Surgical interventions for thyroid gland diseases have increased in the last decades. Radiological imaging techniques are thought to be effective on the progressive increase of thyroid surgery [1]. According to the data of the World Health Organization (WHO), thyroid cancers have a 6.7% rate of cancer diseases worldwide in 2018. It is thought that the number of patients will double in the next 10 years [2]. In Turkiye, this ratio is 14% and is relatively high compared to the EU and is seen worldwide [3]. Although different thyroidectomy surgical techniques of both malignant and benign diseases of thyroidal diseases are defined, total thyroidectomy continues to be a more preferred and recommended surgical option over time [4, 5]. Considering the long-known endemic feature of some of the thyroid diseases, it is thought that there may be differences between the types and rates of thyroid surgeries.
performed in different regions [6, 7]. A study investigating the treatment of thyroid nodules in Türkiye reported that surgical treatment varied by center [8]. Few studies have been performed on this subject. Such studies often present isolated centers or data representing a particular region. Therefore, studies that will compare different regional data within the same country and reveal the differences in thyroid surgery are needed. In a study conducted in the U.S.A., it was emphasized that the same surgical intervention and treatment option may differ across regions throughout the country and this may be due to many factors, and a consensus cannot be provided across the country in terms of surgical treatment [9].

The aim of this study is to shed light in the surgical treatment of thyroid diseases in two non-endemic regions (Istanbul-Van) in Türkiye and to investigate the regional (east-west) possible differences of thyroidectomy causes, applied surgical techniques and post-operative results.

**MATERIALS AND METHODS**

This is a retrospective and observational report. The protocol was approved by the Clinical Research Ethics Committee dated March 13, 2018 and no: 012. The report followed the Declaration of Helsinki. After the approval of the ethics committee, two university hospitals from different regions were included in the present study. One of these university hospitals was in Istanbul which is an industrially advanced metropolitan settled at the western Türkiye, and the other was in the city of Van, which is located at Eastern Türkiye with a patient population generally from rural areas. Both centers are considered non-endemic regions in terms of thyroid disease, in Türkiye. Patients aged 18 years and over from both sexes who underwent thyroidectomy between 2011 and 2017 were included in the study. Patients with missing data were excluded from the study. Epicsis, surgery, and pathology reports were reviewed retrospectively. Parameters such as age, gender, pre-operative diagnoses, FNAB results, operation methods, pathological diagnoses, length of stay (days), and early complications were recorded and statistical differences between two groups were examined.

**Statistical Analysis**

The data were evaluated with SPSS version 22. Compliance of continuous data to normal distribution conditions was tested with Kolmogorov–Smirnov. The average and standard deviation values of the normally distributed data and the median and minimum-maximum values of the data that do not fit the normal distribution were chosen. Categorical data were analyzed with frequency and percentage values. For the continuous data, the differences between the approaches of the two centers were evaluated using the Mann–Whitney U-test or the Student T-test. Chi-square test was used in categorical and nominal data. 5% was accepted limit for Type-1 error.

