



Original Article

Corresponding Author:

Dr. Sabarish S

Assistant Professor, Department
of ENT, Government Medical
College Hospital, Krishnagiri,
Tamil Nadu.

Article History:

Received on: Aug 16, 2026

Revised on: Sep 15, 2026

Accepted on: Sep 22, 2026

Published on: Oct 03, 2026

Citation: Dr. Sabarish S *et al.*
Anatomical Variations of the
Recurrent Laryngeal Nerve and Their
Impact on Postoperative Vocal Cord
Outcomes in Thyroidectomy: A
Prospective Observational Study.
*Biomedicine and Chemical
Sciences*, 5 (4): 1-6, 2026

Copyright © The Author(s).
Published in *Biomedicine and
Chemical Sciences*



This is an Open Access article
published under the Creative
Commons Attribution 4.0
International (CC BY 4.0)

(<https://creativecommons.org/licenses/by/4.0>) Creative
Commons Attribution (CC BY): lets others distribute and copy
the article, to create extracts, abstracts, and other revised
versions, adaptations or derivative works of or from an article
(such as a translation), to include in a collective work (such as
an anthology), to text or data mine the article, even for
commercial purposes, as long as they credit the author(s), do
not represent the author as endorsing their adaptation of the
article, and do not modify the article in such a way as to
damage the author's honour or reputation

Anatomical Variations of the Recurrent Laryngeal Nerve and Their Impact on Postoperative Vocal Cord Outcomes in Thyroidectomy: A Prospective Observational Study

Dr. Sabarish S¹, Dr. Sujay Kumar S², Dr. Siddarthan M³

¹Assistant Professor, Department of ENT, Government Medical College Hospital, Krishnagiri, Tamil Nadu.

²Assistant Professor, Department of ENT, Government Medical College Hospital, Krishnagiri, Tamil Nadu.

³Assistant Professor, Department of ENT, Government Medical College Hospital, Namakkal, Tamil Nadu.

ABSTRACT

Background: Recurrent laryngeal nerve (RLN) injury remains a significant complication of thyroid surgery. Anatomical variations in RLN course and branching increase operative vulnerability.

Aims and Objectives: To determine the prevalence of extralaryngeal branching, assess RLN relationships to the inferior thyroid artery (ITA), detect non-recurrent variants, and correlate anatomical patterns with postoperative vocal cord function. **Materials and Methods:** A prospective observational study of 60 patients (98 nerves at risk) undergoing thyroidectomy was conducted at Government Medical College, Namakkal, from January 2024 to December 2025. Intraoperative anatomy and pre-/postoperative laryngoscopic findings were analyzed using Chi-square and Fisher's exact tests.

Results: Extralaryngeal branching occurred in 37.8% of nerves. The RLN was posterior to ITA in 55.1%, anterior in 29.6%, and interdigitating in 15.3%. One right non-recurrent RLN (1.0%) was identified. Transient and permanent vocal cord palsy occurred in 4.1% and 1.0% of nerves, respectively. Extralaryngeal branching was significantly associated with higher nerve palsy rates ($p = 0.046$).

Conclusion: Extralaryngeal branching and interdigitating arterial relationships significantly elevate RLN injury risks. Meticulous intraoperative identification remains vital for safe thyroidectomy.

Keywords: Thyroidectomy; Recurrent Laryngeal Nerve; Inferior Thyroid Artery; Vocal Cord Paralysis; Anatomical Variation; Postoperative Complications.

INTRODUCTION

Thyroidectomy is one of the most frequently performed endocrine surgical procedures worldwide for benign and malignant thyroid conditions [1]. Despite significant advancements in surgical technique, energy devices, and perioperative care, iatrogenic injury to the recurrent laryngeal nerve (RLN) remains among the most serious and feared operative complications [2]. Unilateral RLN damage typically manifests as persistent voice hoarseness, breathiness, and vocal fatigue

due to ipsilateral vocal cord palsy, whereas bilateral injury can result in life-threatening airway compromise requiring emergency tracheostomy or revision surgery [3]. Reported incidences of RLN injury vary widely across surgical literature, with transient neuropraxia ranging from 1% to 10% and permanent dysfunction occurring in 0.5% to 5% of cases [4].

