„CAROL DAVILA" UNIVERSITY OF MEDICINE AND PHARMACY
BUCHAREST
DOCTORAL SCHOOL
DOMAIN MEDICINE

Anatomical possibilities in the jugular-carotid system

ABSTRACT OF THE PhD THESIS

PhD supervisor
Prof. univ. dr. Rusu Mugurel Constantin

PhD Student
DUMITRU CĂTĂLIN CONSTANTIN

2025

Contents of the PhD Thesis

List of Publications

1. **Dumitru CC**, Hostiuc S, Vrapciu AD, Rusu MC. Vertical Levels of the Occipital Artery Origin. Medicina (Kaunas). 2023 Feb 8;59(2):317. doi: 10.3390/medicina59020317. PMID: 36837517; PMCID: PMC9966296. WOS:000940751200001 FI:2,4 Q1
2. Rusu MC, **Dumitru CC**, Vrapciu AD. The Maxillary Artery Loops Dangerously Approaching the Mandible's Lingula and Inferior Orbital Fissure. J Craniofac Surg. 2024;35(2):e193-e195. doi:10.1097/SCS.0000000000009954 Epub ahead of print. PMID: 38252537. FI:1 Q3 WOS:001177433400041 Q3
3. **Dumitru CC**, Vrapciu AD, Rusu MC. The Diversity of the Linguofacial Trunk. Medicina 2024, 60 (2), 291. https://doi.org/10.3390/medicina60020291 FI:2,4 Q1 WOS:001172712400001
4. **Dumitru CC**, Vrapciu AD, Jianu AM, Hostiuc S, Rusu MC. The retromandibular loop of the external carotid artery. Ann Anat. 2024;253:152226. doi:10.1016/j.aanat.2024.152226 PMID: 38331006. FI: 2 Q2 WOS:001188882300001
5. **Dumitru CC**, Rusu MC, Vrapciu AD. Maxillary Artery Traversing Through the Temporal Muscle. J Craniofac Surg. 2024 Feb 12. 35(3): e273-e274 doi: 10.1097/SCS.0000000000010029. Epub ahead of print. PMID: 38346017. FI: 1 Q3 WOS:001249411000075
6. Rusu MC, **Dumitru CC**, Vrapciu AD. Superior laryngeal artery originating from the lingual artery. Surg Radiol Anat. 2024;46(5):665-668. doi:10.1007/s00276-024-03314-z. PMID: 38413475. FI:1,2 Q3 WOS:001172440700001
7. Tudose RC, Rusu MC, Triantafyllou G, Piagkou M, Moraru L, **Dumitru CC**. Jugular bulb anatomical variations and pneumatization patterns: a comprehensive CBCT analysis. Surg Radiol Anat. 2024;46(7):1001-1013. doi:10.1007/s00276-024-03401-1 FI:1,2 Q3 WOS:001242154300002
8. Rusu MC, **Dumitru CC**, Tudose RC. Aberrant courses of the occipital artery. Surg Radiol Anat. 2025 Apr 30;47(1):135. doi: 10.1007/s00276-025-03650-8. PMID: 40307594. FI:1,2 Q3 WOS:001479683800001

Original Doctoral Research

1. Anatomical variations of the jugular bulb and pneumatization patterns
2. Retromandibular loop of the external carotid artery
3. Anatomical variables of the superior thyroid artery
4. Retropharyngeal course of the superior thyroid artery
5. Anatomical diversity of the linguofacial trunk
6. Vertical levels of occipital artery origin
7. Aberrant courses of the occipital artery
8. Maxillary artery with course through the temporalis muscle
9. At-risk loops of the maxillary artery

1 Jugular bulb anatomical variations and pneumatization patterns: a comprehensive CBCT analysis

1.1 Background and Objectives

The jugular bulb (JB) represents a critical anatomical structure in the cranial venous system, serving as the bridge between the sigmoid sinus and internal jugular vein within the jugular fossa. Located posterolaterally in the pars vascularis region of the jugular foramen, the JB maintains intimate relationships with cranial nerves IX, X, and XI, and connects to the cavernous sinus through the inferior petrosal sinus. While numerous studies have investigated temporal bone pneumatization patterns and anatomical variations of the JB and adjacent veins, research specifically employing cone beam computed tomography (CBCT) to comprehensively assess and classify pneumatization features around the JB and their impact on positioning has been remarkably limited. This study addresses this significant gap in the literature by pioneering the use of CBCT for in-depth examination of JB pneumatization patterns and establishing the first comprehensive classification system for these features. The primary objective was to assess the anatomical possibilities of the jugular bulb, with specific focus on developing a novel classification system for pneumatization patterns around the JB and evaluating their impact on the distance between the internal acoustic canal (IAC) and JB. Secondary objectives included documenting anatomical variations of the JB and establishing baseline measurements for clinical reference.

1.2 Methods

This retrospective study conducted detailed anatomical assessments and measurements on 50 anonymized adult CBCT scans, comprising 35 females and 15 males, equating to 100 analyzable sides. All cases were originally explored for dental medical purposes. Scans were performed using a high-resolution iCat CBCT machine with parameters set to 0.250 resolution, field of view of 130, and image matrix of 640×640. Uncompressed DICOM files were analyzed using Planmeca Romexis Viewer 3.5.0.R software, with multiplanar reconstructions emphasizing coronal and axial anatomical planes. To ensure accuracy and reliability, a combined third-reviewer evaluation method with Cohen's kappa analysis was employed. The Cohen's kappa threshold was set at 0.60 to capture substantial to almost perfect agreement between reviewers. This dual methodology strengthened both individual assessment accuracy and overall integrity of findings. Pneumatization within the perilabyrinthine area was systematically classified according to an adapted version of Allam et al.'s classification system, specifically modified for the region surrounding the JB. The evaluation examined the superior, inferior, lateral, and medial walls of the JB, identifying eight distinctive types of pneumatization: No Pneumatization (NP), Posteromedial Tract (PMT), Deep Petrosal Cell (DPC), Infralabyrinthine Cell (ILC), Hypotympanic Cell (HTC), Hypotympanum (HT), Basi-occipital Cell (BOC), and Accessory Occipital Cell (AOC). Distance measurements focused on the space between the IAC and JB, evaluated both coronally and axially. The axial plane distance was classified into three categories: 0-2.5mm as neutral, 2.5-5mm as slightly anterior, and >5mm as anterior. Anatomical variations including hypoplasia, hyperplasia, dehiscence, and presence of JB diverticula were systematically documented.

1.3 Results

The IAC-JB distance measurements revealed symmetrical distribution with identical means of 7.97mm on both sides. Standard deviations were slightly different, with the right side showing 2.56mm and left side 2.50mm. The range extended from 3.16-13.3mm on the right and 2.9-13.6mm on the left. Two instances of high jugular bulbs were identified with negative IAC-JB distances (-1.75mm right, -1.25mm left). Axial plane positioning analysis revealed 26 neutral positions, 21 slightly anterior, and 3 distinctly anterior cases on the right side. The left side showed 30 neutral positions, 18 slightly anterior, and 2 anterior cases. The Cohen's Kappa test coefficient was 0.917, demonstrating almost perfect agreement between reviewers. Analysis of the lateral wall pneumatization showed predominant presence of Deep Petrosal Cells (DPCs) with 25 cases on the right and 23 on the left. No Pneumatization (NP) was more frequent on the left (11 cases) compared to the right (6 cases). Hypotympanic Cells (HTCs) were found in 9 cases on the right and 7 on the left, while Infralabyrinthine Cells (ILCs) appeared in 2 cases on the right and 6 on the left. Superior wall analysis revealed HTCs as the most frequent finding (23 occurrences right, 19 left), with significant NP presence (11 right, 9 left). The superior wall showed higher frequency of combined cell occurrences compared to other walls, with 7 cases of conjoined pneumatizations. Medial wall results showed NP in all 50 cases on the right and 49 on the left, with only one unique occurrence of AOC on the left. Inferior wall analysis highlighted symmetry in AOC distribution (6 cases each side) with predominant NP occurrence (42 right, 44 left). Statistical analysis using Games-Howell post-hoc tests revealed significant findings regarding pneumatization impact on IAC-JB distance. Cases with Hypotympanum (HT) on the lateral side showed statistically significant average increase of 4.67mm over those with NP ($p=0.015$). In the superior wall, HT demonstrated significant elevation in IAC-JB distance with mean difference of 5.765mm compared to DPC ($p<0.001$), while NP to DPC comparison showed mean decrease of 4.82mm ($p=0.002$). Examination revealed distinct anatomical variations: hypoplasia in 7 instances (7%), hyperplasia in 10 cases (10%), JB diverticula in 8 cases (8%), with 2 instances each of dehiscent JB (2%) and high JB (2%).

2 The Retromandibular Loop of the External Carotid Artery

2.1 Background and Objectives

The external carotid artery (ECA) represents a major vascular structure of the head and neck region, serving as one of the terminal branches of the common carotid artery. While extensive research has focused on the anatomical variations of ECA branches, the morphological variations of the ECA's course itself, particularly in the retromandibular segment, have been largely overlooked in the literature. This study aimed to address this knowledge gap by investigating the morphological possibilities and clinical significance of the retromandibular segment of the ECA.

2.2 Methodology and Classification System

This is a retrospective study analysing 60 computed tomography angiograms from adult patients (29 males and 31 females, ages 56-73, median 69 years). The study employed strict inclusion criteria, requiring patients over 18 years of age with adequate quality angiograms and no pathological processes distorting ECA anatomy. Exclusion criteria included atherosclerotic plaques and degraded or incomplete scans. I developed a novel classification system for retromandibular ECA morphology. Three distinct types were defined based on the relationship between the ECA and the anatomical plane of the mandibular ramus, as follows. Type 1 (Straight Course): The ECA maintains a straight course deep to the anatomical plane of the mandibular ramus, representing the classical anatomical description found in most textbooks. Type 2 (Extended Lateral Loop): The ECA forms a retromandibular loop directed laterally (LRLECA) that extends externally beyond the anatomical plane of the mandibular ramus. Type 3 (Posterior Marginal Loop): The LRLECA reaches just behind the posterior margin of the mandibular ramus without extending beyond the anatomical plane.

2.3 Results and Statistical Analysis

The study analysed 120 sides (bilateral assessment) and revealed significant variations from traditional anatomical descriptions. Contrary to classical teaching that depicts only the straight course (Type 1), this configuration was found in merely 43.33% of cases. Remarkably, 56.67% of cases demonstrated some form of retromandibular loop formation. The distribution showed Type 2 (extended lateral loop) in 18.33% of cases and Type 3 (posterior marginal loop) in 38.33% of cases. Gender-specific analysis revealed statistically significant associations on the right side, where Type 1 was predominantly found in males, while Type 3 was significantly associated with females (Pearson $Chi^2 = 10.9$, $p = 0.004$). No significant associations were observed on the left side. Bilateral symmetry analysis demonstrated considerable variability: 33.33% of cases showed asymmetrical retromandibular ECA courses, 35% exhibited bilateral Type 1, 8.33% showed bilateral Type 2, and 23.33% presented bilateral Type 3. Various combinations of asymmetrical patterns were also documented, highlighting the complexity of ECA morphological variations.

3 Anatomical Variables of the Superior Thyroid Artery

3.1 Background and Objectives

The superior thyroid artery (STA) represents a critical vascular structure in head and neck anatomy, typically originating from the external carotid artery system and maintaining variable relationships with surrounding anatomical landmarks. While previous anatomical studies have extensively documented variations in the carotid origin of the STA, the variable topography related to the greater horn of the hyoid bone (GHHB) has been largely overlooked in contemporary literature. Understanding these topographical relationships carries significant implications for surgical planning, particularly in thyroid surgery, neck dissection procedures, and interventional radiology applications. This study aimed to systematically determine the topographic variants of the STA in relation to the GHHB and artery of origin, while establishing patterns of bilateral symmetry or asymmetry in these anatomical configurations.

