A Morphometric Study of the Larynx

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Summary: Objective. Describe anatomical measurements of a selection of laryngeal structures, performing a comparison of such measurements between men and women and between different age groups.
Study Design. Populational morphometric study.
Participants. Larynges from 50 male and 50 female fresh cadavers of older than 40 years were removed during autopsy.
Methods. The following measurements were made on the external angle laryngeal framework between the blades of the thyroid cartilage: width of the thyroid cartilage, distance from the thyroid notch to the anterior commissure (AC), distance from the AC to the inferior thyroid border, distance from the AC to the larynx proeminence, length of membranacea part of vocal fold (VF), length of cartilaginea part of VF, width and thickness of true VF.
Results. The differences between men and women were highly significant. All measured values of larynx obtained in the study were greater in men than in women, except for the thyroid angle, which was higher in women ($P < 0.05$). A significant difference in the comparison between the morphological measurements in the age groups for both men and women was not observed ($P > 0.05$).
Conclusion. The comparison of larynx dimensions showed the presence of sexual dimorphism in the group of South Brazilian people studied. There was no morphometric difference between the larynx samples of the individuals of the same sex after 40 years of age.
Key Words: Larynx–Anatomy–Morphometry–Pathology.

INTRODUCTION

Until about 20 years ago, knowledge of morphometric larynx aroused little interest. However, with the advent of optical fibers and methods of radiological investigation, such as computerized tomography and magnetic resonance imaging, better visualization has been provided of the laryngeal structures and greater interest has been aroused on the part of clinicians and surgeons.[1–4]

Clinical procedures and surgical techniques targeted toward diagnosis and treatment of laryngeal disorders are becoming increasingly precise and sophisticated, making profound knowledge of the anatomical and morphometric aspects of the larynx structure essential. Therefore, this knowledge is not necessarily principally to avoid complications but to achieve improved phonatory quality for the patients under treatment.[3]

Understanding the morphology of the laryngeal framework, one of the most complex organs of human body,[5] is a crucial step toward elucidating the detailed laryngeal embryology, anatomy, and physiology.

Numerous data on laryngeal dimensions can be found in textbooks of anatomy; however, these data provide only incomplete information for the planning of laryngeal framework procedures. Different studies have described the larynx morphometry in different population groups,[3,6,7] but no studies have been found aimed at describing the pattern of morphometric larynges in individuals of South America.

The aim of this study has been to describe exact anatomical measurements of a selection of laryngeal structures, performing a comparison of such measurements between men and women and between different age groups and to establish the normal range of variation in the measurements of laryngeal structures in a South Brazilian population.

MATERIALS AND METHODS

Ethical considerations

The study was reviewed and approved by the Research Ethics Committee of the Institute of Cardiology, Porto Alegre, Rio Grande do Sul. An informed consent was obtained from each family of the participants.

Design

One hundred larynges were harvested from 50 men and 50 women from fresh cadavers of older than 40 years, which had been autopsied at the Department of Forensic Medicine of Porto Alegre, Rio Grande do Sul. None of the cadavers had a history of trauma or recent infection that involved or might have affected the laryngeal function. The removal of the larynx occurred in less than 12 hours postmortem. The larynges were excised, and the soft tissue and perichondria of the thyroid cartilages were removed. A needle was inserted at the level of the anterior commissure (AC) from the endolarynx through the thyroid cartilage.

Measurements

Measurements of the thyroid cartilages were obtained with a goniometer Carci and digital calibrated caliper (Starrett, Tolls

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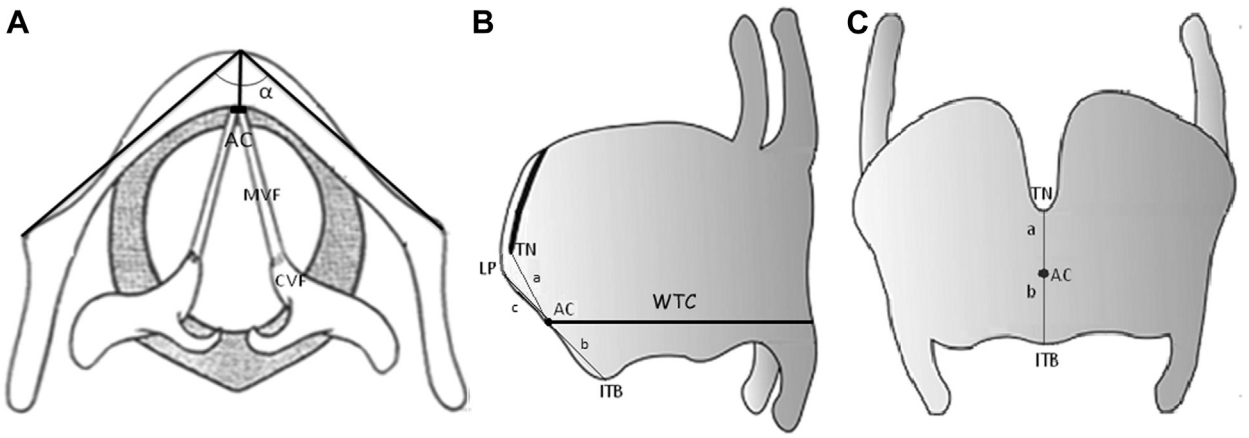

