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Relationship between Initial Thyroid Operation and the Location of Locoregional Recurrence in Papillary Thyroid Cancer: a Single Tertiary Center Experience

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ABSTRACT

Purpose: Locoregional recurrence of papillary thyroid cancer (PTC) after initial thyroid operation is frequent in high-risk patients. However, many studies have reported on risk factors for recurrence without presenting the actual location or patterns of these recurrences. We evaluated the efficacy of initial thyroid operation, which could affect the location of recurrence and prognosis of PTC, thereby requiring reoperation.

Methods: This was a retrospective observational cohort study of patients undergoing initial thyroidectomy for PTC with recurrences during follow-up at a single tertiary center.

Results: In total, 210 (12.8%) first recurrences and 23 (1.4%) second recurrences were detected after the initial thyroid operation. Recurrences occurred mostly after total thyroidectomy (TT) with central compartment node dissection (CCND) (51.5%) and TT with lateral neck node dissection (LND) (27.5%). The most frequent site of the first locoregional recurrence was the lateral neck node area at the non-operated site of the initial thyroid operation (67.1%). Among patients with a second recurrence, 91.3% had a first recurrence within 5 years after operation.

Conclusion: Patients receiving TT with CCND or TT with LND should undergo a thorough examination of lateral neck node area during follow-up, especially at the non-operated lateral neck site. In addition, close observation for a second recurrence is needed for patients with a first recurrence in the early years after the initial operation.

Keywords: Papillary thyroid cancer; Initial thyroid operation; Locoregional recurrence; Non-operated site; Initial operated site

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

Author Contributions

Conceptualization: Choong Sil Rah, Tae-Yon Sung, Suck Joon Hong. Data curation: Jin Gi Chang, Won Woong Kim, Yu-mi Lee, Min Ji Jeon, Dong Eun Song, Young Jun Choi. Formal analysis: Choong Sil Rah, Tae-Yon Sung. Investigation: Tae-Yon Sung. Project administration: Tae-Yon Sung, Ki-Wook Chung, Suck Joon Hong. Writing - original draft: Choong Sil Rah, Tae-Yon Sung. Writing - review & editing: Tae-Yon Sung, Ki-Wook Chung.

INTRODUCTION

Papillary thyroid cancer (PTC) is a relatively slow-growing tumor with favorable clinical long-term outcomes (1,2). The concern of PTC is related to recurrence-free survival (RFS) because the cancer-specific mortality is quite low. However, locoregional recurrence occurs in 30% of PTC patients and 75% of high-risk patients, with increased morbidity related to reoperation (2,3).

After initial thyroid operation for PTC, serum thyroglobulin (Tg) level measurement and neck ultrasonography (US) at regular intervals are safe tools for the detection of recurrence (4-6). Risk factors related to PTC recurrence after the initial operation include patient age, tumor size, lymph node (LN) metastasis, extranodal extension, and the surgeon's operation volume (7-11).

Once locoregional recurrence is detected in PTC, reoperation of the lesion is the gold-standard treatment (12-15). Other treatment options for recurrent PTC include close observation or conservative treatment such as ethanol injection or radiofrequency ablation (16-19). Complete remission (CR) ranging from 17% to 100% after reoperation of recurrent PTC has been reported for various categories of serum Tg cut-off levels and/or neck US structural findings, but with uncertainty regarding reoperation-related complications or the locations of locoregional recurrence (12,20,21).

The aim of this study was to evaluate the efficacy of initial thyroid operation for PTC, which could affect the specific patterns or locations of recurrence and prognosis of recurrent PTC, thereby requiring reoperation.

MATERIALS AND METHODS

1. Study population

This retrospective observational cohort study evaluated patients with PTC who underwent an initial thyroid operation by a single surgeon (S.J.H.) at Asan Medical Center, Seoul, Korea between 1996 and 2004. The study protocol was approved by our Institutional Review Board, which waived the requirement for informed consent (IRB 2013-0291). In all, 1,647 consecutive PTC patients were eligible for this study, with adequate medical records and follow-up. The patients underwent an initial thyroid operation with curative intent and the clinicopathological characteristics were evaluated. Patients with synchronous distant metastasis at the time of operation were excluded.