**RESULTS**

The study included a total of 1232 patients. Two hundred and forty patients were from Istanbul (first center) and 992 patients were from Van (second center). The male/female patient ratio for both centers was 19%/81% and 14%/86% (46/194 and 172/801), respectively, and there was no statistically significant difference between the two centers (p=0.59). The average patient age in the first center was 47.21 years, whereas it was 44.8 years in the second center. In terms of patient age between two centers, it was observed that there was a relatively older patient population in the first center (p=0.035) (Fig. 1). Consid-
ering the diagnostic distribution of the patients according to the pre-operative thyroid USG results, toxic nodular goiter and multinodular goiter were the most common radiological diagnosis in the first and second centers, respectively. There was a significant statistical difference between the radiological diagnostic findings between the two centers ($p<0.001$) (Fig. 2). The rates of fine needle aspiration cytology (FNAC) were 28.75% (69 patients) in the first group and 82.86% (822 patients) in the second group. There was a statistically significant difference between the two groups in the pre-operative FNAC rates, especially between the non-diagnostic FNAC results (graph 2), ($p<0.001$). When the final post-operative pathology results were examined, malignancy was detected in 47 patients (19.85%) in the first group, and in 240 patients (24.19%) in the second group. There was a significant statistical difference between the two groups in terms of post-operative malignant diagnosis ($p<0.001$) (Fig. 3). When thyroidectomy surgeries performed in both centers were examined, it was observed that a total of seven different types of thyroidectomy surgeries were performed (Table 1). As seen on the table, the rate of bilateral total thyroidectomy (BTT) in the first center was 82.5% (198 patients). In the second center, this rate was 65.6% (622 patients). Detailed examination of the type of surgery performed and some of the post-operative pathological diagnoses is shown in Table 2. As can be seen from the table, BTT and its types were preferred in the first center for papillary carcinoma, papillary microcarcinoma, and benign thyroid diseases. In the second center, although BTT and its derivatives were observed, TLE and its derivatives were seen to be preferred more common than the first center. As a result of the Chi-square analysis, it was determined that the type of surgery may differ from center to center ($p<0.001$). In both centers, a total of 85 patients underwent secondary surgical intervention. The most common surgery performed in both centers is BTT and was performed in the first and second centers at a rate of 85.7% (6 patients) and 70.5% (55 patients), respectively. There was no statistically significant difference between the centers in terms of secondary surgical methods ($p=0.712$). Since reliable data for late complications could not be reached, late post-thyroidectomy complications were not evaluated in the present study. Early complications were examined in 1108 patients and were observed in 139 (12.5%) patients (Table 3). The most common early post-thyroidectomy complication was hypocalcemia in both centers. The hypocalcemia ratio was 3.9% (38 patients) and 15.5% (21 patients) at the 1st and 2nd centers, respectively. When the total complication rates are examined, there was a statistically significant difference between the two centers ($p<0.001$).
DISCUSSION

This study is the first study that compared the results of patients who underwent thyroidectomy in different regions of Türkiye. The male/female ratios seen in thyroid diseases in the centers participating in the present study are similar to those published in other regions in our country [10]. On the other hand, studies showing that thyroidectomy surgery is performed more frequently in female patients are also reported [11, 12]. Patient age groups in both centers correlated with the results of the previous studies from the same geographical region [10, 13]. As a result of thyroid USG and laboratory tests performed before thyroidectomy in both centers, toxic nodular goiter was frequently observed in the western region and MNG in the eastern region. As a matter of fact, considering that both regions are not endemic for any toroidal disease, there is no study explaining the reason for this difference between the centers. There are also studies demonstrating that there are more MNGs in the western region [14]. In a multicenter study conducted in our country and attended by 400 clinicians, it was reported that only 38.5% of clinicians care about FNAB in patients with thyroid pathology [8]. We think that this may have an effect on the difference in pre-operative FNAB rates and results between the two centers.

Prevailing logic states that the incidence of thyroid diseases and treatment options historically increase depending on the development of diagnostic methods and the technological progress. During this period, various

| Table 1. Thyroid surgery types and rates |
|-----------------------------------------|
| Surgery performed | Center | Total (%) |
| | | First center (%) | Second center (%) |
| Bilateral total thyroidectomy (BTT) | | 82.5 | 65.60 | 69.00 |
| BTT+Central lymph node dissection (CND) | | 1.30 | 6.20 | 5.20 |
| BTT+Unilateral lymph node dissection (ULND) | | 0.00 | 1.7 | 1.30 |
| BTT+CND+ Bilateral lymph node dissection (BLND) | | 0.00 | 0.10 | 0.10 |
| Thyroid lobectomy (TL) | | 11.30 | 16.60 | 15.50 |
| TL+Parathyroid adenom (PTA) | | 0.0 | 4.60 | 3.70 |
| TL+PTA+CND | | 0.00 | 0.60 | 0.50 |
| Another center | | 1.70 | 4.00 | 3.50 |
| Unusual | | 0.00 | 0.30 | 0.30 |
| Bilateral subtotal thyroidectomy | | 3.30 | 0.20 | 0.80 |
| Total | | 240 | 948 | 1188 |
| | | 100.00 | 100.00 | 100.00 |

