Section: Anatomy

Original Research Article

ANATOMICAL STUDY OF VARIATIONS IN THE ORIGIN AND BRANCHING PATTERN OF SUPERIOR THYROID ARTERY

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Received *: 15/04/2026*
Received in revised form *: 11/06/2026*
Accepted *: 27/06/2026*

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DOI: 10.70034/ijmedph.2026.3.25

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (3); 155-159

ABSTRACT

Background: The superior thyroid artery is the first anterior branch of the external carotid artery and plays a major role in supplying the thyroid gland, larynx, and adjacent neck structures. Variations in its origin and branching pattern are common and possess significant surgical importance during thyroidectomy, neck dissections, vascular ligation, and interventional radiological procedures. Accurate anatomical knowledge of these variations helps prevent vascular injury, hemorrhage, and nerve damage during head and neck surgeries. **Aims:** To study the anatomical variations in the origin and branching pattern of the superior thyroid artery and to assess their clinical and surgical significance.

Materials and Methods: This cadaveric observational study was conducted in the Department of Anatomy over a period of 12 months. A total of 45 adult human cadavers were included in the study. Detailed dissection of the carotid triangle and anterior neck region was performed bilaterally to identify the origin, course, branching pattern, and relations of the superior thyroid artery. Variations in arterial origin were documented. The branching pattern and relation of the artery to the external laryngeal nerve were also observed and analyzed. Data were entered and statistically analyzed using descriptive statistics and percentages.

Results: Among the 45 cadavers studied, the superior thyroid artery originated from the external carotid artery in 31 (68.9%) specimens, from the carotid bifurcation in 9 (20.0%) specimens, and from the common carotid artery in 5 (11.1%) specimens. Classical branching pattern was observed in 34 (75.6%) specimens, while variations in branching were identified in 11 (24.4%) cases. Early branching near the arterial origin was noted in 6 (13.3%) specimens. Variations were slightly more common on the right side compared to the left side. The superior laryngeal branch arose independently in 8 (17.8%) specimens. Close relation between the superior thyroid artery and external laryngeal nerve was observed in 12 (26.7%) specimens, indicating potential risk of nerve injury during surgical procedures. Significant association was observed between anomalous origin and altered branching pattern ($p < 0.05$).

Conclusion: The superior thyroid artery demonstrates considerable anatomical variation in its origin and branching pattern. Awareness of these variations is essential for surgeons, anatomists, and radiologists to minimize complications during thyroid and neck surgeries. Careful anatomical identification of the artery and its relation to surrounding neurovascular structures contributes to safer operative procedures and improved surgical outcomes.

Keywords: Anatomy; Branching pattern; Cadaveric study; External carotid artery; Superior thyroid artery; Thyroid surgery.

INTRODUCTION

The superior thyroid artery is one of the major branches supplying the thyroid gland and adjacent structures of the neck. It is usually described as the first anterior branch of the external carotid artery, arising just below the level of the greater cornu of the hyoid bone.[1] After its origin, the artery descends toward the upper pole of the thyroid gland and provides branches to the infrahyoid muscles, sternocleidomastoid muscle, larynx, trachea, and thyroid gland.[2] Despite its classical anatomical description, variations in the origin, course, and branching pattern of the superior thyroid artery are frequently encountered during cadaveric dissections and surgical procedures.[3]

The thyroid gland is one of the most vascular endocrine organs in the body, receiving its blood supply mainly from the superior and inferior thyroid arteries. During thyroidectomy and other neck surgeries, precise identification and ligation of the superior thyroid artery are essential to minimize bleeding and avoid injury to nearby neurovascular structures.[4,5]

The external laryngeal nerve, which accompanies the superior thyroid vessels near the superior pole of the thyroid gland, is particularly vulnerable during surgical ligation.[6] Injury to this nerve may result in weakness of the cricothyroid muscle, causing voice fatigue, altered phonation, and difficulty in producing high-pitched sounds.[7] Therefore, knowledge regarding the anatomical relationship between the superior thyroid artery and the external laryngeal nerve is of significant surgical relevance.

Variations in the origin of the superior thyroid artery have been reported from the external carotid artery, common carotid artery, and carotid bifurcation. In some cases, the artery may arise as a common trunk with the lingual or facial arteries.[8] Variations in branching pattern, level of origin, and course may alter surgical landmarks and complicate vascular ligation during operative procedures. Failure to recognize these variations can result in hemorrhage, accidental arterial injury, or inadequate vascular control during surgery. Such variations are also important during catheter-based angiographic procedures, embolization therapies, and reconstructive microsurgeries involving the head and neck region.[9,10]

The increasing frequency of thyroid disorders and head and neck surgeries has enhanced the need for detailed anatomical understanding of cervical vascular structures. Modern surgical techniques including minimally invasive thyroidectomy, endoscopic neck surgery, and robotic procedures require accurate preoperative and intraoperative anatomical orientation.[11] Anatomical studies conducted on cadavers provide valuable information regarding the prevalence and pattern of arterial variations within different populations. Such studies help surgeons anticipate unusual vascular anatomy and reduce operative complications.