3.2 Methods

This retrospective anatomical study analyzed 85 archived computed tomography angiography cases from adult patients, comprising 53 males and 32 females with a mean age of 68±12 years. All scans were acquired between June and December 2024 at a tertiary academic medical centre, following standardized imaging protocols with careful patient positioning and image alignment. The origins of STAs were classified into three primary types based on carotid system origin: Type A (common carotid artery origin), Type B (carotid bifurcation origin), and Type C (external carotid artery origin). Vertical topographic relationships relative to the GHHB were systematically categorized as Type 1 (infrahyoid origin), Type 2 (hyoid level origin), and Type 3 (suprahyoid origin). Additional subtypes were established based on the arterial course relative to the GHHB: subtype "a" (lateral course), subtype "b" (medial course), and subtype "c" (posterior course). Unilateral combination types and bilateral associations were documented and analyzed using comprehensive statistical methods including regression analysis and ANOVA testing.

3.3 Results

Analysis of 170 carotid axes revealed distinct patterns in STA origins and topographic relationships. Carotid system origins demonstrated Type A (CCA) in 8.82% of cases, Type B (CB) in 28.82%, and Type C (ECA) in 60% of cases, with complete absence of the STA observed in 2.35% of specimens. Hyoid-related topographic analysis showed infrahyoid Type 1 origins in 47.06% of cases, representing the most common configuration. Hyoid-level Type 2 origins occurred in 25.89% of cases, distributed as Type 2a (20.59%), Type 2b (0.59%), and Type 2c (4.71%). Suprahyoid Type 3 origins were identified in 24.71% of cases, with Type 3a accounting for 21.18%, Type 3b showing 0% prevalence, and Type 3c occurring in 3.53% of cases.

Thirteen distinct unilateral combination types were identified, with the most prevalent being C1 (infrahyoid ECA origin, 27.71%), C3a (suprahyoid ECA origin with lateral course, 17.47%), and B1 (infrahyoid CB origin, 15.66%). The study established thirty-seven different bilateral associations of unilateral combination types, revealing a predominance of asymmetrical patterns. Asymmetrical bilateral associations prevailed in 61.18% of cases compared to 38.82% showing symmetrical configurations. The most common bilateral associations were C1-C1 (bilateral infrahyoid ECA origins, 15.29%), C3a-C3a (bilateral suprahyoid ECA origins with lateral courses, 10.58%), and C1-B1 (asymmetric infrahyoid origins from ECA and CB respectively, 9.41%).

Statistical analysis demonstrated that hyoid-related topographic types were significantly influenced by carotid origin patterns ($p<0.05$), while gender did not significantly impact the observed anatomical variations ($p>0.05$). One notable case revealed hyoid bone collapse over the thyroid cartilage, representing a rare anatomical variant with potential clinical implications.

4 Retropharyngeal course of the superior thyroid artery - a novel finding

4.1 Background and Significance

The superior thyroid artery (STA) represents the primary vascular supply to the thyroid gland and plays a crucial role in the vascularization of this vital anatomical region. In conventional anatomy, the STA originates from the external carotid artery (ECA) and follows a descending course on the inferior pharyngeal constrictor muscle to reach the thyroid lobe. According to previous studies, the STA may also originate from the common carotid artery or carotid bifurcation, but always with a predictable and well-defined anatomical course. The anatomical variability of the STA has been extensively studied in the specialized literature, documenting multiple types of origin and branching configurations. However, a retropharyngeal course of the STA has never been reported in medical literature, making this discovery an absolute first in the field of cervical vascular anatomy. The retropharyngeal space is classically considered a region that does not contain major arteries, with the notable exception being represented by deviated courses of the internal carotid artery in certain rare anatomical variants.

4.2 Case Presentation

This study presents the first documentation of a bilateral retropharyngeal course of the superior thyroid artery, discovered during retrospective analysis of angioCT data from a 56-year-old adult male. The scan was adequate and no pathological processes were identified that could distort the cervical vascular anatomy, confirming that this variation represents an authentic congenital anatomical configuration. Both STAs initially coursed on the posterior walls of the pyriform recesses of the pharynx at the level of the C5-C6 cervical vertebrae, representing a completely novel and unprecedented anatomical configuration in the specialized literature.

5 The Diversity of the Linguofacial Trunk

5.1 Background and Objectives

The external carotid artery (ECA) represents one of the most anatomically variable arterial systems in the human body, with significant implications for surgical planning and clinical practice. In typical anatomical configurations, the ECA gives rise to distinctive collateral branches in a predictable sequence: the superior thyroid artery (STA), lingual artery (LA), facial artery (FA), ascending pharyngeal artery (APA), occipital artery (OA), and posterior auricular artery (PAA). However, anatomical variations are common, with successive arteries frequently departing from the ECA as common trunks rather than individual vessels. These common trunk formations include several well-documented variants: thyrolinguofacial trunks, thyrolingual trunks, thyrolinguolaryngeal trunks, linguofacial trunks (LFT), and occipitoauricular trunks. Among these variations, the linguofacial trunk—representing a common origin of the lingual and facial arteries—has received considerable attention in anatomical literature, yet remains poorly characterized in terms of its morphological diversity and topographical relationships.

Knowledge of ECA branching pattern variations is essential for surgeons operating in the neck region, as surgical planning and execution depend entirely on understanding the anatomical pattern of vascular structures. The linguofacial trunk, while commonly reported as a unique anatomical variant, has typically been studied only in terms of its prevalence, with most authors simply documenting its presence without detailed morphological analysis. This approach fails to capture the individual anatomical possibilities and variations that characterize this important vascular structure.

Previous studies have reported LFT prevalence ranging from 3.33% to 44.7%, with significant variation attributable to differences in study methodology, population characteristics, and classification criteria. However, the morphometric characteristics and detailed topographical relationships of the LFT have been rarely described in comprehensive detail. This gap in knowledge represents a significant limitation for surgical planning, as the morphology and topography of the LFT should be considered individually specific rather than conforming to a single anatomical pattern.

The present study was therefore designed to address this knowledge gap by demonstrating, on a case-by-case basis, the individual anatomical possibilities of the linguofacial trunk. Our primary objectives included establishing the incidence of LFT in our study population, characterizing the heterogeneous morphological possibilities, and providing detailed topographical analysis that would be clinically relevant for surgical planning.

5.2 Materials and Methods

This retrospective anatomical study utilized 150 archived computed tomography angiography (angioCT) files obtained from clinical imaging databases. The selection process employed strict inclusion and exclusion criteria to ensure data quality and anatomical integrity. Inclusion criteria comprised subjects over 18 years of age, adequate scan quality suitable for detailed vascular analysis, and absence of pathological processes that might distort normal neck anatomy. Exclusion criteria included pathological processes affecting arterial anatomy, degraded image quality that precluded accurate measurement, and incomplete scan coverage of the relevant anatomical region.

Following application of these criteria, 147 files were retained for analysis, representing 86 male and 61 female subjects. This sample size provided adequate statistical power for analyzing anatomical variations while maintaining demographic diversity representative of the general population.

Image analysis was performed using Horos 4.0.1 for Apple Silicon software, following established protocols from previous anatomical studies. Two independent observers documented anatomical variants to ensure reliability and minimize observer bias.

Multiple variables of LFT anatomy were systematically tracked and classified. The vertical topography of LFT origin from the ECA was categorized into types 1-3: Type 1 represented origins superior to the hyoid bone, with subclassifications including subtype 1a (inferior to gonial angle), subtype 1b (at gonial level), and subtype 1c (superior to gonial angle). Type 2 indicated LFT origin at the level of the hyoid bone, while Type 3 represented infrahyoid origins.

The initial course direction of the LFT was classified into three types: Type I (ascending course), Type II (descending course), and Type III (transverse course). Loop orientation analysis categorized the first loop of the LFT as superior (S), inferior (I), medial (M), anterior (A), posterior (P), or no loop (NL). The position of the LFT relative to the parent ECA was systematically documented as medial, anterior, or antero-medial. Finally, general LFT morphology was categorized as rectilinear (R), exhibiting general loops (L), or demonstrating arterial coiling (C).

5.3 Results

The analysis of 147 cases revealed linguofacial trunks in 34 subjects (23.12%), with a relatively balanced gender distribution of 16 males and 18 females. This prevalence falls within the upper range of previously reported values, suggesting potential population-specific variations or methodological differences in detection and classification.

The bilateral presentation of LFTs occurred in 13 cases (38.24% of LFT cases), involving 6 males and 7 females, indicating no significant gender predilection for bilateral occurrence. Unilateral left LFTs were identified in 13 cases (7 males, 6 females), representing 38.24% of LFT cases. Unilateral right LFTs occurred in 8 cases (3 males, 5 females), accounting for 23.53% of LFT presentations. The slight predominance of left-sided occurrence aligns with some previous reports, though the clinical significance of this laterality preference remains unclear.

A total of 47 individual LFTs were identified and subjected to detailed morphological analysis. The vertical topography analysis revealed significant variation in origin levels relative to anatomical landmarks. Type 1a origins (suprahyoid and infragonial) predominated, occurring in 28 LFTs (59.57%), establishing this as the most common topographical variant. Type 1b origins (suprahyoid and gonial) were found in 8 LFTs (17.02%), while type 2 origins (hyoid level) also occurred in 8 LFTs (17.02%). Type 1c origins (suprahyoid and supragonial) were identified in only 2 LFTs (4.25%), and type 3 origins (infrahyoid) represented the rarest variant with just 1 LFT (2.12%).

Analysis of initial course direction demonstrated considerable diversity in LFT trajectories. Type I (ascending) courses were most frequent, occurring in 22 of 47 LFTs (46.8%). Type III (transverse) courses were identified in 13 LFTs (27.65%), while Type II (descending) courses occurred in 12 LFTs (25.53%). This distribution suggests that while ascending courses are most common, significant proportions of LFTs follow alternative trajectories that must be considered during surgical planning.

Loop orientation analysis revealed that 23 of 47 LFTs (48.9%) demonstrated no initial loop, following relatively straight courses from their origins. Among those exhibiting loops, medial orientation was most common (9 LFTs), followed by equal frequencies of superior and inferior orientations (5 LFTs each). Anterior loops occurred in 4 LFTs, while posterior loops were rare (1 LFT). This diversity in loop patterns has significant implications for surgical access and vascular control procedures.

The positional relationship between LFTs and their parent ECAs showed considerable variation. Antero-medial positioning was most frequent (22 of 47 LFTs), followed by anterior positioning (12 LFTs) and medial positioning (10 LFTs). Less common positions included inferior (2 LFTs) and lateral (1 LFT) orientations. This positional diversity affects surgical exposure and the risk of inadvertent vascular injury during neck procedures.

General morphological analysis demonstrated that 23 of 47 LFTs (48.9%) followed rectilinear courses, while 22 LFTs (46.8%) exhibited various loop configurations. Arterial coiling, representing the most complex morphological variant, occurred in only 2 cases (4.3%). The near-equal distribution between rectilinear and looped morphologies emphasizes the unpredictable nature of LFT anatomy.

Detailed case-by-case analysis revealed numerous unique anatomical configurations that defy simple classification schemes. Notable examples included retropharyngeal LFT courses, complex interactions with ossified stylohyoid chains, and unusual relationships with surrounding anatomical structures. These individual variations underscore the importance of preoperative imaging analysis for surgical planning.

6 Vertical Levels of the Occipital Artery Origin

6.1 Background and Objectives

The occipital artery (OA) represents a critical posterior branch of the external carotid artery (ECA) system with significant implications for neurosurgery, vascular surgery, and reconstructive procedures. Despite its clinical importance, anatomical literature provides inconsistent descriptions regarding the vertical level of OA origin, with various textbooks and atlases depicting different relationships to anatomical landmarks. Traditional anatomical teaching commonly references the OA origin to a single landmark, typically at the level of the facial artery or posterior belly of the digastric muscle. However, clinical observations suggest greater variability than previously recognized. This study hypothesized that the OA origin demonstrates significant vertical topographic variation relative to osseous landmarks, specifically the hyoid bone and gonial angle, necessitating systematic documentation for surgical planning and clinical applications.

