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## A prospective study: Zuckerkandl tubercle an important anatomical landmark in identification of recurrent laryngeal nerve in thyroid surgery

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### Abstract

**Introduction:** The Zuckerkandl tubercle (ZT) is an anatomic landmark that can be used for the identification of the RLN intra-operatively. A prospective study was carried out on patients who underwent thyroidectomies, from September 2016. All cases were admitted from Surgery and ENT Outpatient department. The cases were studied according to proforma.

Written informed consent was taken

**Conclusion:** Zuckerkandl's tubercle which is defined as posterior exterior of lateral lobes of the thyroid gland is a common anatomical structure found in the majority of cases. Excision of the tubercle requires fine and meticulous dissection with great care because of close relationship between ZT and RLN. Identification of ZT, an understanding of the relationship between the ZT and RLN and isolation of the nerve before dissection of ZT are essential for performing safe thyroid surgery.

**Keywords:** zuckerandl tubercle, recurrent laryngeal nerve, thyroid

### Introduction

The Zuckerkandl tubercle (ZT) is an anatomic landmark that can be used for the identification of the RLN intra-operatively. It is located between the superior and inferior pole, pointing toward the tracheo-esophageal groove<sup>[3]</sup>. The ZT is a lateral or posterior projection from the lateral thyroid lobe, which indicates the point of embryologic fusion of the ultimo-branchial body and principal median thyroid process<sup>[4]</sup>. Thyroid gland develops as the midline descent of the thyroid tissue from the foramen caecum to the level of the larynx along the thyroglossal tract. It descends anterior to the pharyngeal gut, as a bilobed diverticulum and remains connected to the tongue by the thyroglossal duct, which disappears later<sup>[3]</sup>. At this stage, the thyroid tissue develops into right and left lobes of thyroid gland. There is also a lateral thyroid gland component which arises from the 4<sup>th</sup> branchial cleft and ultimo-branchial body which fuses with the median components of the thyroid gland to form a tubercle known as Zuckerkandl tubercle. This tubercle is the most posterior pyramidal extension of pure thyroid tissues of the lateral lobes of the thyroid gland in the area of the ligament of Berry<sup>[4]</sup>. Superior parathyroid gland is also derived from the 4<sup>th</sup> brachial cleft so is commonly found in close association with that tubercle, usually cephalad to that tubercle. This tubercle is usually found in the cleft between trachea and oesophagus which is a common pathway of recurrent laryngeal nerve. It may be mistaken for a thyroid nodule, mass or lymph node. It is a projection of normal thyroid tissue from the posterior or lateral lobes of the thyroid gland. It has been used as an anatomical landmark for location of the recurrent laryngeal nerve. Early elevation of this tubercle usually allows the identification of recurrent laryngeal nerve, which can be easily and safely encountered even though it is not initially visible. Sheahan and Murphy reported that ZT is a critical anatomical landmark in thyroid surgery, being present in most of the thyroid lobes, especially in the larger ones. They believed that adequate recognition and dissection of the ZT is essential for successful thyroid surgery<sup>[7]</sup>.

Historically, thyroid surgery has been fraught with complications. Injury to the recurrent laryngeal nerve (RLN), superior laryngeal nerve, or the parathyroid glands may result in profound lifelong consequences for the patients. In-depth knowledge of the anatomical relations and variations in the thyroid and parathyroid glands, as well as of the vascular supply and

