

Original article:

Morphometric study of human thyroid gland with emphasis on pyramidal lobe – a cadaver based study on eastern indian population

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Abstract

Introduction: This study deals with the histo-morphometric study of human thyroid glands, with emphasis on pyramidal lobe.

Materials & Methods : 102 formalin preserved cadavers were dissected and Thyroid Glands (65 male and 37 female) were studied. The specimens were studied for the extent and dimensions of lobes, isthmus and the number, extent and attachment of both the PL and levator glandulae thyroideae (**LGT**). Multiple sections of the PL at different levels were studied histologically with Hematoxylin & Eosin.

Results : Right lobe of thyroid gland was slightly larger in males on all aspects while the left lobe was almost equal in both genders. The size of right lobe of thyroid gland in males increased with age, in vertical aspect, while in females the findings were exactly opposite. The isthmus were slightly wider and shorter in males. **PL** was seen in 22% cases with non-elderly male preponderance, with left sided predominance(75%). **LGT** was seen in 11.7% cases, arising from apex of **PL**. Histologically, all the **PL** had thyroid follicles in various sections, made from base to apex.

Discussion : This study highlights the extents & measurements of lobes and isthmus of human thyroid glands to facilitate the screening using radiological tools. Moreover, **PL** is more prevalent in males with its origin from the left lobe of thyroid gland mainly. Thyroid follicles are a constant finding in this lobe, which makes it more matter of concern for the oncologists and head-neck surgeons.

Key words : Pyramidal lobe, Levator Glandulae Thyroideae, Fibromuscular band, Thyroid gland

Introduction

The thyroid gland is a butterfly shaped, brownish highly vascular endocrine gland situated anteriorly in front of the trachea and presents two lobes, one on each side of the midline, connected by a narrow median isthmus. Proper knowledge of the normal anatomy of the thyroid gland is immensely helpful in performing meticulous surgeries related not only

to the thyroid gland but also the anterior part of neck.

The pyramidal lobe (PL) and levator glandulae thyroideae (LGT) are important anatomical variations¹ which need attention of anatomists as well as surgeons. PL might extend from the isthmus/lobe(s) of the gland and often show a fibromuscular structure extending upwards, known as

LGT. It may extend up to the hyoid bone, along the midline with a number of possible variations².

This study focuses on the existence of the PL and LGT and the incidence of the same, since this might be a site for accessory thyroid tissue with possible foci of thyroid carcinomas³, which might pose problems during surgical procedures involving thyroid gland.

Recurrence of Grave's Disease can be a major clinical problem if pyramidal lobe is left behind during performing total thyroidectomy for the same. Papillary carcinoma of thyroid gland (though a rare entity) occurs most commonly in pyramidal lobe and so may remain unnoticed for some time. Also intra-glandular metastasis and multifocal diseases might have their origin at the pyramidal lobe. Next, presence of pyramidal lobe might pose a post operative problem in patients requiring radioactive iodine therapy, since it will absorb most of the I131 radioactive material.⁴

Aims and Objectives

The present study is focussed upon following objectives :

- i. Study of location of thyroid gland with number of lobe(s), isthmus and presence of any pyramidal lobe in the specimen(s).
- ii. Extent of the isthmus with vertical and transverse dimensions.
- iii. Extent of pyramidal lobe(if present).
- iv. Histological study of pyramidal lobe for presence or absence of thyroid tissue.

Any correlation with gender or age is also considered in this study during analysis of the results.

Materials & Methods

The study was done with 102 cadavers from Departments of ANATOMY and FORENSIC

MEDICINE, IPGME&R, KOLKATA. 65 were male and 37 were female cadaveric specimens. The cadaver was placed in supine position and, using a handled scalpel with 20 gauze blade, a vertical incision was given, extending from the symphysis menti to the symphysis pubis, encircling the umbilicus. The part of the respiratory passage from base of the tongue to the bifurcation of the trachea, along with the intact thyroid gland as well as any PL and LGT(if any), was taken out by dissecting from the specimen by en mass dissection of the pertinent part. The specimen was then washed with water and preserved in formalin. The overall extent of each lobe and their measurements along vertical, antero-posterior and transverse dimensions were taken. Similarly, the isthmus were examined with respect to their extent and measurements along vertical and transverse dimensions. Finally, the number, extent and attachment of both the PL and LGT were noted in pertinent specimen. All measurements were taken with the help of divider and slide callipers.