| Table 2. Preferred rates of thyroidectomy type according to the center in thyroid diseases |
|-----------------------------------------------|
| Preferred thyroidectomy | Center | Papillary carcinoma | Micropapillary carcinoma | Benign |
| | | % | n | % | n | % | n |
| BTT and derivatives | Western (first) | 81.48 | 22 | 94.44 | 17 | 83.24 | 154 |
| | Eastern (second) | 70.21 | 99 | 82.5 | 66 | 71.22 | 292 |
| LE and derivatives | Western (first) | 14.81 | 4 | 0 | 0 | 11.89 | 22 |
| | Eastern (second) | 23.4 | 33 | 6.25 | 5 | 22.44 | 92 |

BTT: Bilateral total thyroidectomy; LB: Lobectomy.
techniques of thyroidectomy for different thyroid diseases have been defined and started to be applied [15, 16]. Ultimately, American Thyroid Association guidelines are thought to be guiding and generally standardizing the procedures performed in the diagnosis and surgical treatment of thyroid diseases [17]. Nevertheless, BTT is becoming increasingly common and complication rates are as low as other types of thyroidectomies [4, 18–20]. Another study conducted in the U.S.A. Detected more than 6 times difference between thyroidectomy surgery rates in different regions of the country. It has been demonstrated that this is not associated with the incidence of thyroid diseases, demographic data, health-care center, and regional socioeconomic parameters [21]. Considering that there are different methods of thyroidectomies, it can be concluded that there will be proportional differences across the country among different thyroidectomy surgeries [15]. There is no study from another country showing these differences. The present study demonstrates that 19 different types of thyroidectomy operations were performed on patients who attended two different university hospitals located in the eastern and western regions of Türkiye. While a total of 5 thyroidectomy surgery types were preferred in the western center, all 19 different surgery types were performed in the eastern center. When the change of the operation according to the current diagnosis was examined, the rates of performing only BTT in benign and malignant thyroid diseases were 84.86%/78.72% in the first center, and 59.75%/46.25% in the second center. More detailed examinations show, as seen in Table 2, that the rate of performing BTT and its derivative operations in the surgical treatment of papillary and micropapillary thyroid cancers was 81.48% and 94.44%, respectively, in the first center. In the second center, these rates were 70.21% and 82.5%, respectively. As seen from the results, the rate of performing BTT in papillary cancers in the first center coincides with the accepted rates [16, 20]. In the same group of patients, LE and its derivatives differed between the centers by performing 14.81%/0% in the first center and 23.4%/6.25% in the second center, respectively. Although the most preferred surgical treatment technique for benign thyroidal diseases is BTT in both centers, there was a difference between the centers. In the first center, BTT + derivatives and TLE + derivatives were performed at the rate of 83.24% (154 patients) and 11.89% (22 patients), respectively. In the second center, these rates were 71.22% (292 patients) and 22.44% (92 patients). We assume that the possible reason for the fact that the rates of performing BTT in both centers are higher than the literature data, was to avoid the risks of post-operative random thyroid cancer, recurrent nodular goiter, re-surgery, and to eliminate the risk of malignant changes in the remaining thyroid gland [22, 23]. When examined in general, there are significant statistical differences between the types of surgeries performed between the two regions. It was not possible to find a clear, scientific explanation for this difference. In terms of early complications, although the data of the first center are compatible with the literature, a significantly low rate of hypocalcemia was observed in the second center [24, 25]. High rates of total thyroidectomy may be considered as