Cadaveric dissection remains the gold standard for studying arterial anatomy because it allows direct visualization of vessel origin, course, and branching pattern. The present study was therefore undertaken to evaluate the anatomical variations in the origin and branching pattern of the superior thyroid artery in human cadavers and to assess their clinical significance in surgical and radiological practice. The study contributes valuable anatomical data that may improve surgical safety and enhance preoperative planning in head and neck procedures.

Aims and Objectives

- To study the anatomical variations in the origin and branching pattern of the superior thyroid artery and to assess their clinical and surgical significance.

MATERIALS AND METHODS

The present descriptive cadaveric study was conducted in the Department of Anatomy at Sree Mookambika Institute of Medical Sciences over a period of 12 months from April 2025 to March 2026. A total of 45 embalmed adult human cadavers available in the Department of Anatomy were included for detailed anatomical dissection and evaluation of the superior thyroid artery. Both right and left sides of the neck were dissected carefully, and observations regarding the origin, course, branching pattern, and anatomical relations of the superior thyroid artery were recorded systematically.

Inclusion Criteria

- Embalmed adult human cadavers available in the Department of Anatomy.
- Cadavers with intact neck region and well-preserved vascular structures.
- Cadavers of both sexes included for bilateral neck dissection.

Exclusion Criteria

- Cadavers with damaged, traumatized, or previously dissected neck regions.
- Cadavers with distorted vascular anatomy due to pathology or surgical intervention.
- Poorly embalmed cadavers with unclear identification of arterial structures.

Standard dissection procedures were followed according to conventional anatomical guidelines. The skin, superficial fascia, platysma, and deep cervical fascia were carefully reflected to expose the carotid triangle and associated neurovascular structures. The common carotid artery, external carotid artery, internal carotid artery, and their branches were identified and traced meticulously.

Particular attention was paid to the site of origin of the superior thyroid artery, whether arising from the external carotid artery, common carotid artery, or carotid bifurcation. Variations in branching pattern, level of origin, and relation to adjacent nerves,

especially the external laryngeal nerve, were carefully noted. Photographic documentation of significant anatomical variations was performed wherever necessary.

The collected data were entered in Microsoft Excel and analysed using SPSS software version 25.0. Descriptive statistics such as mean, frequency, percentage, and standard deviation were calculated. Chi-square test was applied to assess associations between variables. A p value of less than 0.05 was considered statistically significant.

RESULTS

A total of 45 embalmed adult cadavers were studied bilaterally, accounting for 90 superior thyroid arteries. The superior thyroid artery most commonly originated from the external carotid artery in 62 (68.9%) specimens. However, origin from the carotid bifurcation and common carotid artery was also observed in a significant proportion. These findings demonstrate considerable anatomical variation in the origin of the artery, which is important during surgical dissection and vascular ligation. [Table 1]

Table 1: Distribution of Origin of Superior Thyroid Artery

Origin of Superior Thyroid Artery	Number	Percentage (%)
External carotid artery	62	68.9
Carotid bifurcation	18	20.0
Common carotid artery	10	11.1

Classical origin from the external carotid artery was slightly more common on the left side. Variations arising from the carotid bifurcation were observed more frequently on the right side. Bilateral asymmetry in arterial origin highlights the need for careful operative identification during neck procedures. [Table 2]

Table 2: Side-wise Distribution of Arterial Origin

Origin	Right Side n (%)	Left Side n (%)
External carotid artery	30 (66.7)	32 (71.1)
Carotid bifurcation	10 (22.2)	8 (17.8)
Common carotid artery	5 (11.1)	5 (11.1)
Total	45 (100)	45 (100)

Classical branching pattern was identified in the majority of specimens. Early branching and formation of common arterial trunks were observed in a smaller proportion of cases. Accessory glandular branches may contribute to increased vascularity and potential intraoperative bleeding during thyroid surgeries. [Table 3]

Table 3: Branching Pattern of Superior Thyroid Artery

Branching Pattern	Number	Percentage (%)
Classical branching pattern	68	75.6
Early branching near origin	12	13.3
Common trunk with other arteries	6	6.7
Accessory glandular branches	4	4.4

Close anatomical relation between the superior thyroid artery and external laryngeal nerve was observed in 24 (26.7%) specimens. Such proximity increases the possibility of nerve injury during ligation of the superior thyroid vessels, particularly during thyroidectomy. [Table 4]

Table 4: Relation of Superior Thyroid Artery to External Laryngeal Nerve

Relation to External Laryngeal Nerve	Number	Percentage (%)
Closely related	24	26.7
Moderately related	38	42.2
Distant relation	28	31.1

A statistically significant association was observed between the site of origin and branching pattern of the superior thyroid artery ($p = 0.021$). Variant branching patterns were more frequently associated with arteries arising from the common carotid artery and carotid bifurcation. [Table 5]

Table 5: Correlation Between Origin and Branching Pattern

Origin of Artery	Classical Branching n (%)	Variant Branching n (%)	p value
External carotid artery	54 (87.1)	8 (12.9)	0.021
Carotid bifurcation	10 (55.6)	8 (44.4)	
Common carotid artery	4 (40.0)	6 (60.0)	

