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**Original Research Article**

# MORPHOMETRIC STUDY OF PYRAMIDAL LOBE AND LEVATOR GLANDULAE THYROIDAE AND ITS SURGICAL SIGNIFICANCE

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## ABSTRACT

**Introduction:** The thyroid gland is an important endocrine gland in human body , thyroid disorder being the common health problem affecting almost 5% of the population. Incomplete removal of thyroid gland may cause recurrence of disease and it could be dangerous when complete removal of gland tissue is indicated in Grave's disease or malignant carcinoma . Remains of pyramidal lobe ,the cause. Hence its necessary to know the true incidence of anatomic variants of thyroid viz , pyramidal lobe or levator glandulae thyroidae to perform safe and effective surgery.

**Aims:** To study the morphological variations of lobes of thyroid gland . viz. pyramidal lobe, levator glandulae thyroidae and its incidence in western maharashtra population.

**Materials and methods:** The study was conducted on total of 60 thyroid glands(male-34, female-26) collected during routine dissection from adult cadavers of both sexes aged more than 18 yrs in the department of anatomy ,B. J. government medical college , Pune. A cross sectional descriptive type of study was performed.

**Results:** Pyramidal lobe was found in 25% cases , more common in females (30.76%), than males (20.58%) . Levator glandulae thyroidae was seen in (38.33%) cases, more common in females (38.46%) than males (38.23%) . Pyramidal lobe was mostly originated from center of isthmus (46.6%) and least from right end of isthmus (6.66%) . In pyramidal lobe, length and breadth were more in males whereas thickness was more in females. Maximum 73.9% LGT seen were muscular in texture followed by fibromuscular , fibrous respectively. Maximum number of LGT seen were extending from pyramidal lobe to hyoid bone (43.47%), followed by either lobe of thyroid gland to hyoid bone . All dimentions of LGT were more in males. PL associated with LGT was seen in 23.33% cases , males 20.59% and females 26.92% , thus showing female preponderance.

**Conclusion:** The study highlights the incidence of pyramidal lobe and levator glandulae thyroidae which is important to keep in mind for successful thyroid surgeries to prevent recurrence of diseases .

**KEY WORDS:** Pyramidal lobe (PL), Levator glandulae thyroidae (LGT), Thyroid gland morphometry.

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## INTRODUCTION

The thyroid gland is an important endocrine gland in human body situated anteriorly in the lower part of neck extending from the level of 5th

cervical to 1st thoracic vertebra. It consists of two symmetrical lobes connected by an isthmus which lies against second,third and fourth tracheal rings (butterfly shaped, H shaped) [1]. Thyroid gland derives its name from its resemblance to a shield (greek: thyreos-shield; eidos-form) [2]. The size ,shape of thyroid gland may alter remarkably with age ,sex, physiological state ,race and geographical location. It is larger and heavier in females than males and it hypertrophies during menstruation and pregnancy [3].

Thyroid disorder is common health problem among large number of endocrinopathies. Most of the diseases affecting thyroid gland e.g. goiter, thyrotoxicosis , adenoma, carcinoma etc are usually associated with enlargement of gland and require medical and surgical intervention viz. total thyroidectomy or hemithyroidectomy - the surgery of choice. The completeness of resection is important specially in malignant diseases, autoimmune diseases otherwise the disease may recur [4,5]. Thyroid gland surgery is the most common surgery performed in head and neck region. Hence the knowledge of variation in morphological and topographical anatomy is very important in evaluation and management of thyroid disorders in clinical practice for physicians, radiologists for postoperative scintigraphy and surgeons for performing thyroidectomy.

The organogenesis of thyroid gland in humans is often disturbed leading to a variety of morphological variations of thyroid such as hypoplasia, aplasia (agenesis of lobe or isthmus), ectopy [6].

The pyramidal lobe is considered as a normal variant of thyroid gland and has normal thyroid tissue. As all thyroid diseases are found in pyramidal lobe, its study bears great importance. It can arise from isthmus or from either lobes . Levator glandulae thyroidae which is considered to be a remnant of thyroglossal duct can also have varied attachments .