We analyzed the following clinicopathological characteristics: patient age, patient sex, primary tumor size, initial thyroidectomy type, initial central compartment node dissection (CCND), initial lateral neck node dissection (LND), extrathyroidal extension (ETE), tumor (T) and node (N) classification, postoperative follow-up duration, the reason for CCND in the initial operation, and the location of the locoregional recurrences. In this analysis, the extent of ETE was categorized according to the 8th edition of the American Joint Committee on Cancer (AJCC) tumor size, lymph nodes affected, metastases (TNM) staging system (22).

2. Initial thyroid operation strategy

At the time of operation, patients who refused total thyroidectomy (TT) were recommended to receive sufficient information about the potential risks and benefits of thyroid lobectomy versus TT. At Asan Medical Center, prophylactic CCND is preferred even in clinically LN-negative patients. Therapeutic CCND is performed when metastatic LN is diagnosed before the operation or for the suspicion of metastatic LN in preoperative evaluation or during the operation. Ipsilateral CCND was performed for ipsilateral cancer and bilateral CCND for bilateral cancers. LND was performed only when lateral LN metastasis was diagnosed by fine-needle aspiration cytology (FNAC) before the operation. The LND area generally included the lateral neck at levels II, III, and IV. Lateral level V was included only when clinically proven or suspicious LN was detected before the operation. CCND was always performed in patients who received LND. Radioactive iodine (RAI) remnant ablation following TT was performed 4–6 weeks after the initial operation, according to our institution's protocol.

3. Follow-up protocols

Follow-up examinations including physical examination, serum thyroid stimulation hormone (TSH), free T4 and Tg measurements, and neck US were regularly performed for all patients at 6- to 12-month intervals and every 12 months thereafter. Neck computed tomography (CT), chest CT, and/or ¹⁸F-deoxyglucose positron emission tomography were performed for clinical suspicion of locoregional or distant metastasis. In this study, locoregional recurrence was defined as the structural reappearance of pathologically proven malignant lesions in locoregional areas after the initial thyroid operation. However, even the appearance of highly suspicious locoregional lesions in cross-sectional or functional imaging studies was not considered a true structural recurrence unless the lesion was confirmed by FNAC or surgical biopsy. Distant metastasis was defined as the appearance of metastatic lesions in other organs in imaging studies. In this study, the recurrence defined the overall presentation of contralateral remnant thyroid recurrence, locoregional recurrence, and distant metastasis. For locoregional recurrence, the recurrence sites were categorized into three regions; thyroid operative bed recurrence, central LN area recurrence, and lateral LN area recurrence.

4. Reoperation strategy

During this study period, when loco-regional recurrence occurred in thyroid operative bed, mass excision was performed. When nodal recurrence occurred on the site/level of cervical area that has not been previously operated, CCND and/or modified radical neck dissection (MRND) was performed according to the site/level of recurrence. If the nodal recurrence occurred at the site/level operated previously, nodal picking was performed. For patients who had lobectomy as initial operation, we performed at least completion thyroidectomy regardless of the location of recurrence. In addition, we performed either nodal picking, CCND and/or MRND according to the site/level of recurred lesion.

5. Statistics

Continuous variables are presented as means±standard deviation or as medians and ranges, while categorical variables are presented as absolute numbers and percentages. Student's t-tests were used to compare continuous variables after confirming a normal distribution and Fisher's exact tests were used for between-group comparisons of categorical variables. P<0.05 was considered significant. The statistical analyses were performed using R (v 3.10) and R libraries survival (R Foundation for Statistical Computing, Vienna, Austria; www.R-project.org).

RESULTS

1. Study population

Of 1,647 consecutive PTC patients who underwent initial thyroid operation in a single tertiary center, 210 (12.8%) presented with a first structural recurrence requiring a first reoperation. Of them, 23 (1.4%, 23/1,647; 11.0%, 23/210) presented with a second recurrence and seven (0.4%, 7/1,647; 30.4%, 7/23) presented more than three recurrences. Eighteen patients died during the follow up period, of which 7 were thyroid cancer-related death.

2. Clinicopathological characteristics of initial thyroid operation patients

The clinicopathological characteristics of the patients enrolled in this study and comparison of the non-recurrence and recurrence groups are summarized in **Table 1**. The median age was 44 years and the tumor size was 1.8 cm. For initial thyroid operation, 75.6% patients underwent TT with or without LN dissection. All the patients having more than TT received RAI remnant ablation. Almost all patients (99.3%) had CCND and 12.1% had LND. About 59.4% had ETE including microscopy. For T and N classification, T1 and N1a were most frequent (54.8% and 50%, respectively). The duration of postoperative follow-up was 106 months.

