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Review Article

Thyroid Tubercle of Zuckerkandal Anatomical and Surgical Experience from 60 Thyroidectomies

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Abstract

Objective: To highlight a poorly recognized anatomical variation of the lateral lobe of the thyroid gland, which may be useful for identifying the recurrent laryngeal nerve during thyroid surgery.

Materials and Methods: We conducted an 8-month prospective study including 60 patients who underwent total thyroidectomy. Special attention was given to anatomical variations of the thyroid gland (presence or absence of a distinct Zuckerkandl's tubercle), to the recurrent laryngeal nerve, and to the location of the parathyroid glands.

Results: Zuckerkandl's tubercle (ZT) was identified in 87.5% of the thyroid lobes examined (105 out of 120), with a predominance on the right side (96.7%) compared with the left (78.3%).

According to the Pelizzo classification, the majority of identified ZT were grade 3 (54.2%), followed by grade 2 (20%), and grade 1 (13.3%).

ZT was absent (grade 0) in 12.5% of cases, more frequently on the left side.

In 100% of cases, ZT pointed directly toward the inferior laryngeal nerve, confirming its role as a reliable intraoperative landmark for nerve identification.

Conclusion: Zuckerkandl's tubercle is a poorly known and variable anatomical feature of the thyroid gland that may, in fact, not be as rare as historically believed. Emerging from embryologic development, it can serve as a dependable anatomical landmark for identifying the recurrent laryngeal nerve during thyroid surgery. It should be included in the Nomina Anatomica as the "processus posterior glandulae thyroideae," as originally described by Zuckerkandl.

Keywords: Anatomy; Recurrent Laryngeal Nerve; Total Thyroidectomy; Zuckerkandl's Tubercle; Processus Posterior Glandulae Thyroideae

Abbreviations

ZT : Zuckerkandl's Tubercle; RLN: Preservation of the Recurrent Laryngeal Nerve; ILN: Inferior Laryngeal Nerve

Introduction

Preservation of the recurrent laryngeal nerve (RLN) remains one of the major challenges in thyroid surgery. Its protection largely depends on the identification of reliable anatomical landmarks that can guide the surgeon throughout its cervical course. Among these potential landmarks, the Zuckerkandl tubercle (ZT) holds particular interest. First described by Emil Zuckerkandl in 1902 [1], the ZT is a posterior or posterolateral projection of the thyroid lobe, whose presence and degree of development are variable [1,2]. When present, the ZT maintains close anatomical relationships with the structures located on the posterior and medial aspects of the thyroid gland, particularly with the RLN. This consistent relationship, reported by several authors, has led to the consideration of the ZT as a useful surgical landmark for identifying the nerve. However, its constancy, morphology, and the exact nature of its relationship with the RLN remain subjects of debate in the literature [2]. In this context, the present study aims to determine the incidence of the Zuckerkandl tubercle in a series of thyroidectomies performed in our department, to describe its morphological characteristics, and, most importantly, to analyze its anatomical relationship with the recurrent laryngeal nerve. This work contributes to clarifying the role of the ZT in enhancing the safety of thyroid surgery.

Materials and Methods

We conducted a prospective study over a 6-month period (August 2023 to January 2024) including a series of 60 patients hospitalized in the Department of Otolaryngology – Head and Neck Surgery at Mohamed VI University Hospital in Marrakech, who underwent total thyroidectomy.

The study population consisted of 43 women and 17 men, with a mean age of 53 years (range: 16–84 years). All patients were operated on by the same surgical team, and no intraoperative neuromonitoring was used.

Preoperative data

All surgical procedures were total thyroidectomies (n = 60).

The surgical indications were as follows:

- 41 benign multinodular goiters
- 5 cervico-thoracic (plunging) goiters
- 6 cases of Basedow's thyroiditis
- 8 cases of papillary carcinoma (including 2 microcarcinomas)

We classified the size of Zuckerkandl's tubercle (ZT) according to the grading system proposed by Pelizzo[1].

