

Linear Measurements of Vocal Folds and Laryngeal Dimensions in Freshly Excised Human Larynges

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Summary: Introduction. Understanding the morphology of the larynx, one of the most complex organs of the human body, is an important step toward understanding the detailed laryngeal anatomy, and physiology. Different studies have described the linear measurements of the larynx in different measuring methods, but no studies have been structured to describe vocal fold length in freshly excised larynges.

Objectives. The aim of this study was to describe exact anatomical measurements of vocal folds and some laryngeal structures in freshly excised larynges, and to compare such measurements between males and females. This can help improve the diagnostic and therapeutic procedures in the laryngology field.

Subjects and Methods. This study was applied on 21 patients having different types of laryngeal carcinoma: 11 males and 10 females with the age range 41–75 years old. Every patient was assessed using laryngeal endoscopy and photography, and the length of the membranous vocal fold was measured using a millimeter-graded ruler that was photographed with focus with the same magnification used in the video laryngoscopy of the glottis. Then patients were exposed to total laryngectomy, and excised larynges were used for a direct measuring of the membranous and cartilaginous vocal folds. Then measures of men and women were compared statistically. Measures of excised larynges were also compared with those of the video endoscopy using a video-printed ruler.

Conclusion. Freshly excised larynges can be used for accurate quantitative measuring of the vocal fold length and laryngeal dimensions. There are considerable differences in all measured dimensions between males and females.

Key Words: Linear measurements–Vocal folds–Laryngeal dimensions–Freshly excised–Human larynges.

INTRODUCTION

The true vocal fold and supraglottic structures are important structures of the larynx. Along with airway protection, the larynx and true vocal cord are also active during voice production and respiration. The increasing need for diagnosis and treatment of laryngeal and voice diseases requires precise data for the laryngeal dimensions.¹

In the past, knowledge of morphological features of the larynx aroused little interest. However, with the advent of technology and methods of radiological investigation such as magnetic resonance imaging (MRI) and computerized tomography, better visualization of the laryngeal structures has been provided and greater interest has been aroused on the part of clinicians and surgeons.² Understanding the morphology of the larynx, one of the most complex organs of the human body, is a crucial step toward elucidating the detailed laryngeal embryology, anatomy, and physiology.²

Many morphological studies were applied to describe the structure and dimensions of the human larynges. Most of them show that there is sexual dimorphism in all measured laryngeal dimensions. Although these differences are not clear in children,

they arise at puberty, suggesting that they occur due to the vocal remodeling that happens during puberty.^{3–6}

The aim of this study was to describe exact anatomical measurements of vocal folds and some laryngeal structures in freshly excised larynges and to compare such measurements between males and females in order to establish a normal range variation of these measurements among Egyptians. This can help improve the diagnostic and therapeutic procedures in the field of laryngology.

SUBJECTS AND METHODS

Design

This study was applied at the ORL Department, Faculty of Medicine, Zagazig University, in the period from May 2014 to December 2016. It was conducted on 21 patients having different types of laryngeal carcinoma: 11 males and 10 females with the age range 41–75 years old. The site and side of laryngeal masses were assessed by laryngovideostroboscopy using a rigid 70-degree laryngoscope, from Xion Medicals (Germany), connected to a camera in association with stroboscopic light. Then the length of the membranous vocal fold (at the healthy side) was measured using a millimeter-graded ruler that was photographed with focus with the same magnification used in the video laryngoscopy of the glottis.⁷ Every laryngeal photo had its own printed ruler according to its suitable focus. Diagnosis of the cancer was confirmed with computed tomography (CT) and histopathological examination. Then patients were exposed to total laryngectomy according to the recommendations of surgeons, and excised larynges were used for measuring the intended vocal fold and laryngeal measures by a millimeter graded tool (Figures 1A and 1B).

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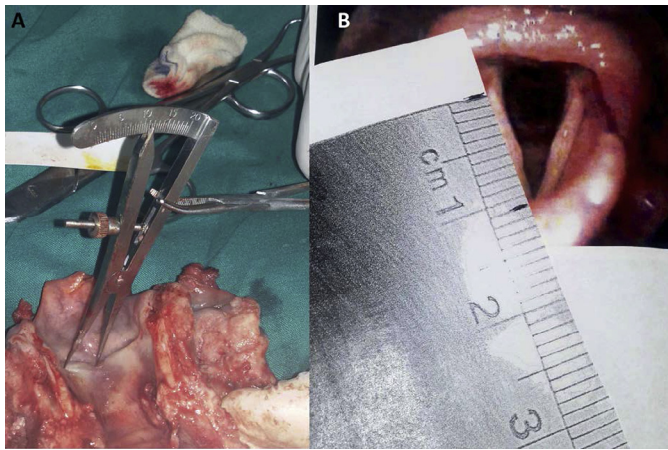


FIGURE 1. Measuring the membranous vocal fold length in a 41-year-old female patient. **A.** Direct measuring. **B.** Endoscopic measuring.

