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Topographic anatomy of the thyroid gland and recurrent laryngeal nerve in cadavers: A descriptive cross-sectional cadaveric study with surgical relevance.

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Abstract:

Background:
Injury to the recurrent laryngeal nerve (RLN) is a significant complication of thyroid surgery. Due to its variable anatomical course and relationship with the thyroid gland and inferior thyroid artery, thorough anatomical understanding is essential to minimize surgical risk.

Objective:
To evaluate the anatomical variations of the RLN about the thyroid gland and inferior thyroid artery in adult cadavers, with emphasis on surgical relevance.

Methods:
A descriptive study was performed on 20 formalin-fixed adult cadavers (40 heminecks). Bilateral dissections were conducted to assess the RLN's position (in or outside the tracheoesophageal groove), its relationship with the inferior thyroid artery, extra laryngeal branching, and laryngeal entry level. Observations were recorded and analyzed using descriptive statistics.

Results:
The RLN was located within the tracheoesophageal groove in 85% of heminecks. It lay posterior to the inferior thyroid artery in 57.5%, anterior in 25%, and between its branches in 17.5%. Extra laryngeal branching was observed in 12.5%, more often on the right. In 10% of cases, the nerve entered the larynx at a higher-than-usual level. Asymmetry between the right and left sides occurred in 20% of cadavers. No statistically significant side differences were noted ($p > 0.05$).

Conclusion:
The recurrent laryngeal nerve exhibits notable anatomical variations that hold significant surgical relevance. Awareness of these variations is critical for preventing nerve injury during thyroidectomy.

Recommendations:
Surgeons should carefully identify the RLN during dissection, avoid blind ligation near the inferior thyroid artery, use intraoperative nerve monitoring, when possible, integrate cadaveric training in surgical education, and consider preoperative imaging for detecting anatomical variations.

Keywords: *Recurrent laryngeal nerve, Thyroid gland, Inferior thyroid artery, Anatomical variations, Cadaveric study, Tracheoesophageal groove, Extra laryngeal branching, Thyroidectomy*
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Introduction

Thyroidectomy is one of the most frequently performed endocrine procedures, but it carries a significant risk of injury to the recurrent laryngeal nerve (RLN), a key motor nerve that supplies all intrinsic laryngeal muscles except the cricothyroid. Damage to this nerve can result in hoarseness, dysphonia, aspiration, or even life-threatening airway compromise in cases of bilateral injury [1].

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The RLN originates from the vagus nerve and exhibits considerable anatomical variability. On the right side, it typically loops around the subclavian artery, while on the left, it encircles the aortic arch before ascending in the tracheoesophageal groove. However, this expected course is not always observed. The nerve may deviate laterally or medially, and its relationship to the inferior thyroid artery can vary—passing anterior, posterior, or between its branches—which increases the risk of iatrogenic injury during surgery [2]. Additionally, extra laryngeal branching of the RLN occurs in approximately 20–30% of cases, more commonly on the right, complicating its identification and preservation [3]. Rarely, a non-recurrent laryngeal nerve is encountered, typically on the right side, and is usually associated with an aberrant right subclavian artery or other vascular anomalies [4].

Cadaveric dissection remains a critical tool in understanding these variations, particularly in regional populations where anatomical norms may differ due to genetic and ethnic diversity [5]. While intraoperative nerve monitoring (IONM) has been introduced to enhance nerve identification, it is not a substitute for detailed anatomical knowledge and is often unavailable in resource-constrained settings [6].

In India, where IONM is not routinely accessible in many surgical centers, reliance on visual identification of the RLN during thyroid surgery is paramount. Therefore, there is a pressing need for region-specific anatomical studies. This cadaveric study aims to investigate the course, branching pattern, and relationship of the RLN to the thyroid gland and inferior thyroid artery, to enhance surgical safety and reduce the risk of complications.

Materials and Methods

Study Design and Setting

This was a descriptive cross-sectional cadaveric study conducted between January 2024 and February 2025 in the Departments of Anatomy at Kakatiya Medical College, Warangal, Government Medical College, Narsampet, and Government Medical College, Mulugu, Telangana, India.

Sample Size and Selection Criteria

A total of 20 formalin-fixed adult human cadavers (comprising 40 heminecks) were included in the study. Cadavers were selected regardless of sex, provided that the cervical region was intact and free of any gross anatomical deformities, prior surgeries, trauma, or pathological lesions. Cadavers with visible neck pathology or surgical scarring that could obscure anatomical landmarks were excluded from the analysis.