FIGURE 1. Measurements included in the study (external view). **A.** Superior view. **B.** Lateral view. **C.** Anterior view. α, external angle between the blades of the thyroid cartilage; WTC, width of the thyroid cartilage; a, distance from the thyroid notch to the AC; b, distance from the AC to the inferior thyroid border; c, distance from the AC to the larynx proeminence; AC, anterior commissure; MVF, membranacea part of vocal fold; CVF, cartilaginea part of vocal fold; TN, thyroid notch; ITB, inferior thyroid border; LP, larynx proeminence. Images adapted from Sprinzl et al[3] and images B and C adapted from Cicekcibasi et al.[8]

number 727–6/150; series 0002317). The following measurements on the laryngeal framework were made (Figure 1).

Measurements included in the study (external view).

External angle between the blades of the thyroid cartilage at the AC, measuring the angle and the tangent lines of the right and left blades from a point outside the AC obtained by a transfixing needle.

1. Width of the thyroid cartilage (WTC): anterior-posterior extension of the blades of the thyroid cartilage at the AC to the posterior margin of the blade.
2. Distance from the thyroid notch (TN) to the AC.
3. Distance from the AC to the inferior thyroid border in midline.
4. Distance from the AC to the larynx proeminence.

The larynges were divided in the sagittal plane with a vertical incision. The boundary between the membranous and cartilaginous part of the vocal fold (VF) was marked by inserting a needle being held the following measures (Figure 2):

Measurements realized with larynges sectioned in the sagittal plane (internal view).

1. Length of membranacea part of VF: extension from the AC to begin of vocal process of the arytenoid cartilage.
2. Length of cartilaginea part of VF: the anterior end of the vocal process until its later insertion in the horizontal plane of the interarytenoid mucosa.
3. Length of VF: obtained by sum of length of both cartilaginea and membranacea part of VF.
4. Width of true VF (WVF): we draw a tangential line to the vocal process that extends the medial edge of the VF at the time of insertion of the arytenoid cartilage (vocal process) until its lateral limit, near the thyroid cartilage.
5. Thickness of true VF (TVF): extension from the free edge of the VF in the vertical plane, the height of the vocal process to the base of the VF in the infraglottis.

Statistical analysis

The WTC length of membranacea part of VF, length of cartilaginea part of VF, TVF, and WVF measurements were made bilaterally, and the average between them was used for statistical analysis. Data were analyzed by *SPSS* software and Student *t* test ($P < 0.05$) to compare the values between the sexes and one-way analysis of variance ($P < 0.05$) for comparison between the different age groups (40–49, 50–59, 60–69, and older than 70) for both sexes.

RESULTS

Thousand two hundred ninety-four measurements were taken, and 13 measured (carried out) in each of the 100 larynx studied. Six measurements, three of a female part and three of a male, were not performed for damaging the same. For each of the parameters, the mean and standard deviation were determined. The significance of difference between the individual parameters was examined with Student *t* test. The differences between men and women were highly significant. The detailed data of the various measurements are shown in Table 1. A significant difference in the comparison between the morphological measurements in the age groups both in men and women was not observed.

DISCUSSION

Synopsis of findings

The comparison of dimensions obtained on larynx samples of the men and women cadavers showed the presence of sexual dimorphism. There was significant statistical difference in all the measured values. All measured values were greater in men than in women, except for the thyroid angle, which was higher in women. When comparison was made between the age groups of the same sex, no significant difference among the measured values was observed, indicating that after 40 years, there is little morphometric difference between larynx samples of the individuals of the same sex.