Although the racial and ethnic variations are known, this study is performed to find variations of thyroid in Indian population and contribute additional data to literature.

**Aims and objectives**: Aim of the present study is

1) To study the morphological variations of lobes of thyroid gland. viz. pyramidal lobe and levator glandulae thyroidae .

2) To study the incidence of pyramidal lobe and levator glandulae thyroidae and to highlight their surgical significance .

3) To compare the results of present study with previous studies.

## MATERIALS AND METHODS

This cross sectional descriptive type of study was conducted on total of 60 thyroid glands(male-34, female-26) collected during routine dissection from adult cadavers of both sexes aged more than 18 yrs in the department of anatomy ,B. J. Govt medical college , Pune during period from March 2013 to March 2015. Parameters studied are as follows. Pyramidal lobe –presence/absence. If present , length, breadth, thickness(mm), origin from lobe, isthmus etc noted. Levator glandulae thyroidae –presence/absence. If present, length, breadth, thickness(mm), texture ,upper and lower attachment (extension) noted. All measurements were taken with sliding caliper. Statistical analysis was done to find out wheather there was any significant difference regarding variations of thyroid gland . Chi square test was applied. P value < 0.05 was considered significant. The study is ethically approved by the ethical committee of B. J. Govt medical college and S.G.H. Pune.

## OBSERVATIONS AND RESULTS

**Table 1:** Pyramidal lobe and LGT Incidence.

| | Male(34) | Females(26) | Total (60) |
|---|---|---|---|
| Pyramidal lobe | 7(20.58%) | 8(30.76%) | 15(25%) |
| LGT | 13(38.23%) | 10(38.46%) | 23(38.33%) |
| Pyramidal lobe with LGT | 7(20.59%) | 7(26.92%) | 14(23.33%) |
| Pyramidal lobe only | 0 | 1(3.84%) | 1(1.66%) |
| LGT only | 6(17.65%) | 3(11.53%) | 9(15%) |

In present study out of total 60 cases , pyramidal lobe was found in 15 cases (25%) more common in females (30.76%) than males (20.58%) and all are unilateral. Out of total 60 cases, LGT seen in 23 cases(38.33%) more common in females (38.46%) than males (38.23%) although the gender variation was not much significant . All are unilateral. Out of 15 PL , 14 were associated with LGT ( 93.33% ).

(Table no. 1) Pyramidal lobe mostly originated from center of isthmus (46.6%) followed by right lobe and left lobe respectively.(Table no. 2)

**Table 2:** Types according to origin and location of base of pyramidal lobe.

| Type | Pyramidal lobe originates from | Males | Females | Total |
|---|---|---|---|---|
| I | Isthmus –Center | 2 | 5 | 7 |
| II | Rt end | 0 | 1 | 1 |
| III | Lt end | 1 | 1 | 2 |
| IV | Right lobe | 3 | 0 | 3 |
| V | Left lobe | 1 | 1 | 2 |
| | Total | 7 | 8 | 15 |

**Table 3:** Pyramidal lobe dimensions.

| | Males | | Females | | Total | |
|---|---|---|---|---|---|---|
| Parameter | Mean | SD | Mean | SD | Mean | SD |
| Length | 12.57 | 3.69 | 11.88 | 3.91 | 12.2 | 3.69 |
| Breadth | 9.86 | 4.06 | 7.75 | 2.19 | 8.73 | 3.26 |
| Thickness | 1.64 | 0.75 | 2.31 | 1.39 | 2 | 1.15 |

**Table 4:** The length of pyramidal lobe.

| | Length (mm) | Male | Female | Total |
|---|---|---|---|---|
| Small | 01-15 | 5 | 6 | 11 |
| Medium | 16 -30 | 2 | 2 | 4 |
| Large | >30 | 0 | 0 | 0 |
| Total | | 7 | 8 | 15 |

In present study the mean length of PL was noted to be 12.2mm, breadth as 8.73mm, thickness as 2mm. The length and breadth were more in males whereas thickness was more in females.(Table no.3) If PL were classified according to length , then most of PL found were of short length i.e. less than 15mm (73.33%).(Table no. 4)

