ORIGINAL RESEARCH PAPER
Volume-6 | Issue-9 | September-2017 | ISSN No 2277 - 8179 | IF : 4.176 | IC Value : 78.46
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

MORPHOMETRIC AND MORPHOLOGICAL STUDY OF THYROID GLAND - A CADAVERIC STUDY.

Anatomy

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ABSTRACT

The thyroid gland lies deep to the strap muscles mainly the sternothyroid and sternohyoid, located anteriorly in the neck at the level of the fifth cervical to first thoracic vertebrae. Anomalies like accessory nodules, ectopic thyroid tissues are usually present at the embryonic origin of thyroid gland, at the foramen caecum, or on the lingual duct and thyroglossal tract within the tongue. These morphological variations are usually diagnosed incidentally during examination for other thyroid gland diseases; therefore the true incidence is uncertain. This study was structured to investigate the gross anatomical features of the thyroid gland in 30 cadavers (27males and 3females) from the North Indian population. In our study we observed pyramidal lobe in (10 %), levator glandular thyroideae (10 %), and absence of isthmus in (13.33 %). This study highlights the various developmental anomalies of the thyroid gland, which is imperative for a safe and effective surgery.

KEYWORDS

Thyroid gland, Levator glandulae thyroideae, pyramidal lobe, agenesis.

INTRODUCTION:

The word 'Thyroid Gland' is Greek, and is loosely translated to mean “shield gland”. (1) The thyroid gland, largest endocrine gland, brownish red and highly vascular, is placed anteriorly in the neck and it lies at the level of the fifth cervical to the first thoracic vertebrae. The estimation of the size of the thyroid gland is clinically important in the evaluation and management of thyroid disorders and can be achieved non-invasively by means of diagnostic ultrasound. There is no significant difference in thyroid gland volume has been observed between males and females from eight months to fifteen years. (2)

The normal size of each lobe of the thyroid gland has been described to be 5 cm long, its greatest transverse and anteroposterior extent being 3 cm and 2 cm respectively. The isthmus measures about 1.25 cm both transversely as well as vertically. (3) The pyramidal lobe, if present, is a triangular and slender projection from the midpoint of upper border of isthmus. Keith et al & Wahl et al showed that approximately 50% of thyroid gland have pyramidal lobe. (1)

A fibrous or fibromuscular band, the levator of thyroid gland, musculus Levator Glandulae Thyroideae, sometimes descends from the body of the hyoid bone above to the isthmus or pyramidal lobe below. Sometimes small detached masses of thyroid tissue may lie above the lobes or isthmus as accessory thyroid glands. (4)

Thus, a thorough knowledge about the morphology of the thyroid gland is a pre-requisite for better understanding of thyroid gland and its diseases specially for the surgeons and interventionists.

AIMS AND OBJECTIVES

The study was conducted with the following aims and objectives:

1. To study the morphometry of thyroid gland.
2. To study the morphological features of the thyroid gland and their variations, if any.

Materials & Methods

Thirty properly embalmed human cadavers of either sex procured from the Department of Anatomy, Government Medical College & Hospital 32 Chandigarh, formed the material for this study. The cadavers were labelled from 1-30 with suffix "M" for male and "F" for female. All embalmed cadavers available during the study period were included, whereas cadavers with gross abnormality in the neck such as any scar or any swelling were excluded from the study. The thyroid gland was exposed according to the incision as given in ROMANES J (Reprinted 2016) (5) and certain findings like the level of thyroid gland, presence or absence of isthmus in relation to the tracheal rings were noted in situ. For taking different morphometric measurements, the gland was taken out and after preserving in 10% formalin, was studied in detail.

The level of the isthmus in relation to the corresponding tracheal ring was noted and the length of the isthmus was measured between two horizontal planes, one passing along the upper border and the other along the lower border of the isthmus. Distance between these two planes was measured. The breadth of the isthmus was measured between two vertical points each passing along the medial surfaces of right and left lobes where the isthmus was connected with them.