Table 1. Clinicopathological characteristics of patients with initial thyroid operation and comparison between the no recurrence and recurrence group

Variables	Total (n=1,647)	Non-recurrence (n=1,437)	Recurrence (n=210)	P value
Age at operation (yr)	44 (9–87)	44 (9–87)	41 (12–77)	0.228
<55	1,302 (79.10)	1,147 (79.80)	155 (73.80)	0.056
≥55	345 (20.90)	290 (20.20)	55 (26.20)	
Sex				<0.001
Female	1,439 (87.40)	1,279 (89.00)	160 (76.20)	
Male	208 (12.60)	158 (11.00)	50 (23.80)	
Primary tumor size (cm)	1.8 (0.1–9.0)	1.4 (0.1–8.0)	2.5 (0.2–9.0)	<0.001
Initial thyroidectomy type				<0.001
Lobectomy	402 (24.40)	379 (26.40)	18 (8.60)	
Total thyroidectomy	1,245 (75.60)	1,058 (73.60)	192 (91.40)	
Initial central compartment node dissection				<0.001
No	11 (0.70)	9 (0.60)	2 (1.00)	
Yes	1,636 (99.30)	1,429 (99.40)	208 (99.00)	
Initial lateral neck node dissection				<0.001
No	1,448 (87.90)	1,311 (91.20)	137 (65.20)	
Yes	199 (12.10)	126 (8.80)	73 (34.80)	
Extrathyroidal extension				<0.001
No	668 (40.60)	622 (43.30)	32 (15.20)	
Yes (including microscopic)	979 (59.40)	815 (56.70)	178 (84.80)	
pT stage at initial operation				<0.001
pT1	902 (54.80)	872 (60.70)	30 (14.30)	
pT2	284 (17.20)	263 (18.30)	21 (10.00)	
pT3	461 (28.00)	302 (21.00)	159 (75.70)	
pN stage at initial operation				<0.001
pN0	631 (38.30)	610 (42.40)	21 (10.00)	
pN1a	823 (50.00)	706 (49.10)	117 (55.70)	
pN1b	184 (11.20)	113 (7.90)	71 (33.80)	
pNx	9 (0.50)	8 (0.60)	1 (0.50)	
Lymph nodes				
Removed lymph nodes	12.3±13.74	11.2±12.38	20±19.13	<0.001
Involved lymph nodes	3.3±5.30	2.5±4.22	8.4±8.29	<0.001
Postoperative follow-up duration (mons)	106 (12–208)	105 (12–206)	117 (0)	0.039

Values are presented as medians (ranges), number (%), or means±standard deviation.

Comparison of the non-recurrence and recurrence groups revealed no difference in age. However, there were significant differences in the primary tumor size, initial thyroidectomy type, CCND, LND, ETE, T and N classification, involved LNs, and the duration of postoperative follow-up ($P < 0.05$). The primary tumor size was 2.5 cm in the recurrence group compared to 1.4 cm in the non-recurrence group. Higher proportions of TT and initial LND cases were observed in the recurrence group than those in the non-recurrence group (91.4% and 73.6%; 34.8% and 8.8%, respectively). In addition, ETE was highly associated with recurrence (84.4%). In T and N classification, T3 was related to recurrence and central/lateral LN (N1a/N1b) metastasis was associated with a higher rate of recurrence (89.5%) than that of N0. A higher number of involved LN was related in the recurrence group and not in the non-recurrence group. The postoperative follow-up duration was shorter in the non-recurrence group than that in the recurrence group (105 vs. 117 months).

3. Clinical presentations of patients with first and second recurrences

The initial thyroid operation types in the recurrence group are presented in **Table 2**. Among the 210 recurrence cases, 107 (51.0%) received TT with bilateral CCND for the initial thyroid operation. Within the recurrence group, patients receiving TT with bilateral CCND and TT with unilateral LND had higher rates of second recurrence (47.8% and 43.5%, respectively) compared to those who received other types of initial thyroid operation. Patients who received CCND for therapeutic reasons showed a higher rate of recurrence (67.6%) than that of the prophylactic group and most of the cases of second recurrence (91.3%) also had CCND for therapeutic reasons.

