

Incidence and Histopathological Features of Intrathyroidal Parathyroid Excision: A High-Volume Single-Center Retrospective Study

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Abstract

Background: Intrathyroidal parathyroid glands represent a rare anatomical variant and are recognized as a potential risk factor for incidental parathyroidectomy during thyroid surgery. Their intraoperative identification is challenging due to their atypical localization. **Methods:** A retrospective analysis was performed on 4,231 thyroid surgeries conducted at a single center between January 2015 and December 2025. Patients with histopathologically confirmed intrathyroidal parathyroid tissue were included. Demographic data, type of surgery, histopathological findings, and pre- and postoperative serum calcium and PTH levels were evaluated. **Results:** Intrathyroidal parathyroid tissue was incidentally excised in 19 patients, corresponding to an incidence of 0.45%. All affected patients were female, with a mean age of 28.6 ± 11.4 years. Histopathological examination demonstrated that the majority of excised parathyroid glands were structurally normal. Transient hypocalcemia occurred in three patients (15.8%) and resolved within six months. No cases of permanent hypocalcemia were observed. **Conclusion:** Intrathyroidal parathyroid glands are an uncommon anatomical variant that may be incidentally excised during thyroid surgery. In this series, their removal was not associated with permanent hypocalcemia. These findings highlight the importance of anatomical variability in the evaluation of incidental parathyroidectomy and postoperative biochemical outcomes.

Keywords: Intrathyroidal parathyroid, incidental parathyroidectomy, thyroidectomy, hypocalcemia, parathyroid preservation

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1. Introduction

Parathyroid glands exhibit substantial anatomical variability as a consequence of their embryological migration, which constitutes a well-recognized challenge during thyroid surgery¹. Among these variations, the presence of parathyroid tissue partially or completely embedded within the thyroid parenchyma, referred to as an intrathyroidal

parathyroid gland, represents a rare but surgically relevant anatomical variant^{2,3}. Previous studies have reported the incidence of intrathyroidal parathyroid glands in thyroidectomy specimens to range between approximately 0.2% and 3.6%, depending on the definition applied and the extent of histopathological examination³⁻⁶.

Incidental parathyroidectomy (IP), defined as the unintentional removal of parathyroid tissue during thyroid surgery, is a frequently encountered pathological finding, with reported incidence rates varying widely from 2.9% to 31% in large surgical series⁵⁻⁷. Although most cases of IP involve extracapsular or perithyroidal parathyroid glands, intrathyroidal localization is considered one of the most important anatomical risk factors for unintended excision due to the difficulty of intraoperative identification^{3,4,6}.

The clinical relevance of IP has primarily been discussed in relation to postoperative alterations in serum calcium and parathyroid hormone (PTH) levels. While transient hypocalcemia is a common and multifactorial complication following total or near-total thyroidectomy, the removal of a single parathyroid gland is generally insufficient to result in permanent hypoparathyroidism⁷⁻¹¹. Therefore, the clinical impact of intrathyroidal IP appears to be limited and largely dependent on the extent of surgery and the preservation of the remaining parathyroid tissue.

Previous investigations of IP have mainly focused on overall incidence, surgical risk factors, and short-term biochemical outcomes⁷⁻¹⁰. However, data specifically addressing the frequency and histopathological characteristics of intrathyroidal parathyroid glands in large, high-volume surgical series remain limited. Most available reports evaluate mixed anatomical locations or small patient cohorts, which restricts accurate assessment of intrathyroidal parathyroid glands as a distinct anatomical subgroup³⁻⁶.

Accordingly, the primary aim of this retrospective, single-center study was to determine the incidence of histologically confirmed intrathyroidal parathyroid glands among thyroidectomy specimens in a high-volume surgical setting. Secondary aims were to describe their histopathological features and to document early postoperative calcium and PTH findings in a descriptive manner, without implying causality.

2. Methods

2.1. Study Design and Patient Selection

This retrospective, single-center study was conducted at the Department of General Surgery, Van Yüzüncü Yıl University Faculty of Medicine. Medical records of patients who underwent thyroid surgery between January 2015 and December 2025 were reviewed. Ethical approval was obtained from the Van Yüzüncü Yıl University Clinical Research Ethics Committee (Decision No: 2025/10-46). Adult patients (≥ 18 years) who underwent total, near-total, or subtotal thyroidectomy for benign or malignant thyroid diseases were eligible. Patients with a history of previous neck surgery, prior parathyroidectomy, or incomplete clinical or pathological data were excluded.