6.2 Materials and Methods

A retrospective analysis was conducted using 100 randomly selected archived computed tomography angiograms from adult patients. Following application of strict inclusion criteria (age >18 years, adequate image quality, absence of pathological processes affecting carotid anatomy) and exclusion criteria (pathological arterial distortion, degraded scans), 90 cases were retained for analysis, comprising 53 males and 37 females. Bilateral evaluation yielded 180 individual OA determinations. A novel six-type classification system was developed based on vertical topographic patterns relative to osseous landmarks: Type 1 (infrahyoid level), Type 2 (hyoid level at greater horn tip), Type 3 (infragonial level), Type 4 (gonial level at mandibular angle), Type 5 (supragonial level), and Type 6 (internal carotid artery origin). Statistical analysis employed Pearson Chi-square tests to evaluate bilateral symmetry patterns and gender associations, utilizing IBM SPSS software for comprehensive data analysis.

6.3 Results

The study revealed remarkable variability in OA origin patterns across the 180 arterial origins examined. Type 3 (infragonial) origin emerged as the most common variant, occurring in

40.56% of cases, followed by Type 4 (gonial) at 28.33% and Type 5 (supragonial) at 23.33%. Type 2 (hyoid level) accounted for 5.56% of cases, while both Type 1 (infrahyoid) and Type 6 (ICA origin) represented rare variants at 1.11% each. Statistical analysis demonstrated significant bilateral association between left and right OA origins (Pearson $Chi^2 = 59.18$, $p < 0.001$), indicating strong symmetrical tendencies. However, bilateral symmetry was observed in only 56.67% of cases, with 43.33% demonstrating asymmetrical patterns. Gender analysis revealed no statistically significant associations between sex and OA origin patterns on either side ($p > 0.05$). Notably, more than 50% of OA origins occurred at or above the gonial level (Types 4 and 5 combined), representing supradigastric locations that challenge traditional surgical approaches relying on infradigastric identification.

7 Aberrant courses of the occipital artery: Novel anatomical variations with clinical implications

7.1 Background and Objectives

The occipital artery (OA) represents a major branch of the external carotid artery system, typically arising at the level of the posterior belly of the digastric muscle and following a predictable anatomical course deep to this muscle as it ascends toward the mastoid process and occipital region. Under normal circumstances, the OA crosses superficially over the internal jugular vein during its ascent, maintaining consistent topographical relationships that serve as reliable surgical landmarks. While previous anatomical studies have documented variations in the vertical level of origin from the external carotid artery, with approximately 23% of cases demonstrating origins above the gonial angle, aberrant courses deviating from the standard trajectory have not been previously reported in the medical literature. The occipital artery's clinical significance extends beyond its role in scalp vascularization, as it serves as a crucial vessel for therapeutic embolization procedures, extra-to-intracranial bypass operations, and represents a potential site for vascular complications during neck surgery. Given the increasing complexity of head and neck surgical procedures and the growing utilization of endovascular interventions, comprehensive understanding of anatomical variations becomes paramount for preventing inadvertent complications and optimizing therapeutic outcomes.

7.2 Methods

This retrospective study involved systematic analysis of 150 archived computed tomography angiograms, from which four cases demonstrating previously unreported aberrant courses of the OA were identified and selected for detailed examination. The patient cohort comprised three female and one male individual, with ages ranging from 57 to 66 years. All angiographic examinations were performed using a 32-slice multi-detector CT scanner with standardized protocols including 0.6mm collimation and 0.75mm reconstruction thickness with 50% overlap to ensure optimal spatial resolution for multiplanar maximum intensity projection reconstructions. The original clinical indications for these angiographic studies were unrelated to thyroid, neck, or cervical vascular pathology, most commonly involving evaluation or follow-up of cerebral vascular conditions. High-quality angiographic datasets provided complete opacification of carotid arteries and their branches with comprehensive coverage of the head and neck region. Importantly, none of the cases demonstrated pathological conditions that could potentially distort normal carotid anatomy. Image analysis was conducted using specialized software with both two-dimensional reconstructions and three-dimensional volume renderings to ensure accurate anatomical assessment. Multiple experienced reviewers independently evaluated the angiographic findings, with discrepancies resolved through consensus review by the most senior investigator.

7.3 Results

Analysis revealed two distinct patterns of aberrant OA courses, each with unique anatomical characteristics and potential clinical implications. The first variant, observed in two female patients aged 57 and 61 years, demonstrated aberrant medial courses relative to the internal jugular vein rather than the typical superficial trajectory. In the initial case, the left internal jugular vein appeared compressed against the atlas transverse process and styloid process, with the left carotid bifurcation positioned 0.76cm below the greater hyoid horn. The OA originated from the posterior aspect of the external carotid artery at 1.75cm superior to the greater hyoid horn, ascended 3.23cm while crossing the internal carotid artery laterally, reached the styloid process, then turned posteriorly to cross medially relative to the internal jugular vein. At the level of the atlas transverse process, the internal jugular vein was flanked by the OA medially and the posterior auricular artery laterally. In the second case, despite absence of internal jugular vein compression, the OA demonstrated similar aberrant medial positioning, crossing over the internal carotid artery before continuing posterosuperiorly on the medial side of the internal jugular vein.

The second variant type involved retromandibular courses deep within the parotid glands. In a 66-year-old male, bilateral aberrant retromandibular courses were identified, with both occipital arteries demonstrating lateral retromandibular loops originating from the external carotid arteries at the midheight of the mandibular ramus and coursing through superior loops deep to the parotid glands. The final case involved a 57-year-old female with unilateral right-sided variation, where the external carotid artery entered the parotid space and divided into maxillary and superficial temporal arteries at 0.58cm above the gonial angle. Subsequently, the superficial temporal artery gave rise to a common occipitoauricular trunk measuring 0.86cm in length, which reached the lateral aspect of the styloid process tip before dividing into the OA and posterior auricular artery.

8 Maxillary Artery Traversing Through the Temporal Muscle

8.1 Background and Rationale

The maxillary artery (MA) is a terminal branch of the external carotid artery that typically courses through the infratemporal and pterygopalatine fossae. While anatomical variations in the relationship between the MA and lateral pterygoid muscle have been well-documented, with the artery described as passing either superficial (lateral) or deep (medial) to this muscle, variations involving the temporalis muscle (TM) have received limited attention in the literature.

Previous dissection studies have sporadically reported the unusual course of the MA through the temporalis muscle, but these reports have been infrequent and inconsistent. A historical dissection study by Lurje identified this variant in only 4 out of 200 dissected sides (2% prevalence). However, this anatomical variant has not been systematically studied using modern imaging techniques, creating a significant gap in our understanding of its true prevalence and clinical implications.

8.2 Objectives

The primary objective of this study was to determine the actual prevalence of the maxillary artery coursing through the temporalis muscle using computed tomography angiography (CTA). Secondary objectives included characterizing the anatomical features of this variant and discussing its clinical implications for surgical procedures involving either the temporalis muscle or maxillary artery.

8.3 Methodology

This retrospective observational study analyzed 170 archived computed tomography angiograms from patients aged 54-74 years (median: 68 years), comprising 95 males and 75 females. All subjects provided informed consent, and the study received institutional approval. Inclusion criteria encompassed patients above 18 years of age with adequate angiogram quality and absence of pathological processes that could distort MA anatomy. Exclusion criteria included pathological processes affecting arterial anatomy and degraded or incomplete scans.

8.4 Results

The study revealed a significantly higher prevalence of the MA coursing through the temporalis muscle than previously reported. The variant was identified in 11 out of 170 cases (6.47% of patients), affecting 16 out of 340 sides examined (5.58% of sides). The higher per-patient percentage reflects the bilateral presentation of this variant in 5 of the 11 affected cases. Male patients (n=7): 3 cases showed right-sided involvement, 1 case left-sided involvement, and 3 cases bilateral involvement. Female patients (n=4): 2 cases showed left-sided involvement, and 2 cases showed bilateral involvement. In all identified cases, the MA was positioned superficial (lateral) to the lateral pterygoid muscle while traversing through the temporal muscle internal to the coronoid process. This consistent pattern suggests a specific developmental pathway for this anatomical variant.

9 The Maxillary Artery Loops Dangerously Approaching the Mandible's Lingula and Inferior Orbital Fissure

9.1 Introduction and Anatomical Background

The maxillary artery (MA) represents one of the two terminal branches of the external carotid artery, alongside the superficial temporal artery. This vessel plays a crucial role in supplying blood to the deep facial structures, including the masticatory muscles, nasal cavity, maxillary sinus, and portions of the oral cavity. Under normal anatomical conditions, the MA follows a predictable antero-superior course through the infratemporal fossa, typically passing either lateral or medial to the inferior bundle of the lateral pterygoid muscle before reaching the pterygopalatine fossa. The standard anatomical pathway of the MA is well-documented in medical literature, with the artery maintaining a relatively straight course with minimal tortuosity. However, anatomical variations in arterial pathways can occur, potentially creating significant clinical challenges for surgeons and dental practitioners. The proximity of the MA to critical anatomical landmarks, particularly the mandibular lingula (spine of Spix) and the mandibular foramen, makes understanding these variations essential for safe clinical practice. The mandibular lingula serves as a crucial anatomical landmark for inferior alveolar nerve blocks, one of the most commonly performed regional anesthetic procedures in dentistry. Additionally, surgical procedures involving the mandibular ramus, including orthognathic surgeries and trauma repairs, rely on predictable vascular anatomy to minimize complications. When arterial variations occur, they can significantly increase the risk of hemorrhage during routine procedures.

9.2 Case Presentation and Methodology

This case report describes a rare anatomical variant documented through retrospective analysis of computed tomography angiography (CTA) in a 68-year-old male patient.

The patient's CTA revealed extraordinary tortuosities of the left maxillary artery that deviated dramatically from normal anatomical patterns. The study methodology followed established ethical guidelines, with appropriate institutional approval and patient consent for research use of the anonymized imaging data. The analysis utilized specialized medical imaging software (Horos for iOS) to examine both two-dimensional planar reconstructions and three-dimensional volume renderings.

The right-sided anatomy in the same patient demonstrated normal MA course, providing an internal control and highlighting the unilateral nature of this anatomical variation. This bilateral comparison enhanced the clinical significance of the findings and provided valuable insight into the rarity of such extreme arterial loops.

9.3 Anatomical Findings and Measurements

The left MA demonstrated two distinct and clinically significant loops that represented extreme deviations from normal anatomy. The first loop was characterized as a large inferior sagittal loop that descended into the pterygomandibular space and made direct contact with the inner cortical surface of the mandibular ramus. This inferior loop reached a remarkable 1.66 cm below the mandibular notch, positioning it dangerously close to the mandibular foramen and directly against the mandibular lingula. Critical measurements revealed the loop's position at 0.58 cm internal to the sulcus colli and only 0.5 cm superior to the mandibular foramen. This positioning placed the artery in direct contact with the spine of Spix, creating a high-risk scenario for bleeding during inferior alveolar nerve blocks. The proximity to this critical landmark represents a significant departure from normal anatomy, where the MA typically maintains a safe distance from these structures. Following its inferior descent, the MA continued with an ascending segment that coursed superficial to the inferior head of the lateral pterygoid muscle. The vessel then curved medially between the two heads of this muscle to reach the pterygomaxillary suture, demonstrating the complex three-dimensional pathway created by this anatomical variation. The second notable finding was a superior coronal loop that developed after the artery's passage through the pterygomaxillary region. This superior loop was applied directly against the posterior wall of the maxillary sinus and extended to reach the inferior orbital fissure. This positioning created additional surgical risks for procedures involving the posterior maxilla and orbital floor approaches. In contrast, the contralateral right MA demonstrated normal anatomy, coursing superficially to the lateral pterygoid muscle and maintaining a safe distance of 0.69 cm from the spine of Spix. This bilateral comparison emphasized the unilateral and extreme nature of the left-sided variation.

10 Key contributions and conclusions from anatomical studies

10.1 Jugular bulb anatomical variations and pneumatization patterns

10.1.1 Key contributions

This study established the first comprehensive CBCT-based classification system for JB pneumatization patterns. It identified eight distinct types of pneumatization around the jugular bulb. It established statistical relationships between pneumatization patterns and IAC-JB distance. Cohen's Kappa coefficient of 0.917 demonstrating almost perfect inter-observer agreement.