The mean RFS duration from the time of initial thyroid operation to the first recurrence was significantly shorter in the second recurrence group than that in the first recurrence only group (25 vs. 41 months, $P = 0.008$). In the second recurrence group, most of the first recurrences were detected during postoperative years 1 to 5. Among the 210 cases of recurrence, 38 (18.1%) had distant metastasis during follow-up.

Table 2. Clinical presentation of the patients with first and second recurrence

Variables	Recurrence (n=210)	1st recurrence only (n=187)	2nd recurrence (n=23)	P value
Initial thyroid operation				0.032
Lobectomy	1 (0.5)	1 (0.5)	-	
Lobectomy + unilateral CCND	15 (7.1)	15 (8.0)	-	
Lobectomy + bilateral CCND	2 (1.0)	2 (1.1)	-	
Total thyroidectomy	2 (1.0)	2 (1.1)	1 (4.3)	
Total thyroidectomy + unilateral CCND	17 (8.1)	17 (9.1)	-	
Total thyroidectomy + bilateral CCND	107 (51.0)	95 (50.8)	11 (47.8)	
Total thyroidectomy + unilateral LND	54 (25.7)	44 (23.5)	10 (43.5)	
Total thyroidectomy + bilateral LND	12 (5.7)	11 (5.9)	1 (4.3)	
Reason for CCND at initial operation				0.084
Prophylactic	63 (30.0)	62 (33.2)	1 (4.3)	
Therapeutic	142 (67.6)	121 (64.7)	21 (91.3)	
Intent unclear or not performed	5 (2.4)	4 (2.1)	1 (4.3)	
RFS before 1st recurrence (mon)	39 (1-185)	41 (1-185)	25 (1-77)	0.008
Time period of 1st recurrence (yr)				0.029
≤1	30 (14.3)	26 (13.9)	4 (17.4)	
>1 and ≤2	42 (20.0)	35 (18.7)	7 (30.4)	
>2 and ≤5	65 (31.0)	55 (29.4)	10 (43.5)	
>5 and ≤10	60 (28.6)	58 (31.0)	2 (8.7)	
>10	13 (6.2)	13 (7.0)	-	

Values are presented as number (%) or medians (ranges).

CCND = central compartment node dissection; LND = lateral neck node dissection; RFS = recurrence-free survival.

4. Locations and patterns of the first recurrence sites after the initial thyroid operation

Twenty-three of 210 (11.0%) patients presented with only distant metastasis at the first recurrence after initial thyroid operation. Among the remaining 187 patients, 19 presented with more than one recurrence site, including the contralateral remnant thyroid and/or locoregional recurrence areas. The sites of locoregional recurrence for the first recurrence included the thyroid operative bed area in 10 cases (4.8%), the central compartment node area in 20 cases (9.5%), and the lateral neck node area in 162 cases (77.1%), as shown in **Table 3**.

In the less-than-TT group (n=18) at the initial thyroid operation, 15 (83.3%) were in the lobectomy with unilateral CCND group (**Table 3**). Among them, the contralateral remnant thyroid was the most frequent recurrence site (n=14, 14/18 [77.8%], 14/210 [6.7%]). In the TT group including CCND and/or LND (n=192), the TT with bilateral CCND group had the most frequent recurrences (n=107, 107/192 [55.7%], 107/210 [51.0%]) followed by the TT with unilateral LND group (n=54, 54/192 [28.1%], 54/210 [25.7%]). In the TT group, the most frequent recurrence site was the lateral LN after the initial TT with bilateral CCND operation.

5. Locations and patterns of the second recurrence sites after thyroid operation

Second recurrences were detected 23 of 210 (11.0%) cases of first recurrence. None of the second recurrence cases developed in patients who received less-than-TT for their initial thyroid operation (**Table 4**). Among patients with second recurrences, most of the first recurrence sites were the lateral neck node area (n=17, 73.9%) followed by distant metastasis

Table 3. Actual location and pattern of first recurrence sites after initial thyroid operation

