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## Gross morphology and morphometry of thyroid cartilage of goat (*Capra hircus*)

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#### Abstract

Thyroid cartilages of indigenous goat (*Capra hircus*) was unpaired, shield shaped cartilage, consisting of laminae, body and cornua. It comprised of thyroid foramen and accessory foramen. Laryngeal prominence was prominent and caudally located. Body presented median laryngeal recess dorsally at the level of laryngeal prominence. Thyro-epiglottic ligament, crico-thyroid ligament and thyrohyoid membrane connected it with the epiglottis, cricoid and hyoid respectively. Length of thyroid cartilage on ventral aspect was less than the main length from anterior to posterior cornu. Growth of thyroid cartilage was appreciated in postnatal period.

**Keywords:** Larynx, thyroid cartilage, hyaline cartilage, laryngeal recess

#### Introduction

Complexity of laryngeal anatomy is the result of curious relationships that exist among the five laryngeal cartilages (Michaels, 1990) [10]. Larynx is basically a trifunctional organ, playing a key role in phonation, regulation of airflow through its lumen and protection of the lower airway during swallowing. mucosa-associated lymphoid tissue (MALT) in auditus laryngeus is responsible for respiratory immunity. Laryngeal mucous secretions help in trapping particulate matter and also helps in humidification of inhaled air (Reighard and Jennings, 1901) [15]. The domestic goat "*Capra hircus*" is an important livestock species in India (MacHugh and Bradley, 2001) [12], which are more prone to respiratory infections (Kumar *et al.*, 2014) [9]. Present study was taken up to understand the anatomy of thyroid cartilages of goat, as thyroid cartilage functions as a protective shield of the larynx (Quintanilla *et al.*, 2022) [16] and it is the largest cartilage of the larynx (Johnston, S.A. and Tobias, K.M., 2017).

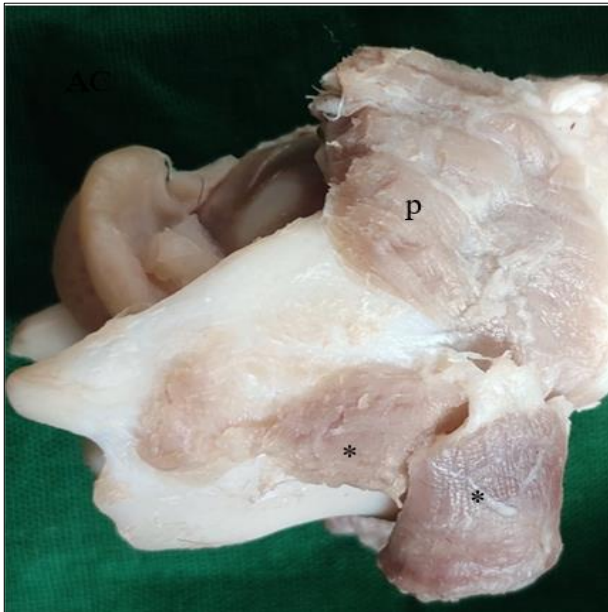
#### Materials and Methods

Present study on "Gross morphology, Morphometry and Histology of thyroid cartilage of goat (*capra hircus*)" was conducted in Department of Veterinary Anatomy, College of Veterinary Science, Rajendranagar, Hyderabad. For this study, twelve larynges of less than one year to more than four years aged goats, irrespective of their sex were collected immediately after slaughter from Jiyaguda slaughter house, Hyderabad, Telangana. Samples were washed with water and preserved in 10% formalin. Larynges were dissected carefully to the extent possible to observe and record the gross features of thyroid cartilage and its associated structures. Length, width and thickness of thyroid cartilage was measured using digital Vernier calipers as per the specifications of Zrunek *et al.*, (1988) [11]. Standard error was analyzed by one-way analysis of variance (ANOVA) with Tukey's post-hoc test. Statistical analysis was performed using SPSS v. 14.