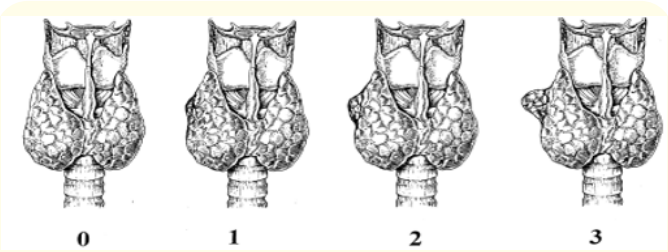

Figure 1: Size classification of Zuckerkandl's tubercle: Grade 0 → not recognizable; Grade 1 → only a thickening of the lateral border of the thyroid lobe; Grade 2 → < 1 cm; Grade 3 → > 1 cm.

Surgical procedure

A horizontal, arc-shaped cervical incision was performed, followed by sectioning of the platysma muscle.

The anterior jugular veins were preserved, and the midline cervical fascia was exposed. The thyroid compartment was opened by incising the linea alba.

Lateral dissection of the strap muscles (sternohyoid and sternothyroid) was carried out, allowing mobilization of the gland.

The cleavage plane of Cuneo and Lorin (between the thyroid capsule and the aponeurotic sheath) was developed up to the jugulocarotid vascular axis.

The middle thyroid veins were ligated.

The superior pole was ligated and dissected above the cricothyroid muscle in order to preserve the recurrent laryngeal nerve (RLN).

The superior parathyroid gland was identified at this stage.

The inferior pole was then ligated, allowing identification of the inferior parathyroid gland.

Lateral dissection was continued with exposure of the recurrent laryngeal nerve.

Tracheal release was performed, followed by sectioning of Gruber's ligament and the vertical lamina of the thyreoglossal tract, and closure was completed.

Throughout the procedure, particular attention was given to anatomical landmarks and to variations in the thyroid lobe, especially the presence or absence of Zuckerkandl's tubercle and the location of the recurrent laryngeal nerve and inferior thyroid artery.

Results

Identification of the recurrent (Inferior) laryngeal nerve

The recurrent laryngeal nerve was identified in all patients.

Classical identification method: crossing with the inferior thyroid artery

The RLN was identified at its crossing point with the inferior thyroid artery in 48 patients (80%).

This classical method, using an inferolateral approach, allowed safe and direct dissection of the nerve in most situations.

In 5 patients (8.3%), this standard approach could not be used due to large goiters obstructing visualization and limiting exposure of the vasculonervous structures.

In these cases, the nerve was identified directly at its entry point into the larynx.

In 6 patients (10%), RLN identification was facilitated by a prominent Zuckerkandl's tubercle, observed only on the right side.

This anatomical structure, located posterolaterally on the thyroid lobe, consistently pointed toward the nerve.

These cases involved large cervical multinodular goiters in which the classical inferolateral approach was difficult or impossible.

Identification of the nerve using Zuckerkandl's tubercle

- We identified 105 recurrent laryngeal nerves (87.5%) using the Zuckerkandl's tubercle (ZT) as an anatomical landmark.
- ZT was identified in 105 lobes (87.5%) out of the 120 lobes explored during the 60 total thyroidectomies.

Distribution:

- **Right side:** 58 lobes (96.7%)
- **Left side:** 47 lobes (78.3%)

Grading according to Pelizzo's classification:

- **Grade 1:** 16 lobes (6 right, 10 left)
- **Grade 2:** 24 lobes (12 right, 12 left)
- **Grade 3:** 65 lobes (40 right, 25 left)

In 100% of cases where ZT was present, it pointed directly toward the recurrent laryngeal nerve, facilitating its identification.

ZT was absent (grade 0) in 15 lobes (12.5%).

Grade	Right thyroid lobe 60	Left thyroid lobe 60	Total 120
0	2 (3,3%)	13 (21,7%)	15 (12.5%)
1	6 (10%)	10 (16,7%)	16 (13,3%)
2	12(20%)	12 (20%)	24 (20%)
3	40 (66,7%)	25 (41,6%)	65 (54,2%)
Total	60 (100%)	60 (100%)	120 (100%)

Table 1: Distribution of Zuckerkandl Tubercle sizes according to the Pelizzo classification system.