2.2. Surgical Procedure

All operations were performed by experienced endocrine surgeons using standard capsular dissection techniques. Particular attention was paid to the preservation of parathyroid glands and their vascular supply. No intraoperative adjunctive imaging modalities such as near-infrared autofluorescence (NIRAF) or indocyanine green (ICG) angiography were used during the study period.

2.3. Pathological Evaluation and Definitions

All thyroidectomy specimens were examined by experienced endocrine pathologists. Incidental parathyroidectomy (IP) was defined as the histopathological identification of parathyroid tissue within thyroidectomy specimens. Parathyroid glands were anatomically classified as extracapsular, perithyroidal (intracapsular), or intrathyroidal.

Intrathyroidal parathyroid glands were defined as parathyroid tissue completely surrounded by thyroid parenchyma and located within the thyroid capsule, without direct contact with the capsular surface. For intrathyroidal glands, histopathological characteristics including gland size, capsular features, and histological appearance were recorded.

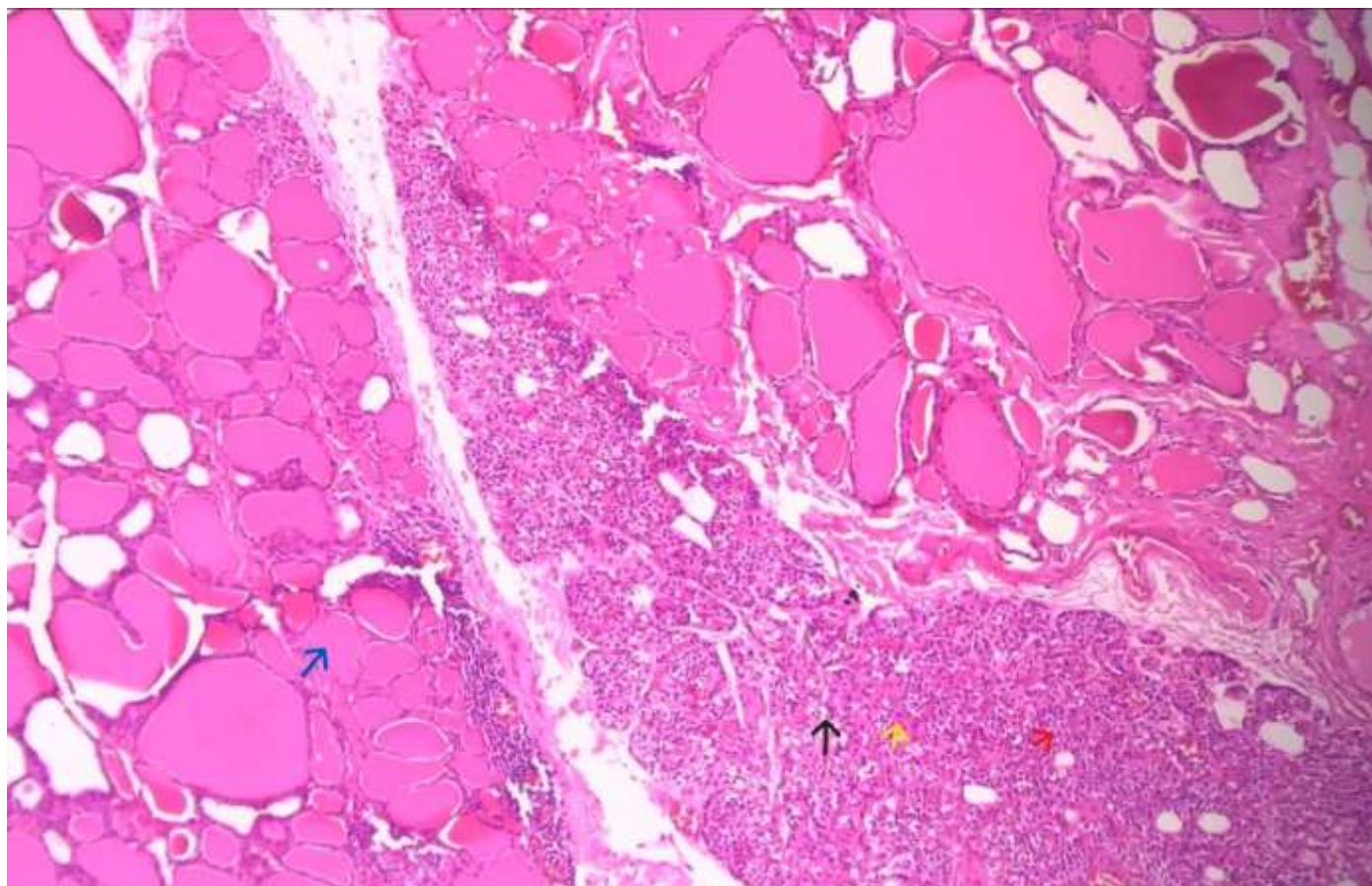


Figure 1. Intrathyroidal parathyroid gland with normal histological features (H&E ×200). Black arrow: parathyroid gland; blue arrow: thyroid gland; yellow arrow: oxyphil cell in parathyroid gland; red arrow: chief cell in parathyroid gland.