Dissection Procedure

Each cadaver was positioned supine with a slight extension of the neck. A midline vertical skin incision was made from the mentum to the manubrium, complemented by a horizontal incision along the clavicular line. Skin flaps and superficial fascia were reflected to expose the infrahyoid strap muscles, which were retracted to access the thyroid gland and its surrounding neurovascular structures.

Careful dissection was carried out to expose the recurrent laryngeal nerve (RLN) bilaterally, tracing its course from the thoracic inlet to its entry into the larynx. The inferior thyroid artery (ITA) and other adjacent structures such as the trachea, esophagus, and vagus nerve were identified and preserved to ensure accurate relational observations. Special attention was paid to identifying any extra laryngeal branching and the precise point of laryngeal entry of the RLN.

Parameters Studied

The following anatomical parameters were recorded on both sides of each cadaver:

- Course of the RLN: Whether within or outside the tracheoesophageal groove
- Relationship to the inferior thyroid artery: Anterior, posterior, or between branches
- Level of entry into the larynx: High, normal, or low
- Presence of extra laryngeal branching: Number and distribution of branches

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- Bilateral symmetry: Comparison of anatomical features between right and left sides

Each dissection and observation were independently verified by two experienced anatomists to minimize observational bias and increase data reliability.

Data Recording and Statistical Analysis

All data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 25.0. Descriptive statistics were used to summarize categorical variables as frequencies and percentages. The Chi-square test was applied to assess side-to-side differences in nerve positioning and branching patterns. A p-value < 0.05 was considered statistically significant.

Ethical Considerations

Ethical approval for this study was obtained from the Institutional Ethics Committees of Kakatiya Medical College, Warangal. All cadaveric dissections were conducted in compliance with institutional protocols and established ethical guidelines for anatomical research, with full respect and dignity accorded to the human remains used in the study.

Results

The course of the Recurrent Laryngeal Nerve

In the present cadaveric study conducted on 20 adult human cadavers, a total of 40 heminecks were meticulously dissected and examined to evaluate the positional course of the RLN about the tracheoesophageal groove. The RLN was identified coursing within the tracheoesophageal groove in 34 heminecks, accounting for **85%** of the total dissections. This represents the classical anatomical trajectory of the nerve, where it ascends in the protected groove formed between the trachea medially and the esophagus laterally—an orientation that facilitates easier identification and safer dissection during thyroid surgeries. The distribution was symmetrical, with an equal number of nerves (17 on each side) maintaining this intra groove course on both the right and left sides.

In contrast, in the remaining 6 heminecks (**15%**), the RLN was found to deviate from this typical path, running outside the tracheoesophageal groove. These aberrant courses involved the nerve being located anterolaterally or laterally to the trachea, occasionally approaching the lateral border of the thyroid gland. Such variations are clinically significant as they increase the risk of iatrogenic injury during thyroidectomy, especially when the nerve is obscured by enlarged glandular tissue or fibrosis in preoperative cases. Despite these observed variations, comparative analysis using the Chi-square test revealed no statistically significant difference in the positional relationship of the RLN with the tracheoesophageal groove when comparing the right and left sides (**$p > 0.05$**), suggesting that the frequency of these deviations is uniformly distributed bilaterally in this cadaveric sample (Table 1).

Table 1: RLN Course in Relation to Tracheoesophageal Groove

RLN Course	Right Side (n=20)	Left Side (n=20)	Total (n=40)	Percentage (%)	p-value
Within Tracheoesophageal Groove	17	17	34	85.0	> 0.05
Outside Tracheoesophageal Groove	3	3	6	15.0	> 0.05

Relationship of the RLN to the Inferior Thyroid Artery

The anatomical relationship between the RLN and the inferior thyroid artery (ITA) demonstrated notable variation across the examined specimens. In the majority of heminecks (23 out of 40; 57.5%), the RLN was found

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coursing posterior to the ITA, which is considered the most common and surgically favorable anatomical configuration. This posterior course allows for easier visual identification and dissection of the nerve during thyroidectomy and minimizes the risk of accidental injury.

