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Morphometric Study of Thyroid And Cricoid Cartilages in Adults By CT Method

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Abstract

Background: The increasing application of sophisticated electro-physiological & radiological methods for the diagnosis and treatment of laryngeal disorders requires an extensive knowledge of the size and proportions of the human larynx & its cartilaginous components.

Aims: The present study was done to know the morphometric features of Thyroid and Cricoid cartilages in adult males and females by CT method in South Indian population and to compare with other studies.

Materials and Methods: The present study was done on 62 (31 Male, 31 Female) patients undergoing CT neck attending the Department of Radiology, KR Hospital attached to Mysore Medical College & Research Institute, Mysore for a period of 1 year from Jan 2014 to Dec 2014.

In the Computerized Tomography of Neck measurements of Thyroid & Cricoid cartilages were taken. The following measurements were taken for Thyroid cartilage, thyroid angle, maximum thyroid width, median antero-posterior diameter, antero-posterior length of right and left lamina. And for Cricoid cartilage antero-posterior and transverse diameter, thickness of Arch and thickness of Lamina were measured.

Results: In both thyroid and cricoid cartilages the mean values of all parameters were correspondingly higher in males except for angle between thyroid laminae which was more in females. Mean thyroid angle in males was 75.43 ± 12.09 and females 89.87 ± 12.79. Mean thyroid width in males was 40.81 ± 5.98 and females 35.52 ± 4.84. Mean median antero-posterior length in males was 29.45 ± 4.57 and females 28.7 ± 4.63. Mean antero-posterior length of right lamina in males was 36.90 ± 5.12 and females 28.7 ± 4.63. Mean antero-posterior length of left lamina in males was 38.4 ± 4.17 and females 28.8 ± 4.17.

Mean antero-posterior length of Cricoid cartilage in males was 27.5 ± 2.84. Mean transverse diameter in males was 27.27 ± 2.36 & females 20.89 ± 2.06. Mean thickness of arch in males was 1.96 ± 0.84 & females 1.94 ± 0.9. Mean thickness of lamina in males was 4.24 ± 1.31 & females 4.51 ± 1.18.

Conclusion: These morphological differences have important clinical and surgical implications. They are critical to the accurate placement of needles and probes in laryngeal electro myography and vocal cord injection, medialization procedures, in performing supraglottic laryngectomy, as well as precise planning of laryngeal framework surgery.

Keywords: Larynx; Thyroid Cartilage; Cricoid Cartilage; Morphometry; Sex determination.

Introduction

The larynx is made up of a series of cartilages interconnected by ligaments and fibrous membranes. The laryngeal cartilages are the unpaired cricoid, thyroid and epiglottic cartilages, and the paired arytenoid, cuneiform, corniculate and tritiate cartilages.[1]

Anatomy of larynx is necessary for those who are involved in fields of surgical treatment of larynx such as speech therapists, anaesthetists, oncologists, pulmonologists, radiologists, general practitioners, ENT specialists and Phoniatritians.[2]

A knowledge of dimensions of cartilages of larynx and trachea is a must for transplantation, stenting, intubation, crico-thyroidotomy and endoscopic procedures.[3]

Subglottic stenosis and post intubational stenosis of lower respiratory tract were two main factors which lead anatomists to work for measurements of various cartilages in early ninties.[4]

Data such as endolaryngeal angles, airway lumina and thickness of parts of laryngeal skeleton can be helpful in planning of endolaryngeal surgical intervention or transcutaneous placement of electrodes for electro myography or the analysis of CT and MRI scans of the larynx.[5]

The increasing application of sophisticated electro physiological, radiological and surgical methods for the diagnosis and surgical methods for the diagnosis and treatment of laryngeal disorders requires profound knowledge of size and proportion of human larynx and its cartilaginous compounds.[5,6]

Symmetry of larynx is extremely important from clinical point of view as a rotated thyroid cartilage and dislocation of superior thyroid cornua projecting in to ipsilateral pyriform fossa may lead to globus pharyngeous, sticking of food in upper neck, dysphagia or odynophagia.[7]

It has also been hypothesized that foramen thyroideum may provide a pathway for adeno carcinaoma and pyriform recess or transglottic tumours but remains resistant to laryngeal cancer as rest of thyroid lamina.[8]

A procedure called 'laryngofissure' that is cutting through the thyroid cartilage and removing the inner perichondrium and everything inward of that in an area of carcinoma is effective in a high percentage of carefully chosen cases. It is emphasized that this approach avoids the necessity of removing the entire larynx.[9]

Thus knowledge of different parameters of various laryngeal cartilages is necessary before attempting different surgical or other interventions. So the present study was designed to attain this information in detail about thyroid and cricoid cartilages.