2.4. Biochemical Assessment

Serum calcium and PTH levels were measured preoperatively and within the first 24 hours postoperatively. Hypocalcemia was defined as a serum calcium level below 8.0 mg/dL. Transient hypocalcemia was defined as resolution within six months; permanent hypocalcemia was defined as persistence beyond six months.

2.5. Statistical Analysis

All data were analyzed using SPSS 28.0 (IBM Corp., Armonk, NY, USA). Since preoperative and postoperative 24-hour serum calcium values were not normally distributed, comparisons were performed using the non-parametric Wilcoxon signed-rank test. Preoperative and postoperative PTH values were normally distributed and analyzed using a paired t-test. Continuous variables are presented as mean ± SD and minimum–maximum values; categorical variables are expressed as frequency and percentage. Statistical significance was set at $p < 0.05$.

3. Results

During the study period, a total of 4,231 thyroidectomy procedures were performed. Histopathological review identified incidental parathyroid tissue in 67 specimens, corresponding to an overall IP rate of 1.6%. Based on pathological localization, parathyroid tissue was classified as extracapsular ($n = 28$, 41.8%), intracapsular/perithyroidal ($n = 20$, 29.9%), and intrathyroidal ($n = 19$, 28.3%). The present analysis focused exclusively on patients with histologically confirmed intrathyroidal parathyroid glands.

The 19 patients with intrathyroidal parathyroid tissue were all female, with a mean age of 28.6 ± 11.4 years (range: 18–52 years). Surgical indications included multinodular goiter in 17 patients (89.4%), papillary thyroid carcinoma in one patient (5.3%), and Graves' disease in one patient (5.3%). All patients underwent total thyroidectomy; central neck dissection was performed in one case due to malignancy.

The mean maximal diameter of the excised parathyroid glands was 4.1 ± 1.3 mm (range: 2–7 mm). Capsular architecture was preserved in 16 glands (84.2%), while partial capsular thinning was observed in three cases (15.8%). Regarding histological features, 15 glands (78.9%) exhibited normal architecture, three (15.8%) showed mild hyperplastic changes, and one (5.3%) demonstrated focal fibrotic changes. No atrophic changes or malignant features were observed.

The mean preoperative serum calcium level was 8.97 ± 0.44 mg/dL, which decreased to 8.62 ± 1.11 mg/dL at 24 hours postoperatively; the Wilcoxon signed-rank test showed no statistically significant difference ($p = 0.256$). The mean preoperative PTH level was 26.30 ± 11.70 pg/mL, increasing to 30.60 ± 11.50 pg/mL postoperatively ($p = 0.395$, paired *t*-test).

At 24 hours postoperatively, three patients (15.8%) exhibited biochemical hypocalcemia (serum calcium < 8.0 mg/dL). All cases were asymptomatic or mildly symptomatic and managed with temporary oral calcium supplementation. Serum calcium levels normalized in all patients, and no cases of permanent hypocalcemia or permanent hypoparathyroidism were observed at the 6-month evaluation.

4. Discussion

Incidental parathyroidectomy remains a well-recognized complication of thyroid surgery and is primarily related to the considerable anatomical variability of parathyroid gland localization. Among these variants, intrathyroidal parathyroid glands represent a particularly challenging subgroup due to the absence of distinct intraoperative landmarks, which significantly limits visual identification during capsular dissection¹. In the present study, histologically confirmed intrathyroidal parathyroid glands were identified in 19 of 4,231 thyroidectomy specimens, corresponding to an incidence of 0.45%. This rate is consistent with previously published series and provides a reliable estimate derived from a high-volume surgical center^{2–6}.

Several studies have emphasized that intrathyroidal parathyroid glands are among the most frequently overlooked anatomical variants. Cho et al. demonstrated that intrathyroidal localization represents one of the histopathological positions most prone to incidental removal¹. Similarly, Campos et al. and Mayer et al. reported that intrathyroidal parathyroid glands are often identified only on postoperative histopathological examination^{3,4}. These observations are supported by Neagoe et al. and Khairy and Al-Saif, who identified intrathyroidal localization as a major anatomical risk factor for IP^{5,6}.