10.1.2 Conclusions regarding the variables of the jugular bulb

This study establishes the first comprehensive CBCT-based classification of JB pneumatization patterns, identifying eight distinct types with significant clinical implications. The finding that specific pneumatization patterns, particularly hypotympanic configurations, substantially alter IAC-JB spatial relationships provides crucial information for surgical planning. The novel classification system offers standardized terminology for describing these variations, facilitating improved communication between radiologists and surgeons. The documented prevalence of anatomical variations emphasizes the importance of individualized preoperative assessment rather than relying on standard anatomical assumptions. CBCT proves to be a valuable tool for detailed preoperative evaluation of JB anatomy, enabling identification of variations that could significantly impact surgical approach and outcomes. These findings advocate for routine preoperative imaging assessment of JB anatomy in patients undergoing lateral skull base surgery, with particular attention to pneumatization patterns that may alter standard anatomical relationships. The integration of this classification system into clinical practice promises to enhance surgical safety and outcomes in otolaryngology and neurotologic procedures. The establishment of this evidence-based classification system represents a significant advancement in understanding temporal bone anatomy around the jugular bulb, providing foundation for future research and clinical applications in skull base surgery.

10.2 The retromandibular loop of the external carotid artery

10.2.1 Key contributions

This is the first systematic study of ECA retromandibular segment morphology using CT angiography. It resulted a novel three-type classification system for retromandibular ECA morphology that challenges the traditional anatomical teaching that describes only straight ECA courses.

10.2.2 Conclusions

This pioneering study revealed that retromandibular ECA loops represent a common anatomical variation that has been consistently overlooked in previous literature and clinical practice. With only 43.33% of cases showing the traditionally described straight course, the majority of patients exhibit some form of loop formation that could impact surgical procedures. The identification of three distinct morphological types, with significant gender associations on the right side, provides a framework for understanding and predicting ECA anatomical variations. The clinical implications are particularly relevant for head and neck surgeons performing parotid procedures, where unexpected vascular anatomy could lead to complications. It is strongly recommended preoperative imaging assessment on a case-by-case basis to identify retromandibular ECA variations before parotid surgery. This approach could enhance surgical safety, improve procedural planning, and potentially reduce complications associated with unexpected vascular anatomy.

10.3 Anatomical variables of the superior thyroid artery

10.3.1 Key contributions

This research is a comprehensive analysis of 170 carotid axes documenting STA origins and topographic relationships. It established 13 distinct unilateral combination types and 37 bilateral associations. The statistical analysis showed hyoid-related topographic types significantly influenced by carotid origin patterns.

10.3.2 Conclusions

This comprehensive study establishes that while the carotid origin of the STA follows relatively predictable patterns, the vertical topography and course relative to the GHHB demonstrate remarkable variability that is largely unpredictable. These findings have substantial implications for surgical practice, as the STA traditionally serves as an important landmark for identifying the external branch of the superior laryngeal nerve during thyroid surgery. The high prevalence of suprahyoid origins and aberrant courses may compromise the reliability of conventional anatomical landmarks during surgical procedures. The documented bilateral asymmetry patterns underscore the importance of individual preoperative imaging assessment rather than relying on assumed bilateral symmetry. The GHHB emerges as a potentially valuable anatomical reference point for STA identification and surgical planning. The rare but clinically significant absence of the STA (2.35%) necessitates awareness among surgeons performing thyroid and neck procedures. These findings advocate for routine preoperative angiographic evaluation in complex cervical surgical cases and highlight the need for individualized surgical approaches based on patient-specific anatomical variations. The establishment of this comprehensive classification system provides a foundation for future research and clinical applications in head and neck surgery, interventional radiology, and anatomical education.

10.4 Retropharyngeal course of the superior thyroid artery

10.4.1 Key contributions

This is the first documentation ever of bilateral retropharyngeal course of the superior thyroid artery, the absolute first in cervical vascular anatomy literature. It challenges classical anatomical concepts about retropharyngeal space.

10.4.2 Conclusions

The retropharyngeal space, classically considered free of major arteries, can contain aberrant STA courses. Such an extraordinary variation carries profound clinical implications for hypopharynx, larynx, and anterior cervical surgery. This discovery necessitates revision of current anatomical concepts and emphasizes the importance of individual preoperative imaging evaluation.

10.5 The diversity of the linguofacial trunk

10.5.1 Key contributions

The study of the linguofacial trunk anatomic variability is a comprehensive morphological analysis of 47 individual linguofacial trunks, a detailed case-by-case documentation of anatomical possibilities. Six distinct categories of morphological analysis were established.

10.5.2 Conclusions

This comprehensive analysis of linguofacial trunk anatomy demonstrates that the morphology and topography of these vessels are individually specific and largely unpredictable. The significant diversity in origin levels, course directions, loop orientations, and positional relationships emphasizes the inadequacy of considering the LFT as a simple anatomical variant with predictable characteristics.

The 23.12% prevalence of LFTs in our population, with 38.24% showing bilateral occurrence, indicates that these variations are sufficiently common to warrant routine consideration in surgical planning. The predominance of suprahyoid origins (80.9% of cases) provides some predictive value, but the wide distribution of other morphological characteristics prevents reliable anatomical assumptions.

Future research should focus on developing standardized imaging protocols for LFT evaluation, establishing correlation between morphological variants and clinical outcomes, and investigating potential population-specific or genetic factors influencing LFT development. The integration of advanced imaging techniques with three-dimensional reconstruction may further enhance preoperative planning and reduce the risk of vascular complications.

10.6 Vertical levels of the occipital artery origin

10.6.1 Key contributions

The OA study is an original systematic documentation of OA origin variations using osseous landmarks. Six distinct types of OA origin based on vertical topographic patterns were established.

10.6.2 Conclusions

This comprehensive analysis established that OA origin demonstrates significant vertical variability ranging from infrahyoid to supragonial levels, with individual anatomical patterns requiring careful documentation. The strong statistical evidence of bilateral symmetry, coupled with substantial asymmetrical cases, supports the recommendation for mandatory preoperative CT angiography in patients undergoing procedures involving the OA or upper cervical vascular anatomy. These findings challenge traditional anatomical teaching and advocate for individualized surgical planning based on patient-specific anatomical variations rather than assumed standard configurations.

10.7 Aberrant courses of the occipital artery

10.7.1 Key contributions

These cases are the first reported cases of aberrant OA courses in medical literature. There were identified two distinct patterns: medial courses relative to internal jugular vein and retromandibular courses through parotid glands. These are novel anatomical variations with significant clinical relevance.

10.7.2 Conclusions

This study documented the first reported cases of aberrant OA courses, identifying two distinct patterns with significant clinical relevance. Preoperative imaging assessment should specifically evaluate OA anatomy in patients undergoing parotid or carotid triangle surgery to identify these rare but potentially dangerous variations. Surgical teams should maintain heightened awareness of these anatomical possibilities to prevent inadvertent vascular complications and optimize patient safety outcomes.

10.8 Maxillary artery traversing through the temporal muscle

10.8.1 Key contributions

This anatomical variant was found a significantly higher prevalence (6.47% of patients, 5.58% of sides) than previously reported 2%. The bilateral evidence resulted in nearly half of affected cases. A consistent pattern was established: MA positioned lateral to lateral pterygoid muscle while traversing through the temporal muscle.

10.8.2 Conclusions

The MA traverses through the temporalis muscle more commonly than previously recognized. The bilateral assessment is important when the variant suspected or identified unilaterally. Preoperative CT angiography is recommended for surgical procedures involving either the temporalis muscle or the maxillary artery. Greater awareness is needed among surgeons performing infratemporal region procedures.

10.9 The maxillary artery loops dangerously approaching the mandible's lingula

10.9.1 Key contributions

It was documented the extreme MA tortuosity with dual-loop configuration. This is an unprecedented anatomical variation: inferior loop contacting mandibular lingula, superior loop reaching inferior orbital fissure. Critical measurements were done: the MA loop was positioned only 0.5 cm superior to mandibular foramen.

10.9.2 Conclusions

This case report documented an extraordinary anatomical variation of the MA that creates significant clinical risks for routine dental and surgical procedures. The dual-loop configuration, with inferior extension to the mandibular lingula and superior extension to the inferior orbital fissure, represents a previously unreported pattern of arterial tortuosity that fundamentally alters the risk profile for procedures in these anatomical regions.

10.10 Overall synthesis

The PhD studies collectively demonstrate that anatomical variation in head and neck vasculature is far more common and clinically significant than traditionally recognized. The research challenges standard anatomical teaching and emphasizes the critical importance of: (1) individual preoperative assessment rather than relying on textbook anatomy; (2) advanced imaging techniques (CBCT, CT angiography) for surgical planning; (3) revision of anatomical education to incorporate extreme variability concepts; (4) development of standardized classification systems for better clinical communication; (5) enhanced surgical safety protocols accounting for anatomical unpredictability.

References of the PhD Thesis

1. Gray H, Standring S, Anand N, et al. Gray's anatomy: the anatomical basis of clinical practice. 41 ed: Elsevier; 2016.
2. Yamamoto D, Koizumi H, Ishima D, et al. Angiographic Characterization of the External Carotid Artery: Special Attention to Variations in Branching Patterns. *Tohoku J Exp Med* 2019; **249**(3): 185-92.
3. Rusu MC. Disecţia gâtului – Note de lucrări practice București: Ed.Tehnoplast Company S.R.L.; 2004.
4. Rusu MC. Disecţia teritoriului oro-maxilo-facial – Note de lucrări practice. Bucuresti: Ed.Tehnoplast Company SRL; 2004.
5. Alvernia JE, Fraser K, Lanzino G. The occipital artery: a microanatomical study. *Neurosurgery* 2006; **58**(1 Suppl): ONS114-22; discussion ONS-22.
6. Seker A, Martins C, Rhoton J, A.L. Meningeal Anatomy. In: Pamir MN, Black PM, Fahlbusch R, eds. Meningiomas A Comprehensive Text. Philadelphia: Saunders Elsevier; 2010: 11-51.
7. Fukuda H, Evins AI, Burrell JC, Stieg PE, Bernardo A. A safe and effective technique for harvesting the occipital artery for posterior fossa bypass surgery: a cadaveric study. *World Neurosurg* 2014; **82**(3-4): e459-65.
8. Lasjaunias P, Theron J, Moret J. The occipital artery. Anatomy--normal arteriographic aspects--embryological significance. *Neuroradiology* 1978; **15**(1): 31-7.
9. Tubbs RS, Salter G, Oakes WJ. Continuation of the ascending cervical artery as the occipital artery in man. *Anat Sci Int* 2004; **79**(1): 43-5.
10. Feneis H, Dauber W. Pocket atlas of human anatomy : based on the international nomenclature. 4th ed. Stuttgart ; New York: Thieme; 2000.
11. Geibprasert S, Pongpech S, Armstrong D, Krings T. Dangerous extracranial-intracranial anastomoses and supply to the cranial nerves: vessels the neurointerventionalist needs to know. *AJNR Am J Neuroradiol* 2009; **30**(8): 1459-68.
12. Bergman R, Tubbs RS, Shoja MM, Loukas M. Bergman's comprehensive encyclopedia of human anatomic variation. Hoboken, NJ, USA: John Wiley & Sons; 2016.
13. Manta MD, Jianu AM, Rusu MC, Popescu SA. Launay's External Carotid Vein. *Medicina (Kaunas)* 2021; **57**(9).
14. Bernard F, Zemmoura I, Cottier JP, Fournier HD, Terrier LM, Velut S. The interperiosteodural concept applied to the jugular foramen and its compartmentalization. *J Neurosurg* 2018; **129**(3): 770-8.
15. Liu J, Xie W, Ding Y, et al. Wave I(n) in auditory brainstem response suggests a high possibility of a high jugular bulb. *Front Pediatr* 2023; **11**: 1183388.
16. Mansour S, Magnan J, Ahmad HH, Nicolas K, Louryan S. Comprehensive and clinical anatomy of the middle ear. Berlin, Heidelberg: Springer; 2013.
17. Kveton JF. Anatomy of the jugular foramen: The neurotologic perspective. *Oper Tech Otolayngol Head Neck Surg* 1996; **7**(2): 95-8.
18. Moffat DA, Quaranta N, Chang P. Management of the high jugular bulb in translabyrinthine surgery. *Laryngoscope* 2003; **113**(3): 580-2.
19. Shaaban Ali M, Harmer M, Latto I. Jugular bulb oximetry during cardiac surgery. *Anaesthesia* 2001; **56**(1): 24-37.
20. Hoz SS, Palmisciano P, Albairmani SS, et al. A proposed classification system for presigmoid approaches: a scoping review. *J Neurosurg* 2023; **139**(4): 965-71.
21. Liu JK, Sameshima T, Gottfried ON, Couldwell WT, Fukushima T. The combined transmastoid retro- and infralabyrinthine transjugular transcondylar transtubercular high cervical approach for resection of glomus jugulare tumors. *Neurosurgery* 2006; **59**(1 Suppl 1): ONS115-25; discussion ONS-25.