#### Results and Discussion

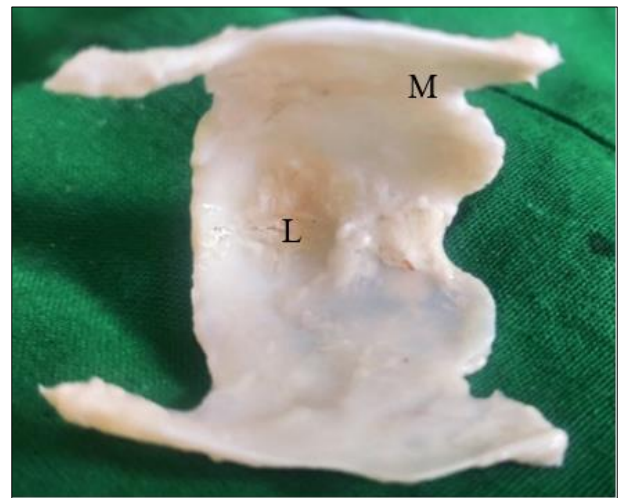
##### Gross morphology

Thyroid cartilage of indigenous goat was largest of all laryngeal cartilages and was outermost cartilage that formed the ventro-lateral walls of the larynx. It was shield shaped cartilage that resembled letter "U" in cross sectional view, identical to felines (Kirby, 2014) [8].

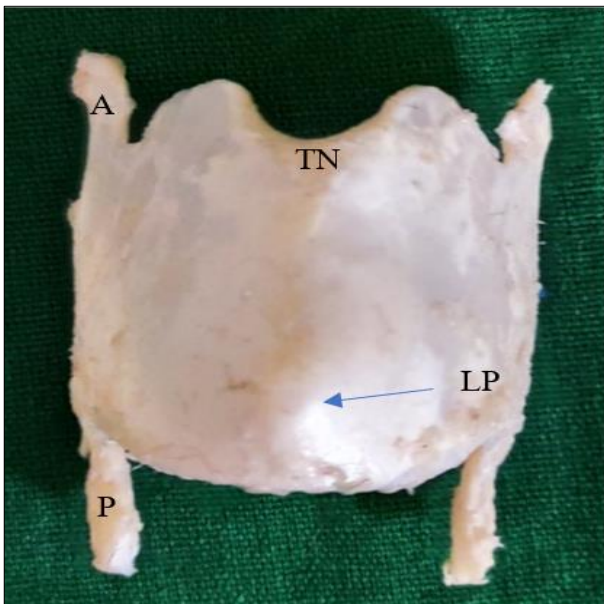


**Fig 1:** Lateral view of intact thyroid cartilage showing extrinsic muscles (\*) inserted to thyroid laminae and origin of thyro-pharyngeus muscle (P)

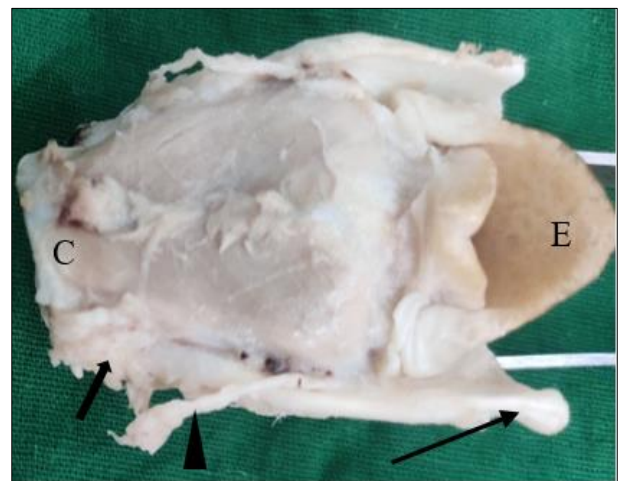
laryngeal prominence (Fig.2) which was prominent and was located caudally, similar to buffaloes but was rostrally located in camels and was absent in donkeys since the laminae were incompletely fused (Eshra *et al.*, 2016) [3]. In contrary, a broad keel connected the laminae in Mangolian gazelle (Frey and Gebler, 2003) [4].



**Fig 3:** Dorsal view of Thyroid cartilage showing laryngeal recess (L) medial surface (M)



**Fig 2:** Ventral view of thyroid cartilage showing thyroid notch (TN), anterior cornu (A), laryngeal prominence (LP), posterior cornu (P)



**Fig 4:** Dorsal view of larynx intact thyroid cartilage showing position of anterior (arrow) and posterior cornua (bold arrow) of thyroid cartilage in relation with epiglottis (E) and cricoid (C) recurrent laryngeal nerve (arrow head)

It was made of hyaline cartilage that enclosed the cricoid, arytenoid cartilages laterally and posterior part of epiglottis ventrally. It was comprised of right and left laminae, body and cornua. Laminae were roughly quadrilateral consisting of lateral and medial surfaces. Lateral surface was convex while medial surface was concave. The lateral surface was occupied by the extrinsic muscle of larynx and thyro-pharyngeus muscle (Fig.1). Anterior part of thyroid lamina adjacent to thyro-hyoid cornu consisted of a part of chondro-pharyngeus muscle. Medial surface of laminae faced the laryngeal cavity and was lined by mucosa. It consisted of vestibular ligament in vestibular cavity and vocal ligament in the glottic region. Thyro-arytenoideus muscles was seen medial to the hyaline cartilage which extended throughout the length of thyroid cartilage.