Multiple sections of the PL at different levels were made and they was fixed in 10% formal saline. Then the cut sections were washed in water. Graded concentrations of alcohol for dehydration were used. Alcohol was removed using Xylol. Subsequently, paraffin blocks were prepared and 5 micron thick sections were made with a microtome. Finally staining was done with Hematoxylin & Eosin as per standard staining protocol. Paraffin was removed using xylol, followed by hydration using reducing concentrations of alcohol viz absolute, 90%, 70%, 50% alcohols. Final change was made in tap water followed by haematoxylin. Blueing was performed subsequently using light microscopy (to visualise optimum staining of basophilic parts) and acid alcohol (for optimum decolourisation, if necessary). Finally counter-staining was done using

Eosin and finally, dehydration was performed using increasing concentrations of alcohol.

Result & Analysis

In the present study, the upper extent of right lobe of thyroid gland, in male, was observed at the level of oblique Line of thyroid cartilage in 67% specimens and in left lobe it was 64% while in female the findings were 76% and 70% respectively. However, in the males, upper extent was noted above the oblique line in 28% and 16% cases for right and left lobe respectively while in case of females the results were 16% each. Therefore, about 5% right lobe and 20% left lobe of thyroid gland in male had their upper pole reaching below the level of oblique line and in female they were 8% and 14% respectively.

56% of thyroid gland in male and 81% of thyroid in female had their isthmus located in front of 1st-3rd tracheal rings.

The size of right lobe of thyroid gland in males increased with age, in vertical aspect with mean values of 4.432 (\pm 0.374), 4.475 (\pm 0.413) and 4.591 (\pm 0.191) cms respectively. However, in females the findings were exactly opposite, with regression in size of thyroid gland with age and the mean values corresponding to that of male

specimen were 4.205 (\pm 0.016), 4.156 (\pm 0.113) and 4.161 (\pm 0.097) cms respectively. But the size of the left lobe did not vary with age. The measurements of the right lobe with respect to their transverse and antero-posterior dimensions did not vary considerably among different age groups in both male and female, but in left lobe, there was slight decrease in antero-posterior dimension of thyroid gland in males with increasing age.

22% specimen showed the presence of PL in our study. Prevalence of PL was more in males (70%) as opposed to females(30%) .75% of the PL extended from the left lobe of thyroid gland while 15% was arising from right lobe and only 10% from the isthmus. 70% of the PL extended up to lower border of the thyroid cartilage and 30% up to cricoid cartilage. In 11.7% specimens presence of LGT were noted. The LGT extended up to the hyoid bone, from the apex of PL. Age-wise variations of PL were recorded among the specimen, showing 45% in the age group of 40-60 years, 40% in >60 years and 15% in 20-40 years. All the PL had thyroid follicles on histological sections. Quantitative assay of the proportion of glandular and fibrous tissue was not done in this study.