Measures

Excised larynges were used for direct measuring of the following measures:

1. The length of membranous vocal fold: measured from the anterior commissure to the vocal process of the arytenoid cartilage (Figure 2).
2. The length of the cartilaginous part of the vocal fold, from the anterior end of the vocal process to its insertion in the interarytenoid mucosa (Figure 2).

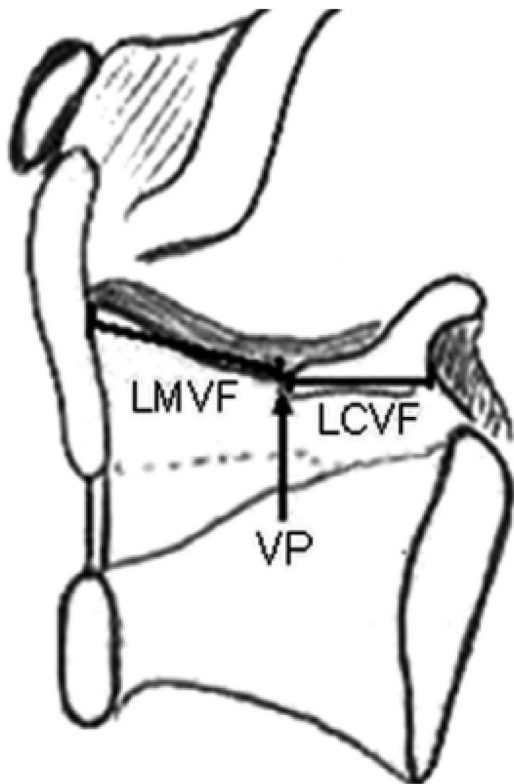


FIGURE 2. Measures of the vocal folds. LCVF, Length of the cartilaginous vocal fold; LMVF, Length of the membranous vocal fold; VP, vocal process (modified from Jotz et al²).

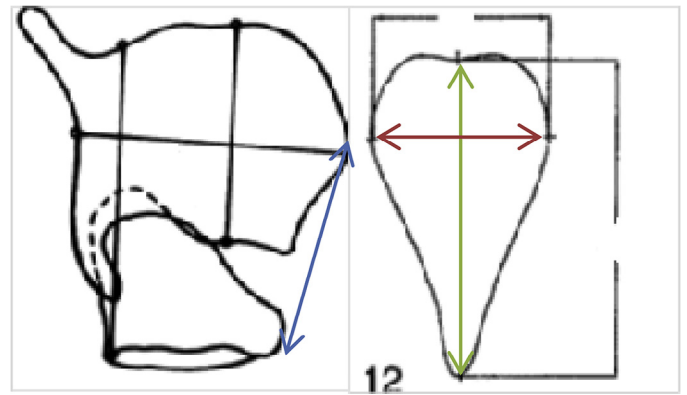


FIGURE 3. Laryngeal measures: (\leftrightarrow) laryngeal height, (\leftrightarrow) epiglottic length and (\leftrightarrow): epiglottic width (modified from Ajmani⁶).

3. The length of the vocal fold: the sum of the length of both cartilaginous and membranous parts of the vocal fold (Figure 2).
4. The width of the true vocal fold: it was measured at the point of insertion of the vocal fold at the vocal process from the medial edge of the vocal fold until its lateral end adjacent to the thyroid cartilage (Figure 2).
5. The thickness of true vocal fold: measured from the free edge of the vocal fold vertically, at the level of the vocal process to the base of the vocal fold at the infra-glottis (Figure 2).
6. The length of the epiglottis: measured vertically at the midline from the highest point downward till the point of insertion in the thyroid cartilage (Figure 3).
7. The width of the epiglottis: measured between the widest two points of the epiglottis horizontally (Figure 3).
8. The main height of the larynx: measured from the thyroid notch till the lower end of cricoid cartilage (Figure 3).

All measures were taken from healthy intact side and tissue (free of any masses).

Statistical analysis

Results were compared statistically using SPSS 20.0 (SPSS Inc., Chicago, IL). The Mann-Whitney (nonparametric) test and an unpaired *t* test were used to compare quantitative data, while Fisher's exact test was used to compare qualitative data. A *P* value less than 0.05 was considered significant.

RESULTS

Participants of this study were divided into two subgroups: the subgroup of males ($N = 11$) aged 59 years \pm 11.5 and the subgroup of females ($N = 10$) aged 57 years \pm 10.7 suffering from different types of laryngeal cancer. Eight males presented with transglottic cancer, two with subglottic cancer, and one with postcricoid carcinoma, while seven females presented with postcricoid carcinoma, two with pyriform sinus cancer, and one with transglottic cancer. Total laryngectomy and bilateral functional lymph node dissection was done for 13 patients, and total laryngopharyngectomy and bilateral functional lymph node dissection and reconstruction by thoracodorsal artery perforator

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