

## Morphological Variations of the Thyroid Gland

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### **Abstract:**

**Introduction:** An extensive knowledge about the Thyroid gland is important to avoid iatrogenic injuries during neck surgeries. The identification and removal of the pyramidal lobe are also of great importance for successful postoperative radioactive iodine treatment in patients with differentiated thyroid carcinoma. The unreliability of preoperative diagnostic methods like ultrasonographic or scintigraphic images for detection of the PL makes anatomical studies important in order to ensure a safer thyroid surgery.

**Aim:** The aim of present study is to highlight the morphological variations and various developmental anomalies of the thyroid gland to form a cornerstone for safe and effective surgery.

**Material & Methods:** This study was structured to investigate the gross anatomical features of the thyroid in 32 cadavers from SSSMC & RI and MGMC during routine dissection of the head & neck region.

**Observation:** The size of the lobes showed variations –In one cadaver, the right lobe showed hypertrophy. An Aberrant Right lobe was encountered in one of the cadavers. The pyramidal lobes were noticed in 13 cadavers (40.6%). The pyramidal lobes were located in the Central part of the isthmus in 23.07% (3 cases), at the Junction of the right lobe with the isthmus 23.07% (3 cases), the Junction of the left lobe with the isthmus, 15.3% (2 cases), at the L lobe 30.7% (4 cases) and R lobe 7.6% (1 case). The absence of isthmus was observed in 2 specimens (6.2%). Totally, Eight of the cadavers (25%) showed the presence of a thin and fibrous Levator Glandulae Thyroidea (LGT) of which 4 were seen arising from pyramidal lobe and 3 from the right lobe. A LGT showed the presence of muscle fibers in it receiving a twig from ansa cervicalis. Interestingly, in one of the cadavers, there were 2 LGTs, 1 arising from the right lobe and another from a small pyramidal lobe.

**Conclusion:** The prevalence of morphological variations including rare presentations like presence of 2 LGT and aberrant thyroids found during the random dissections of cadavers has been highlighted in this study. A thorough knowledge of the thyroid anatomy and its associated anatomical variations is very important for the clinicians so as to avoid undue complications while securing a difficult invasive airway. The possible presence of the PL should not be ignored during preoperative diagnosis in patients with thyroid disease, where it often remains unvisualized.

**Keywords:** LGT-Levator glandulae thyroidea, PL-Pyramidal lobe, Isthmus.

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### **I. Introduction**

Thyroid gland develops from the thyroglossal duct which descends from the developing pharynx with contribution from 4<sup>th</sup> pharyngeal pouch and ultimobronchial body.

It is situated in the anterior part of the neck and has two lobes connected by an isthmus with a conical pyramidal lobe often ascending upwards from the isthmus or adjacent part of the either of the lobes thyroid gland. A fibrous or fibromuscular band, the levator glandulae thyroideae, sometimes descends from the body of the hyoid bone to the isthmus or pyramidal lobe.

The knowledge about the fleshy slip of the levator glandulae thyroideae is important during neck surgery to avoid the iatrogenic injuries. The PL may be a source of recurrent disease when it is not removed during indicated total thyroidectomy. The identification and removal of the PL are also of great importance for successful postoperative radioactive iodine treatment in patients with differentiated thyroid carcinoma. The unreliability of preoperative diagnostic methods like ultrasonographic or scintigraphic images for detection of the PL makes anatomical studies important in order to ensure safer thyroid surgery.

### **II. Aim**

The aim of present study is to highlight the morphological variations and various developmental anomalies of the thyroid gland to form a cornerstone for safe and effective surgery.

### III. Materials AND METHODS

This study was structured to investigate the gross anatomical features of the thyroid in 32 cadavers from SSSMC & RI and MGMC during routine dissection of the head & neck region to observe

1. The presence and absence of the right and left lobes of the thyroid gland.
2. The presence and absence of isthmus.
3. The Presence and absence of pyramidal lobe and their location.
4. The presence or absence of levator glandulae thyroideae and their extent.

#### Observation

Variation in the size of the lobes was encountered in one of the cadavers with the right lobe showing marked hypertrophy.(Fig.1)

During the midline dissection of the neck of one of the cadavers,the L lobe of the thyroid and a part of the isthmus ending blindly was witnessed.There were also signs of inflammation,adhesion and enlargement of deep cervical lymph nodes on the right side of the neck.After releasing the adhesion and on exploring the contents of the carotid sheath,the R.lobe made its appearance. The R.lobe was displaced behind the carotid sheath. It was confirmed as an “aberrant thyroid lobe” as the superior and inferior thyroid arteries were traced to it.(Fig.2)

The pyramidal lobes were noticed in 13 cadavers(40.6%). The absence of isthmus was observed in 2 specimens(6.2%) (Fig.5&6), with the LGT extending from the R.lobe to the thyroid cartilage in one of them (Fig.5).Totally,Eight of the cadavers(25%)showed the presence of a thin and fibrous Levator Glandulae Thyroidea(LGT) of which 4 were seen arising from pyramidal lobe and 3 from the right lobe.