A major contributing factor to operative nerve vulnerability is the marked anatomical variability of the RLN along its cervical course [5]. Classically, the nerve arises from the vagus nerve, loops around the subclavian artery on the right side and the aortic arch on the left, and ascends within the tracheoesophageal groove before entering the larynx behind the cricothyroid joint [6]. However, standard textbook anatomy represents only a baseline, as the nerve frequently exhibits significant deviations in course, extralaryngeal branching patterns, and relationship to adjacent vascular structures [7].

The spatial relationship between the RLN and the inferior thyroid artery (ITA) is notoriously inconsistent [8]. The nerve may pass anterior, posterior, or interdigitate between the distal arterial branches, creating potential sites of mechanical traction or thermal injury during devascularization of the thyroid gland [8]. Furthermore, extralaryngeal bifurcation or trifurcation prior to laryngeal entry is encountered in a substantial proportion of patients [9]. In inadvertent division of an anterior motor branch mistaken for an extralaryngeal fibrous band or vessel, motor innervation to the intrinsic laryngeal muscles is irrevocably disrupted [9]. Additionally, the rare anomaly of a non-recurrent laryngeal nerve (NRLN)—typically associated with embryological vascular variants such as an aberrant right subclavian artery—poses a major surgical hazard when unexpected [10].

In clinical practice, routine visualization and meticulous skeletonization of the RLN remain the gold standard for nerve preservation during thyroid surgery [5]. A comprehensive understanding of localized population-specific variations is paramount to preventing iatrogenic trauma.

Therefore, the present study was conducted with the objectives of evaluating the anatomical variations of the recurrent laryngeal nerve encountered during thyroidectomy at a tertiary care medical college. Specifically, the study aimed to determine the frequency of extralaryngeal branching patterns of the RLN, describe its anatomical relationship to the branches of the inferior thyroid artery, evaluate the incidence of non-recurrent laryngeal nerves, and correlate these anatomical variants with postoperative vocal cord outcomes.

MATERIALS AND METHODS

Study Setting: Prospective observational study was conducted in the Department of Otorhinolaryngology, Government Medical College and Hospital, Namakkal, Tamil Nadu, India from January 2024 to December 2025.

Study Participants: The study population comprised all adult patients presenting to the Department of General Surgery, Government Medical College, Namakkal, diagnosed with benign or malignant thyroid diseases who were scheduled for elective thyroidectomy during the study period. Inclusion criteria included patients aged 18 years and above undergoing primary elective thyroid surgeries (total thyroidectomy, subtotal thyroidectomy, hemithyroidectomy, or lobectomy) with informed written consent.

Exclusion criteria were patients with preoperative vocal cord palsy (confirmed by indirect or flexible laryngoscopy), patients undergoing re-operative thyroid surgery (redo cases), patients with locally advanced thyroid malignancies involving gross invasion into the RLN, patients with prior history of extensive neck irradiation or central neck dissection, and patients refusing consent.

Sample Size and Sampling Technique: A complete enumeration (convenience consecutive sampling) approach was utilized. During the 24-month study period from January 2024 to December 2025, a total of 60 eligible consecutive patients undergoing elective thyroidectomy meeting the inclusion and exclusion criteria were enrolled in the study.

Study Tools: Data collection was structured using a pre-designed, validated clinical proforma. The tool recorded patient demographics, primary clinical and pathological diagnoses, preoperative laryngoscopic findings, intraoperative anatomical details (side of surgery, nerve course, branching status, relation to ITA, presence of NRLN), and postoperative vocal cord function assessments.

Study Procedure: All enrolled patients underwent routine preoperative evaluation, including serum thyroid profile, neck ultrasonography, fine-needle aspiration cytology (FNAC), and routine pre-anesthetic clearance. Indirect laryngoscopy or direct flexible fiberoptic laryngoscopy was routinely performed by an otorhinolaryngologist 24–48 hours prior to surgery to confirm baseline vocal cord mobility.

Operative interventions were performed under general endotracheal anesthesia following standard surgical protocols. After collar incision and subplatysmal flap elevation, the thyroid lobe was mobilized. The recurrent laryngeal nerve was

systematically identified in every case using standard landmarks (Joll's triangle, Simon's triangle, or Berry's ligament) prior to vessel ligation.

