

## Thyroid Tubercle of Zuckerkandl: Importance in Thyroid Surgery

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**Objective:** The Tubercle of Zuckerkandl (TZ), which is the remnant of the lateral thyroid process, is an important anatomic structure that serves as a reliable landmark for the recurrent laryngeal nerve in thyroid surgery. Furthermore, removal of the TZ is critical for the adequate performance of a total thyroidectomy. However, there is little mention of the TZ in surgical textbooks or papers.

**Methods:** Prospective observational study of 138 consecutive thyroid surgeries. The presence of the TZ, its size, and relationship to the recurrent laryngeal nerve, were recorded.

**Results:** A total of 211 thyroid lobes were included in the study. The TZ was identified in 61.1% of all thyroid lobes. The median size was 8 mm (range = 3–40 mm). A TZ was more commonly identified on the right (69.6%) than on the left side (53.2%) ( $P = .02$ ). The recurrent laryngeal nerve was found deep to the TZ in 98.4% of cases.

**Conclusions:** A TZ is present in the majority of thyroid lobes. Awareness of the TZ is critical in performing an adequate total thyroidectomy, and is very useful as a landmark for the recurrent laryngeal nerve.

**Key Words:** Thyroid tubercle, Zuckerkandl.

**Level of Evidence:** 2b (cohort study).

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### INTRODUCTION

The Tubercle of Zuckerkandl (TZ) is an anatomic structure first described by Madelung in 1867,<sup>1</sup> and later by the Viennese anatomist Emil Zuckerkandl, in 1902.<sup>2</sup> He described a posterior projection from the surface of the thyroid which he termed the “tuberculum” or “processus posterior glandulae thyroideae.” Subsequently, the TZ was described as an important anatomic landmark for the recurrent laryngeal nerve during thyroidectomy<sup>3–6</sup> (Figs. 1, 2, and 3).

In our experience, the TZ is a critical anatomic landmark during thyroid surgery, which is present in most thyroid lobes. We believe that recognition and dissection of the TZ is essential to performing an adequate total thyroidectomy. However, there is little mention of the TZ in surgical textbooks or papers. This lack of mention is particularly notable when one considers the amount of literature describing thyroidectomy operations according to the extent of surgery (subtotal thyroidectomy vs. “near-total” thyroidectomy vs. total thyroidectomy). In our view, the management of the tubercle of Zuckerkandl is perhaps the most important determinant of what kind of thyroid surgery has been performed.

The purpose of the present study was to investigate the incidence of the presence of the tubercle of Zucker-

kandl in our patient series, and to describe its size and anatomic relationships, particularly with the recurrent laryngeal nerve.

### MATERIALS AND METHODS

This was a prospective study of 138 consecutive thyroidectomies performed by the senior author (P.S.) between April 2009 and March 2011. Total thyroidectomies, thyroid lobectomies, and completion thyroidectomies (where surgery had not been previously performed on the side currently undergoing surgery) were included. Revision thyroidectomies where surgery had previously been performed on the side undergoing surgery were excluded.

The vast majority of thyroidectomies were performed in a standard fashion. A midline approach between the strap muscles was utilized. The sternohyoid muscle was retracted and the upper end of the sternothyroid muscle was divided. The superior pedicle was divided early in most cases. Capsular dissection of the thyroid lobe with ligation of vessels close to the thyroid capsule was then performed. Parathyroid glands were released from the thyroid capsule and reflected away with their blood supplies intact. The recurrent laryngeal nerve was identified only at its entry point into the larynx, in the vicinity of Berry’s ligament. A TZ was considered to be present when a true lateral projection from the thyroid lobe was encountered. When present, the TZ was used as a landmark for finding the nerve. Once the TZ was identified, its posterolateral limit was defined. An *in vivo* measurement was then taken between the posterolateral limit of the TZ and the posterior surface of the thyroid gland using a ruler. The attachments of the posterolateral limit were then released and the TZ elevated from laterally. With elevation of the TZ, the recurrent laryngeal nerve, which was usually found just deep to this structure, was identified. Terminal branches of the inferior thyroid artery coursing deep to the nerve were then ligated with the nerve under direct vision, and Berry’s ligament divided sharply, releasing the thyroid lobe.

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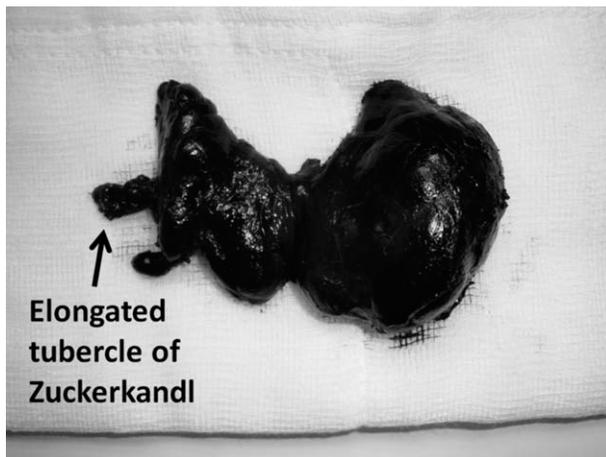


Fig. 1. Total thyroidectomy specimen showing right tubercle of Zuckerkandl.

