12,13}. Many studies focus on retropalatal and retroglossal collapse incorporating the palate and tongue base as parameters and quantifying the collapse by video or picture aided measurements^{14,15}.

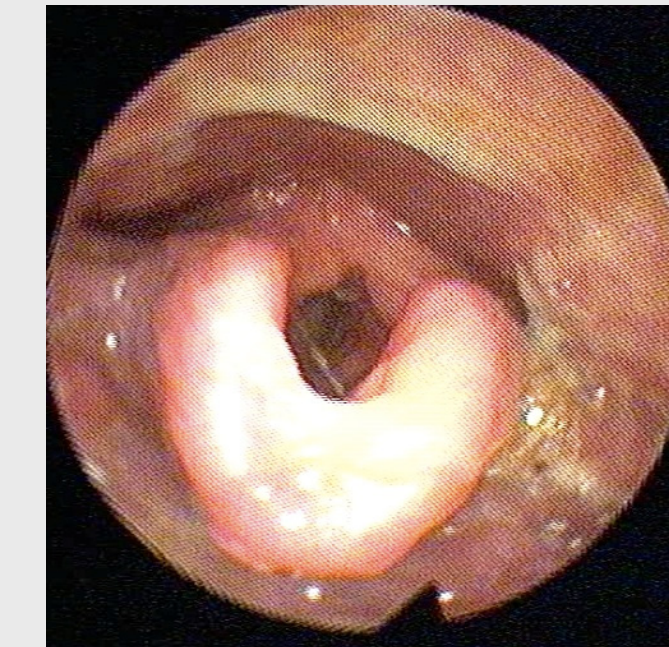


Figure 3. Omega Epiglottis

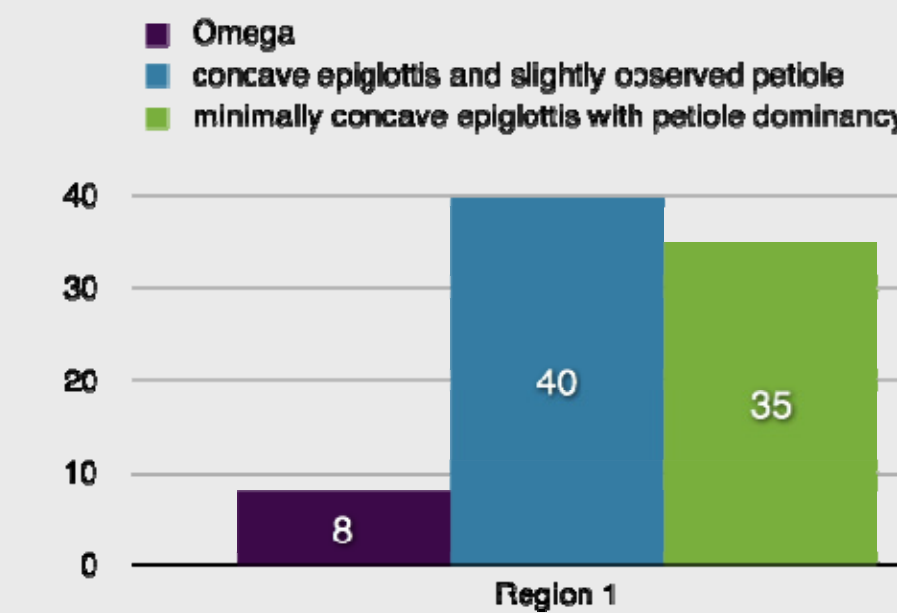


Figure 6. The distribution of epiglottis shape in patients from group 1

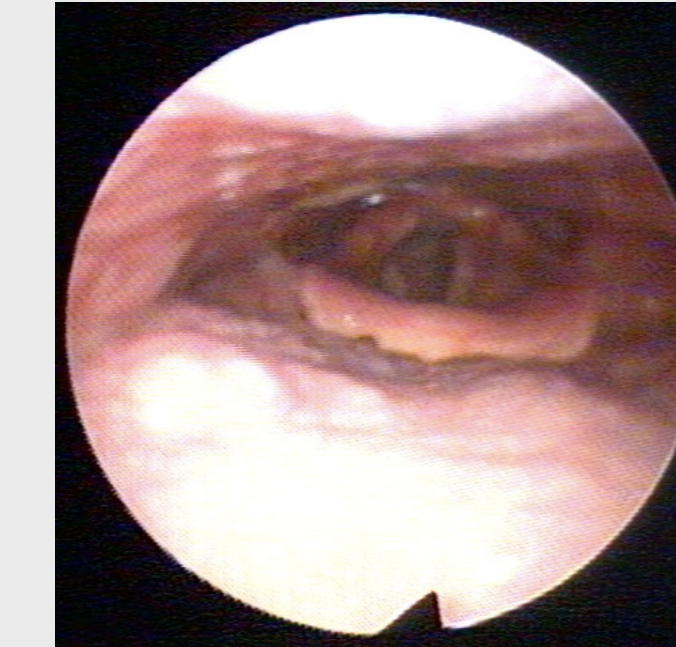


Figure 4. The minimally concave epiglottis with petiole dominancy

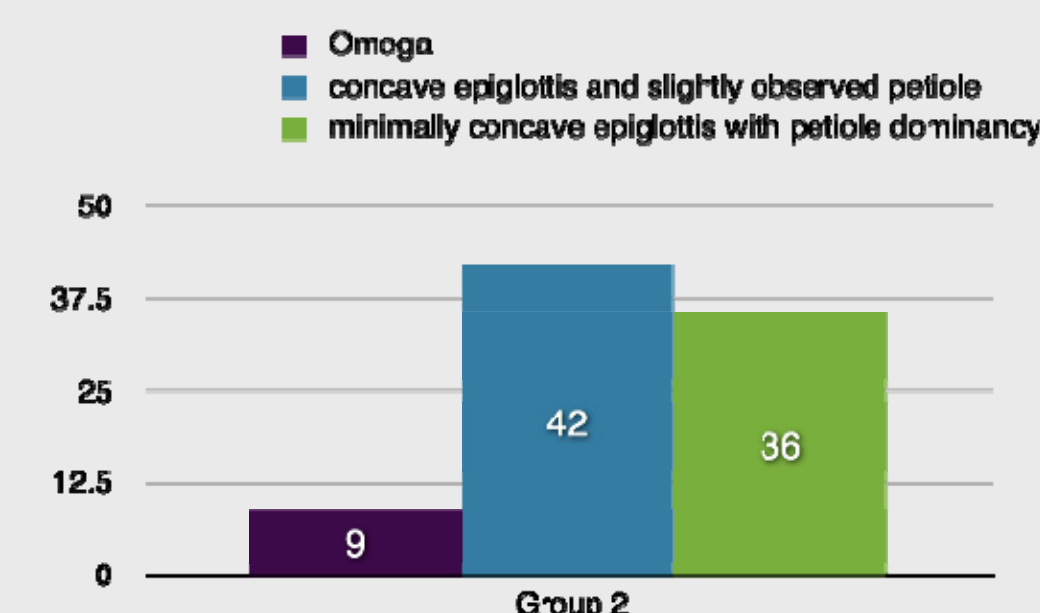


Figure 7. The distribution of epiglottis shape in patients from group 2

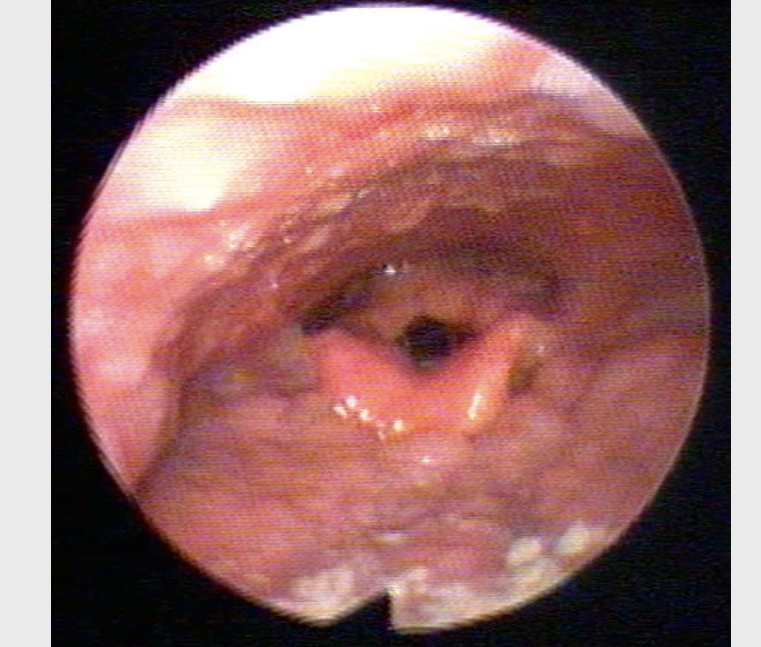


Figure 5. Concave epiglottis with slightly observed petiole

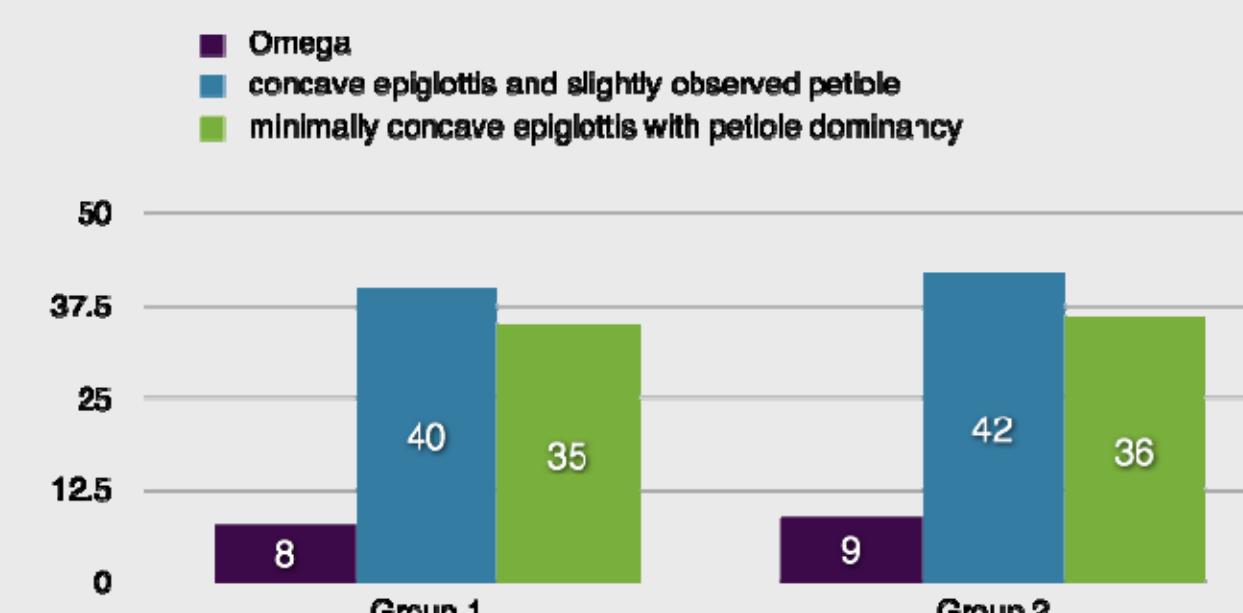


Figure 8. Comparison of the distribution of epiglottis shape in patients from group 1 and group 2

DISCUSSION

Though a vast amount of research has been undertaken regarding retropalatal and retroglossal collapse fewer studies focus on other areas including the lateral pharyngeal wall and hypopharynx. Although the epiglottis is a part of the supraglottic anatomy of the larynx it also extends superiorly into the hypopharynx. The epiglottis may be a contributor to the pathology of OSA in 2 ways;