In 10 heminecks (25%), the RLN was observed passing anterior to the ITA, placing it in a more superficial position and thereby increasing its vulnerability during ligation of the artery. This anterior course necessitates greater surgical caution, particularly in patients with enlarged thyroid lobes or fibrosis from previous surgeries.

In the remaining 7 heminecks (17.5%), the nerve was noted to pass between the branches of a bifurcated inferior thyroid artery. This variant, although less common, is clinically significant because the nerve can be concealed between vascular structures and may be inadvertently damaged during vascular ligation or mobilization of the thyroid lobe.

When analyzed side-wise, the distribution of these patterns was relatively symmetrical. On the right side, the nerve passed posterior to the ITA in 12 cases (60%), anterior in 5 cases (25%), and between branches in 3 cases (15%). Similarly, on the left side, posterior positioning was noted in 11 cases (55%), anterior in 5 cases (25%), and between branches in 4 cases (20%). Statistical analysis using the chi-square test revealed no significant difference between the right and left sides in terms of the vascular relationship of the RLN to the ITA ($p = 0.78$), suggesting that the variation in course is not side-dependent in this sample population (Table 2).

Table 2: Relationship of RLN to Inferior Thyroid Artery

RLN-ITA Relationship	Right Side (n=20)	Left Side (n=20)	Total (n=40)	Percentage (%)	p-value
Posterior to ITA	12	11	23	57.5	> 0.05
Anterior to ITA	5	5	10	25.0	> 0.05
Between branches of ITA	3	4	7	17.5	> 0.05

These findings highlight the importance of careful intraoperative dissection around the inferior thyroid artery, as its close relationship to the RLN in various configurations poses a critical risk zone during thyroid surgeries.

Entry Point of the RLN into the Larynx

The point at which the recurrent laryngeal nerve (RLN) enters the larynx is of paramount clinical importance, particularly during surgical dissection in the region of the cricothyroid joint. In the present study, the RLN was observed to enter the larynx at the normal anatomical level of the cricothyroid junction in 36 out of 40 heminecks (90%). This is the classical site where the nerve typically pierces the inferior constrictor muscle and passes beneath the inferior cornu of the thyroid cartilage, a location that allows for consistent intraoperative identification.

However, in 4 heminecks (10%), the RLN was found to enter the larynx at a higher level, i.e., superior to the cricothyroid junction. Among these cases, 3 were noted on the right side and 1 on the left, though this side distribution did not reach statistical significance. The high-entry variant is surgically relevant, as it may increase the risk of nerve injury, especially during mobilization of the superior pole of the thyroid gland or in procedures involving the upper paratracheal region. In such cases, the RLN may traverse a more superficial or oblique path, making it vulnerable to traction or thermal injury.

Importantly, no instances of low-entry RLNs (entry below the cricothyroid junction) were documented in this sample. The absence of this variation is notable, as lower-entry RLNs are more likely to be obscured by inferior thyroid vessels or fibrofatty tissue, further complicating their identification during surgery (Table 3).

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Table 3: Entry Point of RLN into the Larynx

RLN Entry Point	Right Side (n=20)	Left Side (n=20)	Total (n=40)	Percentage (%)	p-value
Normal (Cricothyroid Junction)	18	18	36	90.0	> 0.05
High Entry (Above Cricothyroid Junction)	2	1	3	7.5	> 0.05
Low Entry (Below Cricothyroid Junction)	0	0	0	0.0	NA

These findings reinforce the need for vigilance in the superior aspect of the thyroid bed, as deviations from the expected entry point, although uncommon, may lead to nerve injury if not anticipated during surgical planning or dissection.

Extra laryngeal Branching

One of the notable anatomical variations observed in the present study was the extra laryngeal branching of the RLN. This phenomenon refers to the division of the RLN into two or more branches before it enters the larynx, typically occurring within 1 to 2 cm of its terminal portion. In this study, extra laryngeal bifurcation or trifurcation was identified in 5 out of 40 heminecks, accounting for a prevalence of 12.5% (Table 4).

Table 4: Extralaryngeal Branching of Recurrent Laryngeal Nerve

Branching Pattern	Right Side (n=20)	Left Side (n=20)	Total (n=40)	Percentage (%)	p-value
No Branching	17	18	35	87.5	> 0.05
Bifurcation or Trifurcation	3	2	5	12.5	> 0.05

Among these, 3 instances were recorded on the right side and 2 on the left, indicating a slight predominance on the right, consistent with prior literature suggesting more frequent anatomical variability on the right side due to its embryological course. In all five cases, the branching was observed to occur in close proximity to the laryngeal inlet, ranging from 0.5 to 1.5 cm above the point of entry into the inferior constrictor muscle.