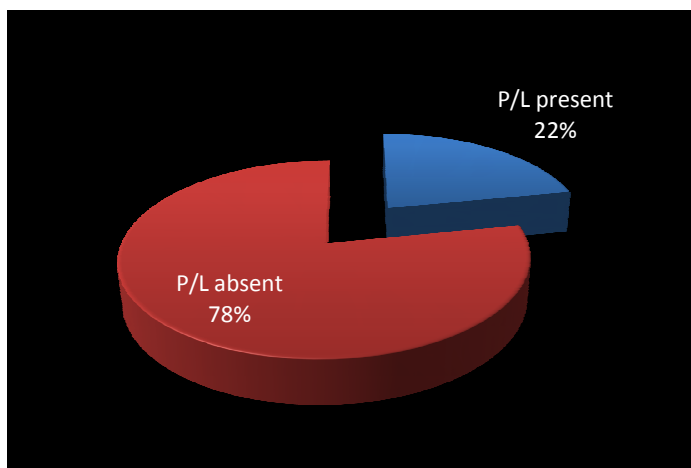


Figure 1 : INCIDENCE OF PYRAMIDAL LOBE

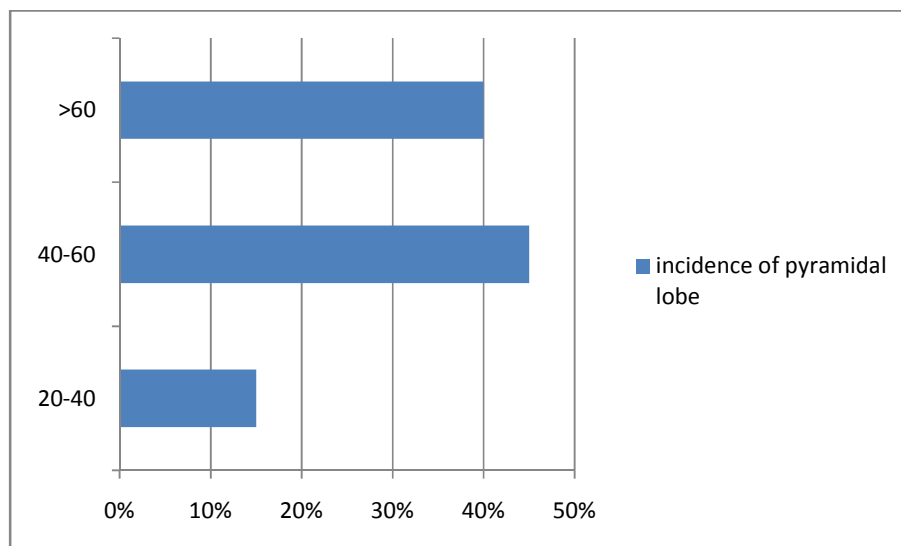


Figure 2 : AGE-WISE INCIDENCE OF PYRAMIDAL LOBE

Discussion

Knowledge of the variations of the thyroid gland, with respect to PL and LGT, is of paramount importance to the Otolaryngologists and the Head-neck surgeons for performing procedures like thyroidectomy, tracheostomy etc. Hence, extensive knowledge regarding these possible variations is of utmost importance not only for the anatomists, but also for other workers on this field.

This study is the first of its kind in West Bengal, where we have undertaken a cadaveric approach to enlighten upon the various aspects in this field. As per our study, the prevalence of PL is around 22% and that of the LGT is around 11.7%. Harjeet *et al*⁵ conducted a study in North-western Indian population and observed a prevalence of around 28% PL but this value was much less than those of the studies conducted abroad like O.Tanriover *et al*⁶ in 2011 among Turkish population (57.8%), Hyung-Sun Won *et al*⁷ in 2011 among Korean population (76%) and Zivic *et al*⁸ in 2011 among Serbian population (61%). However, a similar study in the neighbouring country, Bangladesh, by Banna *et al*⁹ in 2006 noted 37% of cadavers with

PL which is also not consistent with our study showing 22% PL.

With regard to the prevalence of LGT, only 2 studies had corroborating results, Harjeet *et al* (19.5%) and Hussein Muktyaz *et al*¹⁰ (19.6%). Both the studies were conducted in North-western Indian population. A wide range of variation was noted in similar studies conducted in Bangladeshi population. Banna *et al* observed 59.26% study result in this regard while Abu Salat Muhammad Nurunnabi *et al*¹¹ noted only 20% of LGT in their study. Our study result is of lower value than those performed in past (11.7%).

Most of the studies revealed a male preponderance for the prevalence of PL as observed by Ranade *et al*¹² in 2008, Eva Marie Braun *et al*¹³ in 2007, B.Milojevic *et al*¹⁴ in 2013 etc. Our study is consistent with the above mentioned studies with the prevalence of PL being 70% in males and 30% in females. In the study done by Harjeet *et al* in 2003, they noted there was no sexual dimorphism. The study conducted on Serbian population by Zivic *et al* in 2011, however, had a different result.

They noted a female preponderance in the prevalence of PL.

Regarding the age-related incidence of PL, Zivic et al showed most of the cadavers with PL were < 40 years of age. In present study, 85% cadavers were > 40 years of age and 40% were even > 60 years of age.

The present study noted that the PL was arising from the left lobe of thyroid gland in 75% specimen. Most of the previous studies also showed similar results in various parts of the world with few exceptions as well. In a study by Zivic et al in Serbia, it was arising more frequently from the isthmus in midline. Eva Marie Braun et al noted it was extending from left side of isthmus and B.Milojevic et al recorded it was extending from the left side of mid-sagittal plane.

Our study showed upper extent of LGT up to the hyoid bone, extending from the apex of PL, which is more or less consistent with the previous studies regarding the extent of LGT. However, a case report by Faysal et al¹⁵ in 1996 have shown the upper extent of LGT was up to mastoid process.