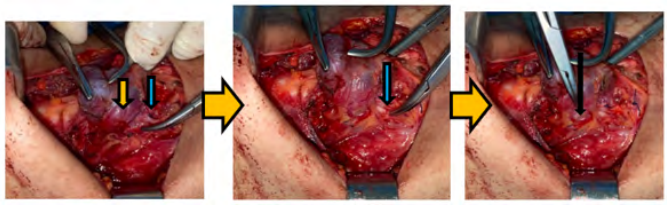

Figure 2: This figure shows that initially, the Zuckerkandl tubercle (ZT) was covering the inferior laryngeal nerve (ILN). After medialization of the lobe and fine dissection, the nerve was found immediately beneath the ZT. Blue arrow: ILN (inferior laryngeal nerve), Yellow arrow: ZT (Zuckerkandl tubercle).

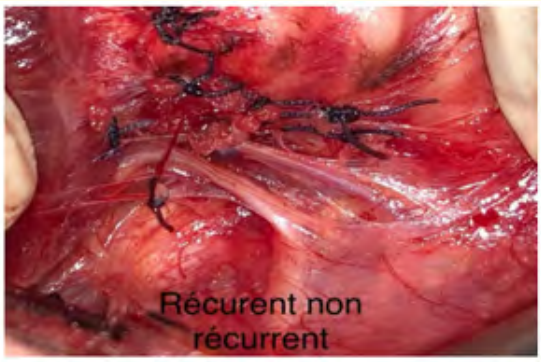

Figure 3: A case of right-sided non-recurrent inferior laryngeal nerve.

Functional outcomes

Voice disorders

In the overall cohort of 60 patients, postoperative complications included one case of transient left recurrent laryngeal nerve (RLN) paralysis, which fully recovered within two months, and one case of permanent right RLN paralysis.

The latter occurred in a 54-year-old female presenting with a posterior malignant goiter (papillary carcinoma PT4), likely due to tumor infiltration.

Discussion

The Zuckerkandl tubercle (ZT) represents a lateral enlargement of the thyroid lobe, resulting from the fusion of lateral and median thyroid anlages [1,2]. It serves as an important anatomical landmark for identifying the RLN and is closely associated with the superior parathyroid glands. Typically, the RLN lies deep to this structure and superficial to the lateral border of the trachea; however, this relationship may vary depending on the size of the tubercle, exposing the RLN to potential injury during thyroid dissection [3].

Preservation of the recurrent laryngeal nerve is a critical issue in thyroid surgery. Identification and complete dissection of the RLN during the procedure are mandatory to maintain its function, as widely recognized in the literature. Multiple surgical techniques and anatomical landmarks have been described for RLN identification [4].

The RLN's crossing point with the inferior thyroid artery remains the most reliable and useful landmark in the majority of cases, and our surgical experience supports this finding.

Embryology [4-6]:

The thyroid gland develops from two anlages: a larger median anlage (an epithelial thickening of the ventral pharyngeal wall) and a smaller, paired lateral anlage (derived from the ventral portion of the fourth pharyngeal pouch).

The Zuckerkandl tubercle is associated with these lateral anlages, which may form the posterior and lateral parts of the thyroid lobes.

The RLN branches from the vagus nerve within the mesenchyme between the fourth and fifth pharyngeal pouches. It approaches the pharyngeal cartilages surrounding the fourth aortic arch and is immediately covered by thyroid tissue derived from the lateral anlages of the fourth branchial pouch. This explains the consistent anatomical relationship between the RLN (located primarily beneath thyroid tissue) and Zuckerkandl's tubercle.

Anatomical reminder [7,8]:

The presence of a tubercle arising from the lateral thyroid lobe is rarely described in anatomical literature and is even absent in some textbooks.

In 1998, Pelizzo "rediscovered" the tubercle as a nearly constant and reliable surgical landmark for RLN identification.