Of particular surgical relevance, the anterior branch was consistently found to be thicker and more prominent than the posterior branch. This morphological observation supports previous electrophysiological studies which have demonstrated that the anterior division carries predominantly motor fibers innervating the intrinsic muscles of the larynx, especially the thyroarytenoid and lateral cricoarytenoid muscles. The posterior branch, being thinner, is presumed to contain mainly sensory fibers or contribute to accessory innervation.

Recognition of extra laryngeal branching is crucial during thyroid and parathyroid surgeries, as inadvertent transection of even one branch—especially the motor-dominant anterior division—can result in postoperative vocal cord dysfunction despite apparent preservation of the main trunk. These findings underscore the importance of meticulous dissection

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near the laryngeal entry point and support the utility of intraoperative nerve monitoring where available.

Anatomical Asymmetry

Anatomical asymmetry between the right and left RLNs was observed in 4 out of the 20 cadavers, accounting for a frequency of 20%. Asymmetry in this context refers to discrepancies in the nerve's course, its relationship to the ITA, and the presence or absence of extra laryngeal branching when comparing the two sides of the same individual (Table 5).

Anatomical Asymmetry of Recurrent Laryngeal Nerve

Anatomical Finding	Number of Cadavers (n=20)	Percentage (%)	Comments
Symmetrical RLN Anatomy	16	80.0	Identical course and relationship on both sides
Asymmetrical RLN Anatomy	4	20.0	Differences in course, arterial relation, or branching pattern
Non-Recurrent Laryngeal Nerve	0	0.0	No cases observed

In these four cadavers, variations included the RLN passing posterior to the ITA on one side and anterior or between the branches on the other, as well as unilateral extra laryngeal bifurcation. Such asymmetry is clinically important because surgeons often rely on the anatomy of one side as a reference during bilateral thyroidectomy procedures. However, these findings reaffirm that the RLN anatomy is not always symmetrical, and assuming similar anatomical patterns on both sides could increase the risk of iatrogenic nerve injury, particularly during reoperations or in cases with distorted anatomy due to goitre, malignancy, or fibrosis.

Notably, throughout the entire sample, no non-recurrent laryngeal nerves (NRLNs) were identified. The absence of this rare but significant anatomical variant—typically found on the right side in association with an aberrant right subclavian artery—suggests a low prevalence in the studied population. Nevertheless, awareness and intraoperative vigilance for NRLNs remain essential, especially when anatomical dissection or preoperative imaging suggests atypical neurovascular configurations.

These findings highlight the necessity of individualized dissection and nerve identification on both sides during thyroid and parathyroid surgery, rather than depending on contralateral anatomical mirroring.

Summary Table: Distribution of RLN Observations (n = 40 Heminecks)

Parameter	Frequency (n)	Percentage (%)
In tracheoesophageal groove	34	85.0
Outside tracheoesophageal groove	6	15.0
Posterior to ITA	23	57.5
Anterior to ITA	10	25.0
Between ITA branches	7	17.5
Normal laryngeal entry	36	90.0
High laryngeal entry	4	10.0
Extralaryngeal branching present	5	12.5
Right-left asymmetry	4	20.0

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Discussion

The recurrent laryngeal nerve (RLN) is a vital structure that must be carefully identified and preserved during thyroid and parathyroid surgeries, given its essential function in phonation and airway protection. Injury to this nerve can lead to significant postoperative morbidity, including hoarseness, aspiration, and, in severe cases, bilateral vocal cord paralysis.

This cadaveric study provides important data on the anatomical variations of the RLN in the Indian population. In 85% of heminecks, the RLN was located within the tracheoesophageal groove, which is consistent with prior studies indicating this as the most common and surgically predictable position [1]. This intragroove course offers a reliable landmark during surgery for nerve identification and preservation. Other studies have also reported that in over 80% of cases, the RLN follows a medial course [7].

In terms of its relationship with the inferior thyroid artery (ITA), the nerve was found to cross posteriorly in 57.5% of heminecks, anteriorly in 25%, and between the arterial branches in 17.5%. These findings are in line with previous research reporting posterior positioning in 55–60% of cases and highlighting the importance of cautious dissection near the ITA to avoid iatrogenic injury [8]. Similar results have been demonstrated in surgical settings where posterior trajectories were reported in over 60% of cases [2].