In order to compare our findings with those of others, we graded the size of the TZ in cases in our series according to the grading system proposed by Pelizzo et al.<sup>3</sup> In this classification, grade 1 represents only a thickening of the thyroid lobe. Grade 2 represents a true lateral projection from the thyroid lobe, but smaller than 1 cm. Grade 3 represents a TZ longer than 1 cm. In the present study, we considered a TZ to be present only when a true lateral projection was encountered. Thus, cases without a true recognizable lateral projection were classified as grade 0/1; and cases with a true recognizable lateral projection were classified as either grade 2 or grade 3, depending on the size of the projection.

A Fisher's exact test was used to test the hypothesis that the TZ was more commonly found on the right than the left side. Permission to conduct this study was obtained from the local clinical research ethics committee.

## RESULTS

Of 138 consecutive thyroid surgeries, there were 77 total thyroidectomies, 50 lobectomies, and 7 completion

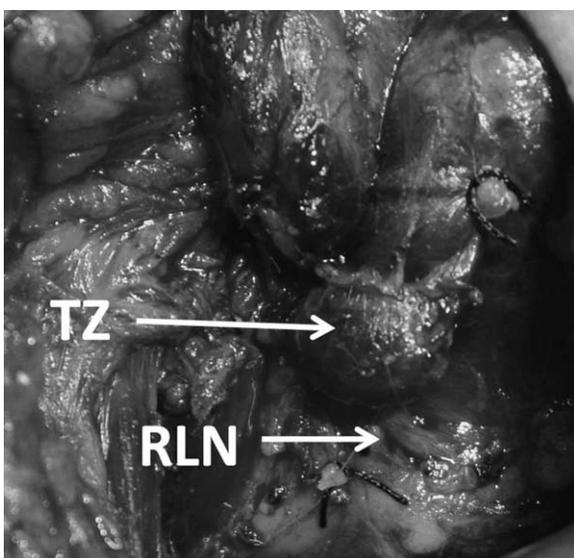


Fig. 2. Nodular tubercle of Zuckerkandl with recurrent laryngeal nerve coursing medial.

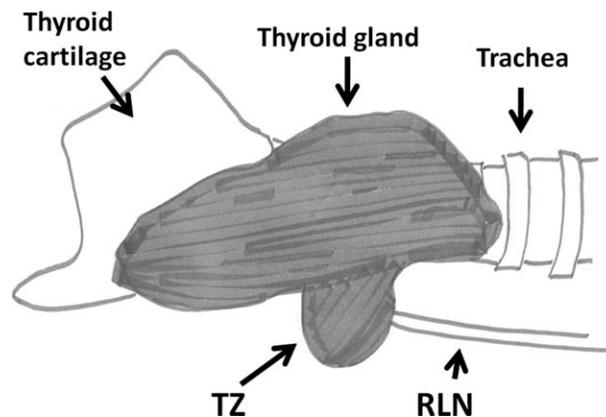


Fig. 3. Schematic drawing showing relationship of recurrent laryngeal nerve with tubercle of Zuckerkandl. RLN = recurrent laryngeal nerve; TZ = tubercle of Zuckerkandl.

thyroidectomies. Four further cases of revision surgery were excluded. This gave a total of 134 thyroidectomies, and 211 thyroid lobes, included in the study.

For 20 thyroid lobes, the presence or absence of a TZ was either not recorded (8) or was recorded as not assessable (12). The reasons for a TZ to be recorded as "not assessable" included cases with extrathyroidal tumor, paratracheal lymph node enlargement obscuring the TZ, or severe friability of the thyroid with tendency to sequestrate or actual sequestration during dissection. The presence or absence of a TZ was thus definitively recorded for 191 thyroid lobes.

A TZ was identified in 61.1% of all thyroid lobes (129/211), and in 67.5% (129/191) of lobes in which the tubercle was definitively assessed. In 12 cases, a "double" (bifid) tubercle was present. The measured size of the TZ ranged from 3 to 40 mm (mean 9.3 mm; median 8 mm).

Table I shows the distribution of TZ sizes according to the grading system of Pelizzo.<sup>3</sup>

The TZ was identified more commonly on the right side (69.6%; 71/102) than on the left side (53.2%; 58/109) ( $P = .02$ ). When cases where the TZ was not assessed were excluded, the tubercle was once again more common on the right (77.2%; 71/92) compared to the left (58.6%; 58/99) ( $P = .008$ ).

In 98.4% (127/129) of cases in which a TZ was identified, the recurrent laryngeal nerve was found deep to this structure. In two cases, however, a tubercle was identified deep to the recurrent laryngeal nerve.