| Complications            | Centre (%) | Total (%) |
|--------------------------|------------|-----------|
| Neuroprolexia            | 20/0       | 20/100.0  |
| Bilateral paralysis      | 0/1        | 1/0.0     |
| Tracheostomy             | 1/0        | 1/0.0     |
| Hypocalcemia             | 38/21      | 59/35.6/100.0 |
| Hipoparathyroidism       | 1/3        | 4/2.1     |
| Bleeding                 | 4/0        | 4/0.0     |
| Non                      | 905/112/1107 | 89.0/11.0/100.0 |
| Total                    | 969/139/1108 | 87.5/12.5/100.0 |

Table 3. Complications seen in centers after thyroidectomy surgery
a reason for the fact that the early complications of thyroideotomy is higher in the western-centered group. On the other hand, it may be thought that the habit of using thermal instruments in western regions may also have an impact on complication rates [26].

According to the results of this study, we conclude that the difference in thyroidectomy surgery types performed vary across regions throughout the country. There is a need for multicenter studies for the creation of a comprehensive thyroideotomy map in Turkie. This would allow the formulation of a national consensus pertaining to the surgical treatment of thyroid disorders as well as the establishment of a standard surgical treatment algorithm.

Ethics Committee Approval: The Yeni Yuzyil University Clinical Research Ethics Committee granted approval for this study (date: 13.03.2018, number: 012).

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

Authorship Contributions: Concept – EZ, SC; Design – EZ, SC, DS; Supervision – EZ, SC; Fundings – EZ, DS, PH; Materials – EZ, SC, PH; Data collection and/or processing – EZ, DS, SC, PH; Analysis and/or interpretation – EZ, SC, DS; Literature review – EZ, SC; Writing – EZ, SC, DS; Critical review – EZ, SC.

