

A metrical study of the laryngeal skeleton in adult Nigerians

M. L. AJMANI

*Department of Anatomy, All-India Institute of Medical Sciences, Ansari Nagar,
New Delhi 110029, India*

(Accepted 1 February 1990)

INTRODUCTION

Few measurements of the laryngeal cartilages have been made. Too-chung & Green (1974) studied various measurements of the cricoid cartilage in specimens obtained from neonatal to 15 years old cadavers with a view to studying the rate of growth of cartilage. Ajmani, Jain & Saxena (1980) have made various measurements of laryngeal cartilages in Indians. The dimensions of adult laryngeal skeletons of man and of the sheep have been studied for the purpose of judging the suitability of the sheep's larynx as a model for various surgical and functional investigations in human laryngology (Zrunek, Happak, Hermann & Streinzer, 1988). Recent interest in the condition of subglottic stenosis and post-intubational stenosis of the lower respiratory tract led to a search through the literature to ascertain the measurements of the various cartilages of the larynx. It is surprising that these measurements are so rarely mentioned. Of all the current texts consulted, none recorded any significant data. Some measurements have been mentioned by Williams, Warwick, Dyson & Bannister (1989) and Hollinshead (1968) but no studies have been carried out so far in Nigerians. This study is intended to establish the normal range of variation in the relative size and shape of the laryngeal cartilages in a Nigerian population.

MATERIALS AND METHODS

The laryngeal cartilages were collected from carefully dissected embalmed human cadavers available at the Department of Anatomy, Faculty of Medical Sciences, University of Jos, Nigeria over a period of six years. After exclusion of one non-Nigerian specimen, 40 sets of cartilages were used in this investigation. The age, sex and height were noted. The larynx was removed together with the trachea from the level of the hyoid bone to the third tracheal ring. After careful removal of all muscles and ligamentous attachments the cartilages were measured in all their dimensions with the help of thread, a vernier caliper and a goniometer. Their shape was also studied. Unequivocal and well-defined points were selected for evaluation. The following 21 measurements (Figs. 1, 2) including the thyroid angle were determined.

Thyroid cartilage

- (1) Length (height) of thyroid lamina (distance from upper to lower borders of lamina).
- (2) Breadth of thyroid lamina (distance from laryngeal prominence to the posterior margins of laminae).
- (3) Length of superior horns (distance from tip to base).
- (4) Length of inferior horns (distance from tip to base).
- (5) Depth of superior thyroid notch (distance from highest level of laminae to the floor of the superior thyroid incisure).

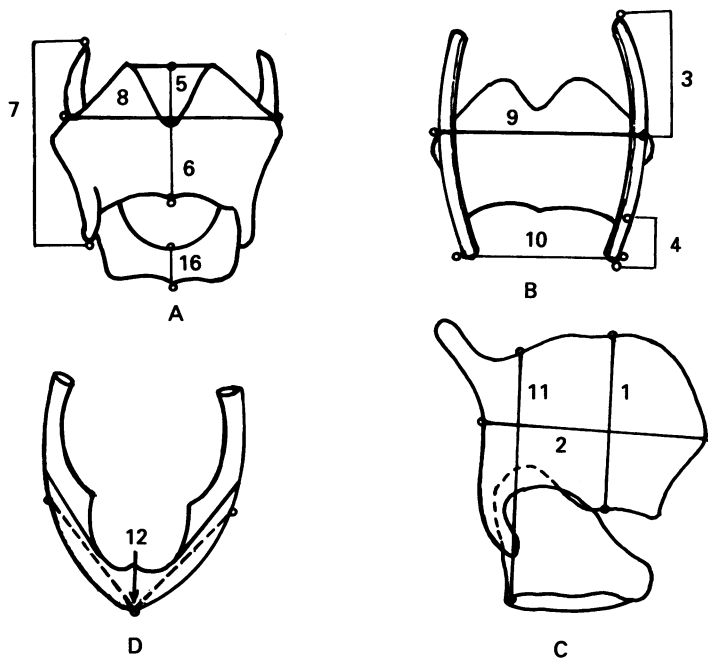


Fig. 1(A-D). Schematic drawings of skeleton of larynx indicating the points of measurements. Thyroid cartilage; (A) anterior view (with cricoid cartilage), (B) posterior view, (C) lateral view (with cricoid cartilage), (D) superior view.