We have recorded a new set of data regarding the variation of PL, whereby we noted that the apex of the PL extends up to the lower border of cricoid cartilage in 30% of the subjects and up to lower border of thyroid cartilage in 70% of the subjects.

Another relevant finding with respect to this study is the existence of active thyroid follicles in all sections of the PL, from base to apex.

Regarding the extent and measurements of lobes of thyroid gland, significant variations were not observed from previous literatures. However, a new set of observation was that the right lobe had increased vertical dimensions with increasing age in case of male subjects while there was a reduction in same for the opposite sex. The position of the isthmus was observed against 1st, 2nd and 3rd tracheal rings in most of the male and female

specimens of thyroid gland, which was also a bit different from other studies which recommended 2nd, 3rd and 4th tracheal rings as the posterior relations of the thyroid isthmus.^{16,17}

Thyroid gland is the first endocrine gland to develop in our body from the 1st branch. The thyroglossal duct system descends in front of the hyoid bone and divides into a bi-lobed structure. Thyroid follicles and intra-canalicular ducts appear subsequently. It is important to note that, the thyroglossal duct does not enter into any of the thyroid lobes and is strictly a mid-line structure. However, the caudal end of the thyroglossal duct might not be obliterated and persists as the pyramidal lobe in many cases. The presence of thyroid follicles in the pyramidal lobe, as found in our study, further strengthens this fact. Moreover, the location of apex of pyramidal lobe correlates with the site of appearance of thyroid follicles in the thyroglossal duct system, i.e., at the level of thyroid cartilage or cricoids cartilage. A surgeon should always explore the upper limit of pyramidal lobe, which might extend up to the thyroid cartilage, as evident from our study, while proceeding for radical thyroid resection.

Conclusion

This study has shown a male preponderance in the prevalence of pyramidal lobe of thyroid gland. The pyramidal lobes were extending mostly from the left lobe of thyroid gland. A fair number (11.7%) of specimen showed levator glandulae thyroideae, which might be of surgical importance. All the pyramidal lobe specimen showed thyroid follicles. The presence of levator glandulae thyroideae might be challenging for the surgeons while performing emergency or elective tracheostomy procedures. This study is, therefore, an effort to highlight the major anatomical variations of thyroid gland pertaining to the presence of pyramidal lobe. However, this study has the shortcomings of not

assessing the proportion of glandular tissue within the pyramidal lobe with advancing age. In recent future, more studies should be welcomed with

increased sample size to arrive at more comprehensive conclusions.