Extra laryngeal branching was noted in 12.5% of heminecks, which is slightly lower than the generally reported range of 18–30% [9–14]. One cadaveric study from Nepal reported a prevalence of 28%, suggesting that branching patterns may vary based on population characteristics and methodological differences [4]. In all cases in this study, the anterior branch was found to be larger, consistent with reports indicating that this branch predominantly carries motor fibers to the intrinsic muscles of the larynx [6,7]. Failure to identify and protect both branches can result in partial nerve injury, even if the main trunk is preserved.

With respect to the laryngeal entry point, 90% of nerves entered at the cricothyroid junction, while 10% entered at a higher level. These findings are consistent with previous literature reporting high entry in 8–12% of cases [2]. A high entry point can increase the risk of nerve injury during mobilization of the superior pole, emphasizing the need for cautious dissection in this region.

Asymmetry between the right and left RLNs was observed in 20% of cadavers, particularly in their vascular relationships and branching patterns. This aligns with earlier findings that anatomical symmetry between the two sides cannot be assumed, even in the same individual [1,7]. Therefore, nerve identification should be performed independently on each side during surgery.

No non-recurrent laryngeal nerves (NRLNs) were identified in this study. Though rare, this variant—typically observed on the right side and often associated with an aberrant subclavian artery—has been reported in approximately 0.5–1% of cases [3]. Awareness of this possibility remains important, especially when preoperative imaging suggests vascular anomalies.

Although intraoperative nerve monitoring (IONM) has proven effective in reducing RLN injuries, particularly in complex or revision surgeries, it is not a replacement for comprehensive anatomical knowledge. Evidence indicates that IONM is most beneficial when used alongside direct visualization and a sound understanding of anatomical variability [11,13]. International guidelines have also recommended the use of IONM in high-risk thyroid procedures to enhance surgical safety [6,15].

Limitations and Generalizability

While this study provides valuable insights into the anatomical variations of the RLN, several limitations must be acknowledged. First, the sample size was limited to 20 cadavers (40 heminecks), which, although adequate for descriptive anatomical exploration, may not fully represent the broader variability present in the living population. The fixed number of specimens available during the study period restricted the scope for subgroup analysis based on age, sex, or other demographic factors.

Secondly, cadaveric studies inherently lack dynamic physiological factors such as tissue pliability, vascular pulsatility, and the presence of pathological alterations (e.g., goitre, malignancy, or inflammation), which are frequently encountered during live surgical procedures. These factors can significantly influence the visual and tactile

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identification of the RLN during thyroidectomy. Consequently, while cadaveric anatomy provides foundational knowledge, intraoperative conditions may differ.

Additionally, embalming and fixation techniques may alter tissue consistency and anatomical relationships to a minor degree, potentially affecting nerve localization and vascular orientation. Though standard dissection protocols were followed, slight distortions caused by formalin fixation cannot be entirely ruled out.

In terms of generalizability, the findings of this study are most applicable to the adult Indian population, given that all cadavers were sourced from three government medical colleges in Telangana, India. Anatomical variations have been shown to differ among ethnicities and regions; thus, extrapolation of these results to other populations should be done with caution. However, the observed prevalence rates for various RLN relationships and branching patterns closely mirror global trends reported in previous literature, suggesting that the findings are largely consistent with international data.

Future studies incorporating larger, more diverse samples, possibly complemented by radiological imaging or intraoperative correlation, would strengthen the generalizability and clinical applicability of these anatomical observations. Despite its limitations, this study serves as an important regional reference and reinforces the need for cautious and individualized surgical dissection to safeguard the RLN during thyroid procedures.

Conclusion

This cadaveric study provides critical anatomical insights into the RLN and its topographic relationship with the thyroid gland and ITA in the adult Indian population. Through bilateral dissections of 20 cadavers (40 heminecks), several important observations were made that hold direct relevance to thyroid and parathyroid surgery.

The majority of RLNs (85%) were located within the TEG, a finding that reinforces its status as a reliable intraoperative landmark. However, deviations from this classical path in 15% of heminecks underscore the necessity for individualized nerve identification rather than relying solely on expected anatomical norms.