a.The rigidity of the epiglottis
b.Retro-displacement an shape of the epiglottis.

Obstruction at the level of the epiglottis is a rare cause for OSA. In there study Catalfumo et al. demonstrated 12 patients with obstructive sleep apnea induced by epiglottic prolapse. They stated that in the 11.5 per cent of patients who failed the uvulopalatopharyngoplasty procedure, the reason was a narrow airway at the hypopharyngeal level caused by an abnormal epiglottis and that partial epiglottidectomy can increase the cure rate of patients with OSA by 10-15 per cent¹⁶.

Golz et al. compared 2 groups of patients after examination with FOL showed a posteriorly displaced epiglottis with the first group consisting of adult OSA patients and the second group of infants with laryngomalacia. They reported that similar pathophysiological mechanisms may be involved in both laryngomalacia and in OSA due to a posteriorly displaced epiglottis and partial resection of the epiglottis with a microlaryngoscopic CO2 laser can offer effective and relatively safe treatment¹⁷.

To our knowledge there are no studies indicating a quantitive measurement or the morphologic impact of the anatomy of the epiglottis on OSA. Although it is logical to assume that a more posteriorly placed floppy epiglottis can cause obstructive symptoms relatively easier than an anteriorly placed sturdy epiglottis there are no studies that quantify the posterior displacement of the epiglottis and its effect on OSA. Our study aimed to analyze whether the morphology or ALSE had any effect on the severity of OSA. Statistically significant differences in regard to the ALSE were not observed between patients with OSA and the normal population thus showing that the measurement of the ALSE for severity of OSA would be an ineffective predictive factor. We do believe however that the epiglottis is a major component when considered as a single unit with the tongue base and tongue base collapse combined with a wider ALSE would hypothetically increase the severity of OSA. To asses this assumption a larger cohort and quantification of tongue base collapse with epiglottic size would be necessary.

CONCLUSIONS

Morphology or convexity of the laryngeal surface of the epiglottis does not seem to have an effect on the pathophysiology of OSA or the severity of the disease.

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