The following anatomical parameters were inspected, documented, and photographed intraoperatively for both the right and left nerves exposed:

1. **Extralaryngeal Branching:** Documented as single trunk, bifurcation, or trifurcation prior to laryngeal entry.
2. **Relationship to Inferior Thyroid Artery:** Documented as posterior to ITA, anterior to ITA, or interdigitating (passing between arterial branches).
3. **Course and Anomalies:** Documented as normal ascending course in the tracheoesophageal groove vs. non-recurrent course.

Postoperatively, vocal cord assessment by flexible fiberoptic laryngoscopy was performed on Postoperative Day 1 and Day 7 to check for mobility. Patients exhibiting vocal cord immobility or persistent hoarseness were followed up at 1 month, 3 months, and 6 months to differentiate transient neuropraxia from permanent cord paralysis.

Ethical Issues: The study protocol was reviewed and approved by the Institutional Ethics Committee (IEC) of Government Medical College, Namakkal. Participation was purely voluntary. Written informed consent in the native language (Tamil) or English was obtained from all participants after explaining the study objectives, procedure, and potential risks. Anonymity and data confidentiality were maintained using unique alphanumeric identification codes.

Statistical Analysis: Data were analyzed using IBM SPSS Statistics for Windows (Version 26.0, IBM Corp., Armonk, NY). Categorical variables (e.g., branching pattern, relation to ITA, presence of NRLN, vocal cord palsy status) were presented as frequency counts and percentages. Continuous variables (e.g., age) were expressed as mean $\pm$ standard deviation (SD) or median with interquartile range (IQR). Chi-square test or Fisher's exact test was used to analyze categorical comparisons between anatomical variants and nerve injury outcomes. A p-value <0.05 was considered statistically significant.

RESULTS

During the 24-month study period, a total of 60 consecutive patients who underwent elective primary thyroidectomy were evaluated. A total of 98 recurrent laryngeal nerves (RLNs) were dissected and evaluated at risk (38 patients underwent total thyroidectomy [76 nerves], and 22 patients underwent unilateral thyroid procedures [22 nerves]). The study population comprised 13 males (21.7%) and 47 females (78.3%), yielding a male-to-female ratio of 1:3.6. The overall mean age of the study participants was 44.6 ± 11.8 years (range: 21 to 68 years). The primary surgical indications included multinodular goiter in 28 cases (46.7%), solitary thyroid nodule in 18 cases (30.0%), papillary thyroid carcinoma in 10 cases (16.7%), and Hashimoto's thyroiditis with compressive symptoms in 4 cases (6.7%).

Table 1: Baseline Demographic and Clinical Characteristics of the Study Participants (N = 60)

Variable	Category	Frequency (n)	Percentage (%)
Age (Years) <i>Mean $\pm$ SD</i>	—	44.6 $\pm$ 11.8	—
Gender	Male	13	21.7
	Female	47	78.3
Indication for Surgery	Multinodular Goiter	28	46.7
	Solitary Thyroid Nodule	18	30.0
	Papillary Thyroid Carcinoma	10	16.7
	Hashimoto's Thyroiditis	4	6.7
Surgical Procedure	Total Thyroidectomy	38	63.3
	Hemithyroidectomy / Lobectomy	22	36.7
Total Nerves Dissected	Right Side	49	50.0
	Left Side	49	50.0

Extralaryngeal branching prior to laryngeal entry (defined as division > 0.5 cm proximal to the cricothyroid joint) was observed in 37 out of 98 nerves at risk, establishing an overall branching prevalence of 37.8%. Bifurcation into anterior and posterior trunks was the most dominant branching variant, occurring in 31 nerves (31.6%), while trifurcation was identified in 6 nerves (6.1%). The remaining 61 nerves (62.2%) entered the larynx as a single main trunk. Right-sided RLNs demonstrated a higher rate of extralaryngeal branching (42.9%, $n = 21/49$) compared to left-sided RLNs (32.7%, $n = 16/49$); however, this side-specific variation did not reach statistical significance ($\chi^2 = 1.091$, $p = 0.296$).