Previous large-scale studies and meta-analyses have shown that IP is associated with an increased incidence of transient hypocalcemia, particularly following total thyroidectomy^{7,8}. However, permanent hypoparathyroidism is uncommon when only a single parathyroid gland is removed and the remaining glands are preserved. In the present cohort,

transient hypocalcemia occurred in three patients (15.8%) and resolved within six months, while no cases of permanent hypocalcemia were observed. These findings are consistent with prior reports indicating that meticulous surgical technique and preservation of the remaining parathyroid glands significantly reduce the risk of permanent functional impairment^{9–11}.

Histopathological analysis revealed that most intrathyroidal parathyroid glands were structurally normal, with only a minority demonstrating mild hyperplastic or fibrotic changes. This finding supports the concept that incidental excision is largely attributable to embryological and anatomical variation rather than intrinsic parathyroid pathology^{1,3,5}.

In recent years, technological adjuncts such as near-infrared autofluorescence (NIRAF) have gained attention for their potential to improve intraoperative identification of parathyroid tissue. Meta-analyses demonstrated high diagnostic accuracy of NIRAF and suggested a reduction in postoperative hypocalcemia rates^{12,13}. Additional studies have reported that NIRAF and related adjunctive techniques may contribute to decreased rates of incidental parathyroidectomy^{14,15}. Liu et al. further improved identification accuracy by combining NIRAF spectroscopy with machine learning-based classification¹⁶, and a recent meta-analysis of randomized controlled trials confirmed the reliability of NIRAF in clinical practice¹⁷.

Indocyanine green (ICG) angiography has also been proposed as a tool for assessing parathyroid gland vascularization and predicting early postoperative hypocalcemia^{18–20}, and ongoing trials aim to clarify its role in preserving parathyroid function²¹. Emerging approaches including artificial intelligence-based perfusion analysis of surgical videos may further enhance parathyroid identification in the future²². However, the absence of permanent hypocalcemia in the present series suggests that surgical experience and careful capsular dissection remain the most critical determinants of long-term parathyroid function.

The present study contributes meaningful data by documenting the incidence and histopathological characteristics of intrathyroidal parathyroid glands in a large, single-center cohort. The finding that all incidentally excised glands were intrathyroidal underscores the importance of this anatomical variant as a distinct risk factor for incidental parathyroidectomy. Importantly, the lack of permanent hypocalcemia indicates that, even in the presence of intrathyroidal parathyroid excision, preservation of overall parathyroid function is achievable with appropriate surgical technique.

4.1. Limitations

This study has several limitations. Its retrospective design and single-center setting may limit generalizability. Systematic preoperative localization or intraoperative identification techniques specifically targeting parathyroid glands were not routinely employed. Long-term biochemical follow-up focused on definitive hypoparathyroidism was not available for all patients. Advanced adjunctive technologies such as NIRAF or ICG angiography were not used, and therefore no conclusions can be drawn regarding their potential role in identifying or preserving intrathyroidal parathyroid glands.

5. Conclusion

This study demonstrates that intrathyroidal parathyroid glands represent a rare anatomical variant that may result in incidental parathyroidectomy during thyroid surgery. In this large single-center series, the incidence of intrathyroidal parathyroid glands was 0.45%, and their inadvertent removal was not associated with permanent hypocalcemia. Histopathological examination showed that most excised glands were structurally normal, indicating that incidental parathyroidectomy in these cases is primarily related to

anatomical localization rather than underlying parathyroid pathology. These findings emphasize the importance of anatomical variability in the interpretation of incidental parathyroidectomy and postoperative outcomes following thyroidectomy.

Ethical Approval: The Non-interventional Clinical Research Ethics Committee of Van Yüzüncü Yıl University approved this work (Decision No: 2025/10-46, Date: 17/10/2025).

Informed Consent: Approval from the Institutional Review Board was obtained. Given the retrospective design, informed consent was not required.

Conflict of Interest: The authors declare no conflict of interest.

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Data Availability: Available from the corresponding author on request.