REFERENCES

1. Russ G, Leboulleux S, Leenhardt L, Hegedüs L. Thyroid incidentalomas: epidemiology, risk stratification with ultrasound and workup. Eur Thyroid J 2014;3:154–63.
2. World Health Organization. International Agency for Research on Cancer. Available at: https://gco.iarc.fr/today/online-analysis-multibars]. Accessed Jul 18, 2022.
3. Republic of Turkey Ministry of Health. Health Statistics Yearbook. Available at: https://dosyamerkez.saglik.gov.tr/Eklenti/36164,siy2018en2pdf.pdf[0]. Accessed Jul 18, 2022.
4. Padur AA, Kumar N, Guru A, Badagabetla SN, Shanthakumar SR, Virupakshamurthy MB, et al. Safety and effectiveness of total thyroideotomy and its comparison with subtotal thyroideotomy and other thyroid surgeries: a systematic review. J Thyroid Res 2016;2016:7594615.
5. Mishra A, Agarwal A, Agarwal G, Mishra SK. Total thyroideotomy for benign thyroid disorders in an endemic region. World J Surg 2001;25:307–10.
6. Mathonnet M, Cuerq A, Tresallet C, Thalabard JC, Fery-Lemonnier E, Russ G, et al. What is the care pathway of patients who undergo thyroideotomy in France and its potential pitfalls? A national cohort. BMJ Open 2017;7:e013589.
7. Hedinger C. Geographic pathology of thyroid diseases. Pathol Res Pract 1981;171:285–92.
8. Aydoğan BI, Demirer S, Erbil Y, Erdoğan MF. Diagnostic and therapeutic approaches to thyroid nodules in Turkey. Turk J Endocrinol Metab 2020; 24: 47-54.
9. Birkmeyer JD, Reames BN, McCulloch P, Carr AJ, Campbell WB, Wennberg JE. Understanding of regional variation in the use of surgery. Lancet 2013;382:1121–9.
10. Durmus Y, Celik M, Bulbul BY, Ayturk S, Tastekin E, Can N, et al. Complementary thyroideotomy in papillary thyroid cancer. 19th European Congress of Endocrinology 2017;ECE2017.
11. Yagmur Y, Akbulut S, Sakarya H, Sogutcu N, Gumus S. Assessment of the relationship between clinical and histopathological features in cases of thyroideotomy. Ann Ital Chir 2018:89:199–205.
12. Simsek B, Guldogan OE, Ozden S, Saylam B, Karabeyoglu SM, Tez M. Concomitant thyroid cancer in patients with primary hyperparathyroidism in an endemic goitre region. Ann Ital Chir 2017;88:15–9.
13. Yildiz S, Eker E, Ozturk M, Alay M. A comparison of haemogram parameters of patients with thyroid papillary cancer and nodular goiter in Van, Turkey. Pak J Med Assoc 2019:69:1642–6.
14. Ugurlu S, Caglar E, Yesim TE, Tanrikulu E, Can G, Kadioglu P. Evaluation of thyroid nodules in Turkish population. Intern Med 2008:47:205–9.
15. Hobbs CG, Watkinson JC. Thyroideotomy. Surgery (Oxford) 2007;25:474–8.
16. Patel KN, Yip L, Lubitz CC, Grubbs EG, Miller BS, Shen W, et al. Executive summary of the American Association of Endocrine Surgeons Guidelines for the definitive surgical management of thyroid disease in adults. Ann Surg 2020;271:399–410.
17. Gharib H, Papini E, Garber JR, Duick DS, Hegedüs L, et al; AACE/ACE/AME Task Force on Thyroid Nodules. American Association of Clinical Endocrinologists, American College of Endocrinology, and Associazione Medici Endocrinologi Medical Guidelines for clinical practice for the diagnosis and management of thyroid nodules-2016 update. Endocr Pract 2016;22:622–39.
18. Efremidou EI, Papageorgiou MS, Liratzopoulos N, Manolos KJ. The efficacy and safety of total thyroideotomy in the management of benign thyroid disease: a review of 932 cases. Can J Surg 2009;52:39–44.
19. Cirez B, Uludag M, Yerkin G, Yener F, Akgun I, Isgor A. Changes in the choice of thyroideotomy for benign thyroid disease. Surg Today 2013;43:625–31.
20. Bilimoria KY, Bentrem DJ, Ko CY, Stewart AK, Winchester DP, Talamentis MS, et al. Extent of surgery affects survival for papillary thyroid cancer. Ann Surg 2007;246:375–81.
21. Francis DO, Randolph G, Davies L. Nationwide variation in rates of thyroideotomy among US medicare beneficiaries. JAMA Otolaryngol Head Neck Surg 2017;143:1122–5.
22. Albayrak Y, Demiryilmaz I, Kaya Z, Aylu B, Güzels C, Ozcan O, et al. Comparison of total thyroideotomy, bilateral subtotal thyroideotomy and Dunhill operations in the treatment of benign thyroid disorders. Minerva Chir 2011;66:189–95.
23. AboAmra M, Elias AA. Feasibility of total thyroideotomy for management of benign thyroid disease. Al-Azhar Assiat Med J 2019:17:277–80.
24. Del Rio P, Rossini M, Montana CM, Viani L, Pedrazzi G, Loderer T, et al. Postoperative hypocalcemia: analysis of factors influencing early hypocalcemia development following thyroideotomy. JAMA Otolaryngol Head Neck Surg 2019;143:1122–5.
25. Nair CG, Babu MJ, Menon R, Jacob P. Hypocalcaemia following total thyroideotomy: An analysis of 806 patients. Indian J Endocrinol Metab 2013;17:298–303.
26. Remouza A, Rasihashemi SZ, Safaeiyani A, Hosseini M. Comparing postoperative complication of LigaSure Small Jaw instrument with clamp and tie method in thyroideotomy patients: a randomized controlled trial [IRCT2014010516077N1]. World J Surg Oncol 2018;16:154.