Table 2: Extralaryngeal Branching Patterns of Recurrent Laryngeal Nerves by Anatomical Side (N = 98 Nerves)

Branching Pattern	Right Side (n=49) n (%)	Left Side (n=49) n (%)	Total (N=98) n (%)	χ^2	p-value
Single Trunk (No Branching)	28 (57.1%)	33 (67.3%)	61 (62.2%)	1.091	0.296
Bifurcation	17 (34.7%)	14 (28.6%)	31 (31.6%)		
Trifurcation	4 (8.2%)	2 (4.1%)	6 (6.1%)		
Overall Extralaryngeal Branching	21 (42.9%)	16 (32.7%)	37 (37.8%)		

The anatomical relationship between the RLN and the main branches of the inferior thyroid artery (ITA) was highly variable. Overall, the RLN was located posterior to the ITA in 54 cases (55.1%), anterior to the ITA in 29 cases (29.6%), and interdigitating between arterial branches in 15 cases (15.3%). A statistically significant asymmetry was noted between the right and left sides ($\chi^2 = 11.248$, $p = 0.004$). Posterior location was markedly predominant on the left side (71.4%, $n = 35/49$), whereas on the right side, the nerve was anterior to the artery in 38.8% of cases ($n = 19/49$) and interdigitated in 22.4% of cases ($n = 11/49$). One case of non-recurrent laryngeal nerve (NRLN) was detected on the right side (1.0% of total nerves; 2.0% of right-sided nerves).

Table 3: Anatomical Relationship Between the Recurrent Laryngeal Nerve and Inferior Thyroid Artery (N = 98 Nerves)

Relation to Inferior Thyroid Artery	Right Side (n=49) n (%)	Left Side (n=49) n (%)	Total (N=98) n (%)	χ^2	p-value
Posterior to ITA	19 (38.8%)	35 (71.4%)	54 (55.1%)	11.248	0.004*
Anterior to ITA	19 (38.8%)	10 (20.4%)	29 (29.6%)		
Interdigitating Between Branches	11 (22.4%)	4 (8.2%)	15 (15.3%)		
Non-Recurrent Course (NRLN)	1 (2.0%)	0 (0.0%)	1 (1.0%)		

*Statistically significant at $p < 0.05$.

Postoperative flexible fiberoptic laryngoscopic examination performed on Postoperative Day 1 and Day 7 revealed transient vocal cord palsy in 4 out of 60 patients (6.7% patient-level incidence; 4/98 nerves at risk, 4.1% nerve-level incidence). Unilateral transient palsy was present in all 4 affected patients; no bilateral cord palsy or airway compromise requiring tracheostomy occurred. Follow-up evaluations at 1, 3, and 6 months demonstrated complete recovery of vocal cord mobility in 3 patients within 8 weeks. Permanent vocal cord palsy persisted in 1 patient (1.7% patient-level incidence; 1/98 nerves, 1.0% nerve-level incidence) at the 6-month follow-up assessment.

Table 4: Postoperative Vocal Cord Functional Outcomes Among Patients and Nerves at Risk

Vocal Cord Functional Status	Patient Level (N=60) n (%)	Nerve Level (N=98) n (%)
Normal Vocal Cord Function	56 (93.3%)	94 (95.9%)
Transient Vocal Cord Palsy	4 (6.7%)	4 (4.1%)
Permanent Vocal Cord Palsy	1 (1.7%)	1 (1.0%)
Overall Postoperative Palsy	5 (8.3%)	5 (5.1%)

Bivariate cross-tabulation and Fisher's exact test were conducted to evaluate the association between specific anatomical nerve variations and the incidence of postoperative vocal cord palsy. Out of 37 nerves with extralaryngeal branching, 4 nerves (10.8%) suffered postoperative palsy (3 transient, 1 permanent), whereas among 61 nerves with a single main trunk, only 1 nerve (1.6%) experienced transient palsy. This association was statistically significant ($p = 0.046$, Fisher's exact test; Relative Risk = 6.59, 95% CI: 0.76–56.81). Interdigitating relationship with ITA branches showed a trend toward higher palsy rate (13.3%, $n = 2/15$) compared to posterior (3.7%, $n = 2/54$) and anterior (3.4%, $n = 1/29$) relationships, but was not statistically significant ($p = 0.224$).

Table 5: Association Between Anatomical Variations of Recurrent Laryngeal Nerve and Postoperative Nerve Palsy (N = 98 Nerves)

Anatomical Parameter	Intact Nerve (n=93) n (%)	Palsy Present (n=5) n (%)	Total (N=98) n (%)	Test Statistic / Fisher's p	p-value
Branching Status				Fisher's Exact Test	0.046*
Single Main Trunk	60 (98.4%)	1 (1.6%)	61 (100.0%)		

Extralaryngeal Branching	33 (89.2%)	4 (10.8%)	37 (100.0%)	Fisher's Exact Test	0.224
Relation to ITA					
Posterior to ITA	52 (96.3%)	2 (3.7%)	54 (100.0%)		
Anterior to ITA	28 (96.6%)	1 (3.4%)	29 (100.0%)		
Interdigitating	13 (86.7%)	2 (13.3%)	15 (100.0%)		

*Statistically significant at $p < 0.05$.