The length (vertical extent) of each lobe was measured between two horizontal planes - one passing along the highest point of the apex of the lobe and the other along the lowest point of the base. Distance between these two planes was measured. The breadth (transverse extent) of each lobe was measured between two vertical planes each passing along the maximum convex point on the lateral surface of the lobe and maximum convex point on the medial surface of the lobe respectively. The width (antero-posterior extent) will be taken between two vertical planes each passing through the maximum convexity of the lobe in front and behind respectively. (As shown in Fig: 1)

Any other variations in the morphology of the thyroid gland like presence of pyramidal lobe, Levator glandulae thyroideae or absent isthmus was noted accordingly.

The length of the pyramidal lobe was measured between two horizontal planes, one passing along the upper border of isthmus or the apex of the lobe where it started and the other at the level where it ended. Also the length of the Levator glandulae thyroideae, was taken by making two horizontal planes, one passing along the upper border of the isthmus or the upper border of the pyramidal lobe where it started and the other at the lower border of the hyoid bone where it ended. The distance between these two planes was measured.

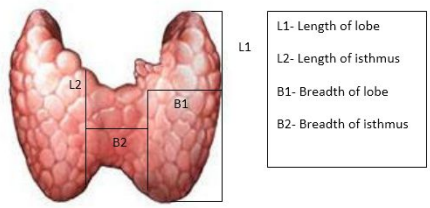

Fig: 1 showing different dimensions of thyroid gland.

RESULTS:

It was observed that out of 30 cases, 24 followed the standard book description and 7 out of them showed varying degrees of variations from the normal morphology. The detailed description of the morphological study of the thyroid gland is as follo

There was difference in the length, breadth and the width between the right and the left lobes. The mean dimensions of both the lobes were recorded as follows:

Table No.1 Dimensions of the right and the left lobes of the thyroid gland

Dimensions (cms)	Right lobe	Left lobe
Mean length	4.9	5
Mean breadth	1.9	2
Mean width	1.1	1

Table No.1 shows the dimensions of the right and the left lobe of the thyroid gland. The mean length, breadth and width of the right lobe were found to be 4.9 cms, 1.9 cms and 1.1 cms respectively. Similarly, the mean length, breadth and width of the right lobe were found to be 5 cms, 2 cms and 1 cms respectively.

The length, breadth and the corresponding tracheal rings of the isthmus w.r.t the trachea were noted. Also the presence or absence of the isthmus was recorded. It was observed that 3 out of 30 cases i.e. 10% showed agenesis of the isthmus. (Fig: 4). 96% were related to the 2nd and the 3rd tracheal ring while 4% showed their relation with 1st to 4th tracheal ring. The detailed descriptions of the dimensions observed are as follows.

Table No 2. Dimensions of the isthmus of the thyroid gland

Dimensions (cms)	Isthmus
Mean Length	2.8
Mean Breadth	1.9

Table No 2 shows the mean length and breadth of the isthmus of the thyroid gland which was found to be 2.8 cms and 1.9 cms respectively.

Presence or absence of the pyramidal lobe was noted in all the cases. It was observed that 3 out of 30 cases i.e. 10%, showed presence of pyramidal lobe. The origin, length, breadth and the shape of the pyramidal lobe was noted. 2 out of 3 pyramidal lobes were arising from the junction of the right lobe with the isthmus while 1 of them had its origin from the upper border of the isthmus. The shapes of all the 3 pyramidal lobes were found to be pyramidal.

Table No.3 Dimensions of the pyramidal lobes of thyroid gland

Dimensions (cms)	Pyramidal Lobe
Mean Length	2.9
Mean Breadth	1.9

Table No 2 shows the mean length and breadth of the pyramidal lobes of the thyroid gland which was found to be 2.9 cms and 1.9 cms respectively.