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laryngeal nerves, is the cornerstone of safe thyroid or parathyroid surgeries [6]. Visualization of the RLN is absolutely essential for good surgical outcomes because many authors report decreased incidence of vocal cord paresis with visualization. Visual identification of the RLN during thyroid surgery has been shown to be associated with lower rates of RLN palsy but does not guarantee success against an outcome of postoperative vocal cord paralysis. RLN palsy is still being reported with a permanent palsy rate of 1-2% and a temporary palsy rate of up-to 5-6%. Furthermore, most RLN palsy injuries are not recognized intra-operatively. RLN injury can result from transaction, clamping, stretching, electro-thermal injury, ligature entrapment, or ischemia [6]. Paresis of the RLN is a serious complication that may prevent the affected individual from continuing his or her profession. There are two major problems in RLN palsy inability to visualize the cord movement directly during operation and the anatomical integrity of the RLN, which does not indicate intact function. Theoretically, the surgical anatomy of the RLN has been clarified but the nerve anatomical variations could lead to difficulty during surgery. Different surgical landmarks have been proposed for locating the RLN, but none of them are universally accepted. These include Simone's triangle, its relation with the inferior thyroid artery, and its relation with the inferior pole of the thyroid gland. Alternatively, traction maneuvers or intra-operative electrophysiological monitoring have also been proposed as a means of avoiding RLN injury [6].

**Material and methods**

- A prospective study was carried out on patients who underwent thyroidectomies, from September 2016.
- All cases were admitted from Surgery and ENT O.P.D. The cases were studied according to proforma.
- Written informed consent was taken.

Presence and location of the ZT was noted intra-operatively. A sterile needle with calibrations in millimeters will be used to measure approximate diameter from recurrent laryngeal nerve to ZT. Size of the tubercle was measured in removed specimens using a Vernier caliper and grading was done according to the grading proposed by Pelizzo *et al.* [2]. The relationship of the ZT to the RLN was assessed in medio-lateral and antero-posterior planes during the surgery. Intra-operative photographs were taken to visualize the ZT and its relationship to the RLN. All thyroid specimens were also photo graphed immediately after surgery.

**Inclusion & exclusion criteria**

**(a) Inclusion criteria**

1. Willing for surgery and giving written consent.
2. Fit for surgery.
3. Aged between 25 to 65years.
4. Primary Total thyroidectomy
5. Primary Hemi-thyroidectomy.

**(b) Exclusion criteria**

1. Unfit for surgery.
2. Refusal for surgery.
3. Age < 21 and > 70 years.
4. Revision total / hemi- thyroidectomy.

**Surgical Technique**

All operations were performed on patients under general anaesthesia by our experienced surgeon. In our study thyroidectomies technique approaching the recurrent laryngeal nerve from Zuckerkandl's tuberculum [2] the stages of operation was almost all the same as in the current standard procedure. Firstly, the middle thyroid vein was sectioned in order to achieve a good thyroid mobilization and making the cricothyroid space visible. Secondly, the superior pole vessels were legated and divided carefully while protecting the external branch of the superior laryngeal nerve, after that the inferior thyroid veins were subsequently divided [2]. Thirdly, after the thyroid lobe was gently retracted medially, it was released from the surrounding thin areolar tissue by bloodless blunt dissection. The extra capsular plane was followed for dissection. Fourthly, we begin the RLN dissection with delicate workmanship by looking specifically for Zuckerkandl tubercle. It was easy to identify, if it was well-developed. As it is described by Pezillo [2], when it wa encountered, the tuberculum looks like an arrow pointing toward the nerve. Frequently the nerve runs in a tunnel deep behind the tubercle. Additionally, the nerve may lying in front when the tuberculum was a very small lateral projection or only a thickening of the lateral edge of thyroid lobes. In each patient, the ZT was searched. If present, its relationship with RLN investigated and then recorded. To avoid a RLN injury, the dissection should be done very carefully. The crucial aspect of RLN dissection in this region was to dissect beyond the lateral border of the tubercle and lift it up to ensure that the RLN was not damaged

**ZT classification**

The ZTs were graded according to Pelizzo as grade-0, unrecognizable; grade-I, only a thickening of the lateral lobe; grade-II, smaller than 1 cm; or grade-III, larger than 1 cm.

