Original Article

Distance Between Cricothyroid Articulation in Relation to Age & Sex: A Cadaveric Study in Bangladeshi Population

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Abstract

Background*: The cricothyroid joint is an important anatomical structure of the larynx and its morphometric variation with age and sex has clinical relevance.*

Methods*: A descriptive cross-sectional investigation was carried out to evaluate the interval between the cricothyroid joints relative to age and gender in cadaveric samples from Bangladesh. A total of sixty human larynges were collected postmortem over a period of six months. Amongthem, forty-five samples were obtained from autopsied individuals aged between 9 and 60 years and fifteen samples were collected from stillborn fetuses with a gestational age ranging from 28 to 40 weeks. The distance between the right and left cricothyroid joints was measured in millimeters using slide calipers and variations were analyzed according to age category and sex.*

Results*: The mean distance between the cricothyroid joints was 9.40 mm in the fetal group, 20.44 mm in the pediatric group and 24.07 mm in the adult group. The highest mean distance was observed in the adult group, where as the lowest was found in the fetal larynges. The differences in mean measurements among all age groups were statistically highly significant.*

Conclusion*: The distance between the cricothyroid joints increases progressively with age, showing significant variation among fetal, pediatric and adult larynges.*

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Introduction

The larynx functions primarily as an organ for breathing and sound production, situated within the airway between the pharynx and the trachea. Although phonation is important, its main role is to serve as a protective valve at the entrance of the lower airways, preventing the inhalation of foreign materials[1,2,3]. Highly developed in humans, the voice box is central to language, a key indicator of intellect[4]. Its structure comprises a framework of cartilages connected by synovial joints, ligaments and fibrous membranes, all lined with mucous membrane and operated by intrinsic muscles[2,3,5]. It consists of nine cartilages: three single (thyroid, cricoid and epiglottic) and three paired (arytenoid, corniculate and cuneiform)[3,6]. The cricothyroid joint (CTJ) is a synovial joint linking the inferior cornu of the thyroid cartilage to a facet on the cricoid arch, located at the junction of the cricoid lamina and arch. Each joint is surrounded by a capsular ligament, reinforced posteriorly and contains abundant elastin fibers. This joint permits a rocking motion where the cricoid rotates on the thyroid cornu around a transverse axis, along with limited gliding. The recurrent laryngeal nerve is positioned directly behind this joint[1,3,4]. The cricoarytenoid joint, another synovial joint between the arytenoid base and the cricoid lamina, has a lax capsule allowing both rotation and gliding. Movements at the CTJ enable the arytenoids to rotate, swinging the vocal processes to widen or narrow the glottis. A combined gliding motion opens the vocal folds into a V - shape in humans.

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Medial gliding occurs with medial rotation and lateral gliding with lateral rotation. The posterior cricoarytenoid ligaments limit forward movement and their resting position may determine the placement of a denervated vocal cord[1,4,5]. The CTJ, critical for adjusting vocal pitch, is often described as a diarthrodial hinge joint. Since Isshiki's 1974 description of laryngeal framework surgery[6], phonosurgical procedures like cricothyroid approximation to raise pitch have become a growing specialty[7,8]. Altering pitch involves changing vocal cord length and tension, with studies showing pitch elevation correlates with a 2-5 mm lengthening of the vocal fold[9,10,11]. Understanding the CTJ's anatomy aids surgeons, as its rotary action changes the distance between the cricoid and thyroid cartilages[12]. Detailed descriptions of these joints are often absent from standard anatomy and otolaryngology texts[13] and few studies focus on their functional morphology[6,11,14,15,16]. Precise anatomical knowledge is essential for diagnosing abnormalities and planning surgeries like intubation, thyroplasty, or laryngectomy. While MRI is useful, it can yield measurements smaller than actual anatomical dimensions[17]. Therefore,cadaveric study remains a fundamental prerequisite for gaining the detailed surgical insight required. This study was designed to provide a detailed anatomy of the CTJ to assist surgeons performing laryngeal framework surgery.

Methods

Laryngeal specimens were obtained from cadavers autopsied at the Forensic Medicine Department and from deceased neonates in the Obstetrics and Gynecology Department at Mymensingh Medical College, Mymensingh, collected intermittently between October 2008 and March 2009. All cadaveric samples originated from medico-legal cases involving unnatural death, with an additional group from stillborn infants. Selection criteria included only fresh specimens from individuals deceased within the prior 12 to 24 hours and stillborn infants immediately after delivery. The age of individuals from whom larynges were collected ranged from newborn to 60 years. For stillborn infants, the gestational age was between 28 and 40 weeks. During routine postmortem examination, a "Block Dissection" was performed on each cadaver. The excised tissue block was then gently rinsed under running tap water to remove blood and clots as thoroughly as possible. Each specimen was labeled with a waxed cloth tag bearing a unique identification number before being fixed and stored in a 10.0% formalin-saline solution. To assess the distance between the cricothyroid articulations in relation to age and sex, the specimens were categorized into three groups: Group A (stillborn infants at 28 to 40 weeks gestation)[18]. Group B (ages 9 to 16 years) and Group C (ages 17 to 60 years)[19]. Through careful dissection, the surrounding muscles, ligaments and mucous membrane were removed to fully expose the cricothyroid articulation. The distance between the articulations was measured using vernier calipers and recorded in millimeters (Figure 1)[20].