**Levator glandulae thyroidae:** In present study, out of total 60 cases, 23 LGT are seen, males-13, females- 10 . All are unilateral. Maximum 17 LGT (73.9%) seen are muscular in texture followed by fibromuscular, fibrous and fibroglandular respectively.(Table no. 5) Maximum number of LGT seen were extending from pyramidal lobe to hyoid bone (43.47%), followed by either lobe of thyroid gland to hyoid bone . In one case we found it separate extending from cricoid cartilage to hyoid bone.(Table no. 6) Lot of variations are found in attachment of LGT. In LGT, length, breadth and thickness all dimentions are more in males.(Table no.7) Hence pyramidal lobe and LGT both are longer in males.

**Table 5:** Types according to texture of LGT seen.

| Type | LGT Texture | Cases |
|---|---|---|
| I | Muscular | 17 |
| II | Fibrous | 2 |
| III | Fibromuscular | 3 |
| IV | Glandular partly, partly fibrous | 1 |

**Table 6:** According to upper and lower attachment of LGT.

| Extension of LGT | | |
|---|---|---|
| From | To | Cases |
| Pyramidal lobe | Hyoid | 10 |
| | Thyroid cartilage | 4 |
| | Cricoid cartilage | - |
| Right lobe | Hyoid | 2 |
| | Thyroid cartilage, then to Hyoid | 1 |
| Left lobe | Thyroid cartilage | 2 |
| Separate, from cricoid | Hyoid | 1 |
| Isthmus | Thyroid | 3 |

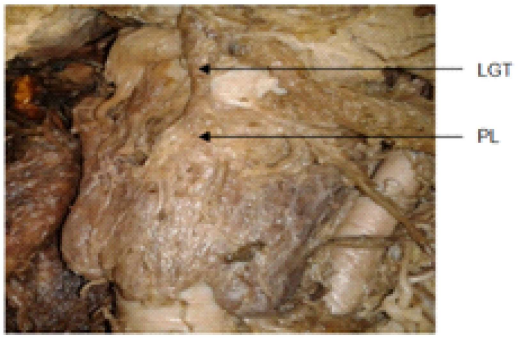
**Table 7:** LGT dimensions.

| | Males | | Females | | Total | |
|---|---|---|---|---|---|---|
| Paramater | Mean | SD | Mean | SD | Mean | SD |
| Length | 28.23 | 10.18 | 20.6 | 5.58 | 24.91 | 9.18 |
| Breadth | 7.15 | 4.12 | 5.8 | 3.68 | 6.57 | 3.91 |
| Thickness | 1.5 | 1.22 | 1.4 | 0.74 | 1.45 | 1.01 |

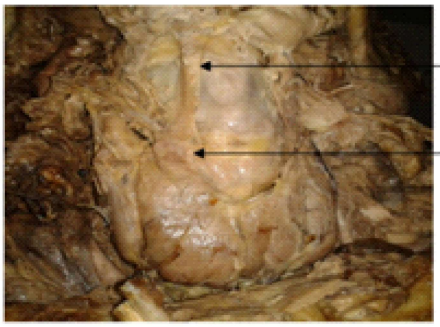
In present study the chi square value and P value for pyramidal lobe is 0.81 and 0.63 respectively. It shows that it is statistically insignificant. The presence of levator glandulae thyroidae has chi square value and P value as 0.0003 and 0.014 respectively . It shows that it is statistically significant .The presence of pyramidal lobe with LGT has chi square value and P value as 0.330 and 0.43 respectively. It shows the combined presence is statistically insignificant.