Presence or absences of Levator glandulae thyroideae were noted in all the cadavers. It was observed that 3 out of 30 cases i.e. 10%, showed its presence. The nature, origin, extent, length and the breadth of the Levator glandulae thyroideae were noted. It was observed that in 2 cases, the nature of the Levator glandulae thyroideae were fibro muscular and in 1 case, it was fibrous on gross visualization. All of them were originating from the apex of the pyramidal lobe and were extending upto the body of the hyoid bone.

No ectopic thyroid tissue was found in any of the cases.

Table No 4. Dimensions of the Levator Glandulae Thyroideae

Dimensions (mms)	Levator Glandulae Thyroideae
Mean length	36
Mean breadth	6

Table No 3 shows the mean length and breadth of the Levator glandulae thyroideae which was found to be 36 mm and 6 mm respectively.

DISCUSSION:

The dimensions of the lobes were found to be asymmetrical in the present study. There was no significant difference in mean dimensions of the lobes between male and female cases. The mean length (height) of right lobe was found to be 4.9 cms and that of the left lobe was 5 cms. The mean breadth of right lobe was 1.9 cms and that of the left lobe was 2 cm. The mean width of right lobe was 1.1 cms and that of left lobe was 1 cm respectively.

Table No 5 Comparison of mean length and breadth of the lobes of the thyroid gland with earlier available studies.

SL No.	Author & Year	Right Lobe(cms)		Left Lobe(cms)	
1	Harjeet et.al. 2004	Length	3.82	Length	4.04
		Breadth	1.7	Breadth	1.8
2	Joshi SD 2010	Length	4.32	Length	4.22
		Breadth	1.8	Breadth	1.9
3	Present Study 2016	Length	4.9	Length	5
		Breadth	1.9	Breadth	2

Harjeet et.al. observed the mean length of the right lobe to be 3.82 cms while that of the left lobe to be 4.04 cms. Joshi SD observed the mean length of the right lobe to be 4.32 cms while that of the left lobe to be 4.22 cms.

The mean length of the lateral lobes is described as 5 cms in most of the Anatomical texts. All these morphological variations regarding the dimensions of the thyroid gland must be kept in mind before undertaking any surgical and interventional procedures. (6, 7)

In the present study we have found that 3 out of 30, i.e. 10 % showed agenesis of isthmus with male to female ratio being 2:1. Its incidence varies between 3%–33%, as agenesis has been reported by various authors.

Table No. 6 Comparison of incidence of agenesis of isthmus between the present study and earlier studies.

Sl. No.	Authors & Year	Incidence
1	Marshall, 1895.	10 %
2	Won & Chung, 2002.	3%
3	Harjeet et al.2004	7.9%
4	Braun et al, 2007	6.9%
5	Ranade et al,2008	33%
6	Dixit et al, 2009	14.6%
7	Present Study 2016	10%

Agenesis of isthmus can be associated with, absence of a lobe or the presence of ectopic thyroid tissue and hence in clinical practice when such a condition is diagnosed, it is necessary to perform a differential diagnosis against other pathologies such as autonomous thyroid nodule, thyroiditis and so on. While planning for thyroidectomy one should be prepared to find variations like ectopic thyroid nodules around the normally located thyroid gland and also has to be precise in dissection as important nerves and vessels lies in the vicinity of thyroid gland. Tracheostomy can be potentially dangerous in such cases if a pre-procedure examination is not carried out as in securing invasive airway during emergencies, injuries or during unanticipated difficult intubation. (8)

A high division of the thyroglossal duct can generate two independent thyroid lobes with the absence of the isthmus. The absence of the isthmus can be associated with other types of dysorganogenesis, such as the absence of either lobe or the presence of ectopic thyroid tissue. (9)

In one of the studies done on Caucasian cadaver, agenesis of isthmus of thyroid gland with enlarged lobes was reported. Though the incidence of agenesis varies from 5 to 10%, the incidence in north-west Indians is reported to be 7.9 in gross specimens.

