

MORPHOMETRY OF THE THYROID AND CRICOID CARTILAGES IN ADULTS ON C.T. SCAN.

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ABSTRACT

In the present study, C.T.scan was done in 60 living subjects (30 males and 30 females) from region of Haryana who were undergoing C.T. scan for some reason other than larynx. Patients were in age group 20-50 years. A total of eleven measurements of thyroid and cricoid cartilages were taken on C.T. Scan to study sexual dimorphism. All parameters of thyroid cartilage except angle were found to be significantly more in males as compared to female. Thyroid angle was significantly smaller in males. Sex difference was also statistically significant for all parameters of cricoid cartilage except antero-posterior diameter. The measurements in living were also compared with those of cadavers. All of the CT measurements were lower than autopsy measurements. However, the difference was not statistically significant for most of the measurements.

Key Words : Laryngeal frame work, thyroid cartilage, cricoid cartilage, botulinium

INTRODUCTION

Accurate anatomic knowledge of laryngeal cartilages is essential in diagnostic and therapeutic procedures in the field of laryngology. Besides pure anthropometry, such information has potential application to study laryngeal physiology¹, in advanced methods of larynx imaging², and in surgery of laryngeal framework³. It is obvious that the application of such elaborate system requires profound knowledge of the normal morphometry of the larynx in living individual. Search through English literature did not reveal any morphometric study of laryngeal cartilages in living individuals based on C.T.Scan, although many morphometric studies have been reported on cadavers^{4,8}.

In view of scanty literature, the present preliminary work is proposed to study the morphometry of thyroid and cricoid cartilages in adult subjects by computed tomography (C.T) Scan.

MATERIAL & METHOD

Material used for present study includes 60 living individuals (30 males and 30 females) with age group varying between 20-50 years, who were undergoing C.T.Scan in the radiology department of

PGIMS, Rohtak, and MAMC Agroha for reasons other than laryngeal pathology. Patients with laryngeal pathology were excluded. Following five measurements of thyroid cartilage were taken at one level (Fig 1) where both thyroid laminae were clearly visible and joined to each other at an angle and the length of lamina was maximum.

1. Thyroid angle (angle between the two thyroid laminae)
2. Anteroposterior length of right lamina. (distance from thyroid angle to the posterior margin of the right lamina)
3. Anteroposterior length of left lamina (distance from thyroid angle to the posterior margin of the left lamina).
4. Maximum thyroid breadth (distance between the posterior margins of the two lamina)
5. Median Anteroposterior diameter (distance between the thyroid angle and a point midway between maximum thyroid breadth) Following six measurements of cricoid cartilage (Fig. 2) were taken at one level where a complete ring of cartilage was clearly visible.

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

The results were analysed statistically using "SYSTAT" Software.

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Table I: PARAMETERS OF THYROID AND CRICOID CARTILAGE ON C.T.SCAN

S.No.	PARAMETER	Male (mean+S.D.)	Female (mean+S.D.)	Student 't' test (p)
Thyroid cartilage				
1	Angle	72.60±8.26°	84.87±8.12°	0.000
2	Antero-posterior length of right lamina (mm)	33.9±5.1	29.7±5.1	0.003
3	Antero-posterior length of left lamina (mm)	33.9±5.9	29.2±4.6	0.002
4	Maximum thyroid breadth diameter (mm)	37.8±3.6	34.7±3.8	0.002
5	Median Antero-posterior diameter (mm)	31.4±4.4	25.2±4.0	0.000
Cricoid cartilage				
1	Transvers diameter (outer) (mm)	25.0±4.7	21.2±3.0	0.001
2	Transvers diameter (inner) (mm)	16.8±3.1	13.3±2.3	0.000
3	Antero-posterior diameter (outer) (mm)	23.6±4.4	22.8±2.9	0.447
4	Antero-posterior diameter (inner) (mm)	17.6±4.5	16.1±3.3	0.141
5	Thickness of arch (mm)	2.3±0.4	2.1±0.4	0.028
6	Thickness of lamina (mm)	4.2±0.9	3.7±0.8	0.028

: Values < 0.05 are statistically significant

OBSERVATIONS

Table 1 shows various parameters of thyroid and cricoid cartilages measured in male and in female in living individuals on C.T.Scan. Following observations can be made:

1) All these parameters except angle were found to be more in males as compared to females. The difference was statistically significant for all parameters