**Fig. 1:** Different variants of LGT.

1) From, isthmus (PL) to hyoid, glandular, muscular



2) From right lobe (PL) to hyoid right side, muscular




3) From left lobe (PL) to hyoid left side, muscular


## DISCUSSION

Thyroid gland is first endocrine gland to develop in embryo. It develops from thyroglossal duct, endodermal diverticulum from the floor of primitive pharynx at level of 2nd and 3rd arch. It descends while its caudal end bifurcates and gives rise to thyroid lobes. The developing thyroid comes into intimate relationship with caudal pharyngeal complex (derived from 4th and 5th pharyngeal pouches) and fuses with it. Cells arising from this complex are believed to give origin to the parafollicular cells of thyroid which represents ultimobronchial body of lower animals. Pyramidal lobe is often present and considered as normal variant. It may originate from isthmus or from one of the lobes of thyroid [7]. Sgalitzer stated that the pyramidal process develops out of the lower part of the thyroglossal duct by differentiation of duct tissue into glandular tissue . The length of pyramidal process depends on the position at which fragmentation of the thyroglossal duct first occurs [8]. Pyramidal lobe is also called as lobus pyramidalis glandulae thyroidae, Lalouette's pyramid, Morgagni's appendix, pyramid of thyroid. Kadasne in 2011 classified pyramidal lobe into a) detached from the gland, b) too small, c) too large –reaching hyoid bone, d) can be on right side of isthmus [9]. Pyramidal lobe may or may not be associated with LGT. When pyramidal lobe is absent, LGT may attach directly to upper part of isthmus.The incidence of pyramidal lobe and LGT was studied by many workers in different populations all over the world as stated below. (Table no. 8)

**Table 8:** Incidence of PL and LGT in different studies.

| Author | Year of study | Sample size | % of presence of PL | % of LGT | % PL with LGT |
|---|---|---|---|---|---|
| Ranade et al.[6] | 2008 | 105 | 58% | 49.50% | - |
| Begum M et al [10] | 2009 | 60 | 26% | 15% | - |
| Nurunnabi ASM et al [11] | 2009 | 60 | 41.67% | 20% | - |
| Daksha Dixit et al.[12] | 2009 | 41 | 7.31% | 7.31% | - |
| Joshi S D et al [13] | 2010 | 90 | 37.80% | 30% | - |
| O. Tanriover et al. [3] | 2011 | 90 | 57.80% | ----- | - |
| Kulkarni V et al [14] | 2012 | 20 | ---- | 30% | - |
| Hussain Muktyaz et al. [15] | 2013 | 56 | 41% | 19.60% | - |
| Abhijeet Yadav et al [16] | 2014 | 26 | 30.76% | 34.61% | - |
| Veerahanumaiah S et al [4] | 2015 | 89 | 46% | 41% | - |
| Kafeel Hussain et al [17] | 2015 | 32 | 40.60% | 25% | - |
| Emin Gurleyik et al [5] | 2015 | 166 | 65.70% | -- | - |
| Shobha Gaikwad et al [18] | 2016 | 100 | 26.59% | 30.85% | 11.70% |
| Anjan Rajkonwar et al [19] | 2016 | 80 | 38.75% | 18.75% | |
| Present Study | 2015 | 60 | 25% | 38.33% | 23.33% |

In present study we found pyramidal lobe in 25% cadavers and LGT in 38.33% cadavers. In literature we find pyramidal lobe incidence varying from 7% to 65% max and LGT incidence varying from 7% to 49% max. In the present study incidence of pyramidal lobe (25%) was almost similar to results of Begum et al (26%) and Gaikwad et al (26.59%). The minimum incidence was found by Daksha Dixit et al (7.31%) while the maximum incidence was seen by Emin Gurleyik et al (65.7%). Considering incidence of LGT, present study result (38.33%) is nearly similar to the results of Abhijeet Yadav et al (34%) .The minimum incidence was seen by Daksha Dixit et al (7.31%) while the maximum incidence of LGT was seen by Ranade et al (49.5%). In present study PL associated with LGT was found to be 23.33% the percentage was much higher than study by Shobha Gaikwad et al which was 11.70% . (Table no. 8) In present study pyramidal lobe was more common in females. Ranade et al [6] and Prakash et al [20] found it more common in males. In present study LGT was more common in females but gender variation was not statistically significant. Whereas Ranade et al and Prakash et al found it more common in males.