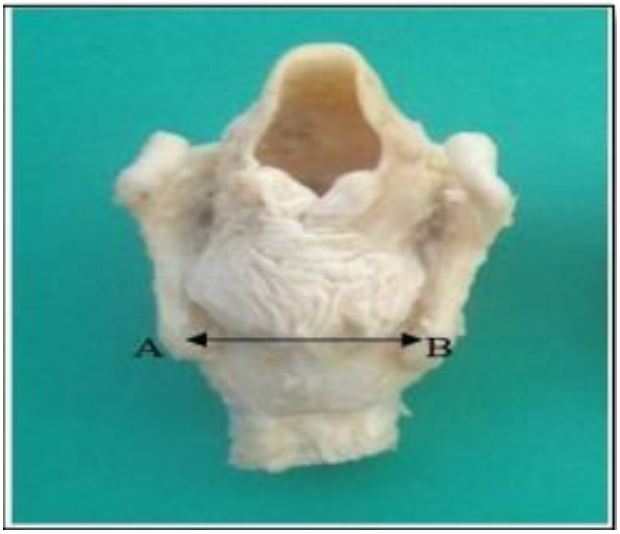

Figure 1: Cartilage model of larynx (posterior view) taken from age groups C(17 to 60 years), showing the distance between cricothyroid articulation All collected information was organized, compiled and subjected to statistical analysis using the Statistical Package for the Social Sciences (SPSS), version 11.0. Comparisons across the different groups were conducted using a one-way ANOVA test, while differences between sexes were evaluated with an unpaired Student's t-test. A probability (P) value of less than 0.05 was deemed statistically significant. The research protocol received approval from the Ethical Review Committee of Mymensingh Medical College Hospital, Mymensingh, Bangladesh.

Results

This research was conducted on sixty human larynges at the Anatomy Department of

Mymensingh Medical College, Mymensingh. The sample comprised forty-five specimens obtained from cadavers of both sexes and fifteen from stillborn infants at a viable gestational age of twenty-eight to forty weeks. As indicated in Table 2 and Figure 2, the analysis revealed that the mean distance between the cricothyroid articulations was 9.40 mm in Group A (stillborn infants at 28-40 weeksgestation), 20.44 mm in Group B (ages 9-16 years) and 24.07 mm in Group C (ages 17-60 years). The measurements ranged from 8 to 11 mm in Group A, 18 to 24 mm in Group B and 20 to 29 mm in Group C.

Table I: Age group of the study subjects

Age group	Total numbe of specimens	Male	Female
Group A: Stillborn infants betwee 28 and 40 weeks of gestation	15	06	09
Group B: 9 to 16 years old	16	06	10
Group C: 17 to 60 years old	16	17	12

Table II: Distance between Cricothyroid Articulations in Different Age Groups

Age group	Total numbe of specimens	Mean distance±SD (mm) (Range)
Group A: stillborn infants between 28 and 40 weeks of gestation	15	9.40±1.06 (8-11)
Group B: 9 to 16 years old	16	20.44±1.86 (18-24)
Group C: 17 to 60 years old	29	27.07±2.59 (20-29)

The greatest average span between the cricothyroid joints was observed in Group C (24.07 mm), while the smallest was in Group A (9.40 mm). The differences in mean distance between each paired Group A and B, A and C and B and C- were all determined to be highly significant.