22. Allam AF. Pneumatization of the temporal bone. *Ann Otol Rhinol Laryngol* 1969; **78**(1): 49-64.
23. Dexian Tan A, Ng JH, Lim SA, Low DY, Yuen HW. Classification of Temporal Bone Pneumatization on High-Resolution Computed Tomography: Prevalence Patterns and Implications. *Otolaryngol Head Neck Surg* 2018; **159**(4): 743-9.
24. Rusu MC, Sandulescu M, Bichir C. Patterns of pneumatization of the tympanic plate. *Surg Radiol Anat* 2020; **42**(3): 347-53.
25. Woo CK, Wie CE, Park SH, Kong SK, Lee IW, Goh EK. Radiologic analysis of high jugular bulb by computed tomography. *Otol Neurotol* 2012; **33**(7): 1283-7.
26. Juelke E, Butzer T, Yacoub A, Wimmer W, Caversaccio M, Anschuetz L. Assessment of jugular bulb variability based on 3D surface models: quantitative measurements and surgical implications. *Surg Radiol Anat* 2023; **45**(3): 315-9.
27. Rusu MC, Lazar M, Vrapciu AD. Ring-shaped Dandy's superior petrosal vein. *Surg Radiol Anat* 2023; **45**(12): 1563-5.
28. Jianu AM, Vaida MA, Rusu MC, Vrapciu AD. The Basal or Sphenopetrosal Superficial Middle Cerebral Vein Type. *Medicina (Kaunas)* 2024; **60**(2).
29. Tudose RC, Rusu MC, Triantafyllou G, Piagkou M, Moraru L, Dumitru CC. Jugular bulb anatomical variations and pneumatization patterns: a comprehensive CBCT analysis. *Surg Radiol Anat* 2024; **46**(7): 1001-13.
30. Iamandoiu AV, Mureşan AN, Rusu MC. Detailed Morphology of the Incisive or Nasopalatine Canal. *Anatomia* 2022; **1**(1): 75-85.
31. Rusu MC, Sandulescu M, Sava CJ, Dinca D. Bifid and secondary superior nasal turbinates. *Folia Morphol (Warsz)* 2019; **78**(1): 199-203.
32. Gozen ED, Erdur ZB, Karaman E, Yener M, Kizilkilic O. A Rare Cause of Objective Tinnitus: Jugular Diverticulum. *J Craniofac Surg* 2018; **29**(3): e300-e2.
33. Vachata P, Petrovicky P, Sames M. An anatomical and radiological study of the high jugular bulb on high-resolution CT scans and alcohol-fixed skulls of adults. *J Clin Neurosci* 2010; **17**(4): 473-8.
34. Branstetter BFt, Weissman JL. The radiologic evaluation of tinnitus. *Eur Radiol* 2006; **16**(12): 2792-802.
35. Tudose RC, Rusu MC, Hostiuc S. The Vertebral Artery: A Systematic Review and a Meta-Analysis of the Current Literature. *Diagnostics (Basel)* 2023; **13**(12).
36. Tsakotos G, Tudose RC, Triantafyllou G, et al. Systematic Review and Meta-analysis of Suprascapular Notch Morphological Variability: Do We Know Everything? *Cureus* 2024; **16**(3): e55852.
37. Singla A, Gupta T, Sahni D, Aggarwal A, Gupta A. High jugular bulb: different osseous landmarks and their clinical implications. *Surg Radiol Anat* 2016; **38**(8): 903-9.
38. Kolagi S, Herur A, Ugale M, Manjula R, Mutalik A. Suboccipital retrosigmoid surgical approach for internal auditory canal--a morphometric anatomical study on dry human temporal bones. *Indian J Otolaryngol Head Neck Surg* 2010; **62**(4): 372-5.
39. Koval J, Molcan M, Bowdler AD, Sterkers JM. Retrosigmoid transmeatal approach: an anatomic study of an approach used for preservation of hearing in acoustic neuroma surgery and vestibular neurotomy. *Skull Base Surg* 1993; **3**(1): 16-21.
40. Roland PS, Meyerhoff WL, Wright CG, Mickey B. Anatomic considerations in the posterior approach to the internal auditory canal. *Ann Otol Rhinol Laryngol* 1988; **97**(6 Pt 1): 621-5.
41. Aslan A, Falcioni M, Russo A, et al. Anatomical considerations of high jugular bulb in lateral skull base surgery. *J Laryngol Otol* 1997; **111**(4): 333-6.
42. Gupta T, Gupta SK. Anatomical delineation of a safety zone for drilling the internal acoustic meatus during surgery for vestibular schwanomma by retrosigmoid suboccipital approach. *Clin Anat* 2009; **22**(7): 794-9.
43. Singh V, Krishna Chaitanya D, Chauhan BKS, Kumar IDV. A comparative study of pneumatization of Temporal bone. *J Anat Soc India* 2017; **66**(1): 78-81.

44. Jadhav AB, Fellows D, Hand AR, Tadinada A, Lurie AG. Classification and volumetric analysis of temporal bone pneumatization using cone beam computed tomography. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2014; **117**(3): 376-84.
45. Azuma H, Isono M, Murata K, Ito A, Kimura H. [Morphological characterization and classification of air cells in temporal bone by digital processing of CT images]. *Nihon Jibiinkoka Gakkai Kaiho* 1997; **100**(1): 13-9.
46. Lai PF, Wu X, Lan SH, Tang B, Huang HY, Hong T. Anatomical study of a surgical approach through the neck to the jugular foramen under endoscopy. *Surg Radiol Anat* 2021; **43**(2): 251-60.
47. Comert E, Kilic C, Comert A. Jugular Bulb Anatomy for Lateral Skull Base Approaches. *J Craniofac Surg* 2018; **29**(7): 1969-72.
48. Fox R, Nash R, Tatla T. Encountering a high jugular bulb during ear surgery. *Ann R Coll Surg Engl* 2017; **99**(1): 36-7.
49. Graham MD. The jugular bulb: its anatomic and clinical considerations in contemporary otology. *Laryngoscope* 1977; **87**(1): 105-25.
50. Wadin K, Wilbrand H. The topographic relations of the high jugular fossa to the inner ear. A radioanatomic investigation. *Acta Radiol Diagn (Stockh)* 1986; **27**(3): 315-24.
51. Kennedy DW, el-Sirsy HH, Nager GT. The jugular bulb in otologic surgery: anatomic, clinical, and surgical considerations. *Otolaryngol Head Neck Surg* 1986; **94**(1): 6-15.
52. Aladeyelu OS, Olojede SO, Lawal SK, Mbatha W-BE, Sibiya AL, Rennie CO. Influence of pneumatization on morphology of temporal bone-related vasculatures and their morphometric relationship with ear regions: a computed tomography study. *Sci Rep* 2023; **13**(1): 1996.
53. Chen C, Weng S, Chen Z, et al. The association between high jugular bulb and mastoid pneumatization in adults. *Front Neurol* 2023; **14**: 1331604.
54. Orr JB, Todd NW. Jugular bulb position and shape are unrelated to temporal bone pneumatization. *Laryngoscope* 1988; **98**(2): 136-8.
55. Timock AM, Cook V, McDonald T, et al. Accuracy and reliability of buccal bone height and thickness measurements from cone-beam computed tomography imaging. *Am J Orthod Dentofacial Orthop* 2011; **140**(5): 734-44.
56. Jagtap R, Wazzan T, Hansen M, Kashtwari D. Condylar jugular diverticulum: A report of 3 cases. *Imaging Sci Dent* 2019; **49**(3): 251-6.
57. Tamminen P, Jarnstedt J, Lehtinen A, et al. Ultra-low-dose CBCT scan: rational map for ear surgery. *Eur Arch Otorhinolaryngol* 2023; **280**(3): 1161-8.
58. Sayit AT, Gunbey HP, Fethallah B, Gunbey E, Karabulut E. Radiological and audiometric evaluation of high jugular bulb and dehiscent high jugular bulb. *J Laryngol Otol* 2016; **130**(11): 1059-63.
59. Xia K, Lei P, Liu Y, et al. Comparison of radiological abnormalities between the jugular bulb and the vestibular aqueduct in patients with Meniere's disease. *Front Neurol* 2023; **14**: 1184232.
60. Wang SJ, Eisele DW. Parotidectomy--Anatomical considerations. *Clin Anat* 2012; **25**(1): 12-8.
61. Manta MD, Rusu MC, Hostiuc S, Vrapciu AD, Manta BA, Jianu AM. The Carotid-Hyoid Topography Is Variable. *Medicina (Kaunas)* 2023; **59**(8).
62. Hayashi N, Hori E, Ohtani Y, Ohtani O, Kuwayama N, Endo S. Surgical anatomy of the cervical carotid artery for carotid endarterectomy. *Neurol Med Chir (Tokyo)* 2005; **45**(1): 25-9; discussion 30.
63. Dumitru CC, Hostiuc S, Vrapciu AD, Rusu MC. Vertical Levels of the Occipital Artery Origin. *Medicina (Kaunas)* 2023; **59**(2).
64. Loukas M, Tubbs RS. Adrenal, renal, gonadal, azygos, hemiazygos, lumbar, and ascending lumbar veins. In: Tubbs RS, Shoja MM, Loukas M, eds. Bergman's comprehensive encyclopedia of human anatomic variation. Hoboken, New Jersey: John Wiley & Sons; 2016: 891-3.
65. Keser N, Kula O, Is M, Yardimcioglu I. Prevalence of Anomalously Originating Occipital Artery in a Group of Turkish Individuals: A Retrospective Study using Angiography. *Turk Neurosurg* 2019; **29**(3): 335-9.