Laminae of both sides united ventrally, resulting in the formation of median long plate. The body consisted of

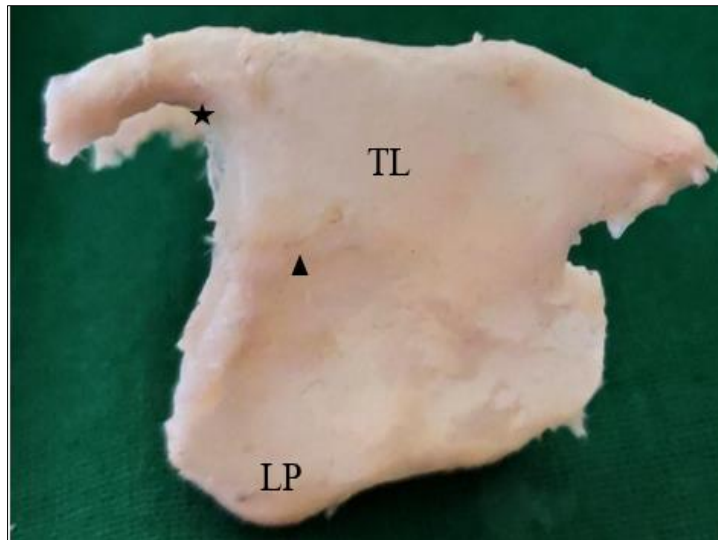
Laryngeal recess was observed on the dorsal surface of the body at the level of laryngeal prominence. It was a deep depression, similar to the findings of Nakano and Muto, (1988) [13] in mouse with little variation where he mentioned it as the laryngeal sac and was deeper. The laryngeal recess showed adipose tissue and insertion of vocal ligament to the thyroid cartilage (Fig. 3).

The dorsal border was uneven with irregular convexity, that continued on to cranial and caudal cornua. Anterior cornua was short but broad while the posterior cornu was long and narrow. However, white-tailed deer showed shorter and thicker caudal cornu than rostral cornu (Bisaillon, 1985) [2]. The anterior cornu was observed dorso-cranially while posterior cornu was dorso-caudal in position. Both anterior and posterior cornu curved downward but the curvature of the latter was more prominent. Anterior cornu extended anteriorly lateral to the epiglottis and caudal end of posterior cornu

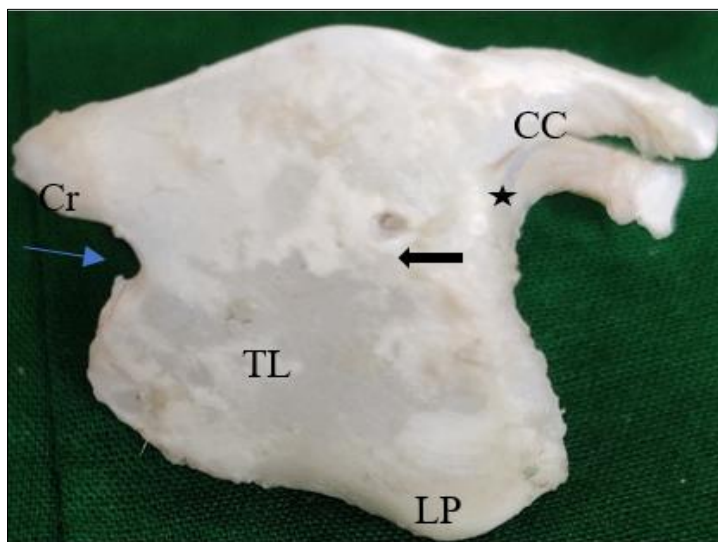


extended till the caudal border of cricoid cartilage. Anterior cornu consisted of facet laterally for articulation with thyroid cornu of hyoid bone while facet on caudal cornua for cricoid cartilage was located medially which was in accordance with

Aishwarya *et al.* (2018) [1] in Gaddi goat. Recurrent laryngeal nerve was located medial to the dorsal end of thyroid lamina (Fig.4). These findings were identical to thyroid cartilage of Musk ox (Frey, *et al.*, 2006) [5].