**Results**

**Table 1:** Age of Patient

Age group (yrs)	No. of Cases	Percentage
21-30	7	14.00%
31-40	17	34.00%
41-50	19	38.00%
51-60	4	8.00%
60-70	3	6.00%
Total	50	100.00%

50 patients participated in our study. We took patients from 21 to 70 year age group. Most of patients were found in the 41-50 years of age group consisting 38% (19 cases) of total and in 31-40 years age group 34% (17 cases) were found. The mean age of patient was 42.24 ± 11.38.

**Table 2:** Gender Distribution

Sex	No. of Cases	Percentage
Male	9	18.00%
Female	41	82.00%

In our study 9 cases (18%) of male and 41 cases (82%) of female were found. So F:M ratio is 41:9.

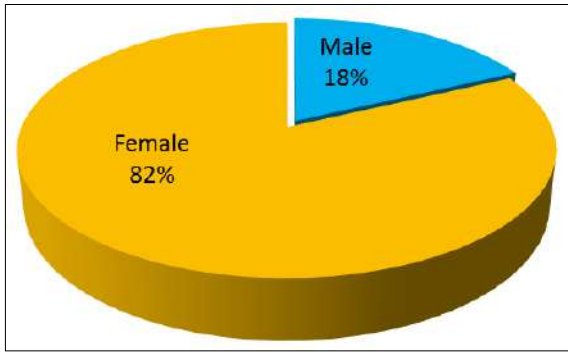


Fig 1: Gender distribution of patients involved in over study

Table 3: FNAC

FNAC	No. of Cases	Percentage
Colloid Goitre	42	84.00%
Follicular Adenoma	3	6.00%
Hashimoto Thyroiditis	2	4.00%
Pappilary Thyroid Carcinoma	2	4.00%
Sq. Cell Carcinoma	1	2.00%
Total	50	100.00%

In our study FNAC showed 42 cases (84%) of Colloid Goitre.

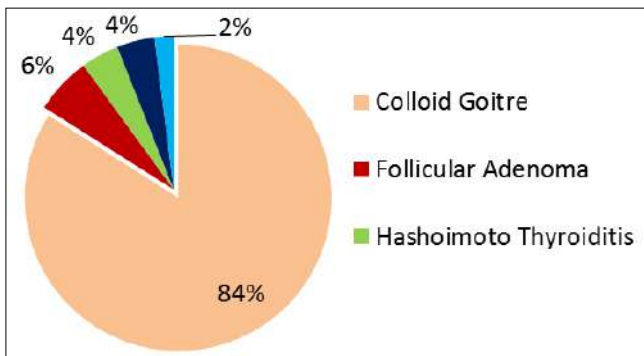


Fig 2: Pre-operative FNAC finding

Table 4: Relationship of Side of Lobe of Involved with Patient

Lobe Involved	No. of Cases	Percentage
Right	28	56.00%
Left	18	36.00%
Bilateral	4	8.00%

In our study 28 cases (56%) right side lobe involved and left side lobe involved 18 cases (36%) while in 4 cases (8%) both side lobe were involved. The prevalence was 56% for right & 18% for left lobe while prevalence of involvement of both lobe was 12%.

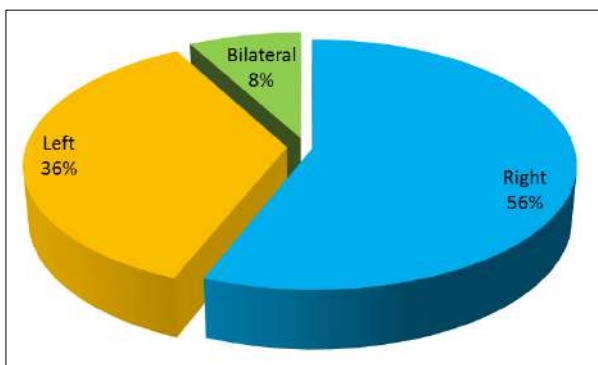


Fig 3: Pre-operative clinically enlarged lobes

Table 5: Type of Surgery Performed

Type of Operation Done	No. of Cases	Percentage
Left Hemithyroidectomy	18	36.00%
Right Hemithyroidectomy	26	52.00%
Total Thyroidectomy	6	12.00%

