



# Thyroid Surgery and Inadvertent Removal of Parathyroids

Orhan Asya<sup>1</sup> · Ali Cemal Yumuşakhuylu<sup>2</sup> · Yavuz Gündoğdu<sup>3</sup> · Sefa İncaz<sup>2</sup> · Çağatay Oysu<sup>2</sup>

Received: 25 March 2021 / Accepted: 26 April 2021  
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**Abstract** This study aimed to determine the incidence of inadvertent parathyroid removal during thyroid surgery and define its associated risk factors. In this single-center record-based study, we retrospectively analyzed the clinical and pathological records of 462 patients undergoing thyroidectomy. Incidental parathyroidectomy was detected in 61 of 462 patients (13.2%). The incidence of inadvertent parathyroid removal was 17.6% (36 of 205 patients) in patients having malign thyroid diseases, compared with 9.7% (25 of 257 patients) in patients with benign thyroid diseases ( $p = 0.045$ ). Incidentally removed parathyroid tissue was intrathyroidal in 8 of the 61 patients. Thus, the ratio of intrathyroidal parathyroid tissue among all patients was 1.7% (8 out of 462). Central neck dissection was

carried out in 40 patients (8.7%). Fourteen of these 40 patients (35%) had an incidental parathyroid in their specimen compared with 47 of 422 patients (11.1%) who did not undergo central neck dissection ( $p < 0.001$ ). Incidental parathyroidectomy occurred in 13.2% of patients undergoing thyroidectomy in our study. The majority of patients had one parathyroid identified in their specimen. Central neck dissection was significantly predictive for incidental parathyroidectomy. Well-trained senior otolaryngology residents can safely perform thyroid surgery with similar rates of incidental parathyroidectomy as their masters.

**Keywords** Thyroidectomy · Parathyroid · Thyroidectomy complication · Unintentional parathyroidectomy

**Supplementary Information** The online version contains supplementary material available at <https://doi.org/10.1007/s12070-021-02590-0>.

✉ Orhan Asya  
orhan4913@gmail.com

Ali Cemal Yumuşakhuylu  
dralicemal@yahoo.com

Yavuz Gündoğdu  
yavuzgundogdu\_25@hotmail.com

Sefa İncaz  
sefa.incaz@gmail.com

Çağatay Oysu  
coysu@hotmail.com

<sup>1</sup> Otolaryngology Unit, Malazgirt State Hospital, Hastane Street, 49400 Malazgirt, Muş, Turkey

<sup>2</sup> Department of Otolaryngology, Marmara University Pendik Training and Research Hospital, Istanbul, Turkey

<sup>3</sup> Otolaryngology Unit, İzzet Baysal State Hospital, Bolu, Turkey

## Introduction

Currently, thyroidectomy is an effective approach for treating many benign and malign thyroid pathologies with minimal complications. Although there were substantial problems with thyroid surgery associated with intraoperative and postoperative bleeding during the nineteenth century [1], thanks to Kocher and Halstad, modern thyroid surgery is among the most frequently performed surgical operations and one of the safest operations [2]. The thyroid gland is in close contact with important anatomical structures, mainly the recurrent laryngeal nerves and parathyroid glands, which makes thyroid surgery more challenging. Although thyroid surgeons are highly familiar with the typical and possible location of parathyroid glands and perform meticulous dissection, occasionally, the parathyroid gland/s can be unintentionally removed during

thyroid surgery, as evidenced by pathology reports. The present study aimed to determine the incidence of inadvertent parathyroid removal during thyroid surgery and define the associated risk factors for this error.

## Materials and Methods

In this single-center record-based study, we retrospectively analyzed all thyroidectomies (total thyroidectomy and lobectomy) performed at Marmara University Medical Faculty Otolaryngology and Head and Neck Clinic between January 1, 2012, and September 30, 2020. Thyroidectomy was performed similarly in all cases, paying attention to the protection of recurrent laryngeal nerves and parathyroid glands and their vascular supply. After removal of the thyroid gland, the specimen was also grossly investigated for the presence of parathyroid glands. Patients undergoing central and/or lateral neck dissection were included in our study. Patients undergoing thyroidectomy for non-thyroid disease, such as laryngectomy or surgery for hyperparathyroidism, were excluded. Parathyroid glands implanted into the tissue because of accidental removal or devascularization were not accepted as inadvertent removal. Parathyroid glands not targeted for removal and noticed during pathologic examination of thyroid specimen were accepted as inadvertent removal. Four-hundred and sixty-two patients were included in the study pathology and presented with multinodular goiter, adenoma, Graves' disease, thyroiditis and malign thyroid lesions such as papillary thyroid carcinoma (PTC), follicular thyroid carcinoma (FTC), medullary thyroid carcinoma (MTC), anaplastic carcinoma, or poorly differentiated carcinoma. Thyroidectomy operations were also grouped into four different categories according to seniority regarding who performed the surgery (senior resident, specialist, associated professor, professor). The incidence of inadvertent parathyroid removal between groups was also evaluated. Statistical analysis was carried out using SPSS version 17.0. The suitability of the variables to normal distribution was examined using histogram graphics and a Kolmogorov-Smirnov test. A Chi-square test was used for categorical data, and a Mann-Whitney U test was used for nonparametric data. P-values of less than 0.05 were evaluated as statistically significant.