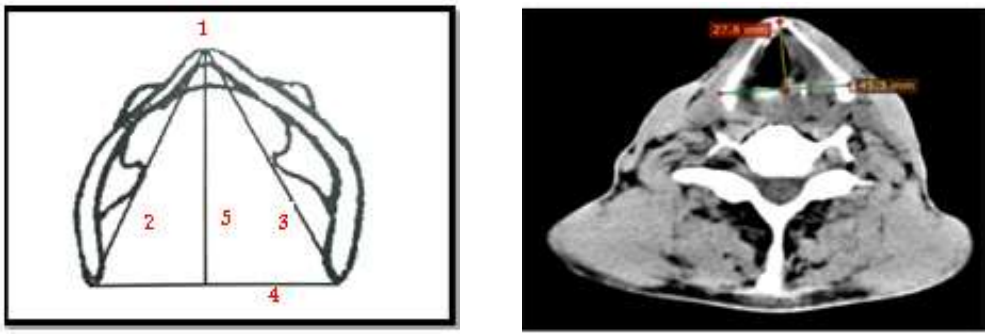
Materials and Methods

The present study was done on 62 (31 Male, 31 Female) patients undergoing CT neck attending the Department of Radiology, KR Hospital attached to Mysore Medical College & Research Institute, Mysore. The duration of study was 1 year from Jan 2014 to Dec 2014. The present study includes CT scans of both male and female patients of adult age group (18 to 70 years). We have excluded CT scans of patients below 18 years & above 70 years age and also CT scans done for cases with history of previous laryngeal surgery.

The details of the case such as name, age, sex, address, in patient number and indications for CT scan were collected. In the Computerized Tomography of Neck measurements of Thyroid & Cricoid cartilages were taken.

In the present study, the computerized tomography films will be taken in 3–4 slices and measurements will be taken at two levels by using Radiant Dicom Viewer software.

Following five measurements of Thyroid cartilage was taken at one level, where both Thyroid laminae were clearly visible and joined to each other at an angle and the length of lamina was maximum (Fig. 1).



(a) (b)

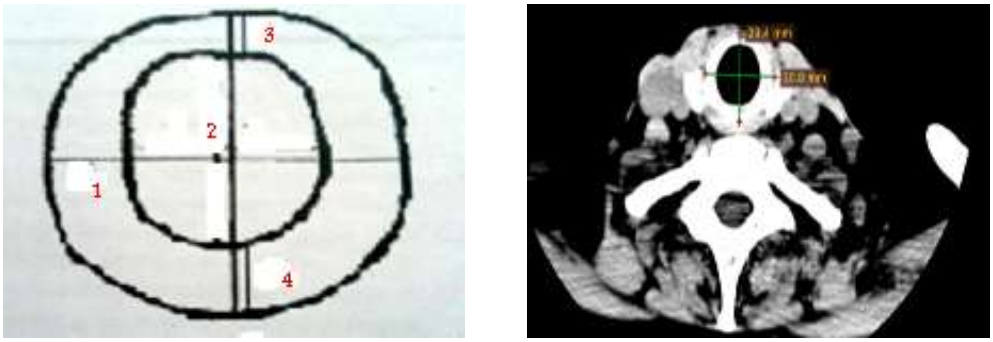
Fig. 1: Showing various measurements of thyroid cartilage (a) line diagram, (b) CT photograph.

Thyroid angle (angle between two thyroid laminae)

1. Antero-posterior length of right lamina (distance from Thyroid angle to the posterior margin of the right lamina)
2. Antero-posterior length of left lamina (distance from thyroid angle to the posterior margin of the left lamina)
3. Maximum thyroid breadth (distance between the posterior margins of the two laminae)
4. Median antero-posterior diameter (distance between the thyroid angle and a point midway between maximum thyroid breadth)

Following measurements of Cricoid cartilage were taken at one level where a complete ring of cartilage was clearly visible (Fig. 2).