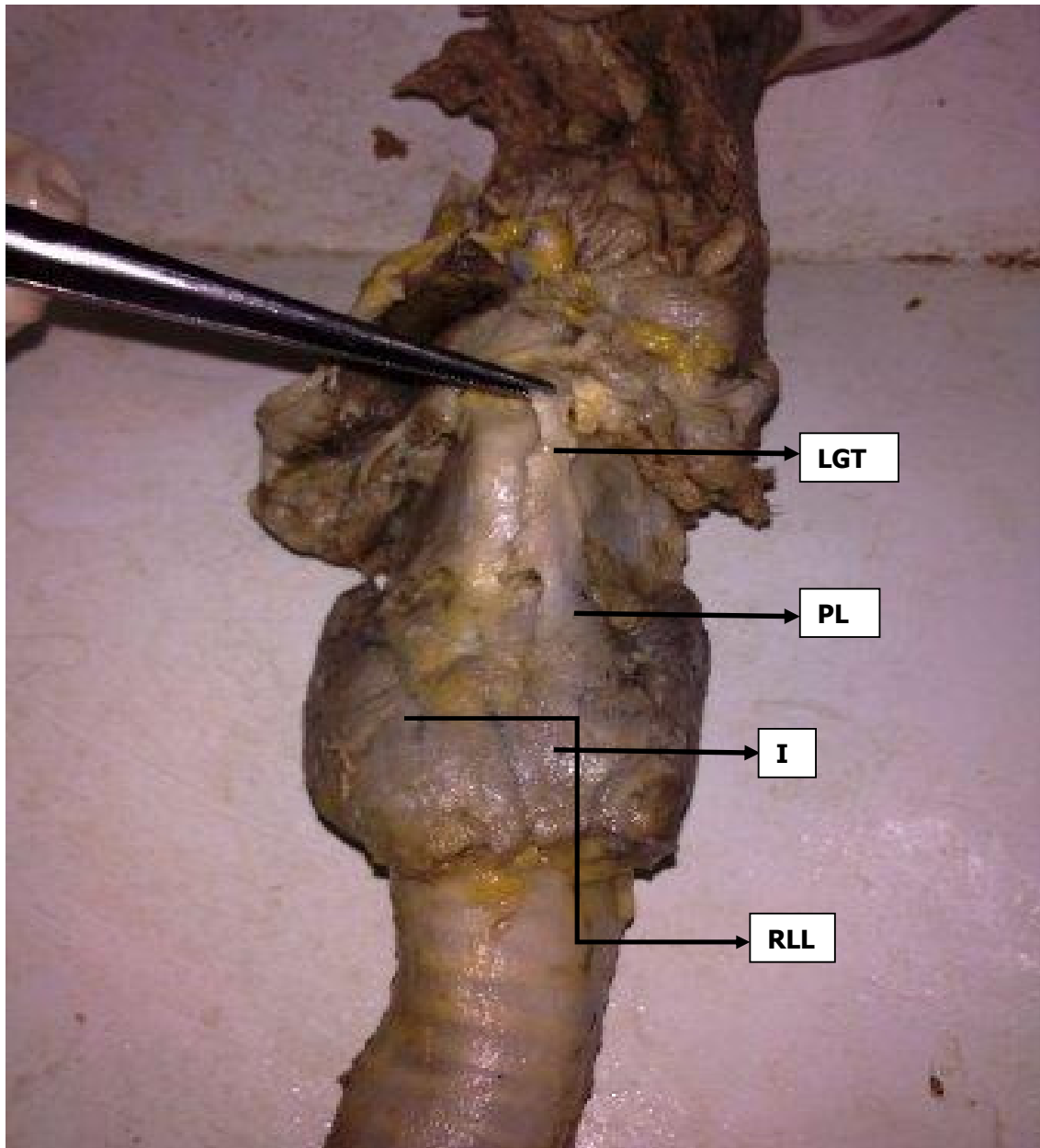


Figure 3 : Anterior view of thyroid gland in front of the laryngeal framework, showing the parts of the gland.

- PL :** Pyramidal lobe
- LGT :** Levator glandulae thyroideae
- LL :** Right Lateral lobe
- I :** Isthmus