Initial thyroid operation	Recurrence (n=210)	1st recurrence sites	No.
Lobectomy	1	Contralateral lobe	1
		Central LN	1
		Lateral LN	1
Lobectomy + unilateral CCND	15	Contralateral lobe	12
		Central LN	5
		Lateral LN	3
Lobectomy + bilateral CCND	2	Contralateral lobe	1
		Central LN	1
		Lateral LN	0
Total thyroidectomy	2	Thyroid operative bed	1
		Central LN	1
		Lateral LN	1
		Distant metastasis	1
Total thyroidectomy + unilateral CCND	17	Thyroid operative bed	2
		Central LN	1
		Lateral LN	13
		Distant metastasis	1
Total thyroidectomy + bilateral CCND	107	Thyroid operative bed	4
		Central LN	7
		Lateral LN	100
		Distant metastasis	7
Total thyroidectomy + unilateral LND	54	Thyroid operative bed	1
		Central LN	4
		Lateral LN	36
		Distant metastasis	19
Total thyroidectomy + bilateral LND	12	Thyroid operative bed	2
		Central LN	0
		Lateral LN	8
		Distant metastasis	5

LN = lymph node; CCND = central compartment node dissection; LND = lateral neck node dissection.

Table 4. Actual location and pattern of second recurrence sites after thyroid operation

Initial thyroid op type	2nd recurrence (n=23)	1st recurrence site	No.	2nd recurrence site	No.
Total thyroidectomy	1	Thyroid operative bed		Thyroid operative bed	
		Central LN		Central LN	
		Lateral LN	1	Lateral LN	
		Distant metastasis		Distant metastasis	1
Total thyroidectomy + unilateral CCND		Thyroid operative bed		Thyroid operative bed	
		Central LN		Central LN	
		Lateral LN		Lateral LN	
		Distant metastasis		Distant metastasis	
Total thyroidectomy + bilateral CCND	11	Thyroid operative bed	1	Thyroid operative bed	2
		Central LN	2	Central LN	1
		Lateral LN	10	Lateral LN	9
		Distant metastasis	1	Distant metastasis	2
Total thyroidectomy + unilateral LND	10	Thyroid operative bed		Thyroid operative bed	1
		Central LN	1	Central LN	2
		Lateral LN	6	Lateral LN	10
		Distant metastasis	6	Distant metastasis	4
Total thyroidectomy + bilateral LND	1	Thyroid operative bed	1	Thyroid operative bed	
		Central LN		Central LN	1
		Lateral LN		Lateral LN	1
		Distant metastasis		Distant metastasis	

LN = lymph node; CCND = central compartment node dissection; LND = lateral neck node dissection.

Table 5. Relationship between the initial thyroid operation site and first recurrence sites (n=210)

Relationship of 1st recurrence site with initial thyroid operation site	No. of patient (%)
Non-initial operated site	141 (67.1)
Initial operated site	23 (11.0)
Non-initial operated site & initial operated site	13 (6.2)
Non-initial operated site + distant metastasis	4 (1.9)
Initial operated site + distant metastasis	5 (2.4)
Non-initial operated site & initial operated site + distant metastasis	1 (0.5)
Distant metastasis only	23 (11.0)

(n=6, 26.1%); among the sites of second recurrence, the lateral neck node area was the most common (n=20, 87.0%).

6. Relationships between the initial thyroid operation site and the first and second recurrence sites

This study analyzed the recurrence sites according to the lesion of recurrence defined as the initial operated site (including thyroid operative bed and central and lateral neck areas) or non-initial operated site to assess the relationship between first and second recurrence sites and initial thyroid operation site, as described in **Tables 5** and **6**. Among first recurrences, 67.1% (n=141) of cases occurred in non-initial operated sites. Only 11.0% (n=23) of first recurrences were detected in the initial operated site. Among the second recurrences, 6 (26.1%) cases

Table 6. Relationship between the initial thyroid operation site and first recurrence sites with second recurrence sites (n=23)

Relationship of 2nd recurrence site with initial thyroid operation site	No. of patient (%)	Relationship of 2nd recurrence site with initial thyroid operation site and 1st recurrence site	No. of patient (%)
Non-initial operated site	6 (26.1)	Non-operated site	5 (21.7)
Initial operated site	4 (17.4)	Operated site	8 (34.8)
Non-initial operated site & initial operated site	4 (17.4)	Non-operated site & operated site	2 (8.7)
Non-initial operated site + distant metastasis	1 (4.3)	Non operated site + distant metastasis	0 (0.0)
Initial operated site + distant metastasis	2 (8.7)	Operated site + distant metastasis	3 (13.0)
Non-initial operated site & initial operated site + distant metastasis	1 (4.3)	Non-operated site & operated site + distant metastasis	1 (4.3)
Distant metastasis only	5 (21.7)	Distant metastasis only	4 (17.4)

recurred in non-initial operated sites. Five cases (21.7%) of recurrence were detected as distant metastasis only. However, when we added the initial operated site and first recurrence site, most of the second recurrences were detected in the operated sites (34.8%).