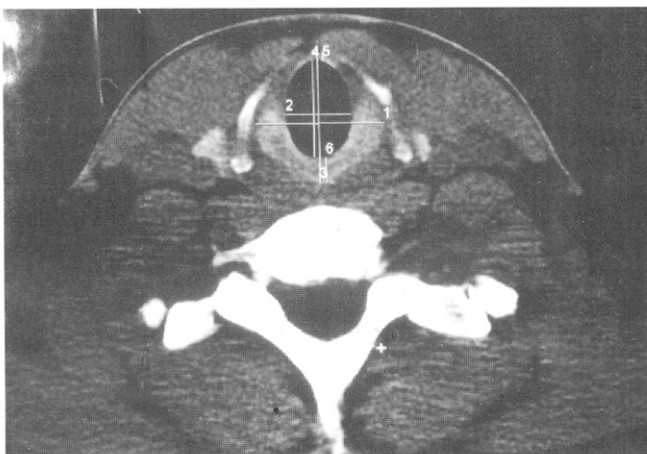


Fig. 1a: C.T.Photograph showing measurements of thyroid cartilage

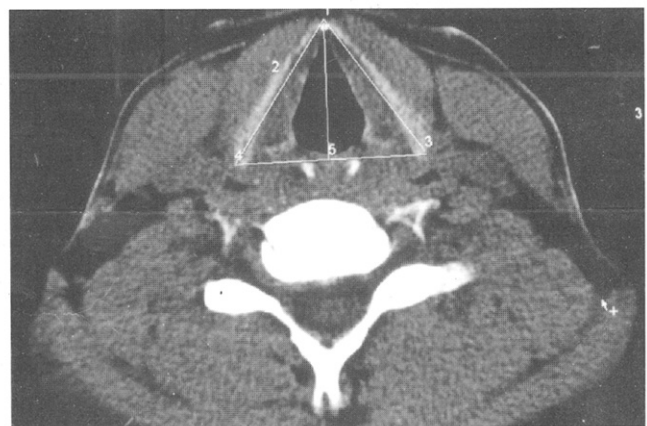


Fig. 1b: C.T.Photograph showing measurements of cricoid cartilage.

Table II: COMPARISON OF PARAMETERS OF THYROID AND CRICOID CARTILAGE IN AUTOPSY AND ON C.T.SCAN

S.No.	PARAMETER	Autopsy Male* (mean+S.D)	C.T. Scan Male (mean+S.D)	't' Test (p)	Autopsy Female (mean+S.D)	C.T. Scan Female (mean+S.D)	't' Test (p)
Thyroid cartilage							
1	Angle	85.25±9.54°	72.60±8.26°	0.000	97.85±10.35°	84.87±8.12°	0.000
2	Antero-posterior length of righth lamina (mm)	36.8±4.8	33.9±5.1	0.047	30.0±6.5	29.7±5.1	0.900
3	Antero-posterior length of left lamina (mm)	35.2±5.9	33.7±5.9	0.328	29.5±6.9	29.2±4.6	0.802
4	Maximum thyroid breadth (mm)	38.7±5.9	37.8±3.6	0.757	34.9±4.5	34.7±3.8	0.875
Cricoid cartilage							
1	Transverse diameter (outer) (mm)	25.7±3.2	25.0±4.7	0.527	21.3±4.7	21.2±3.0	0.967
2	Transverse diameter (inner) (mm)	17.2±3.6	16.8±3.1	0.681	15.7±4.4	13.3±2.3	0.048
3	Antero-posterior diameter (outer) (mm)	28.6±4.9	23.6±4.4	0.000	23.2±4.1	22.8±2.9	0.689
4	Antero-posterior diameter (inner) (mm)	19.5±2.5	17.6±4.5	0.087	16.5±5.0	16.1±3.3	0.684
5	Thickness of arch (mm)	3.1±0.84	2.4±0.4	0.001	2.8±0.7	2.1±0.4	0.000
6	Thickness of lamina (mm)	4.8±1.3	4.2±0.9	0.082	4.4±0.8	3.7±0.8	0.003

Value 0.05 are statistically significant...

* Earlies study Jain and Dhall, 2008

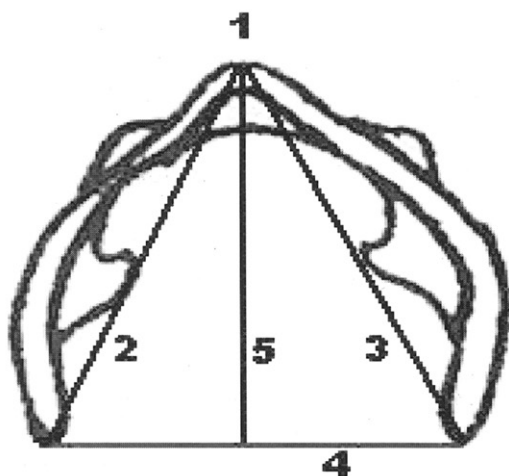


Fig. 2a: Line diagram of C T photograph showing measurements of thyroid cartilage

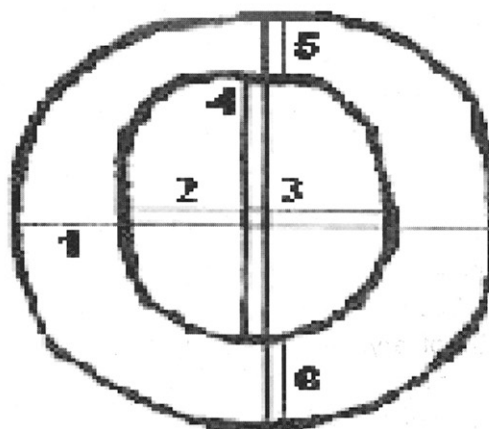


Fig. 2b: Line diagram of C T photograph showing measurements of cricoid cartilage

The numbers are as per text.

of thyroid cartilage. Sex difference was also found to be statistically significant for transverse diameter, thickness of arch and lamina of cricoid cartilage.