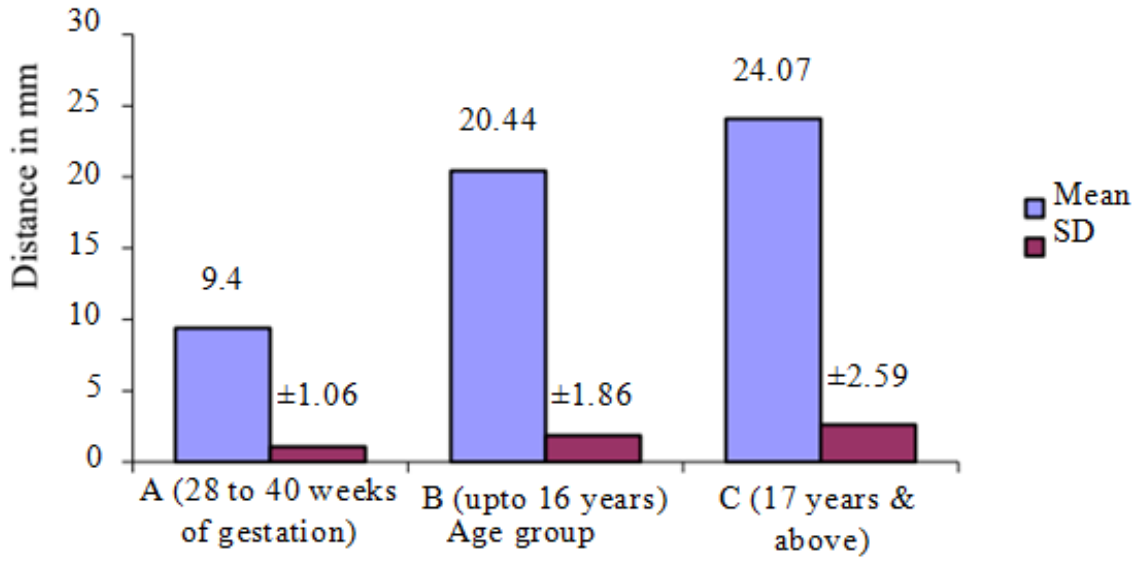

Figure 2: Bar diagram showing the mean distance between cricothyroid articulations in different age groups

Table III: Comparison of distance between cricothyroid articulations among the age groups

Comparison Groups	Level of Significance
A vs. B	P = 0.000 (p<0.001)
A vs. C	P = 0.000 (p<0.001)
B vs. C	P = 0.000 (p<0.001)

Table IV: Comparison of mean distance between cricothyroid articulations in different sex of different age groups

Age group	Sex of the person	Number	Mean distance in mm	±SD	t-value	p value
Group A: Stillborn infants between 28 and 40 weeks of gestation	Male	06	10.00	0.89	1.975	0.070
	Female	09	9.00	1.00		
Group B: 9 to 16 years old	Male	06	20.67	2.34	0.370	0.717
	Female	10	20.30	1.64		
Group C: 17 to 60 years old	Male	17	24.71	2.78	1.621	0.117
	Female	12	23.17	2.08		

Discussion

This investigation determined that the average span between the cricothyroid joints was 9.40 mm in Group A (stillborn infants at 28-40 weeks of gestation), 20.44 mm in Group B (ages 9-16 years) and 24.07 mm in Group C (ages 17-60 years). Ximenes et al. suggested that the thyroid cartilage's longer lamina and the more posterior placement of the cricothyroid articulation in males could increase the difficulty of exposing the arytenoid cartilage during laryngeal framework procedures. The measured distance between these articulations showed a statistically significant variation across age groups but not between sexes[20]. Numerous studies have examined the mechanics of the cricothyroid joint through laryngeal observation during phonation and by testing the mobility of excised cartilages. Employing X-ray photography, Sonninen noted an antero-posterior translation of approximately 3 mm for a three-octave shift in fundamental frequency. Research on laryngeal specimens, however, has yielded conflicting conclusions. Mayet et al. concluded that translation does not occur, as the joint's connecting ligaments restrict such movement[22]. Conversely, Fink observed a 1-2 mm translation when manually applying force to an excised larynx[23]. Furthermore, Vilkman et al., through their analysis of joint obility, demonstrated that translational movement is greater when rotational movement is less pronounced[14,15,21,22,23].

Conclusion

A review of existing literature from standard textbooks and journals on the morphology and histology of the human larynx reveals an absence of specific research on the Bangladeshi population. Consequently, scientific and clinical practice in this area mustrely on foreign data derived from subjects of different ethnicities and geographic environments. This study was therefore conceived to conduct a comprehensive evaluation of the gross and microscopic anatomy of the larynx in Bangladeshi individuals, aimingto contribute to the establishment of national anatomical standards. In this investigation, the mean distance between the cricothyroid articulations was measured at 9.40 mm in Group A (gestational age 28-40 weeks), 20.44 mm in Group B (ages 9-16 years) and 24.07 mm in Group C (age 17 years and above). These findings demonstrate a direct correlation with age, showing an increase in this anatomical dimension

as individuals grow older. The results are also compared with prior observations from Western populations to identify potential racial variations.It is anticipated that these observations will assist clinicians and surgeons in understanding the typical laryngeal anatomy specific to Bangladeshi patients, informing their diagnostic and therapeutic approaches.

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