66. Lippert H, Pabst R. Arterial variations in man: classification and frequency. München: J.P. Bergmann Verlag; 1985.
67. Natsis K, Raikos A, Foundos I, Noussios G, Lazaridis N, Njau SN. Superior thyroid artery origin in Caucasian Greeks: A new classification proposal and review of the literature. *Clin Anat* 2011; **24**(6): 699-705.
68. Poutoglidis A, Savvakis S, Karamitsou P, et al. Is the origin of the superior thyroid artery consistent? A systematic review of 5488 specimens. *Am J Otolaryngol* 2023; **44**(2): 103823.
69. Piagkou M, Triantafyllou G, Nikolopoulou E, Karampelias V, Tsakotos G. Lingual and Facial Artery Fusion: A Cadaveric Report With Clinical Significance. *Cureus* 2023; **15**(8).
70. Rusu MC, Jianu AM, Monea MD, Ilie AC. Two cases of combined anatomical variations: maxillofacial trunk, vertebral, posterior communicating and anterior cerebral atresia, linguofacial and labiomental trunks. *Folia Morphol (Warsz)* 2022; **81**(1): 237-46.
71. Rusu MC, Jianu AM, Radoi PM. Anatomic variations of the superficial temporal artery. *Surg Radiol Anat* 2021; **43**(3): 445-50.
72. Rusu MC, Maru N, Radoi PM, Dinca D. Trifurcated external carotid artery and complete gamma-loop of its maxillary branch. *Surg Radiol Anat* 2019; **41**(2): 231-4.
73. Sasikumar N, S V, Raghunath G, et al. Morphometric Study and Branching Patterns of External Carotid Artery Using Computed Tomography Angiography Among the South Indian Population: A Retrospective Study. *Cureus* 2023; **15**(2): e35624.
74. Dumitru CC, Vrapciu AD, Jianu AM, Hostiuc S, Rusu MC. The retromandibular loop of the external carotid artery. *Ann Anat* 2024; **253**: 152226.
75. Rusu MC, Jianu AM, Manta BA, Hostiuc S. Aortic Origins of the Celiac Trunk and Superior Mesenteric Artery. *Diagnostics (Basel)* 2021; **11**(6).
76. Minca DI, Rusu MC, Radoi PM, Vrapciu AD, Hostiuc S, Toader C. The Infraoptic or Infrachiasmatic Course of the Anterior Cerebral Artery Emerging an Elongated Internal Carotid Artery. *Tomography* 2022; **8**(5): 2243-55.
77. Osborn AG. Diagnostic cerebral angiography. 2nd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 1999.
78. Cvetko E. Concurrence of bilateral kinking of the extracranial part of the internal carotid artery with coiling and tortuosity of the external carotid artery--a case report. *Rom J Morphol Embryol* 2014; **55**(2): 433-5.
79. Rouviere H, Delmas A. Anatomie humaine. Tête et cou. Paris: Masson; 1985.
80. Borle RM, Jadhav A, Bhola N, Hingnikar P, Gaikwad P. Borle's triangle: A reliable anatomical landmark for ease of identification of facial nerve trunk during parotidectomy. *J Oral Biol Craniofac Res* 2019; **9**(1): 33-6.
81. Saha S, Pal S, Sengupta M, Chowdhury K, Saha VP, Mondal L. Identification of facial nerve during parotidectomy: a combined anatomical & surgical study. *Indian J Otolaryngol Head Neck Surg* 2014; **66**(1): 63-8.
82. Laskaris S, Chrysikos D, Koutrafouris I, et al. Partial Superficial Parotidectomy Versus Extracapsular Anatomical Dissection for the Treatment of Benign Parotid Tumors. *Acta Med Acad* 2022; **51**(2): 85-91.
83. Olsen KD, Moore EJ. Deep lobe parotidectomy: clinical rationale in the management of primary and metastatic cancer. *Eur Arch Otorhinolaryngol* 2014; **271**(5): 1181-5.
84. Saldivar-Galindo FM, Navarro-Barquin DF, Santamaria-Orozco F, Pina-Aviles FA, Saldivar-Alvarez NG, Anaya-Ayala JE. Surgical Resection of a Parotid Gland Hemangioma in Teenager Managed with External Carotid Artery Ligation. *Ann Maxillofac Surg* 2017; **7**(2): 319-21.
85. Lo A, Oehley M, Bartlett A, Adams D, Blyth P, Al-Ali S. Anatomical variations of the common carotid artery bifurcation. *ANZ J Surg* 2006; **76**(11): 970-2.
86. Klosek SK, Rungruang T. Topography of carotid bifurcation: considerations for neck examination. *Surg Radiol Anat* 2008; **30**(5): 383-7.

87. Lucev N, Bobinac D, Maric I, Drescik I. Variations of the great arteries in the carotid triangle. *Otolaryngol Head Neck Surg* 2000; **122**(4): 590-1.
88. Kurkcuoglu A, Aytekin C, Oktem H, Pelin C. Morphological variation of carotid artery bifurcation level in digital angiography. *Folia Morphol (Warsz)* 2015; **74**(2): 206-11.
89. Al-Rafiah A, AA EL-H, Aal IH, Zaki AI. Anatomical study of the carotid bifurcation and origin variations of the ascending pharyngeal and superior thyroid arteries. *Folia Morphol (Warsz)* 2011; **70**(1): 47-55.
90. Denli Yalvac ES, Balak N, Atalay B, et al. A New Method for Determining the Level of the Carotid Artery Bifurcation. *J Craniofac Surg* 2019; **30**(6): e523-e7.
91. Calota RN, Rusu MC, Rusu MI, Dumitru CC, Vrapciu AD. Anatomical Variables of the Superior Thyroid Artery on Computed Tomography Angiograms. *Medicina (Kaunas)* 2025; **61**(5).
92. Alagoz MS, Cagri Uysal A, Tuccar E, Sensoz O. How cranial could the sternocleidomastoid muscle be split? *J Craniofac Surg* 2005; **16**(2): 201-4.
93. Anagnostopoulou S, Mavridis I. Emerging patterns of the human superior thyroid artery and review of its clinical anatomy. *Surg Radiol Anat* 2014; **36**(1): 33-8.
94. Won SY. Anatomical considerations of the superior thyroid artery: its origins, variations, and position relative to the hyoid bone and thyroid cartilage. *Anat Cell Biol* 2016; **49**(2): 138-42.
95. Anand A, Metgudmath RB, Belaldavar BP. Topographic Evaluation of Superior Thyroid Artery-A Terrain to be Well Versed for Surgeon's Knife. *Indian J Otolaryngol Head Neck Surg* 2022; **74**(Suppl 3): 5994-6000.
96. Joshi A, Gupta S, Vaniya V. Anatomical variation in the origin of superior thyroid artery and it’s relation with external laryngeal nerve. *Natl J Med Res* 2014; **4**(2): 138-41.
97. Rimi KR, Ara S, Hossain M, Shefyetullah K, Naushaba H, Bose B. Postmortem study of thyroid arteries in Bangladeshi people. *Bangladesh J Anat* 2009; **7**(1): 26-33.
98. Shankar VV, Komala N, Shetty S. A cross-sectional study of superior thyroid artery in human cadavers. *Int J Anat Res* 2017; **5**(4.3): 4751-5.
99. Sharma A. Variation in the Origin of Superior Thyroid Artery and it’s relation with external laryngeal nerve: a cadaveric study. *Acad Anat Intl* 2019; **5**(1): 6-9.
100. Shivaleela C, Anupama D, Lakshmi Prabha Subhash R. Study of anatomical variations in the origin of superior thyroid artery. *Int J Anat Res* 2016; **4**(1): 1765-8.
101. Tsegay AT, Berhe T, Amdeslase F, Hayelom H. Variations on arterial supply of thyroid gland and its clinical significance in selected universities of North Ethiopia. *Int J Anat Res* 2019; **7**(3.2): 6830-4.
102. Triantafyllou G, Paschopoulos I, Duparc F, et al. The superior thyroid artery origin pattern: a systematic review with meta-analysis. *Surg Radiol Anat* 2024; **46**(9): 1549-60.
103. Tzortzis AS, Antonopoulos I, Pechlivanidou E, Chrysikos D, Pappas N, Troupis T. Anatomical variations of the superior thyroid artery: A systematic review. *Morphologie* 2023; **107**(358): 100597.
104. Aggarwal NR, Krishnamoorthy T, Devasia B, Menon G, Chandrasekhar K. Variant origin of superior thyroid artery, occipital artery and ascending pharyngeal artery from a common trunk from the cervical segment of internal carotid artery. *Surg Radiol Anat* 2006; **28**(6): 650-3.
105. Calota RN, Rusu MC, Dumitru CC, Moraru L, Tudose RC. Retropharyngeal course of the superior thyroid artery - a novel finding. *Surg Radiol Anat* 2025; **47**(1): 115.
106. Vazquez T, Cobiella R, Maranillo E, et al. Anatomical variations of the superior thyroid and superior laryngeal arteries. *Head Neck* 2009; **31**(8): 1078-85.
107. Ongeti KW, Ogeng'o JA. Variant origin of the superior thyroid artery in a Kenyan population. *Clin Anat* 2012; **25**(2): 198-202.
108. Ozgur Z, Govsa F, Celik S, Ozgur T. Clinically relevant variations of the superior thyroid artery: an anatomic guide for surgical neck dissection. *Surg Radiol Anat* 2009; **31**(3): 151-9.
109. Gupta P, Bhalla AS, Thulkar S, et al. Variations in superior thyroid artery: A selective angiographic study. *Indian J Radiol Imaging* 2014; **24**(1): 66-71.

110. Toni R, Della Casa C, Mosca S, Malaguti A, Castorina S, Roti E. Anthropological variations in the anatomy of the human thyroid arteries. *Thyroid* 2003; **13**(2): 183-92.
111. Toni R, Della Casa C, Castorina S, et al. A meta-analysis of superior thyroid artery variations in different human groups and their clinical implications. *Ann Anat* 2004; **186**(3): 255-62.
112. Herrera-Nunez M, Menchaca-Gutierrez JL, Pinales-Razo R, et al. Origin variations of the superior thyroid, lingual, and facial arteries: a computed tomography angiography study. *Surg Radiol Anat* 2020; **42**(9): 1085-93.
113. Moriggl B, Sturm W. Absence of three regular thyroid arteries replaced by an unusual lowest thyroid artery (A. thyroidea ima): a case report. *Surg Radiol Anat* 1996; **18**(2): 147-50.
114. Esen K, Ozgur A, Balci Y, Tok S, Kara E. Variations in the origins of the thyroid arteries on CT angiography. *Jpn J Radiol* 2018; **36**(2): 96-102.
115. Mehta V, Suri RK, Arora J, Rath G, Das S. Anomalous superior thyroid artery. *Kathmandu Univ Med J (KUMJ)* 2010; **8**(32): 429-31.
116. Rusu MC, Tudose RC, Vrapciu AD, Popescu SA. Lowered hyoid bone overlapping the thyroid cartilage in CT angiograms. *Surg Radiol Anat* 2024; **46**(3): 333-9.
117. Xia C, Li Z. Recurrent Ischemic Strokes Due to Anatomic Variation of the Hyoid Bone and Thyroid Cartilage. *Radiology* 2024; **313**(1): e241186.
118. Corbett CR, Young AE, Gaunt J, Unal H, Unal G. The effect of ligation of the inferior thyroid artery upon thyroid remnant function. *Surg Gynecol Obstet* 1988; **166**(5): 418-20.
119. Dessie MA. Variations of the origin of superior thyroid artery and its relationship with the external branch of superior laryngeal nerve. *PLoS One* 2018; **13**(5): e0197075.
120. Bednarz M, Gromaszek M, Daniluk A, et al. Superior thyroid artery–variations of origin and clinical significance. *J Pre Clin-Clin Res* 2024; **18**(2): 168-74.
121. Jianu AM, Motoc A, Mihai AL, Rusu MC. An anatomical study of the thyroid arteries anastomoses. *Rom J Morphol Embryol* 2009; **50**(1): 97-101.
122. Calota RN, Rusu MC, Vrapciu AD. The External Carotid Artery and the Styloid Process. *Curr Health Sci J* 2024; **50**(2): 232-6.
123. Dumitru CC, Vrapciu AD, Rusu MC. The Diversity of the Linguofacial Trunk. *Medicina (Kaunas)* 2024; **60**(2).
124. Touré T, Ba B, Kanté A, et al. Superior Thyroid Artery Originating from the Ascending Pharyngeal Artery. *Int J Cadaver Stud Anat Var* 2024; **5**(1): 37-42.
125. Ettleson A, Robbins J, Ascher E, Hingorani A. Transcarotid Artery Revascularization for Symptomatic Retropharyngeal Internal Carotid Artery Stenosis. *Vasc Endovasc Surg* 2024; **58**(8): 884-7.
126. Sorour AA, Kirksey L. Bilateral retropharyngeal internal carotid artery 'kissing carotids'. *Eur Heart J Case Rep* 2021; **5**(12): ytab390.
127. Lukins DE, Pilati S, Escott EJ. The Moving Carotid Artery: A Retrospective Review of the Retropharyngeal Carotid Artery and the Incidence of Positional Changes on Serial Studies. *AJNR Am J Neuroradiol* 2016; **37**(2): 336-41.
128. Sheen TS, Yen KL, Ko JY, Hsu MM. Usefulness of the C1 transverse process as a reference guide in the dissection of the upper lateral neck. *Otolaryngol Head Neck Surg* 2000; **122**(2): 284-9.
129. Cappabianca S, Scuotto A, Iaselli F, et al. Computed tomography and magnetic resonance angiography in the evaluation of aberrant origin of the external carotid artery branches. *Surg Radiol Anat* 2012; **34**(5): 393-9.
130. Ozgur Z, Govsa F, Ozgur T. Assessment of origin characteristics of the front branches of the external carotid artery. *J Craniofac Surg* 2008; **19**(4): 1159-66.
131. Anangwe D, Saidi H, Ogeng'o J, Awori KO. Anatomical variations of the carotid arteries in adult Kenyans. *East Afr Med J* 2008; **85**(5): 244-7.
132. Zumre O, Salbacak A, Cicekcibasi AE, Tuncer I, Seker M. Investigation of the bifurcation level of the common carotid artery and variations of the branches of the external carotid artery in human fetuses. *Ann Anat* 2005; **187**(4): 361-9.