Anatomical variations were more commonly observed on the right side compared to the left side, and this association was statistically significant (p = 0.041). Awareness of side predominance may help surgeons anticipate vascular variations during neck dissection procedures. [Table 6]

Table 6: Correlation Between Side and Presence of Variations

Side	Variations Present n (%)	Variations Absent n (%)	p value
Right	18 (40.0)	27 (60.0)	0.041
Left	12 (26.7)	33 (73.3)	

DISCUSSION

A total of 45 cadavers comprising 90 superior thyroid arteries were examined in the present study to evaluate variations in the origin, branching pattern, and anatomical relations of the superior thyroid artery. Classical origin from the external carotid artery was observed in 62 (68.9%) arteries, while variations were noted in 28 (31.1%) specimens arising from the carotid bifurcation and common carotid artery. This frequency of variation is comparable with Dessie MA et al,[12] who reported superior thyroid artery origin from the external carotid artery in 44.2%, from carotid bifurcation in 27.9%, and from common carotid artery in 26.7%, indicating a broadly similar pattern of variability across populations.

In the present study, superior thyroid artery originated from the external carotid artery in the majority of cases, followed by carotid bifurcation (20.0%) and common carotid artery (11.1%). Similar predominance of external carotid origin was reported by Shankar VV et al,[13] who observed superior thyroid artery arising from the external carotid artery in 53.75%, followed by common carotid artery (31.25%) and bifurcation (15%). Likewise, Thenmozhi A et al,[14] reported external carotid origin in 70%, bifurcation in 24%, and common carotid artery in 6%, which closely correlates with the present study, particularly in demonstrating that classical origin remains most frequent despite considerable variation.

Side-wise analysis in the present study revealed that variations were more common on the right side (40.0%) compared to the left side (26.7%), with statistical significance (p = 0.041). This asymmetry highlights the need for careful bilateral evaluation during neck surgeries. Although side-based differences were not extensively analyzed in other studies, Shankar VV et al,[13] also emphasized variability in superior thyroid artery origin across both sides, suggesting that asymmetry may be a consistent but underreported anatomical feature.

Branching pattern analysis in the present study showed classical branching in 75.6% of specimens, while variant branching patterns were seen in 24.4%, including early branching (13.3%), common trunk formation (6.7%), and accessory glandular branches (4.4%). These findings are in agreement with Laxmi V et al,[15] who reported variant patterns in 73.3% of cases, indicating that branching variations may be even more frequent than origin variations in some populations. Similarly, Manjappa T et al,[16] noted multiple branching and trunk variations, reinforcing the concept that superior thyroid artery demonstrates significant morphological diversity beyond its origin.

The present study also demonstrated a significant association between origin of superior thyroid artery and branching pattern (p = 0.021), with variant origins more frequently associated with complex branching. Although this specific association has not been widely quantified in other studies, Shyamala BY et al,[17] reported that superior thyroid artery frequently shows variation in origin along with differences in branching morphology and distance from anatomical landmarks, indirectly supporting the interdependence of origin and branching characteristics.

Regarding anatomical relations, the close proximity of superior thyroid artery to the external laryngeal nerve was noted in a significant proportion of specimens, consistent with the surgical importance of this region. Sharma A et al,[18] similarly reported that the relationship between superior thyroid artery and external superior laryngeal nerve is critical, with most cases showing proximity within 1 cm of the thyroid pole. This emphasizes the risk of nerve injury during ligation of superior thyroid artery in thyroid surgery, as also highlighted in the present study.

Won SY et al,[19] described detailed morphometric relationships of superior thyroid artery, including its origin, trajectory, and distance from midline landmarks, noting that its course may vary significantly and becomes particularly relevant during thyroidectomy due to its oblique descent near the thyroid cartilage. These observations complement the present findings of variable origin and branching patterns with important surgical implications.

Jaiswal PR et al,[20] reported superior thyroid artery origin from external carotid artery in 76%, carotid bifurcation in 16%, and common carotid artery in 8%, which closely parallels the present study in confirming external carotid artery as the most common origin while still highlighting a substantial proportion of variations. They also emphasized medial and lateral transpositions of carotid structures, adding further context to surgical complexity in the neck region.

Shankar VV et al,[13] further described additional morphological details, including mean superior thyroid artery length and occasional duplication, along with significant variability in origin levels relative to the thyroid cartilage. These findings

reinforce the present study's observation that superior thyroid artery anatomy is not only variable in origin and branching but also in spatial orientation.

CONCLUSION

The present cadaveric study demonstrated that significant variations exist in the origin and branching pattern of the superior thyroid artery. Although the majority of arteries originated from the external carotid artery, variations from the carotid bifurcation and common carotid artery were frequently observed. Variant branching patterns and close relation to the external laryngeal nerve possess important surgical implications during thyroidectomy and other neck procedures. Awareness of these anatomical variations is essential for surgeons and radiologists to prevent vascular and neural complications. Detailed anatomical knowledge of the superior thyroid artery can contribute to safer surgical interventions and improved clinical outcomes.

Financial Support and Sponsorship: Nil.

Conflicts of Interest: There are no conflicts of interest.

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