Normally the two lobes of thyroid gland are joined together by an isthmus in the upper part of trachea. Absence of isthmus is indeed a

quite rarity in humans. The basic mechanism of agenesis of isthmus can be attributed to anomalous embryological development. Accessible literature suggests that chromosome 22 plays a major role in its development. (8)

Pyramidal Lobe & Levator Glandulae Thyroidea

In the present study, we found that 3 out of 30 cases, i.e. 10% were having Pyramidal lobes as well as Levator glandulae thyroideae. The range of the incidence of the presence of the pyramidal lobe (PL) and Levator glandulae thyroideae (LGT) was found to be between 10 % to 58 % and 10 % to 59.4 % respectively as the work has been done by various authors.

Table No.7 Comparison of mean length & breadth of PL & LGT between present study and earlier available studies.

Sl No	Authors & Year	P L (cms)		L G T (cms)	
		Length	Breadth	Length	Breadth
1	Gupta R, 2011	2.3	1.3	3.5	0.3
2	Milojevic B, 2013	2.26	1.12	3.7	0.5
3	Present study 2016	2.9	1.9	3.6	0.6

Table No 8.Comparison of Incidence of Pyramidal Lobe (PL) & Levator Glanduleae Thyroideae (LGT) among present study and earlier available studies.

Sl.No	Authors & Year	P L %	L GT %
1	Marshall 1895	43	28.3
2	Harjeet et al 2004	28.9	33.5
3	Ranade et.al 2008	58	33
4	Joshi SD 2010	37.77	30
5	Eneytullah 2013	22	32
6	Milojevic 2013	55.2	59.4
7	Present Study 2016	10	10

In the present study, we observed that 2 out of 3 pyramidal lobes were arising from the junction of the right lobe with the isthmus while 1 of them had its origin from the upper border of the isthmus. All the 3 pyramidal lobes were associated with Levator glandulae thyroideae. It was observed that in 2 cases, the natures of the Levator glandulae thyroideae were fibro muscular and in 1 case, it was fibrous on gross visualization. All of them were originating from the apex of the pyramidal lobe and were extending upto the body of the hyoid bone.

Most authors have described the origin of pyramidal lobe from the upper border of the isthmus, slightly from the left of mid-sagittal plane. It represents a development of glandular tissue from the caudal end of the thyroglossal duct. (10)

Pyramidal lobes could be a source of pitfalls in thyroidectomy, due its frequency by unreliable preoperative diagnosis on scintigraphic images. (11)

Total, subtotal & partial thyroidectomy performed for different stages of carcinoma thyroid require precise and accurate knowledge of variations associated with thyroid gland. During thyroidectomy the pyramidal lobe also called Lolouett's lobe - should be looked for & removed otherwise it can result in incomplete resection of the thyroid gland. All thyroid diseases are described in the pyramidal lobe which is formed from normal thyroid tissue. Residual thyroid tissue in the pyramidal lobe can lead to serious complications in diseases like carcinoma & Grave's disease where complete removal of thyroid gland is indicated. (12)

Gunapriya et al., reported a case of presence of LGT with absence of pyramidal lobe on the right side, which stretched from the upper border of isthmus of thyroid gland, to the lower border of the lamina of thyroid cartilage, which measured 1 cm in length and 0.6 cm in breadth Tallapaneni S et al., observed that the LGT was arising from the upper part of anterior border of the thyroid cartilage and got inserted into the substance of the right lobe along the lower 2/3 of its anterior border with the agenesis of the isthmus. (13)

CONCLUSION: The prevailing morphology of the thyroid gland was studied in detail in an attempt to establish standard pattern and deviations, if any, among thirty adult human cadavers. . In our study we observed pyramidal lobe in (10 %), levator glandular thyroideae (10 %), and absence of isthmus in (13.33 %).

Thus, it can be concluded that the present study highlights the different morphological variations like agenesis of isthmus and presence of pyramidal lobe along with levator glandulae thyroidea the knowledge of which will definitely help the surgeons and the interventionists in different emergency situations.

Fig: 2 Showing Absent Thyroid Isthmus (Arrow).

Fig: 3 Showing LGT (with Forceps)

Fig 4: Showing attachment of LGT to PL and Hyoid bone.

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