DISCUSSION

We evaluated the clinicopathological characteristics and outcomes of 210 PTC patients presenting first recurrences after initial thyroid operation at our center and the relationship between initial thyroid operation and the location of recurrence. In this study, the risk factors for recurrence in PTC patients were male sex, large tumor size, and advanced stages at the time of operation among those who received TT and with pT3 or N1 classifications. These recurrence-related risk factors were also reported in previous studies (2,9).

When we subdivided the initial thyroid operation type into each thyroid, CCND, and LND types, half of the patients received TT with bilateral CCND (51.0%) followed by TT with unilateral LND (25.7%). CCND performed for therapeutic reasons had a higher recurrence rate than that of the prophylactic group. This suggests that patients who underwent an initial thyroid operation at our institution had an advanced disease status at the time of diagnosis. Most of the cases with a second recurrence had received TT with CCND or TT with LND (up to 91.3%). This finding could be related to the reports from other studies that high-risk patients have higher recurrence rates and that LN-related factors are associated with the risk of recurrence (8,9).

In postoperative RFS before the first recurrence, patients with a second recurrence had a shorter mean RFS (25 months) compared that in patients with only one recurrence (41 months). Most of the first recurrences were detected in postoperative years 2 to 5 (31.0%), followed by years 5 to 10 (28.6%). Among them, second recurrences were mostly presented in patients with a first recurrence within 2 to 5 years (43.5%), followed by 1 to 2 years (30.4%). Only 8.7% of the recurrence group with a second recurrence presented their first recurrence after postoperative year 5. Kim et al. reported a high LN recurrence rate within postoperative 4 years, with a peak in years 1 to 3, which is similar to our study results (23). However, patients presenting with recurrence within postoperative year 1 (14.3%) could be related to persistent disease instead of recurrence. Therefore, patients with a second recurrence who presented with a first recurrence within 2 years of the operation could have had insufficient initial evaluation to detect the initial disease status. In other studies, the metastasis found within 1 to 2 years after the first thyroid surgery could be persistent disease rather than the recurrence (12,21). However, among patients presenting a late first recurrence in this study, the follow-up period could have been too short to detect a second recurrence.

To our knowledge, this is the first study to evaluate the actual locations of locoregional recurrence and patterns of second recurrence sites after the initial thyroid operation. In the lobectomy group with recurrence (n=18), most of the first recurrences were detected in the contralateral lobe (n=14). This suggests that thorough US examination is required for patients who receive lobectomy with or without CCND in order to detect new nodules in the remnant contralateral thyroid lobe. In the TT group (n=192), most of the first recurrences were detected in lateral neck node sites (n=158). This suggests that the US or CT evaluation to detect the suspicious LNs in the lateral neck are very important during follow-up. Also, thorough inspection of suspicious lateral neck LN could be necessary at the time of initial

diagnosis. This suggestion is supported by the finding in our study that most of the patients with a second recurrence had received TT with bilateral CCND (47.8%) followed by TT with unilateral LND (43.5%) and most of the first and second recurrences occurred in lateral LN sites. Most importantly, analysis of the relationship between the initial thyroid operation site and first and second recurrence sites revealed that most of the first recurrences were in non-operated sites (67.1%). However, second recurrence sites were mostly found in operated sites (34.8%), followed by non-operated site (21.7%). This suggests that a well-performed initial operation is important to reduce recurrence at the operated site.

CONCLUSION

In conclusion, the contralateral remnant thyroid lobe was the most frequent site of recurrence in lobectomy patients while the lateral neck node area was the most frequent site of recurrence in TT patients. Patients receiving TT with CCND or LND should undergo a thorough examination of the lateral neck node area during follow-up, especially the non-operated lateral neck site. Furthermore, a well-performed initial thyroid operation is critical to reducing the chance of recurrence in the operated sites and close observation for a second recurrence is required for patients who develop a first recurrence in the early years after the initial operation.

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