References

1. Cho JG, Choi SY, Oh KH, et al. A new histopathological location of parathyroid gland with high possibility of unintended parathyroidectomy. *Gland Surg.* 2023;12(12):1714.
2. Alanzi AR, Ghafouri A, Khalifa W, et al. Incidence and risk factors of inadvertent parathyroidectomy during thyroid surgery: a single-center retrospective study. *Saudi J Otorhinolaryngol Head Neck Surg.* 2020;22(2):78-81.
3. Campos NS, Cardoso LP, Tanios RT, et al. Risk factors for incidental parathyroidectomy during thyroidectomy. *Braz J Otorhinolaryngol.* 2012;78(1):57-61.
4. Mayer AW, Sharp A, Aziz S, Balasubramanian SP. Distribution of inadvertently excised parathyroid glands during thyroid surgery and the link with post-surgical hypoparathyroidism. *J Laryngol Otol.* 2023;137(11):1226-1232.
5. Neagoe RM, Cvasciuc IT, Muresan M, Sala DT. Incidental parathyroidectomy during thyroid surgery – risk, prevention, and controversies. *Acta Endocrinol (Buchar).* 2017;13(4):467.
6. Khairy GA, Al-Saif A. Incidental parathyroidectomy during thyroid resection: incidence, risk factors, and outcome. *Ann Saudi Med.* 2011;31(3):274-278.
7. Bai B, Chen Z, Chen W. Risk factors and outcomes of incidental parathyroidectomy in thyroidectomy: a systematic review and meta-analysis. *PLoS One.* 2018;13(11):e0207088.
8. André N, Pascual C, Baert M, et al. Impact of incidental parathyroidectomy on parathyroid function after total thyroidectomy. *Eur Ann Otorhinolaryngol Head Neck Dis.* 2020;137(2):107-110.
9. Youssef T, Gaballah G, Abd-Elal E, El-Dosoky E. Assessment of risk factors of incidental parathyroidectomy during thyroid surgery. *Int J Surg.* 2010;8(3):207-211.
10. Mencia M, Calcaterra N, Ogola G, et al. Factors contributing to unintentional parathyroidectomy during thyroid surgery. *Proc (Bayl Univ Med Cent).* 2020;33(1):19-23.
11. Du W, Fang Q, Zhang X, et al. Unintentional parathyroidectomy during total thyroidectomy surgery: a single surgeon's experience. *Medicine.* 2017;96(11):e6411.
12. Wang B, Zhu CR, Liu H, Yao XM, Wu J. The ability of near-infrared autofluorescence to protect parathyroid gland function during thyroid surgery: a meta-analysis. *Front Endocrinol.* 2021;12:714691.
13. Lu W, Chen Q, Zhang P, Su A, Zhu J. Near-infrared autofluorescence imaging in thyroid surgery: a systematic review and meta-analysis. *J Invest Surg.* 2022;35(9):1723-1732.
14. Kostek M, Cetinoglu I, Sengul Z, et al. Clinical significance and risk factors of incidental parathyroidectomy after total thyroidectomy. *Endocrine.* 2025.
15. Granata R, Zanghi A, Scribano M, et al. Incidental Parathyroidectomy After Thyroid Surgery: A Single-Center Study. *Biomedicine.* 2024;12(10):2372.

16. Liu J, Wang X, Wang R, et al. Near-infrared auto-fluorescence spectroscopy combined with Fisher's linear discriminant analysis improves intraoperative real-time identification of normal parathyroid in thyroidectomy. *BMC Surg.* 2020;20(1):4.
17. Javed A, Alburaiki A, Sharma N, et al. Utilisation of Near Infrared Autofluorescence in Parathyroid Identification During Thyroidectomy: A Systematic Review and Meta-Analysis of Randomised Controlled Trials. *Clin Otolaryngol.* 2025.
18. Vidal Fortuny J, Sadowski SM, Belfontali V, et al. Randomized clinical trial of intraoperative parathyroid gland angiography with indocyanine green fluorescence predicting parathyroid function after thyroid surgery. *Br J Surg.* 2018;105(4):350-357.
19. Karahan SN, Toprak S, Celik B, et al. Impact of Indocyanine Green Angiography on postoperative parathyroid function: a propensity score matching study. *J Clin Med.* 2024;13(11):3038.
20. Santa Ritta Barreira CE, Miranda AP, Peixoto TF, Pinheiro RN. Indocyanine green angiography to evaluate immediate hypoparathyroidism after thyroid cancer surgery. *Endocrine.* 2025.
21. Moreno-Llorente P, García-González G, Pascua-Solé M, et al. Indocyanine green angiography-guided thyroidectomy versus conventional thyroidectomy for preserving parathyroid function: study protocol for a randomized trial. *Front Endocrinol.* 2023;14:1193900.
22. Epperlein JP, Hardy NP, Mac Aonghusa P, Cahill RA. Extracting, visualizing, and learning from dynamic data: perfusion in surgical video for tissue characterization. *IEEE ICDH.* 2022:7-12.