## Results

A total of 462 patients were included in the study, 134 men and 328 women. Of these thyroidectomies, 399 were total thyroidectomies, and 63 were lobectomies. The average age of the patients was  $45.7 \pm 15.3$  years. The final

pathological diagnosis was categorized as malign thyroid disease (205 patients, 44.5%), Graves' disease (37 patients, 8%), or a benign thyroid disease other than Graves' disease (220 patients, 47.5%). Incidental parathyroidectomy was detected in 61 of 462 patients (13.2%). The incidence of inadvertent parathyroid removal was 17.6% (36 of 205 patients) in patients having malign thyroid diseases, compared with 9.7% (25 of 257 patients) in patients with benign thyroid diseases ( $p = 0.045$ ) as shown in Table 1. Eleven of the 462 thyroidectomies (2.4%) were revision surgeries for persistent or recurrent disease. Of these 11 cases, 3 (27%) were found to have unintentional parathyroid removal, and this ratio was 12.9% (58 of 451 patients) for primary thyroidectomy cases ( $p = 0.16$ ) as shown in Table 1.

Incidentally removed parathyroid tissue was intrathyroidal in 8 of the 61 patients. Thus, the ratio of intrathyroidal parathyroid tissue among all patients was 1.7% (8 out of 462). Because it is not possible to preserve intrathyroidal parathyroid tissue during thyroidectomy, the actual rate of inadvertent parathyroidectomy that could be preserved was 11.5% (53 out of 462). The number of parathyroid glands removed ranged from one to two per patient. Fifty-seven patients (93.5%) had one, and four patients (6.5%) had two parathyroid glands removed. Among these four patients with two parathyroids in their specimen, one patient had one parathyroid in a central dissection specimen and one in the right lobe; one patient with one parathyroid in the right thyroid lobe and one in the left thyroid lobe; one patient with one parathyroid in the central dissection specimen and one in the right thyroid lobe; and the last patient with two parathyroids in the central dissection specimen as shown in Table 2.

Central neck dissection was carried out in 40 patients (8.7%). Fourteen of these patients (35%) had an incidental parathyroid in their specimen compared with 47 of 422 patients (11.1%) who did not undergo a central neck dissection ( $p < 0.001$ ) as shown in Table 3.

The intrathyroidal parathyroid gland cannot always be preserved in thyroid surgery, and its removal is not associated with the operating surgeon. In our clinic, senior residents were also not allowed to perform central neck dissections. In this context, if intrathyroidal parathyroid cases and patients undergoing a central neck dissection were excluded, incidental parathyroidectomy was detected in 16 of 150 cases in the surgery performed by senior assistants; 15 of 164 cases in specialists; and 14 of 107 cases in associate professors. There were no significant associations between groups ( $p = 0.253$ ) as shown in Table 4.

**Table 1** Patient Demographics, Operative Procedure, Pathologic Diagnosis and Operating Surgeon

		Incidental parathyroidectomy				<i>p</i>
		No		Yes		
		n	%	n	%	
Sex	Man	119	(30)	15	(25)	0.415
	Woman	282	(70)	46	(75)	
Type of thyroid surgery	Total thyroidectomy	343	(86)	56	(92)	0.184
	Lobectomy	58	(14)	5	(8)	
Pathological diagnosis	Graves	34	(9)	3	(5)	<b>0.045</b>
	Benign nodular	198	(49)	22	(36)	
	Malign thyroid diseases	169	(42)	36	(59)	
Operating surgeon	Senior assistant	134	(34)	17	(28)	0.573
	Specialist	149	(37)	21	(34)	
	Associate professor	93	(23)	19	(31)	
	Professor	25	(6)	4	(7)	
Revision surgery	No	393	(98)	58	(95)	0.163
	Yes	8	(2)	3	(5)	

Bold value indicate statistical significance

Chi-square test

**Table 2** Location of Incidental Parathyroidectomy

		n	%
Single gland removal of 57 patients	Intrathyroidal	8	(14)
	Left lobe	23	(40)
	Right lobe	20	(35)
	Central dissection	6	(11)
Two glands removal of 4 patients	Right lobe and left lobe	1	(25)
	Right lobe and central dissection	2	(50)
	Central dissection	1	(25)
Incidental parathyroidectomy	No	401	(87)
	Yes	61	(13)

**Table 3** Relationship of central neck dissection and incidental parathyroidectomy

		Incidental parathyroidectomy				<i>p</i>
		No		Yes		
		n	%	n	%	
Central neck dissection	No	375	(89)	47	(11)	<b>0.000</b>
	Yes	26	(65)	14	(35)	