The PL was found in 40.6% of cases (13 out of 32 specimens).The PL was more frequently located on the left side of the midsagittal plane. Based on the origin and location of its base, the the pyramidal lobes were classified as follows.They were located in the Central part of the isthmus in 23.07% (3 cases)(fig.3,9), at the junction of the right lobe with the isthmus 23.07% (3 cases)(Fig.7),the junction of the left lobe with the isthmus,2cases (15.3%)(Fig.11),at the L lobe 30.7% (4 cases)(Fig.12,13) and R lobe 7.6% (1 case)(Fig.5). The base of the PL was located directly below the level of the cricoids arch, inferomedial from the oblique line of the thyroid cartilage. Thus,In terms of the PL position, the cricoid arch and the oblique line represent useful anatomical landmarks for resection. The apex in majority of cases was located below the level of the superior border of the thyroid cartilage (Figure 12). In some cases the apex of the PL reached the hyoid bone (15.3% ,2 cases) (Figure 10).

A very short LGT was seen arising from the pyramidal lobe and extended only upto the cricoid cartilage (Fig.12).LGT arising from the pyramidal lobe extended upto the thyroid cartilage in one specimen(Fig.7).In 2 other specimens ,it extended upto hyoid bone (Fig.9), of which, one showed the presence of muscle fibers in it receiving a twig from ansa cervicalis.(Fig.10).

LGT arising from the R.lobe extended upto the thyroid cartilage in 2 cadavers and upto the hyoid bone on one. Strikingly,in One cadaver, there were 2 LGT, 1 extending from the right lobe to the cricoid cartilage and another from a small pyramidal lobe to the thyroid cartilage.(Fig.13).

### IV. Discussion

Developmental anomalies of the thyroid are quite common varying from agenesis of a lobe ,ectopic thyroid, thyroglossal cyst ,absence of isthmus to presence of pyramidal lobe and Levator glandulae thyroidea(LGT). LGTs taking origin from the hyoid bone or thyroid cartilage and getting inserted into the lobes,isthmus,pyramidal process or capsule of the gland have also been previously reported by Bergman et al,1988<sup>2</sup>;Berkovitz and Moxham <sup>3</sup>,1988;Ferner and Staubesand<sup>7</sup>,1978;Gardner et al<sup>8</sup>,1975 Kopsch1909<sup>11</sup>; Lehr,1979<sup>12</sup>;Piersol<sup>18</sup>,1930;Romanes<sup>20</sup>,1981;Williams et al,1989<sup>24</sup>;Zuckerman<sup>26</sup>,1961). The presence of LGT is independent of the presence or absence of a pyramidal process(Gardner et al<sup>8</sup>,1975;von lanz and Wachsmuth<sup>23</sup>,1982,Romanes<sup>20</sup>,1981).In the present study,apart from encountering all the above, there were 2 LGT, 1 extending from the right lobe to the cricoid cartilage and another from a small pyramidal lobe to the thyroid cartilage.

One of the LGTs extending from the pyramidal lobe to the hyoid bone showed the presence of muscle fibers in it receiving a twig from ansa cervicalis. Based on the innervation of the muscle,one can ascertain that it belongs to the infrahyoid musculature. Varying incidences of presence of muscle fibres have been postulated .Lehr studied 203 mixed racial cadavers and found this muscle only in 1 case (0.49%). Enayetullah (1996)<sup>6</sup> observed this muscle in 32% of cases and most of them were associated with the pyramidal lobe.The origin of this Fibromuscular band remains an enigma. Mansberger Ar Jr and Wei JP<sup>13</sup> (1993) pointed out that the PL may be attached to the hyoid bone by a fibrous tissue. Ignjatović M<sup>10</sup> (2009) illustrated a case, in which a double pyramidal lobe was joined to the hyoid bone by a fibrous cord. Similar findings were reported by Ozgur Z et al.<sup>16</sup>(2011) and Prakash et al.<sup>19</sup> (2012), who defined the FMB as the levator glandulae thyroideae muscle in the

form of a fibrous or fibromuscular band. It is possible that the FMB may originate from two structures. First, it may represent the fibrous remnant of the thyroglossal duct or tract that is found in 41.3% of infants and children as a predominantly left-sided structure according to a histological study conducted by Sprinzi GM et al<sup>21</sup>. (2000). Second, it may represent the levator glandulae thyroideae, an accessory and variable muscle that has been reported to occur in 0.49% to 31.2% of cases.