In present study, Right Hemithyroidectomy was done in 26 cases (52%), Left Hemithyroidectomy was done in 18 cases (36%), and Total thyroidectomy was done in 6 cases (12%). Out of 6 cases, 3 cases had involvement of both lobes and 3 patients with thyroid nodule in 1 lobe also underwent total thyroidectomy because FNAC of thyroid was suggestive of papillary Carcinoma of thyroid & Sq. Cell Carcinoma.

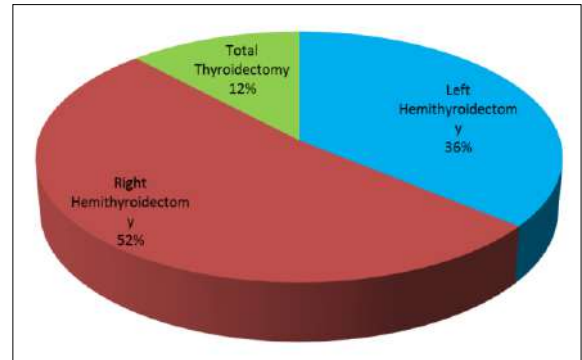


Fig 4: type of operative procedure perform in over study

Table 6: Size of Thyroid Nodule on USG

Size of Thyroid Nodule	No. of Cases	Percentage
<4 cm in greatest dimension	27	54.00%
≥4 cm in greatest dimension	23	46.00%
Total	50	100.00%

In our study, size of thyroid nodule was more than 4 cm on USG in 27 patients (54%) and less than 4 cm in 23 patients (46%).

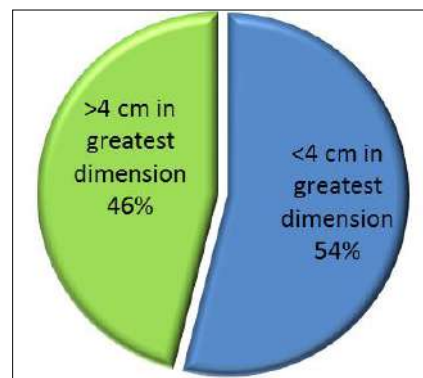


Fig 5: Pre-operative size of zuckerkanle's tubercle on USG

Table 7: The Incidence of Zuckerkanl's Tubercle (ZT) in the Thyroid Lobes

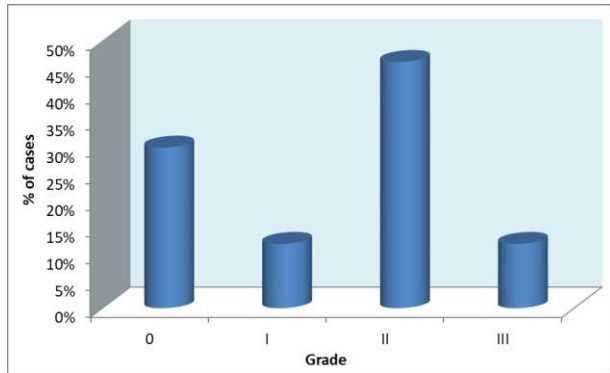
Procedure	Right ZT	Left ZT	B/L ZT	Total
Right Hemithyroidectomy (n – 26)	21	0	0	21
Left Hemithyroidectomy (n – 18)	0	13	0	13
Total Thyroidectomy (n – 6)	0	0	1	1

In present study Right Hemithyroidectomy was done 26 cases and ZT found 21 cases in right lobe and left hemithyroidectomy was done 18 cases and ZT found 13 cases in left lobe. Total thyroidectomy was done in 6 cases and ZT found only 1 case in both lobes.