According to the origin and location of pyrami-

dal lobe , Milejovic B. et al classified 5 types of pyramidal lobe (21) – from a) isthmus –center

b) isthmus- right end

c) isthmus – left end

d) right lobe

e) left lobe

**Table 9:** Pyramidal lobe location comparison.

| Study | Isthmus center | Isthmus Rt side | Isthmus Lt side | Rt lobe | Lt lobe |
|---|---|---|---|---|---|
| O.Tanriover 2011 [3] | 14(27.1%) | 17(32.6%) | 21(40.3%) | -- | -- |
| Milejovic et al 2013 [20] | 9(28.1%) | 9(28.1%) | 7(21.9%) | 1(3.1%) | 6(18.8%) |

The same classification was used in present study where we found pyramidal lobe mostly originated from center of isthmus (46.66%) followed by right lobe and then left lobe. Emin Gurleyik et al found it from isthmus center (52%) whereas Anjan Rajkonwar found it from isthmus left side (74%) and Kafeel Hussain found it from left lobe (30%). (Table no. 9) Many workers found it coming from left side viz. Begum M et al, Nurunnabi ASM et al, Joshi S D et al, Prakash et al etc.

**Table 10:** Dimensions of pyramidal lobe.

| | B. Milejovic et al | | Present Study | |
|---|---|---|---|---|
| Parameter | Mean | SD | Mean | SD |
| Length (mm) | 22.6 | 10.5 | 12.2 | 3.69 |
| Breadth (mm) | 11.2 | 3.1 | 8.73 | 3.26 |
| Thickness (mm) | 3.6 | 1.1 | 2 | 1.15 |

**Table 11:** Pyramidal lobe classification according to length.

| Length (mm) | Small (1-15mm) | Medium (16-30mm) | Large ( >30mm) |
|---|---|---|---|
| Emin Gurleyik 2015 | 42(38.5%) | 42(38.5%) | 25(23%) |
| Present Study 2015 | 11(73.33%) | 4(26.66%) | 0 |

In present study the mean length of PL was noted to be 12.2mm, breadth as 8.73mm, thickness as 2mm. The values were much less than the values in Milejovic study.(Table no.10) If PL is classified according to length ,then most of PL found were of short length in the present study (73.33%). Emin Gurleyik found majority of pyramidal lobes to be short to medium in size, a few being long.(Table no.11)

**Levator glandulae thyroidae:** Levator glandulae thyroidae is an accessory muscle extending from hyoid bone to the isthmus or pyramidal lobe. Many workers studied it and found varied opinions. Standring, Hamilton and Mossman described it as a fibrous and fibromuscular band that stretches from the pyramidal lobe or upper border of isthmus of thyroid gland ,usually on left side of median plane,to the body of hyoid bone above [1,22]. The pyramidal lobe and levator glandulae thyroidae both develop from remnants of epithelium and connective tissue of the thyroglossal duct. According to Gregory and Guse , Soemmerring's levator glandulae thyroidae is an accessory muscle which runs from hyoid bone to insert partly on thyroid cartilage and partly on isthmus of thyroid gland. Merkel thought that the levator glandulae thyroidae was constant and glandular, though it was usually surrounded by muscle fibres. W.Henry Hollinshed stated this structure as a muscular slip , attached to hyoid bone, frequently on left side and usually assumed to be a derivative of infrahyoid muscle. Eisler stated that levator may be innervated either through ansa cervicalis (hypoglossi) or through vagus by superior laryngeal branch [23]. In our study we found different types of LGT, viz. muscular, fibrous, fibromuscular, partly fibrous, partly glandular as shown in photos above.

## CONCLUSION

Pyramidal lobe is a normal variant of thyroid gland varying in its location, origin, size. LGT is fibrous, muscular band which is a remnant of thyroglossal duct varying in its location. Study of both these morphological variants is important for complete removal of all thyroid pathologies including carcinomas for which total thyroidectomy is the surgery of choice . Failing which recurrence of the disease from the left out pyramidal lobe tissue is the most common complication in Grave's disease and papillary carcinoma . Also preservation of pyramidal lobe is essential in C cell hyperplasia of thyroid gland as pyramidal lobe and isthmus does not contain C cells.(24) Hence accurate knowledge of these variations is important for anatomists , radiologists and general surgeons and ENT surgeons to perform safe and effective surgery.

## ABBREVIATIONS

**PL –** Pyramidal lobe **Rt –** Right **Lt –** Left
**LGT –** Levator glandulae thyroidae

## Conflicts of Interests: None

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