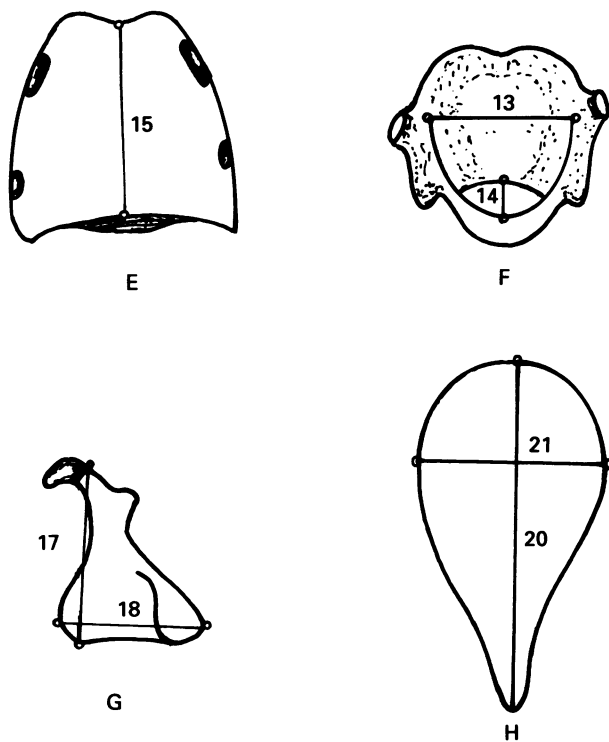


Fig. 2.(E-H). Schematic drawings of skeleton of larynx indicating the points of measurements. Cricoid cartilage; (E) posterior view, (F) superior view. Arytenoid cartilage with corniculate cartilage; (G) lateral view. Epiglottic cartilage; (H) anterior view.

- (6) Anterior thyroid height (distance from upper to lower thyroid incisure).
- (7) Dorsal thyroid height (distance between tips of superior and inferior horns).
- (8) Maximum thyroid breadth (length at the level of the thyroid tubercle).
- (9) Upper thyroid breadth (outer distance between bases of superior horns measured from the posterior aspect).
- (10) Lower thyroid breadth (outer distance of inferior horns measured from the posterior aspect).
- (11) Main height of larynx (floor of the thyroid notch to lower margin of cricoid cartilage).
- (12) Thyroid angle (angle between the two thyroid laminae).

Cricoid cartilage

- (13) Transverse diameter.
- (14) Anteroposterior diameter.
- (15) Height of lamina.
- (16) Anterior height of cricoid arch.

Arytenoid cartilage

- (17) Height (distance between apex and muscular process).
- (18) Breadth (distance between tips of muscular and vocal processes).

Corniculate cartilage

- (19) Diameter.

Epiglottic cartilage

- (20) Length (distance between width of the broad rounded extremity to the long narrow end).
- (21) Breadth (distance between the sides attached to the arytenoid cartilage).

RESULTS

A total of 40 specimens, 28 males and 12 females, was studied. The ages ranged from 17 to 50 years in male and 20 to 50 years in female cadavers. The total body height varied from 144 to 170 cm. For each of the parameters, the mean and standard error of the mean were determined. The significance of difference between the individual parameters was examined with Student's *t* test. The differences in sizes between male and female larynges were highly significant. The detailed data of the various measurements are shown in Table 1.

DISCUSSION

All the major measurements of the larynx, i.e. length, transverse diameter and anteroposterior diameter are greater in the male than in the female. According to Zrunek *et al.* (1988), the dimensions of male human larynges are 10–30% greater than those of female specimens. There are no significant differences between European and Nigerian larynges.

The differences in the dimensions between male and female laryngeal cartilages are conspicuous and mostly highly significant. These results are somewhat similar to those of Ajmani *et al.* (1980), Lang, Fischer & Nachbaur (1984) and Zrunek *et al.* (1988). Except for values 3 and 12, all the measurements of the thyroid cartilage are greater in the male than in the female although many of the comparisons do not give a significant figure. The superior horn measures between 8 and 28 mm and the inferior horn between 6 and 23 mm. Ajmani *et al.* (1980) have recorded similar findings in

Table 1. Mean values (1 to 21) and standard deviations of the means are based on data from 28 male and 12 female specimens. Sex differences were examined with Student's *t* test. Last column shows significance in terms of *P*

Measurement	Male	Female	<i>P</i>
	Mean (mm) ± S.D.	Mean (mm) ± S.D.	
1	37.92 ± 4.42	35.25 ± 3.10	N.S.
2	34.89 ± 4.08	32.17 ± 4.27	N.S.
3	20.70 ± 2.99	20.92 ± 3.01	N.S.
4	18.35 ± 3.11	17.35 ± 2.67	N.S.
5	11.68 ± 0.97	10.20 ± 0.51	0.001
6	22.32 ± 7.38	17.25 ± 6.58	0.05
7	44.82 ± 6.45	37.25 ± 7.47	0.01
8	50.51 ± 7.80	40.80 ± 6.45	0.001
9	47.45 ± 5.19	39.50 ± 5.80	0.001
10	38.25 ± 8.40	31.20 ± 7.50	N.S.
11	45.06 ± 8.41	38.08 ± 8.25	0.05
12	89.92 ± 13.67	106.38 ± 28.36	0.05
13	29.84 ± 6.10	25.84 ± 3.48	0.05
14	28.82 ± 4.07	24.06 ± 2.53	0.001
15	26.50 ± 6.30	24.60 ± 5.32	N.S.
16	8.35 ± 4.30	7.50 ± 4.25	N.S.
17	15.68 ± 0.87	13.20 ± 1.19	0.001
18	11.62 ± 1.03	9.65 ± 0.89	0.001
19	5.51 ± 1.46	5.47 ± 1.02	N.S.
20	40.76 ± 5.62	38.29 ± 5.02	N.S.
21	26.29 ± 2.07	24.65 ± 2.09	0.05