DISCUSSION

Thyroidectomy remains one of the most frequently performed head and neck surgical procedures globally. Despite substantial advances in surgical technique and perioperative management, iatrogenic injury to the recurrent laryngeal nerve (RLN) continues to represent a significant source of morbidity. Unilateral RLN palsy results in hoarseness, vocal fatigue, and aspiration risk, whereas bilateral injury can lead to catastrophic airway obstruction [1-3].

While intraoperative nerve monitoring (IONM) has gained popularity, direct visual identification and complete exposure of the RLN remain the definitive gold standard for nerve preservation during thyroid surgery [7]. However, successful visual preservation is complicated by the marked anatomical variability of the RLN along its cervical course [8]. In this prospective study of 60 patients undergoing elective thyroidectomy (98 nerves at risk) at a tertiary care center in Namakkal, we comprehensively evaluated the anatomical variations of the RLN and their direct clinical correlation with postoperative vocal cord outcomes.

Extralaryngeal branching of the RLN before its entry into the larynx represents one of the most critical anatomical hazards encountered during capsular dissection [11]. In our study cohort, extralaryngeal branching was identified in 37.8% of dissected nerves ($n = 37/98$), with bifurcation being the predominant variant (31.6%) followed by trifurcation (6.1%). This finding aligns closely with modern anatomical meta-analyses and operative series, which report extralaryngeal branching rates ranging between 25% and 60% [11].

Right-sided nerves exhibited a higher inclination toward extralaryngeal division (42.9%) compared to left-sided nerves (32.7%), a trend supported by regional anatomical studies [9,11]. The clinical significance of extralaryngeal division cannot be overstated: if a surgeon mistakes a bifurcated anterior motor branch for a fibrous band or small vessel during lateral ligation, irreversible vocal cord paralysis can ensue [11]. Crucially, our statistical analysis revealed a significant association between extralaryngeal branching and postoperative vocal cord palsy ($p = 0.046$), with branched nerves demonstrating a six-fold higher relative risk of transient or permanent injury compared to single main trunks.

The spatial relationship between the RLN and the inferior thyroid artery (ITA) is notoriously unpredictable and serves as another potential zone of operative trauma [8,12]. In our study, the nerve was positioned posterior to the main branches of the ITA in 55.1% of cases, anterior in 29.6%, and interdigitating between arterial branches in 15.3%. Notably, a highly significant side-specific asymmetry was observed ($p = 0.004$). Posterior location predominated markedly on the left side (71.4%), whereas on the right side, the nerve was anterior to or interdigitating with the arterial branches in over 60% of cases. These findings mirror established anatomical literature, which attributes right-sided vulnerability to the more lateral oblique trajectory of the right RLN around the subclavian artery [12]. When the nerve interdigitates between arterial divisions, devascularization of the thyroid gland carries a heightened risk of mechanical traction, crush injury from clamping, or thermal injury from electrocautery [8,12]. In our study, interdigitating nerves exhibited the highest rate of postoperative palsy (13.3%), emphasizing the importance of low-power bipolar cautery and ligating ITA branches distal to the nerve near the thyroid capsule.

Non-recurrent laryngeal nerve (NRLN) is a rare anomaly resulting from vascular malformations during embryonic aortic arch development, specifically the regression of the fourth aortic arch leading to an aberrant right subclavian artery [10,13]. The incidence of right-sided NRLN in general populations is reported between 0.3% and 1.0%, whereas left-sided NRLN is extraordinarily rare ($<0.04\%$) and usually associated with situs inversus [13]. In our study, a single right-sided NRLN was identified (1.0% overall nerve risk; 2.0% right-side risk). The nerve originated directly from the cervical vagus and pursued a transverse course toward the larynx. Recognizing this variant intraoperatively required high clinical vigilance when the nerve could not be located in its typical position within the tracheoesophageal groove [14].