He proposed a 4-grade morphometric classification based on tubercle size:

- **Grades 0 and 1:** Tubercle is barely detectable or reduced to a slight glandular mound
- **Grade 2:** Tubercle < 1 cm
- **Grade 3:** Tubercle > 1 cm

Surgical considerations

Only ZT of grade 3 or 4 (>1 cm) are truly identifiable and useful in thyroid surgery, as the RLN is always located immediately beneath the tubercle for the embryologic reasons described above [9].

The tubercle also theoretically separates the parathyroid glands into superior parathyroids (P IV; cranial and posterior) and inferior parathyroids (P III; caudal and anterior). In our study, no correlation between the tubercle and parathyroid position was observed [9].

The reported rates of positive identification of ZT vary across the literature: 14% for Pelizzo, 17% **for** Gesemjäger, 45% for Gauger, and 55% for Hisham [7-9].

Our series shows ZT presence in 96.7% of right lobes and 78.3% of left lobes, which aligns with published data.

Key observations

- The Zuckerkandl tubercle is an inconstant anatomical structure**.**
- It can be found on both sides, but more frequently on the right**.**
- Our findings corroborate previous reports identifying the right side as the most common site for ZT localization.

We believe that differences in reported frequencies of well-visible Zuckerkandl tubercles can be explained by several factors, including surgical technique, population variability, and anatomical development**.**

Studies	Right Thyroid Lobe	Left Thyroid Lobe
Pelizzo., *et al*. 1998	78.2% (43/55)	75.5% (37/49)
Sheahan 2011	79.4% (81/102)	62.38% (68/109)
Gil-Carcedo., *et al*. 2013	56.88% (62/109)	43.11% (47/109)
Kaisha., *et al*. 2011	59% (86/146)	
Our series	96,7% (58/60)	78,3% (47/60)

Table 2: The table presents a comparison between our series and those published by other authors.

The first factor is the thyroid surgeon's awareness, as the Zuckerkandl tubercle is poorly described in standard anatomical literature [10,11].

The second factor is the surgical procedure itself. Exposure and identification of a Zuckerkandl tubercle is possible when the lateral lobe is retracted laterally after complete ligation of the superior pedicle, which was always our first-line approach. In this situation, during medial dissection of the lobe, the tubercle appears as a small nodule, clearly distinct from the thyroid parenchyma. Careful capsular dissection of the tubercle then allows immediate visualization of the inferior laryngeal nerve beneath it (the nerve sometimes adheres slightly to the tubercle) [10,11].

The third factor is that a well-individualized Zuckerkandl tubercle is not as common as one might think [10,11].

The fourth and final factor is that the presence of this tubercle also depends on the goiter itself. When a hypertrophic nodule involves the tubercle, it becomes particularly prominent [10,11].

Overall, we believe that the thyroid surgeon should be aware of the existence of the Zuckerkandl tubercle, which can facilitate identification of the recurrent laryngeal nerve in some relatively rare cases. However, it should be kept in mind that the best first-line method for locating the recurrent laryngeal nerve is to identify its crossing point with the inferior thyroid artery [12,13].

Finally, we believe that the Zuckerkandl tubercle should be described when teaching thyroid anatomy and embryology. We also recommend that the anatomical term chosen by Zuckerkandl — namely the processus posterior glandulae thyroideae — be included in the Nomina Anatomica. The Nomina Anatomica is the classification system that standardizes anatomical terminology worldwide. It was developed by the International Committee on Anatomical Nomenclature of the International Federation of Associations of Anatomists and is published as a book.

Conclusion

The Zuckerkandl tubercle is a little-known anatomical variation of the thyroid gland that may not be as rare as previously thought. For embryological reasons, it can serve as a reliable anatomical landmark for identifying the recurrent laryngeal nerve during thyroid surgery. Identification of the tubercle depends on several factors, including the type of thyroid surgical procedure. This structure should be included in the Nomina Anatomica as the processus posterior glandulae thyroideae.

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Conflict of Interest

The authors declare no conflict of interest in connection with this publication. The patient has given informed consent for the use of their clinical data and photographs for scientific purposes.

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