Bold value indicate statistical significance

Chi-square test

**Table 4** Relationship between incidental parathyroidectomy and operating surgeon

		Operating surgeon								<i>p</i>
		Senior Assistant		Specialist		Associate professor		Professor		
		n	%	n	%	n	%	n	%	
Incidental parathyroidectomy	No	134	(34)	149	(37)	93	(23)	25	(6)	0.253
	Yes	16	(36)	15	(33)	14	(31)	0	(0)	
	Total	150	(34)	164	(37)	107	(24)	25	(5)	

Chi-square test

This table does not include cases with central neck dissection and intrathyroidal parathyroid

## Discussion

Familiarity with the anatomical localization and blood supply of parathyroid glands is essential in thyroid surgery. Typically, there are four parathyroid glands located extracapsularly on the thyroid gland posterior surface. However, these glands can also be found within the thyroid capsule or rarely within the thyroid gland parenchyma [3]. There are normally two superior parathyroid glands located at the posterior thyroid gland superior pole near the cricothyroid junction. The inferior parathyroid gland position tends to be more variable, and it is more frequently located in the thyroid gland lower pole but can also be positioned in the thymus or mediastinum [3, 4]. During thyroidectomy, parathyroid gland preservation can be achieved by meticulous dissection directly on the thyroid capsule separating the parathyroid glands from the thyroid gland [4]. Despite meticulous dissection, 13.2% of the pathology reports in our series observed the presence of parathyroid tissue in the thyroid specimen that was incidentally removed by the operating surgeon. Our findings with incidental parathyroidectomy are in accordance with the literature. Lee et al. [5] reported an incidence of 11%, Sasson et al. [6] 15%, and Lin et al. [7] 9.1% of incidental parathyroidectomy. The frequency of intrathyroidal location of parathyroid glands is approximately 0.2% according to autopsy studies [8], but this rate increases to between 2 and 5% for patients with primary hyperparathyroidism [9, 10]. Lee et al. [5] found that intrathyroidal parathyroidectomy constituted 22% of all incidental parathyroidectomy cases and 2.4% of all patients in their study (10 out of 414 patients). In our series, intrathyroidal parathyroidectomy comprised 13.1% of all incidental parathyroidectomy cases and 1.7% of all patients in the study (8 out of 462 patients). Apparently, the detection rate of intrathyroidal parathyroid glands in patients operated upon for thyroid pathology is substantially higher than for autopsy series.

We found that the type of thyroid pathology correlated with incidental parathyroid gland removal frequency (e.g., malign thyroid diseases, Graves' disease, and benign thyroid diseases other than Graves' disease). Malign thyroid diseases were found to have a higher association with incidental parathyroid removal. In this research, we considered Graves' disease as a separate group from other benign thyroid diseases due to the fact that it may complicate the operation and protection of the parathyroid gland because of a high thyroid blood supply. However, no difference was detected between Graves' disease and other benign conditions in cases of incidental parathyroid removal. In Lin and colleagues' study [7], no correlation between malign and benign thyroid diseases in cases of incidental parathyroid removal was observed.

We found no relation between revision operations and incidental removal of the parathyroid gland. However, Lin et al. reported a significantly higher association [7]. Whereas it is more difficult to recognize and preserve parathyroid glands in revision thyroid surgery, the absence of a relationship in our study may be attributed to the low number of revision cases in our series. Although only 11 of our 462 patients who underwent thyroid surgery were operated upon for revision surgery, this ratio was 25 out of 220 patients in Lin and co-workers' study [7].

Central neck dissection is another factor associated with incidental parathyroidectomy in our experience. We found a significant relationship ( $p < 0.001$ ) between central neck dissection and incidental parathyroidectomy in our study. Lin et al. [7] also reported a similar result—seven of the 36 patients (19.4%) who had a central neck dissection had an incidental parathyroidectomy compared with 13 of 184 patients (7%) who did not undergo a central neck dissection.

In our clinic, training on thyroid and parathyroid surgery is provided in a highly regular and standard way. Every resident participates in many thyroid and parathyroid surgeries as a secondary surgeon of the operation until they become a senior resident and learn every step of the

surgery in a standard manner. Once they become a senior resident, they perform thyroid and parathyroid surgery as a primary surgeon accompanied by instructors. However, senior residents are rarely allowed to perform revision thyroid surgeries and central neck dissections. Therefore, in our study, we also examined the relationship between incidental parathyroidectomy and the four groups of operating surgeon (senior resident, specialist, associate professor, professor) in the remaining cases after excluding cases with revision surgery and central neck dissection, and we did not find any statistically significant difference between the groups ( $p = 0.253$ ). From this point of view, it can be seen that in a clinic where thyroid and parathyroid surgery is frequently performed and well taught, senior residents can safely perform these surgical operations.

## Conclusion

Incidental parathyroidectomy occurred in 13.2% of patients undergoing thyroidectomy in our experience. The majority of patients had one parathyroid identified in their specimen. Central neck dissection was significantly predictive for incidental parathyroidectomy. Well-trained senior residents can safely perform thyroid surgery with similar rates of incidental parathyroidectomy as their masters.

## Declarations

**Conflict of Interest** The authors declare that they have no conflict of interest.

**Ethical Approval** Marmara University Medical Faculty Ethics Commity for Clinical Research. Approval number is 09.2020.1173.

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