2) There was no significant difference in various parameters between right and left side.

DISCUSSION

Thorough search of the available English literature did not reveal any morphometric study of laryngeal cartilages in living by C.T.scan. Morphology of larynx has gained clinical significance with the introduction of C.T.Scan and MRI. Laryngological imaging and elaboration of new surgical concepts for the treatment of phonatory disorders has recently awakened new interest in larynx morphometry^{3,9,10}. Such studies are helpful for transcutaneous transcricothyroid membrane approach to endolaryngeal structures which is used for several techniques such as placement of electrodes for laryngeal electromyography and transcutaneous botulinum injection of the paralyzed vocal fold.

Way and Sooy¹¹, from their experimental studies on monkeys reported that post-intubation laryngeal injury was related to the difference in size between the tube & the larynx. A number of workers noted that 90% of adults with post-intubation glottic and subglottic stenosis were women¹²⁻¹⁴. The size of thyroid and cricoid cartilages is reported to be smaller in women as compared to men in cadaveric studies⁴⁻⁸ and also in the present study by C.T.Scan. This can explain higher incidence of post-intubation laryngeal injury in women.

Lipton et al¹⁰ studied 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 sagittal plane approximately 5mm 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 botulinum toxin for spastic dysphonia suggesting the importance of taking measurements of larynx in living. It would also be important to see if autopsy measurements could be extrapolated to living individuals or not. Comparison of

measurements of earlier studies on cadavers⁴⁻⁸ and present study in living shows that all C.T measurements are lower than autopsy measurements although the difference is not statistically significant for most of the measurements (Table II). The C.T. measurement of angle is significantly lower than autopsy measurement in both male and female. This may be explained by the fact that muscles are relaxed after death, so relatively mean value of angle is more in autopsy specimens. The significant difference in length of thyroid lamina and thickness of arch and lamina of cricoid cartilage is difficult to explain. This may be due to the fact that in C.T.scan, sections were cut at different levels and it was not possible to take measurements exactly at the same points as used for autopsy specimens.

REFERENCES

1. Williams RG, Eckel R. A new clinical measure of external laryngeal size which predicts the fundamental frequency of the larynx. *Acta Otolaryngol (Stockh)* 1990; 110:141-8.
2. Mancuso AA. In: *Computed tomography of the whole body, The larynx and hypopharynx*. Haaga JR, Alfidi RJ editors, 2nd ed, vol 2. CV mosby company, USA 1988:489-528.
3. Isshiki N. *Phonosurgery*. Springer Tokyo Berlin Heidelberg 1989: 61-9.
4. Maue WM, Dickson DR. Cartilages and ligaments of the adult human larynx. *Arch Otolaryngol* 1971; 94:432-39.
5. Ajmani ML. A metrical study of the laryngeal skeleton in adult Nigerian. *J Anat* 1990; 171:187-91.
6. Longia GS. Anthropometrical features of laryngeal cartilage. *J Forensic Med (Istanbul)* 1990; 6:141-8.
7. Harjeet, Jit I. Dimensions of the thyroid cartilage in neonates, children and adults in North West Indian subjects. *J Anat Soc India* 1992; 41(2): 81-92.
8. Jain M, Dhall U. Morphometry of the thyroid and cricoid cartilages in adults. *J.Anat. Soc. India*, 2008; 57(2):119-23.
9. Hirano M, Kurita S, Yukizane K, Hibi S. Asymmetry of the laryngeal frame work; A morphologic study of cadaver larynges. *Ann Otol Rhinol*

- Laryngol 1989; 98: 135-40.
10. 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.
 11. Way WL, Sooy FA. Histologic changes produced by endotracheal intubation. *Ann Oto Rhinol Laryngol* 1965; 74: 799-812.
 12. Harrison GA, Tonkin JP. Prolonged (therapeutic) endotracheal intubation. *Br J Anaesth* 1968; 40: 241-9.
 13. Hawkins DB. Glottic and Subglottic stenosis for endotracheal intubation. *Laryngoscope*. 1977; 87: 339-46.
 14. Hedden M, Ersoz CJ, Donnelly WH, Safar P. Laryngo tracheal damages after prolonged use of orotracheal tubes in adults. *JAMA* 1969; 207: 703-8.