1. Transverse diameter (outer)
2. Antero-posterior diameter (outer)
3. Thickness of arch
4. Thickness of lamina



(a) (b)

Fig. 2: Showing various measurements of Cricoid cartilage (a) line diagram, (b) CT photograph.

Results

In thyroid cartilage the mean values of all the parameters in males were correspondingly higher than females except for angle between thyroid laminae (Table 1). A significant difference was observed between the values of both sexes in all parameters ($p < 0.05$). The antero-posterior length of right & left lamina was almost equal in females where as in males, left lamina was found slightly more compared to right lamina.

Table 1: Comparison of various Parameters of Thyroid and Cricoid cartilages measured between male and female by CT scan that is in living individuals

	Male				Female			
Parameters	**Mean**	**Std. Dev**	**min**	**max**	**mean**	**Std. Dev**	**Min**	**max**
Thyroid cartilage								
Thyroid angle	75.43	12.09	52.9	111.2	89.87	12.79	69.1	123.3
Maximum thyroid width	40.81	5.98	30.8	57.3	35.52	4.64	27.1	45.3
Median AP diameter	29.45	4.57	19.1	38.8	21.10	3.52	16.6	29.6
AP of right lamina	36.90	5.12	22.7	45.8	28.7	4.63	20.9	38.6
AP of left lamina	38.40	4.17	27.1	44.7	28.8	4.17	22.4	38.7
Cricoid cartilage								
AP diameter	27.5	2.84	23.4	34.4	22.72	2.61	18.6	31.2
Transverse diameter	27.27	2.36	22.2	30.5	20.89	2.06	16.8	24.9
Thickness of Arch	1.96	0.84	0.5	3.8	1.94	0.90	0.90	4.1
Thickness of Lamina	4.24	1.31	2	7.6	4.51	1.18	3	7.8

In Cricoid cartilage the antero-posterior and transverse diameter are equal in males, where as in females antero-posterior diameter is more compared to transverse diameter. There was no significant difference between male and female with respect to thickness of arch and thickness of lamina. The thickness of lamina was more compared to thickness of arch in both the sexes.

Discussion

Morphology of larynx has gained clinical significance with the introduction of CT scan and MRI. This knowledge is helpful for trans-cutaneous trans-cricothyroid membrane approach to endolaryngeal structures which is used for techniques such as placement of electrodes for laryngeal electromyography and transcutaneous botulinium injection of the paralyzed vocal fold.[10]

Laryngological imaging and elaboration of new surgical concepts for the treatment of phonatory disorders has recently awakened new interest in larynx morphometry.[11]

The size of thyroid and cricoid cartilages is reported to be smaller in women as compared to men in cadaveric studies[4] and also in the present study by CT scan. Number of workers noted that 90% of women had post-intubation glottis and subglottic stenosis.[12] This can explain higher incidence of post intubation laryngeal injury in women.

Table 2 showing the mean values of Thyroid and Cricoid cartilages are larger in males compared to females in both the studies except the angle. Mean values of all parameters of both cartilages are more in the present study compared to the study done by Monica Jain[10] which may be due to racial difference. In present study the mean antero-posterior measurement of Cricoid cartilage is equal to the mean transverse diameter in males, where as in females the mean antero-posterior measurement is more compared to the mean transverse diameter.

Table 2: Comparison with study done by Monica Jain[10]

Sl. No	Parameter	Monica Jain[10] (Mean ± SD)		Present study (2019) (Mean ± SD)	
		Male	Female	Male	Female
1	Thyroid angle	72.60 ± 8.26	84.87 ± 8.12	75.43 ± 12.09	89.87 ± 12.79
2	Maximum thyroid width	37.8 ± 3.6	34.9 ± 4.5	40.81 ± 5.98	35.52 ± 4.64
3	AP of right lamina	36.8 ± 4.8	29.7 ± 5.1	36.90 ± 5.12	28.7 ± 4.63
4	AP of left lamina	35.2 ± 5.9	29.2 ± 4.6	38.40 ± 4.17	28.8 ± 4.17
5	AP diameter of Cricoid cartilage	28.6 ± 4.9	23.2 ± 4.1	27.75 ± 2.84	22.72 ± 2.61
6	Transverse diameter of Cricoid cartilage	25.7 ± 3.2	21.3 ± 4.7	27.27 ± 2.36	20.89 ± 2.06