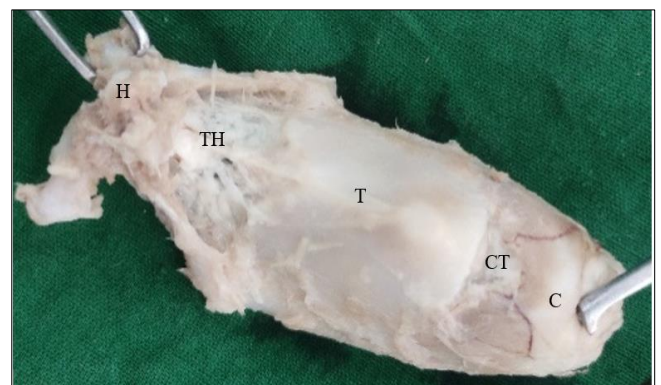


**Fig 5:** Lateral view thyroid Lamina (TL) with oblique line (Arrow Head)



**Fig 6:** Lateral view of thyroid lamina (TL) showing secondary thyroid foramen (bold arrow black) cranial cornu (CC) caudal cornu (CC) cranial fissure (Arrow) caudal fissure (\*) laryngeal prominence (LP).

Cranial and caudal fissures were present between the respective cornua and thyroid lamina. The cranial fissure was deeper than caudal fissure and converted to foramen, the thyroid foramen by fibrous tissue for the passage of cranial laryngeal nerve. Anterior border consisted of a thyroid notch in the center while the caudal border was slightly convex. A faint rough oblique line was observed on lateral surface of lamina which extended upwards and forwards between the caudal and dorsal border (Fig. 5). These observations were in accordance with Ibrahim and Yousif, (1991) [6] in goat. Secondary thyroid foramen was observed towards the posterior third of the lateral surface just above the oblique line (Fig. 6). These findings were in acceptance with Eshra *et al.*, (2016) [3] in buffaloes.



**Fig 7:** Ventral view of postnatal larynx showing body of hyoid (H) thyrohyoid membrane (TH) cricothyroid membrane (CT) thyroid cartilage (T) cricoid cartilage (C)

Similar to the statement of Nickle *et al.*, (1979) <sup>[14]</sup> in domestic animals, cranial border of thyroid cartilage connected with thyroid cornu of hyoid bone by thyro-hyoid membrane while it was connected to cricoid by crico-thyroid membrane on caudal aspect (Fig.7) and thyro-epiglottic membrane extended from thyroid cartilage to epiglottis.

### Morphometry

Mean of dorsal thyroid length (distance between anterior and posterior cornu), length of lamina (distance between cranial and caudal fissures), Split thyroid length (from thyroid notch to caudal border), Lateral length of thyroid lamina, length of anterior cornu, length of posterior cornu, height of lamina, width of thyroid cartilage and thickness were recorded

(Table.1). The dimensions of thyroid cartilage of goat in present study were comparatively less than recordings of Zrunek *et al.*, (1988) <sup>[11]</sup> in sheep while thyroid cartilage of Musk ox, (Frey, *et al.*, 2006) <sup>[5]</sup> was massive with huge variation from the samples measured in present work.

The distance between anterior and posterior cornua (33.20±0.94 mm) was found to be greatest of all the dimensions of thyroid cartilage. In present study, maximum length of thyroid cartilage was more than maximum breadth. According to Thiemann and Bell, (2001), transverse diameter of larynx was greater in donkey, but in present study the width (27.41±1.50 mm) of thyroid cartilage was less than height (30.93±1.31 mm).

**Table 1:** Measurements of thyroid cartilage of Goat

S.no	Anatomical structural	Measurement	Mean (mm)	SE
1	Length	Anterior thyroid length	24.10	1.42
2		Dorsal thyroid length	33.20	0.94
3		Length of thyroid laminae between fissures	21.45	1.59
4		Length of thyroid lamina(lateral)	26.72	1.57
5		Split thyroid length	23.67	0.86
6		Anterior cornua	7.77	0.51
7		Posterior cornua	10.59	0.82
8	Width	Maximum thyroid breadth	27.41	1.50
9		Lower thyroid breadth	23.54	1.69
10		Upper thyroid breadth	24.50	1.29
11	Height	Anteroposterior dimension	30.93	1.31
12	Thickness		5.97	0.56

SE – Standard Error

### Conclusion

Thyroid cartilage was longest, largest and external most cartilage of all the laryngeal cartilages. It extended from the caudal end of epiglottis to the caudal end of cricoid cartilage. It consisted of laminae, body, anterior and posterior cornua. Laryngeal prominence was caudal and prominent with laryngeal recess on dorsal aspect. Secondary thyroid foramen was located at the caudal end of lamina.

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