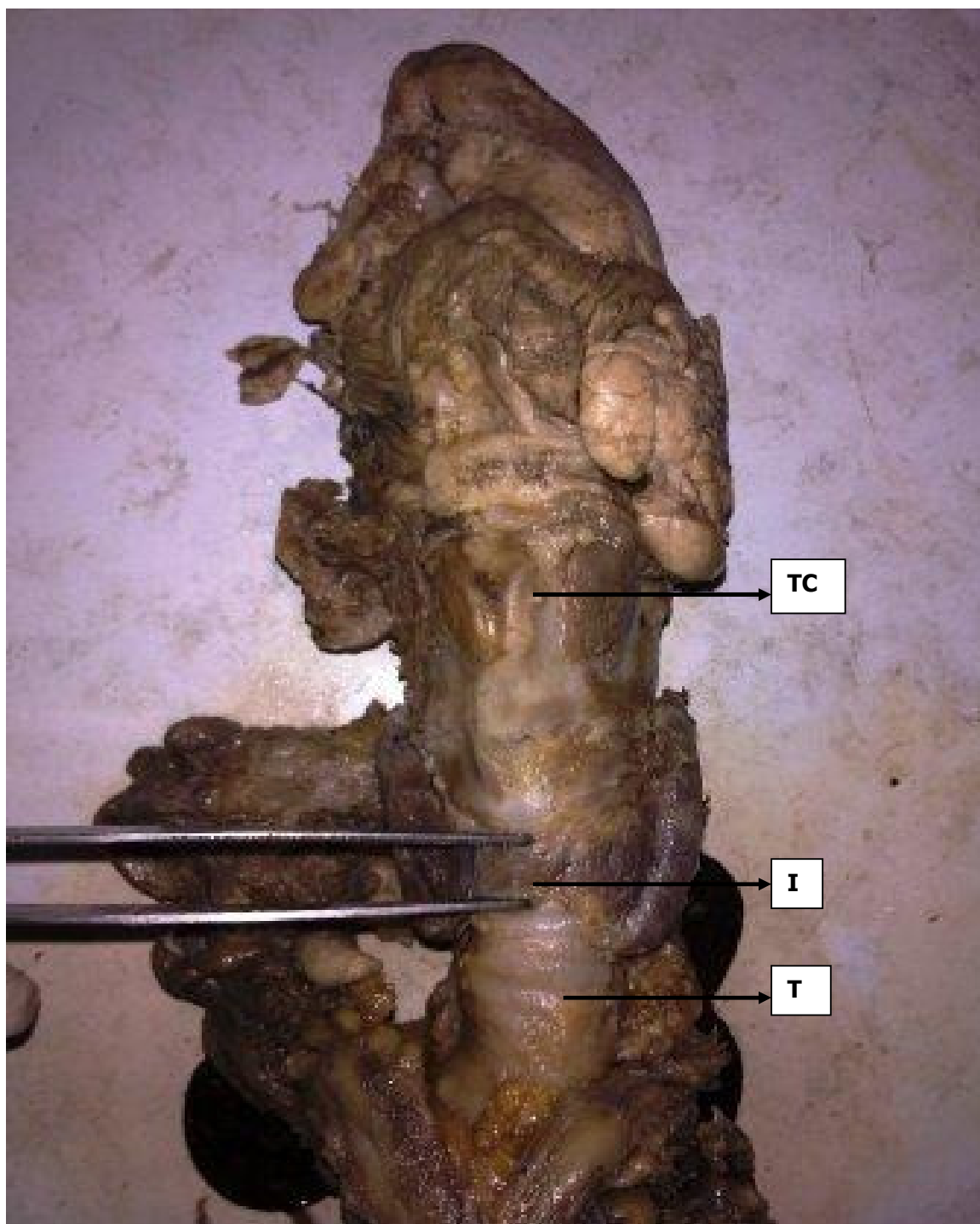


Figure 4 : Anterior view showing absence of pyramidal lobe in thyroid gland specimen.

TC : Thyroid cartilage

T : Trachea

I : Isthmus

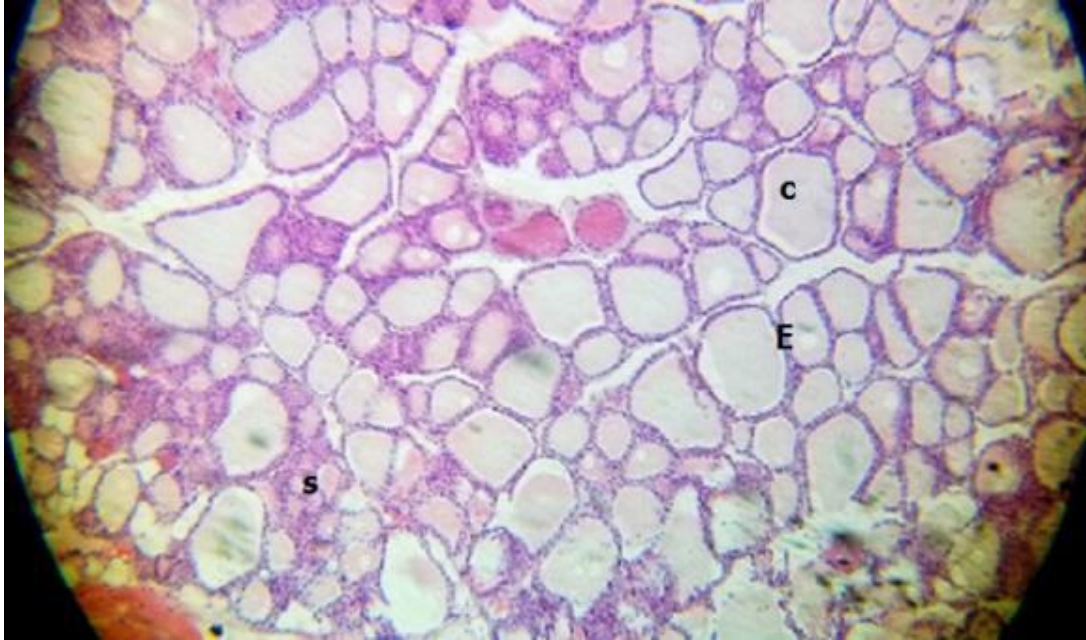


Figure 3 : Haematoxylin and Eosin stained microstructure of pyramidal lobe of thyroid gland. Number of thyroid follicles are seen surrounded by stroma.

C : Colloid

S : Stroma

E : Cuboidal epithelium

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