N.S. = not significant

Indian subjects. In general the superior horn is longer and the inferior horn is shorter (Romanes, 1981; Williams *et al.* 1989). The thyroid angle in the female larynx is significantly larger than that in the male. It varies from 106° to 60° in the male and 132° to 88° in the female with a mean of 89.92° in the male and 106.38° in the female. In the European adult the thyroid angle is 90° in the male and 120° in the female (Romanes, 1981; Williams *et al.* 1989). In Indian subjects it varies from 100° to 43° in the male and from 126° to 85° in the female (Ajmani *et al.* 1980).

The transverse diameter of the cricoid cartilage is greater than the anteroposterior diameter in both the sexes. Similar findings were reported in Indian subjects by Ajmani *et al.* (1980). In the present study the height of the lamina was greater in the male than in the female; it varies from 10 to 38 mm in the male and 9 to 32 mm in the female, with a mean of 26.50 mm in the male and 24.60 in the female. In European adults it varies from 2 to 3 cm (Williams *et al.* 1989) and it varies from 19 to 20 mm in Indian adults (Ajmani *et al.* 1980). According to Too-chung & Green (1974), in the age group from neonatal to 15 years, the coronal diameter of the cricoid cartilage is greater than the sagittal diameter but with age the sagittal diameter increases faster than the coronal. The coronal and sagittal diameters and the height bear a linear relationship.

In the case of the arytenoid cartilage the length and breadth are almost the same on the two sides in both the sexes. By comparing the mean measurements between males and females there is a difference in size, the male measurements being significantly larger. In Indian adults the height is 13.0 mm in the male and 12.3 mm in the female whereas the breadth is 7.7 mm in the male and 5.9 mm in the female (Ajmani *et al.* 1980).

The incidence of the presence of the cuneiform cartilage and the cartilago triticea is greater in the female than in the male and they occur more commonly than in Indian adults. The cuneiform cartilage was observed in 25.0% of cases in females and 18.42% of cases in males. Similarly the incidences of the cartilago triticea is greater in the female (16.66%) than in the male (13.15%). The cuneiform cartilage measures between two and three mm in both the sexes.

The average diameter of the corniculate cartilage is almost the same on both sides in both the sexes. The corniculate cartilage was present more often in females (33.33%) than in males (18.42%). The corniculate cartilage is generally regarded as rudimentary and non-functional in man (Negus, 1929). In the case of the epiglottic cartilage, the average breadth is greater in males than in females.

SUMMARY

Laryngeal cartilages were studied in 40 dissection room specimens of adult age groups ranging from 17 to 50 years in both the sexes. Various dimensions of the laryngeal skeleton were measured and statistical analysis of the data for male and female were evaluated separately. Conspicuous and highly significant differences of the dimensions between male and female laryngeal cartilages were observed. The incidence of the cuneiform cartilage and cartilago triticea was greater in the female than in the male.

REFERENCES

- AJMANI, M. L., JAIN, S. P. & SAXENA, S. K. (1980). A metrical study of laryngeal cartilages and their ossification. *Anatomischer Anzeiger* **148**, 42–48.
- HOLLINSHEAD, W. H. (1968). *Anatomy for Surgeons*, 2nd ed. Vol. I, pp. 465–470. New York: Harper and Row.
- LANG, J., FISCHER, K. & NACHBAUR, S. (1984). Über Masse, Form und Formvarianten der Cartilagine thyroidea et cricoidea. *Gegenbauers Morphologisches Jahrbuch* **130**, 639–657.
- NEGUS, V. E. (1929). Function of the cartilages of Santorini. *Journal of Anatomy* **63**, 430.
- ROMANES, G. J. (1981). *Cunningham's Textbook of Anatomy*, 12th ed., p. 499. Oxford: Oxford University Press.
- TOO-CHUNG, M. A. & GREEN, J. R. (1974). The rate of growth of the cricoid cartilage. *Journal of Laryngology and Otology* **88**, 65–70.
- WILLIAMS, P. L., WARWICK, R., DYSON, M. & BANNISTER, H. (1989). *Gray's Anatomy*, 37th ed., pp. 1249–1252. London: Longman.
- ZRUNEK, M., HAPPAK, W., HERMANN, M. & STREINZER, W. L. (1988). Comparative anatomy of human and sheep laryngeal skeleton. *Acta otolaryngologica* **105**, 155–162.