**Table 8:** Grade of the Zuckerkandl's Tubercle in the Thyroid Lobe

Grade	No. of Cases	Percentage
0	15	30.00%
I	6	12.00%
II	23	46.00%
III	6	12.00%

In our case series, ZT was identified intraoperatively and classified according to classification proposed by Pelizzo. ZT was unrecognized absent in 15 cases (30%). In 6 cases (12%) with grade I, 23 cases (46%) with grade II and 6 cases (12%) with grade III were found out of total 50 patients.



**Fig 6:** Intra-operative grade of the zuckerkandle's tubercle in thyroid lobe

**Table 9:** Type of Relation of RLN to ZT

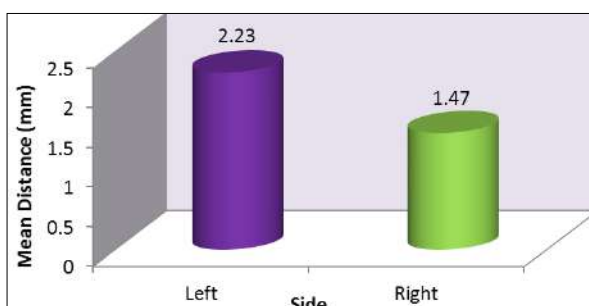
Type of Relation	No. of Cases	Bilateral	Left	Right
-	15	3	3	9
Anterior	1	0	0	1
Posterior	25	0	6	19
Postero Medial	9	1	4	4

In our study we found 35 Zuckerkandl tubercles out of 50 cases. Out of 35 cases we found during surgery 1 case of RLN anterior to ZT, 25 cases of RLN posterior to ZT and 9 cases of RLN posteromedial to ZT.

**Table 10:** Distance between ZT and RLN

Distance (in mm)	Left	Right
0	0	2
1	1	9
2	8	8
3	4	2
Average Distance (mm)	2.23	1.47

In most of the cases distance between recurrent laryngeal nerve and ZT was 2 mm for both right and left side and average distance between RLN and ZT was 2.23 mm in right and 1.47 mm in left side.



**Fig 7:** distance between ZT and RLN (Intraoperative)

**Table 11:** Incidence of Recurrent Laryngeal Nerve Palsy

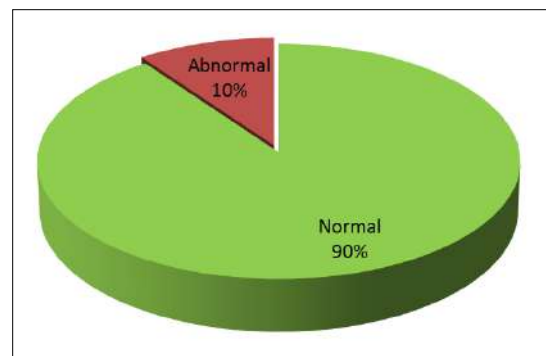
Total	Temporary	Permanent
50	4	1

In our study incidence of temporary recurrent laryngeal nerve palsy was in 4 cases and permanent recurrent laryngeal nerve palsy was in 1 case.

**Table 12:** Result of Examination of Patient by 90° Hopkin Postoperatively

90° Hopkin Postoperatively	No. of Cases	Percentage
Normal	45	90.00%
Abnormal	5	10.00%

All patient0 underwent Hopkin 90 degree endoscopy postoperatively, 45 patients (90%) had normal endoscopic findings and 5 patients had abnormal endoscopic findings.



**Fig 8:** Result of examination post-operative 900 Hopkin (endoscopy) finding

**Conclusion**

Zuckerkandl's tubercle which is defined as posterior exterior of lateral lobes of the thyroid gland is a common anatomical structure found in the majority of cases. Excision of the tubercle requires fine and meticulous dissection with great care because of close relationship between ZT and RLN. Identification of ZT, an understanding of the relationship between the ZT and RLN and isolation of the nerve before dissection of ZT are essential for performing safe thyroid surgery.

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