Blumberg (1981)<sup>5</sup> observed 17 cases preoperatively and 53 cases retrospectively in patients who had undergone thyroid surgery and stated that 60%-65% cases had the pyramidal lobe and in most cases its location was at left side of the gland (left : right =13 : 1). Enayetullah (1996)<sup>6</sup> found the pyramidal lobe and the LGT in 50% and 32% of cases respectively. In most cases, the pyramidal lobe was found on the left side of the isthmus and associated with the LGT. Begum<sup>1</sup>(2004) found pyramidal lobe in 26.7% and most were from the left side. Our data confirm previous findings that the PL More frequently located on the left side of the midsagittal Plane.

Marshall<sup>14</sup>,1895 reported that in 7% of the cases, one of the lateral lobes was markedly larger than the other or may even be completely absent and the pyramidal lobe was present in about 43%, but in not all of these was it symmetrically placed.

The presence of the PL in 40.6% of cases (13 out of 32 specimens) reported here was similar to Park JY et al<sup>17</sup>. (2012) (41.3%) but was somewhat lower than that indicated by Tanriover O et al<sup>22</sup>. (2011), Zivic R et al<sup>25</sup>. (2011) and Ozgur Z et al<sup>16</sup>. (2012) who found the PL in 57.8%, 61% and 65% of cases. Based on these data, which demonstrate that the PL occurs in more than half of specimens or patients, this structure may be thought of as a normal component of the thyroid gland, as suggested by Braun EM et al<sup>4</sup>. (2007). Braun EM et al<sup>4</sup>. (2007) demonstrated a discrepancy in the presence of the PL in cadaveric subjects (the PL was found in 55% of cases upon dissection) and in living subjects using thyroid scintigraphy (where PL was found in only 13% of cases). The reason for this discrepancy could be attributed to the low spatial resolution of this diagnostic method. Thyroid scintigraphy is much more efficient at assessing functional properties than it is in visualization of normal or variable thyroid morphology. A much better method for detecting the PL in living subjects is computed tomography (CT) of the neck. According to Geraci G et al<sup>9</sup>. (2008) the PL was identified in only 50% of cases during preoperative diagnostic treatments using either ultrasonography or Tc-99m pertechnetate scintigraphy

Marshall<sup>14</sup>,1895 had documented that the isthmus was entirely absent in about 10% of the thyroid glands. The absence of isthmus could be explained developmentally, by the separation of the bifurcated lower end of the median thyroid diverticulum from each other. In the absence of the isthmus, tracheostomy is made easy. Hence, Neck ultrasounds may be advised in patients under mechanical ventilation in whom tracheostomy is indicated, taking into account the increased prevalence of morphological variations in the thyroid gland. However, 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. 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 to impossible intubation.

## V. Conclusion

Though the pyramidal lobes and LGTs are not uncommon findings, a sound knowledge in the morphology of the thyroid may reduce the unwarranted outcomes in thyroid surgeries. The prevalence of morphological variations including rare presentations like presence of 2 LGT and aberrant thyroids found during the random dissections of cadavers has been highlighted in this study. A thorough knowledge of the thyroid anatomy and its associated anatomical variations is very important for the clinicians so as to avoid undue complications while securing a difficult invasive airway. Our data about the presence, position and types of the PL may be used to ensure safer partial thyroidectomy in order to preserve thyroid function. The possible presence of the PL should not be ignored during preoperative diagnosis in patients with thyroid disease when it often remains unvisualized.

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**Fig.1 Hypertrophy of R.lobe**



**Fig.2 R. lobe displaced behind the carotid sheath**



**Fig.3 Thyroid with 2 pyramidal lobes**



**Fig.4 Absence of pyramidal lobe**



**Fig.5 Absence of isthmus with LGT extending from the R.lobe to the thyroid cartilage.**



**Fig.6 Absence of isthmus**



**Fig.7** LGT extending from pyramidal lobe Thyroid tothyroid cartilage.



**Fig.8** LGT extending from R.lobe to the Thyroid tothyroid cartilage.



**Fig.9** LGT extending from the R. lobe to hyoid bone



**Fig.10** LGT extending from the pyramidal lobe to hyoid with muscle fibers in it .



Fig.11 LGT extending from pyramidal lobe to hyoid



Fig.12 LGT extending from pyramidal lobe to cricoid cartilage



Fig.13 Presence of two LGT, one extending upto thyroid cartilage another upto cricoid cartilage



Table.1

EXTENSION OF LEVATOR GLANDULAE THYROIDEA	NO. OF SPECIMENS	
FROM	TO	
PYRAMIDAL LOBE	CRICOID CARTILAGE	1
	THYROID CARTILAGE	1
	HYOID BONE	2
R.LOBE	THYROID CARTILAGE	2
	HYOID BONE	1
PYRAMIDAL LOBE AND R.LOBE	CRICOID AND THYROID CARTILAGE	1
L.LOBE	-	-
TOTAL NO. OF CADAVERS WITH LGTs		8
NO.OF CADAVERS WITH PYRAMIDAL LOBES		13
NO. OF CADAVERS WITH NO ISTHUMUS		2