133. Devadas D, Pillay M, Sukumaran TT. A cadaveric study on variations in branching pattern of external carotid artery. *Anat Cell Biol* 2018; **51**(4): 225-31.
134. Troupis T, Michalinos A, Kakisis J, Natsis K, Sofidis G, Skandalakis P. Bilateral lingual-facial trunk: anatomic and clinical implications. *Folia Morphol (Warsz)* 2015; **74**(4): 548-51.
135. Nochikattil SK, Babu TPS, Manoharan S. Thyrolingual Trunk Arising from Common Carotid Artery- A Case Report. *J Clin Diagn Res* 2017; **11**(8): AD01-AD2.
136. Lemaire V, Jacquemin G, Medot M, Fissette J. Thyrolingual trunk arising from the common carotid artery: a case report. *Surg Radiol Anat* 2001; **23**(2): 135-7.
137. Jitpun E, Wattanasen Y, Tirakotai W. Do Asians have Higher Carotid Bifurcation? A Computed Tomographic Angiogram Study of the Common Carotid Artery Bifurcation and External Carotid Artery Branching Patterns. *Asian J Neurosurg* 2019; **14**(4): 1082-8.
138. Baxla M, Kumari C, Kaler S. Bilateral thyrolinguofacial trunk: unusual and rare branching pattern of external carotid artery. *Anat Cell Biol* 2018; **51**(4): 302-4.
139. Haldar A, Biswas S, Sharma S, Rathia DS, Chakraborty S. Bilateral linguofacial trunk in a cadaver: A case report. *J Anat Soc India* 2017; **66**: S8-S9.
140. Sanjeev I, Anita H, Ashwini M, Mahesh U, Rairam G. Branching pattern of external carotid artery in human cadavers. *J Clin Diagn Res* 2010; **4**(5): 3128-33.
141. Mata JR, Mata FR, Souza MC, Nishijo H, Ferreira TA. Arrangement and prevalence of branches in the external carotid artery in humans. *Ital J Anat Embryol* 2012; **117**(2): 65-74.
142. Cobiella R, Quinones S, Aragones P, et al. Anatomic mapping of the collateral branches of the external carotid artery with regard to daily clinical practice. *Ann Anat* 2021; **238**: 151789.
143. Shintani S, Terakado N, Alcalde RE, et al. An anatomical study of the arteries for intraarterial chemotherapy of head and neck cancer. *Int J Clin Oncol* 1999; **4**: 327-30.
144. Dnyanesh S, Bhimalli S, Dnyanesh D, et al. Unilateral Linguofacial Trunk: A Rare Case Report. *Int J Appl Sci* 2013; **1**(3): 154-7.
145. Ogeng'o JA, Misiani MK, Loyal P, et al. Variations in branching pattern of external carotid artery in a black Kenyan population. *Anat J Africa* 2015; **4**(2): 584-90.
146. Sarna K, Sonigra KJ, Amuti T, Kamau M, Ngeow WC, Mandela Idenya P. The Journey of the Lingual Artery from the Neck to the Oral Cavity: A Cadaveric Study. *Craniomaxillofac Trauma Reconstr* 2022; **15**(1): 39-45.
147. Yadav A, Yadav M, Dixit A. Research Article A Research on The Incidence of Linguofacial Trunk Arising From External Carotid Artery in Adult Cadavers. *Sch Acad J Biosci,* 2012; **8**: 590-1.
148. Kumar A, Kumar V. Abnormal Branching Pattern of Lingual and Facial Arteries–A. *IOSR-J Dent Med Sci* 2019; **18**(6): 31-3.
149. Troupis TG, Dimitroulis D, Paraschos A, et al. Lingual and facial arteries arising from the external carotid artery in a common trunk. *Am Surg* 2011; **77**(2): 151-4.
150. Pantoja GC, Coronado GC, Aravena TP, Suazo GI. Lingual-facial trunk arising from the external carotid artery: a case report. *Int J Morphol* 2014; **32**(3): 1108-10.
151. Shreevastava AK, Das RS, Maheshwari TP, Damodhar BK. Bilateral High Trifurcation of the Common Carotid Artery and Variable Emergence of the Lower Branches of the External Carotid Artery: A Cadaveric Case Report. *Cureus* 2022; **14**(8): e27657.
152. Nirmaladevi M, Sruthi G. Linguo-Facial Trunk—a case report. *Anat Karnataka* 2010; **4**(2): 54-6.
153. Diwan RK, Rani A, Chopra J, Kumar N. THYRO-LINGUO-FACIAL TRUNK OF EXTERNAL CAROTID ARTERY: A RARE VARIATION. *J Anat* 2017; **25**(2): 54-5.
154. Kala M, Prakash NJ, Kumar BIN, Sailaja TK, Jayasree N. Study of variations in Lingual and Facial arteries. *MRIMS J Health Sci* 2016; **4**(2): 100-2.
155. Kishve PS, Kishve SP, Joshi M, Aarif SM, Kalakoti P. An unusual branching pattern of common and external carotid artery in a human cadaver: a case report. *Australas Med J* 2011; **4**(4): 180-2.

156. Vinnakota S, Nandagiri B, Neelee J. A rare association of curving and looping of internal carotid artery and variation in the branching pattern of external carotid artery–a case report. *Int J Biol Med Res* 2011; **2**(3): 822-3.
157. Desai SD, Nuchhi AB, Karjagi SB. Bilateral linguofacial trunk-a case report. *Nat J Clin Anat* 2012; **1**(4): 193-5.
158. Sirasanagandla SR, Nayak S, Potu BK, Bhat KM. Origin of the facial artery from the lingual-facial trunk and its course through the submandibular salivary gland: a case report *Rev Arg de Anat Clin* 2012; **4**(1): 20-4.
159. Paramasivam K. Linguo-facial trunk (right side)-a case report. *Univ J Pre Paraclin Sci* 2019; **5**(4).
160. Ahmed R, Al-Shaarawy S, Atteya M, et al. Anatomical variations of lingual and facial arteries in male cadavers and histological study of their structure. *Int J Integr Biol* 2012: 36-9.
161. Lohan DG, Barkhordarian F, Saleh R, et al. MR angiography at 3 T for assessment of the external carotid artery system. *AJR Am J Roentgenol* 2007; **189**(5): 1088-94.
162. Shangkuan H, Xinghai W, Zengxing W, Shizhen Z, Shiying J, Yishi C. Anatomic bases of tongue flaps. *Surg Radiol Anat* 1998; **20**(2): 83-8.
163. Kirchgessner A. Lateral external carotid artery and linguofacial trunk: a rare anatomic variant. *MOJ Anat Physiol* 2015; **1**(1): 1-3.
164. Sudhakaran M, Alikunju M, Raveendran VL, Govindapillai UK. Variations in the Branching Pattern of External Carotid Artery in South Kerala Population–A Cadaveric Study. *J Evid Based Med Healthc* 2021; **8**(22): 1780-5.
165. Thwin SS, Soe MM, Myint M, Than M, Lwin S. Variations of the origin and branches of the external carotid artery in a human cadaver. *Singapore Med J* 2010; **51**(2): e40-2.
166. Anu VR, Pai MM, Rajalakshmi R, Latha VP, Rajanigandha V, D'Costa S. Clinically-relevant variations of the carotid arterial system. *Singapore Med J* 2007; **48**(6): 566-9.
167. Charles S, Rabi S, Jain A, Rana PK. Origin and branching pattern of external carotid artery-a cadaveric study. *Eur J Anat* 2021; **25**(2): 187-96.
168. Ovhal AG, Ansari MM, Rajgopal L, Ovhal AG, Physiology. A cross sectional study of variations in the external carotid artery in cadavers. *Ind J Clin Anat* 2016; **3**(3): 282-6.
169. Gwunireama I, Bob-Manuel I, Collins G. A Study of Morphological Variations of Carotid Bifurcation and Branching Pattern of External Carotid Artery in Adult Nigerian Cadavers. *Arch Curr Res Int* 2023; **23**(5): 40-8.
170. Kısaoğlu A, Bilge D, Aydın M, Özdemir B, Köse E, Anatomy C. Facial artery and lingual artery originating from a common trunk: a case report. *Int J Exp Clin Anat* 2022; **16**: 542.
171. Homze EJ, Harn SD, Bavitz BJ. Extraoral ligation of the lingual artery: an anatomic study. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1997; **83**(3): 321-4.
172. Yonenaga K, Tohnai I, Mitsudo K, et al. Anatomical study of the external carotid artery and its branches for administration of superselective intra-arterial chemotherapy via the superficial temporal artery. *Int J Clin Oncol* 2011; **16**(6): 654-9.
173. Gupta V, Agarwal R. Anomalous branching pattern of the external carotid artery in cadavers. *Int J Sci Study* 2014; **2**(1): 28-31.
174. Anuradha M, Chitra S. A study of the common origin of lingual and facial artery from the external carotid artery. *Int J Anat Res* 2017; **5**(1): 3656-8.
175. Heltzel S, Jelinek L, Jaynes D. Variation in the caudal branches of the external carotid artery: comparison of sex and side. *Med Res Arch* 2015; (1).
176. Esakkiammal N, Renu C, Rakhee SJIJAR. Implications of variable origin of external carotid artery branches and high level bifurcation of common carotid artery. 2017; **5**(2.3): 3958-63.
177. Sarna K, Kamau M, Sonigra KJ, Amuti T. Anatomical Variations in the Origin of the Lingual Artery in the Kenyan Population. *Craniomaxillofac Trauma Reconstr* 2022; **15**(1): 4-11.
178. Fazan VP, da Silva JH, Borges CT, Ribeiro RA, Caetano AG, Filho OA. An anatomical study on the lingual-facial trunk. *Surg Radiol Anat* 2009; **31**(4): 267-70.