Lipton et al.[11] reported a study on the sectional anatomy of larynx with respect to the cricothyroid membrane as applied to the transcutaneous approach to endolaryngeal structures. For example, thyroarytenoid muscle could be approached in a saggital plane approximately 5 mm from the midline at an approximate angle of 50° and a depth of 9–13 mm in males and at an angle of 40° and depth of 7–9 mm in females. Such measurements were obviously related to the size of laryngeal cartilage and were important for the placement of electrographic electrodes and for the injection of botulinium toxin for spastic dysphonia suggesting the importance of taking measurements of larynx in living.

Shin et al. reported mean height of Cricoid cartilage marrow In 13.6 mm (range 5.5 to 20.5 mm) in women & 17.5 mm (range 13.0 to 24.5 mm) in men. The mean thickness of Cricoid cartilage marrow was 3.17 (range 1.22 to 4.75 mm) in women and 5.13 mm (range 3.42 to 7.6 mm) in men[13] which is less compared to present study.

Conclusion

Thus to conclude in the present study all parameters of thyroid and cricoid cartilages are more in males compared to females except thyroid angle which was more in females.

The mean antero-posterior measurement of Cricoid cartilage is equal to the mean transverse diameter in males, where as in females the mean antero-posterior measurement is more compared to the mean transverse diameter.

The size of thyroid and cricoid cartilages is reported to be smaller in women as compared to men in the present study by CT scan.

References

1. Standring S. Larynx. In: Barry K B Berkovitz (editors). Gray's Anatomy. 40th Edition. London: Elsevier Charchill Livingstone: The anatomical basis of clinical practice; 2006. pp.577–93.
2. Kutta H, Knipping S, Claassen H and Paulsen F. Functional anatomy of the larynx from clinical viewpoints. Part I: development, laryngeal skeleton, joints, insertion structures, musculature. HNO 2007;55(7):583–98.
3. Randestad A, Lindholm CE and Fabian P. Dimensions of the cricoid cartilage and the trachea. The Laryngoscope 2000;110:1957–61.
4. Ajmani ML. A metrical study of the laryngeal skeleton in adult Nigerian. J Anat 1990;171:187–91.
5. Eckel HE, Sittel C, Zorowka P, et al. Dimensions of the laryngeal framework in adults. Surg Radiol Anat 1994;16:31–36.
6. Jain M, Dhall U. Morphometry of the thyroid and cricoid cartilages in Adults. J Anat Soc of India 2008;57(2):119–23.
7. Hajiioannou JK, Florou V and Kousoulis P (2010). Superior thyroid cornu anatomical variation causing globus Pharyngeous and dysphagia [serial online]. Available: URL:http://www.PubMed.com
8. Krichner JC, Krichner JA and Sasaki CT. Anatomic foramina in thyroid cartilage:incidence and implications for the spread of laryngeal cancer. Annals of Oto Rhino Laryngology 1989;98(6):421–25.
9. Jackson C and Jackson CL. Malignant disease of larynx: its treatment by laryngofissure and laryngectomy. American Journal of Surgery 1935;30–33.
10. Monika Jain, Usha Dhall. Morphometry of the thyroid and cricoid cartilages in Adults on CT scan. J Anat Soc of India 2010;59(1):19–23.
11. Lipton RJ, McCaffrey TV, Cahill DR. Sectional anatomy of the Larynx: Implication for the transcutaneous approach to endolaryngeal structures. Ann Otol Rhinol Laryngol 1989;98:141–44.
12. Harrison GA, Tonkin JP. Prolonged (therapeutic) endotracheal intubation. BR J Anaesth 1968;40:241–49.
13. Shin HW, Ahn Y, Sung MW, Kim KH, Kwon TK. Measurement of cross-sectional dimensions of cricoid cartilage: A computed tomographic study. Ann. Otol Rhinol Laryngol 2009 April;118(4):253–8.