In relation to the ITA, the RLN was found posterior in 57.5%, anterior in 25%, and between the branches in 17.5% of cases. These positional variations, though mostly symmetrical between right and left sides, highlight a region of high surgical risk where blind ligation or traction can result in iatrogenic nerve injury. The study also recorded ELB in 12.5% of heminecks, more frequently on the right side, with the anterior branch consistently larger, suggesting a dominant motor component. Awareness and preservation of all RLN branches are crucial, as injury to even a single motor division can compromise vocal cord function.

Regarding the nerve's laryngeal entry point, 90% of RLNs entered at the cricothyroid junction, with 10% exhibiting a high-entry variant. Although no NRLNs were identified, their possibility should always be considered, especially on the right side when preoperative imaging suggests vascular anomalies.

The presence of anatomical asymmetry in 20% of cadavers further reinforces that contralateral anatomy cannot be assumed to be a mirror image. This necessitates careful, side-specific dissection during bilateral thyroid surgeries.

In summary, the study confirms that while classical descriptions of RLN anatomy apply to a majority of cases, a significant proportion demonstrate variations that, if unrecognized, may lead to serious complications. Thus, meticulous surgical technique, individualized anatomical assessment, and cautious dissection near the ITA and laryngeal entry point are imperative for safe thyroid surgery. The findings also support the integration of anatomical training with IONM wherever feasible, particularly in reoperative or anatomically complex cases. This study serves as a regional anatomical reference and advocates for heightened surgical vigilance to preserve RLN integrity and ensure optimal patient outcomes.

Recommendations

Based on the anatomical variations observed in this cadaveric study, several recommendations can be made to improve the safety of thyroid and neck surgeries. Surgeons should consistently perform individualized identification of the RLN on both sides, rather than relying on assumed symmetry or standard anatomical landmarks alone. Particular caution is advised in regions where the RLN crosses the ITA or approaches the cricothyroid junction, as

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these are common sites of anatomical variability and potential injury. The presence of extralaryngeal branching and high laryngeal entry points further underscores the need for meticulous dissection. Where available, IONM should be integrated, especially in complex or reoperative cases, as it provides real-time feedback on nerve function and can help in preserving motor integrity. Preoperative imaging may be beneficial in identifying high-risk anomalies, such as a non-recurrent laryngeal nerve, particularly when vascular abnormalities are suspected. Surgical training programs should include regular exposure to cadaveric dissections to familiarize trainees with the full spectrum of RLN anatomical patterns. Documenting and reporting intraoperative anatomical variants can contribute to institutional learning and enhance collective surgical awareness. Ultimately, tailoring surgical approaches based on individual anatomy and adhering to cautious, anatomy-informed techniques can significantly reduce the risk of iatrogenic RLN injury and improve postoperative outcomes.

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Abbreviations

RLN – Recurrent Laryngeal Nerve
TG – Thyroid Gland
ITA – Inferior Thyroid Artery
TEG – Tracheoesophageal Groove
TT – Thyroidectomy
II – Iatrogenic Injury
ELB – Extralaryngeal Branching
CTJ – Cricothyroid Junction
HEP – High Entry Point
NRLN – Non-Recurrent Laryngeal Nerve
MP – Motor Predominance
BAA – Bilateral Anatomical Assessment
MD – Meticulous Dissection;
CAK – Comprehensive Anatomical Knowledge
PFSP – Prevention-Focused Surgical Practice
IONM – Intraoperative Nerve Monitoring
INI – Individualized Nerve Identification.

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Conflict of Interest

The authors declare that there is no conflict of interest related to this study.

Author Contributions

AA contributed to the conceptualization and study design, supervised the cadaveric dissections, and provided critical input during manuscript preparation. SR was involved in the anatomical dissections, data collection, and initial drafting of the manuscript. VD as the corresponding author, led the project administration and coordination across institutions, performed comprehensive data analysis and interpretation, conducted the literature review, and finalized the manuscript for submission. She also ensured compliance with ethical standards and was responsible for responding to peer review. All authors reviewed and approved the final manuscript and agree to be accountable for all aspects of the work.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request. All anatomical observations were documented during institutional cadaveric dissection sessions and maintained in departmental records.

Biography

Dr. Ashok Aenumulapalli is a highly qualified academician and researcher in the field of Medical Anatomy, with extensive experience in teaching, research, and

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