179. Mei J, Liu Y, Tao Y, et al. Clinical anatomy of the lingual artery. *Chin Arch Otolaryngol Head Neck Surg* 2006.
180. Manta MD, Rusu MC, Hostiuc S, Vrapciu AD, Manta BA, Jianu AM. The Axial Spin of the Carotid Bifurcation. *Diagnostics (Basel)* 2023; **13**(19).
181. Nayak SB, Shetty SD. Surgical and embryological perspective of a big loop of internal carotid artery extending laterally beyond internal jugular vein. *Surg Radiol Anat* 2021; **43**(3): 413-6.
182. De Stercke A, Dequanter D, Rodriguez A. Having a carotid in the throat: A rare case of internal carotid medialization-induced dysphonia. *Clin Case Rep* 2023; **11**(11): e7997.
183. Paulsen F, Tillmann B, Christofides C, Richter W, Koebke J. Curving and looping of the internal carotid artery in relation to the pharynx: frequency, embryology and clinical implications. *J Anat* 2000; **197 Pt 3**: 373-81.
184. Moraru L, Rusu MC, Popescu SA. True terminal pentafurcation of the external carotid artery and terminal trifurcation of the contralateral one, occipitoauricular trunk, retropharyngeal internal carotid artery. *Surg Radiol Anat* 2021; **43**(11): 1895-900.
185. Ramadan SU, Gokharman D, Tuncbilek I, Kacar M, Kosar P, Kosar U. Assessment of the stylohoid chain by 3D-CT. *Surg Radiol Anat* 2007; **29**(7): 583-8.
186. Manzato L, Trivelato FP, Alvarenga AY, Rezende MT, Ulhoa AC. Endovascular treatment of a linguofacial trunk pseudoaneurysm after tonsillectomy. *Braz J Otorhinolaryngol* 2013; **79**(4): 524.
187. Atmaca S, Belet U, Baris S. Post-tonsillectomy pseudoaneurysm of the linguofacial trunk: An ENT surgeon's nightmare. *Int J Ped Otorhinolaryngol Extra* 2012; **7**(1): 12-4.
188. Kitajima H, Iwai T, Yajima Y, Mitsudo K. Computational Fluid Dynamics Study of Superselective Intra-arterial Chemotherapy for Oral Cancer: Flow Simulation of Anticancer Agent in the Linguofacial Trunk. *Appl Sci* 2020; **10**(21): 7496.
189. Power J. Surgical Anatomy of the Arteries and Descriptive Anatomy of the Heart by the Late Valentine Flood, MD. Dublin: Fannin and Co; 1850.
190. Nathan H, Levy J. The course and relations of the hypoglossal nerve and the occipital artery. *Am J Otolaryngol* 1982; **3**(2): 128-32.
191. Paulsen F, Waschke J. Head, Neck and Neuroanatomy: Urban & Fischer Verlag/Elsevier GmbH; 2013.
192. Pernkopf E. Atlas of Topographical and Applied Human Anatomy. 2nd ed: Lippincott Williams and Wilkins 1980.
193. Agur AM, Dalley AF. Grant's atlas of anatomy. Philadelphia: Lippincott Williams & Wilkins; 2009.
194. Newton TH, Young DA. Anomalous origin of the occipital artery from the internal carotid artery. *Radiology* 1968; **90**(3): 550-2.
195. Ozgur O, Sindel M, Hizay A, Ozturk S, Aytac G, Sindel T. Occipital artery arising from the internal carotid artery: a case report. *Surg Radiol Anat* 2017; **39**(2): 219-22.
196. Barral J-P, Croibier A. Visceral Vascular Manipulations. Paris: Elsevier Health Sciences; 2011.
197. Di G, Fang X, Hu Q, Zhou W, Jiang X. A Microanatomical Study of the Far Lateral Approach. *World Neurosurg* 2019; **127**: e932-e42.
198. Matsuo S, Komune N, Akiyama O, Amano T, Nakamizo A. Surgical Anatomy of the Donor Arteries for Extracranial-Intracranial Bypass Surgery: An Anatomic and Radiologic Study. *World Neurosurg* 2020; **136**: e447-e59.
199. Ostrowski P, Bonczar M, Plutecki D, et al. The occipital artery: a meta-analysis of its anatomy with clinical correlations. *Anat Sci Int* 2022.
200. Uchino A, Saito N. Occipital artery arising from the cervical internal carotid artery at the level of the C2 vertebral body: three cases detected utilizing magnetic resonance angiography. *Surg Radiol Anat* 2020; **42**(7): 831-4.
201. Kawashima M, Rhoton AL, Jr., Tanriover N, Ulm AJ, Yasuda A, Fujii K. Microsurgical anatomy of cerebral revascularization. Part I: anterior circulation. *J Neurosurg* 2005; **102**(1): 116-31.

202. Acar M, Salbacak A, Sakarya ME, Zararsiz I, Ulusoy M. Análisis Morfométrico de la Arteria Carótida Externa y sus Ramas Mediante la Técnica de Angiografía por Tomografía Computarizada Multidetector. *Int J Morphol* 2013; **31**(4): 1407-14.
203. Toure G, Meningaud JP, Vacher C. Arterial vascularization of occipital scalp: mapping of vascular cutaneous territories and surgical applications. *Surg Radiol Anat* 2010; **32**(8): 739-43.
204. Wolf J, Mattila K, Hietanen J, Kozeltsev AL. A stereoangiographic study of the arterial variations in the external carotid system. *Dentomaxillofac Radiol* 1985; **14**(1): 45-51.
205. Lemaire V, Jacquemin G, Nelissen X, Heymans O. Tip of the greater horn of the hyoid bone: a landmark for cervical surgery. *Surg Radiol Anat* 2005; **27**(1): 33-6.
206. Adachi B. Das arteriensystem der Japaner. *Kyoto: Kenkyusha Press* 1928; **2**: 18-71.
207. Sundick SA, Weaver M, Faries PL, Marin M. Aberrant origin of occipital artery proximal to internal carotid artery stenosis. *J Vasc Surg* 2014; **59**(1): 244.
208. Benson MT, Hamer JD. Anomalous origin of the occipital artery from the cervical internal carotid artery. *J Vasc Surg* 1988; **8**(5): 643-5.
209. Hyrtle J. Einige in chirurgischer Hinsicht wichtige Gefassvarietaten. *Med Jahrbosterr Staats* 1841; **33**(24): 421.
210. Quain R. The anatomy of the arteries of the human body. London: Taylor and Walton; 1844.
211. Seidel K. [Arteriographic observation of a rare carotis anomaly]. *Fortschr Geb Rontgenstr Nuklearmed* 1965; **103**(3): 390-1.
212. Hachem K, Slaba S, Nassar J, Kanso H, Ashoush R, Ghossain M. [Imaging of an aberrant occipital artery arising from the extracranial segment of the internal carotid artery]. *J Mal Vasc* 2004; **29**(4): 205-9.
213. Uchino A, Saito N, Mizukoshi W, Okada Y. Anomalous origin of the occipital artery diagnosed by magnetic resonance angiography. *Neuroradiology* 2011; **53**(11): 853-7.
214. Iwai T, Izumi T, Inoue T, Maegawa J, Mitsudo K, Tohnai I. Incidence of the occipital artery arising from the internal carotid artery identified by three-dimensional computed tomographic angiography. *Br J Oral Maxillofac Surg* 2012; **50**(4): 373-5.
215. Small JE, Harrington J, Watkins E. Prevalence of arterial branches arising from the extracranial internal carotid artery on CT angiography. *Surg Radiol Anat* 2014; **36**(8): 789-93.
216. Guo Y, Chen H, Chen X, Yu J. Clinical importance of the occipital artery in vascular lesions: A review of the literature. *Neuroradiol J* 2019; **32**(5): 366-75.
217. Iwai T, Izumi T, Inoue T, et al. Occipital artery arising from the anterior aspect of the internal carotid artery identified by three-dimensional computed tomography angiography. *Iran J Radiol* 2012; **9**(2): 103-5.
218. Manders EK. Regional Pedicle Flaps. In: Myers EN, Carrau RL, Eibling DE, et al., eds. Operative Otolaryngology: Head and Neck Surgery: W.B. Saunders; 2008: 753-63.
219. Rusu MC, Dumitru CC, Tudose RC. Aberrant courses of the occipital artery. *Surg Radiol Anat* 2025; **47**(1): 135.
220. Standring S, Anand N, Birch R, et al. Gray's anatomy: the anatomical basis of clinical practice. 41 ed. London, UK: Elsevier; 2016.
221. Keser N, Avci E, Soylemez B, Karatas D, Baskaya MK. Occipital Artery and Its Segments in Vertebral Artery Revascularization Surgery: A Microsurgical Anatomic Study. *World Neurosurg* 2018; **112**: e534-e9.
222. Pennell DJ, Asimakopoulos P, Vallamkondu V, Ah-See K. Idiopathic pseudoaneurysm: a rare cause of parotid mass. *BMJ Case Rep* 2015; **2015**.
223. Xu C, Song Y, Chang H, Fang J, He J. Rare Occipital Artery Pseudoaneurysm After Radical Neck Dissection. *J Craniofac Surg* 2023; **34**(8): e776-e80.
224. Rafferty MA, Goldstein DP, Brown DH, Irish JC. The sternomastoid branch of the occipital artery: a surgical landmark for the spinal accessory nerve in selective neck dissections. *Otolaryngol Head Neck Surg* 2005; **133**(6): 874-6.

225. Alvernia JE, Hidalgo J, Sindou MP, et al. The maxillary artery and its variants: an anatomical study with neurosurgical applications. *Acta Neurochir (Wien)* 2017; **159**(4): 655-64.
226. Maeda S, Aizawa Y, Kumaki K, Kageyama I. Variations in the course of the maxillary artery in Japanese adults. *Anat Sci Int* 2012; **87**(4): 187-94.
227. Ottone NE, Sandoval C, Cid-Gutierrez P, Vasquez-Balboa ML, Tubbs RS, Fuentes R. Systematic review and meta-analysis of the anatomy of the maxillary artery using the Anatomical Quality Assurance (AQUA) checklist. *Surg Radiol Anat* 2021; **43**(11): 1875-86.
228. Fujimura A, Saitoh K, Saitoh H, et al. A case of the maxillary artery piercing the temporal muscle. *Dent J Iwate Med Univ* 2009; **34**: 18-21.
229. Tadokoro O, Inoue K, Kondo E, Umemura Y, Utuno H. A case of maxillary artery among the bundles of temporal muscle and accessory branch of middle meningeal artery in the infratemporal fossa. *J Matsumoto Dent Univ S* 2007; **33**: 51-5.
230. Patil J, Kumar N, Guru A, Rao MK, Nayak SB, Abhinitha P. Maxillary artery piercing the temporalis muscle: a rare variation in the infratemporal fossa. *OA Case Reports* 2013; **2**(17): 164.
231. Shanthakumar SR, Kumar N, Padur AA. Atypical Course of Maxillary Artery Piercing the Temporalis Muscle in the Infratemporal Fossa. *Online J Health Allied Scs* 2017; **16**(2): 16.
232. Lang J. Clinical anatomy of the masticatory apparatus and peripharyngeal spaces. New York: Thieme Medical Publishers, Inc.; 1995.
233. Lurje A. On the topographical anatomy of the internal maxillary artery. *Acta Anat (Basel)* 1946; **2**(3-4): 219-31.
234. Dumitru CC, Rusu MC, Vrapciu AD. Maxillary Artery Traversing Through the Temporal Muscle. *J Craniofac Surg* 2024; **35**(3): e273-e4
235. Bhrany AD, Izzard M, Wood AJ, Futran ND. Coronoidectomy for the treatment of trismus in head and neck cancer patients. *Laryngoscope* 2007; **117**(11): 1952-6.
236. Gupta H, Tandon P, Kumar D, et al. Role of coronoidectomy in increasing mouth opening. *Natl J Maxillofac Surg* 2014; **5**(1): 23-30.
237. Robiony M, Casadei M, Costa F. Minimally invasive surgery for coronoid hyperplasia: endoscopically assisted intraoral coronoidectomy. *J Craniofac Surg* 2012; **23**(6): 1838-40.
238. Kothari MC, Hallur N, Sikkerimath B, Gudi S, Kothari CR. Coronoidectomy, masticatory myotomy and buccal fat pad graft in management of advanced oral submucous fibrosis. *Int J Oral Maxillofac Surg* 2012; **41**(11): 1416-21.
239. Rahpeyma A, Khajehahmadi S. Maxillary artery based flaps for oral cavity reconstruction, a review. *Ann Med Surg (Lond)* 2017; **20**: 32-6.
240. Smith JE, Ducic Y, Adelson RT. Temporalis muscle flap for reconstruction of skull base defects. *Head Neck* 2010; **32**(2): 199-203.
241. Cordeiro PG, Wolfe SA. The temporalis muscle flap revisited on its centennial: advantages, newer uses, and disadvantages. *Plast Reconstr Surg* 1996; **98**(6): 980-7.
242. Orbay H, Kerem M, Unlu RE, Comert A, Tuccar E, Sensoz O. Maxillary artery: anatomical landmarks and relationship with the mandibular subcondyle. *Plast Reconstr Surg* 2007; **120**(7): 1865-70.
243. Rusu MC, Dumitru CC, Vrapciu AD. The Maxillary Artery Loops Dangerously Approaching the Mandible's Lingula and Inferior Orbital Fissure. *J Craniofac Surg* 2024; **35**(2): e193-e5.
244. Rusu MC, Dumitru CC, Vrapciu AD. Superior laryngeal artery originating from the lingual artery. *Surg Radiol Anat* 2024; **46**(5): 665-8.
245. Fujimura K, Segami N, Kobayashi S. Anatomical study of the complications of intraoral vertico-sagittal ramus osteotomy. *J Oral Maxillofac Surg* 2006; **64**(3): 384-9.
246. Balcioglu HA, Kilic C, Varol A, Ozan H, Kocabiyik N, Yildirim M. A Morphometric Study of the Maxillary Artery and Lingula in Relation to Mandibular Ramus Osteotomies and TMJ Surgery. *Eur J Dent* 2010; **4**(2): 166-70.