## DISCUSSION

The TZ is believed to represent the remnants of the lateral thyroid processes (ultimobranchial bodies). These bilateral structures arise as a proliferation of pharyngeal endoderm from the ventral portion of the fourth pharyngeal pouch and the vestigial fifth pouch. The ultimobranchial bodies bring to the thyroid gland the superior parathyroid gland and the parafollicular cells, and develop later than the better-known principle median thyroid process. This structure arises from the pharyngeal floor and descends in the midline, and

TABLE I.  
Size of TZ According to Grading System of Pelizzo<sup>3</sup>

	Right	Left	Total
Grade 0/1	21 (21%)	41 (38%)	62 (29%)
Grade 2	36 (35%)	43 (39%)	79 (37%)
Grade 3	35 (34%)	15 (14%)	50 (24%)
Not recorded or not assessable	10 (10%)	10 (9%)	20 (9%)
<b>Total</b>	<b>102</b>	<b>109</b>	<b>211</b>

Percentages calculated from total number of thyroid lobes and rounded to nearest integer.

subsequently forms a bilobed structure anterior to the trachea. Eventually the lateral ultimobranchial bodies fuse with the median thyroid process, and become detached from the pharynx. The residual posterolateral projection towards the pharynx, when present, constitutes the TZ.<sup>4</sup>

Recognition and removal of the TZ is clearly important for the adequate performance of a total thyroidectomy. In cases where the recurrent laryngeal nerve is identified at the level of the inferior thyroid artery and followed superiorly into Berry's ligament, with division of overlying tissue, it is easy to also transect the tubercle where this overlies the nerve, leading to separation of the tubercle from the main thyroidectomy specimen. Depending on the size of the tubercle, this may result in a variable amount of thyroid tissue on each side being left in situ.<sup>7</sup> This remnant thyroid tissue may be a source of persistent radioiodine uptake on radioactive iodine scans, or even of recurrent thyroid mass in cases of multinodular goiter, as is seen after subtotal thyroidectomy.<sup>7,8</sup> To avoid this, it is important to look for the TZ, and ensure that the entirety of this is removed with the specimen.

The findings of our studies are consistent with those of other authors: Pelizzo et al.<sup>3</sup> reported the TZ to be present in 78% of right thyroid lobes and 75% of left thyroid lobes. These authors considered a TZ to be present even when only a thickening of the thyroid lobe was found; however, 68% of lobes had grade 2 or grade 3 TZs, which is almost identical to our figure of 67.5% for thyroid lobes where the TZ was definitively assessed. Gauger et al.<sup>4</sup> reported the TZ to be present in 63% of 100 patients undergoing thyroidectomy, and found the recurrent laryngeal nerve to be medial to the tubercle in 93% of cases. Hisham et al.<sup>5</sup> reported the recurrent laryngeal nerve to be associated with an enlarged TZ in 74% of cases. On the other hand, Page et al.<sup>6</sup> identified the TZ in only 7% of cases. When present, the tubercle always overlay the recurrent laryngeal nerve.

There is great variation in the reported sizes of the TZ. In our study of an Irish cohort, we found 24% of cases to have a grade 3 TZ (39% of tubercles). This compares with 14% in Pelizzo's series (Italian),<sup>3</sup> 45% in Gauger's series (Australian),<sup>4</sup> and 55% in Hisham's series (Malaysian).<sup>5</sup> It is likely that the size of the TZ is dependent not only on the amount

of remnant lateral process tissue, but also on pathology affecting the thyroid. In particular, multinodular enlargement of the tubercle can lead to gross enlargement. The very large tubercles in the present study were all found to be involved with multinodular change.

The TZ is described as being nearly always superficial to the recurrent laryngeal nerve, so serving as an accurate landmark for its identification in thyroid surgery.<sup>3-5,9,10</sup> The reasons for the finding of two cases where the TZ appeared to be superficial to the nerve in the present series is probably because of nodular enlargement of thyroid tissue in the vicinity of the recurrent laryngeal nerve, which extended deep to this structure with continued subsequent enlargement. Thus, these cases may not represent "true" tubercles of Zuckerkandl; however, they highlight the importance of awareness of the possibility of thyroid enlargement deep to the nerve in order to avoid inadvertent injury to the nerve in these cases.

The TZ has been described as theoretically separating the parathyroid glands into the superior parathyroids (located cranial and posterior) and inferior parathyroids (located caudal and anterior).<sup>3,9</sup> The TZ has thus been suggested as a pointer to the superior parathyroid gland.<sup>4</sup> Our experience is that the superior parathyroid gland is nearly always found cranial and posterior to the TZ, in agreement with the findings of Gauger;<sup>4</sup> however, the relationship between the TZ and the superior parathyroid gland was not recorded prospectively in all cases in this series, so this data has not been included in our article.

## CONCLUSION

The TZ is an important anatomic landmark found in most thyroid glands. Awareness of this structure is critical, in our view, to performing an adequate total thyroidectomy (or total lobectomy), while preserving the integrity of the recurrent laryngeal nerve.

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