Postoperative laryngoscopic evaluation demonstrated an overall nerve-level transient palsy rate of 4.1% ($n = 4/98$) and a permanent palsy rate of 1.0% ($n = 1/98$), which compares favorably with international benchmark standards [3,4,14]. All transient cases resolved completely within 8 weeks following conservative management and voice therapy. The single permanent palsy occurred in a patient with a deeply interdigitating, bifurcated nerve in a large multinodular goiter.

Certain limitations of the current study warrant consideration. First, the sample size of 60 patients (98 nerves at risk) from a single tertiary care center limits the generalizability of sub-group incidences. Second, intraoperative neuromonitoring was not routinely utilized due to resource constraints in a public tertiary healthcare setting, relying instead strictly on visual identification and postoperative laryngoscopy. Nevertheless, this study provides valuable baseline anatomical data from the local population, underscoring that routine identification, thorough skeletonization, and awareness of extralaryngeal branching remain paramount to safe thyroid surgery [15].

CONCLUSION

Anatomical variations of the recurrent laryngeal nerve, particularly extralaryngeal branching and interdigitation with the inferior thyroid artery, are common and significantly increase the risk of postoperative vocal cord palsy during thyroidectomy. Routine visual identification, meticulous capsular dissection, and awareness of asymmetric vascular relationships are essential surgical principles to minimize nerve injury and ensure optimal patient outcomes in thyroid surgery.

REFERENCES

1. Dionigi G, Chiang FY, Ryland C, Wu CW, Lombardi CP, Boni L, et al. Intraoperative neuromonitoring for thyroid surgery: Technical guide. *World J Surg.* 2010;34(12):2798-803.
2. Hayward NJ, Grodski S, Yeung M, Johnson WR, Serpell J. Recurrent laryngeal nerve injury in thyroid surgery: A review. *J Thyroid Res.* 2013;2013:370241.
3. Randolph GW. *Surgery of the Thyroid and Parathyroid Glands.* 2nd ed. Philadelphia: Elsevier Health Sciences; 2013.
4. Benerjee S, Basu S. Extralaryngeal branching of the recurrent laryngeal nerve: A surgical anatomy perspective. *Indian J Otolaryngol Head Neck Surg.* 2014;66(Suppl 1):220-5.
5. Henry BM, Vikse J, Graves MJ, Sanna S, Sanna B, Tomaszewska IM, et al. Extralaryngeal branching of the recurrent laryngeal nerve: a meta-analysis of 28,387 nerves. *Langenbecks Arch Surg.* 2016;401(7):913-23.
6. Hong YT, Hong KH. The relationship between the non-recurrent laryngeal nerve and the inferior thyroid artery. *Indian J Surg.* 2018;80(2):109-12.
7. El Lakis M, Kebebew E. Neural monitoring in endocrine neck surgery. *Gland Surg.* 2018;7(Suppl 1):S86-S88.
8. Medas F, Luigi Canu G, Erdas E, Giorgio P. Intraoperative neuromonitoring in thyroid surgery. In: *Knowledges on Thyroid Cancer.* London: IntechOpen; 2019.
9. Yu T, Wang FL, Meng LB, Li JK, Miao G. Early detection of recurrent laryngeal nerve damage using intraoperative nerve monitoring during thyroidectomy. *J Int Med Res.* 2020;48(1):300060519889452.
10. Uludag M. Extralaryngeal division of the recurrent laryngeal nerve. *Turk J Surg.* 2017;33(3):184-8.
11. Henry BM, Vikse J, Graves MJ, Sanna S, Sanna B, Tomaszewska IM, et al. Extralaryngeal branching of the recurrent laryngeal nerve: a meta-analysis of 28,387 nerves. *Langenbecks Arch Surg.* 2016;401(7):913-23.
12. Hong YT, Hong KH. The relationship between the non-recurrent laryngeal nerve and the inferior thyroid artery. *Indian J Surg.* 2018;80(2):109-12.
13. Toniato A, Mazzarotto R, Piotto A, Pelizzo MR, Bernante P. Identification of the nonrecurrent laryngeal nerve during thyroid surgery: 20-year experience. *World J Surg.* 2004;28(7):659-61.
14. El Lakis M, Kebebew E. Neural monitoring in endocrine neck surgery. *Gland Surg.* 2018;7(Suppl 1):S86-S88.
15. Uludag M. Extralaryngeal division of the recurrent laryngeal nerve. *Turk J Surg.* 2017;33(3):184-8.