

# Facial Vein Variation: a Cadaveric Study

ORIGINAL

Humberto Ferreira-Arquez<sup>1</sup>

<sup>1</sup> Professor Human Morphology, Medicine Program, University of Pamplona. Morphology Laboratory Coordinator, University of Pamplona.

## Abstract

**Background:** The veins of the head and neck have a complex developmental pattern which predisposes them to variations in formation and drainage. Superficial veins of the head and neck are utilized for central venous cannulation, oral reconstruction and parenteral nutrition in debilitated patients. Clinical and sonological examinations of these veins may provide clues toward underlying cardiac pathology.

**Aims:** The aim of the present study was to describe anatomical variation and determined the position of the facial vein in relation to neighboring structures.

**Methods and Findings:** Head and neck region were carefully dissected as per standard dissection procedure, studied serially during the years 2013-2017 in 16 males and 2 females, i.e. 36 sides, embalmed adults cadavers with different age group, in the laboratory of Morphology of the University of Pamplona. In 34 sides (94.5%) of the cases the facial vein (FV) terminated into the internal jugular vein via the common facial vein (CFV) as per standard anatomic description. The facial vein on two sides (5.5%) was found to drain into the external jugular vein with different degree of angulations and variable distance from the angle of the mandible. On the right side, the facial vein was draining into external jugular vein (EJV), 63.6 mm below the angle of the mandible. On the left side, the facial vein was draining into EJV, 42.4 mm below the angle of the mandible. The length of the neck was 137.8 mm. The mean distance of the superior and inferior labial veins, deep facial vein, and angular vein from the inferior orbital margin was  $41.89 \pm 3.01$ ,  $52.31 \pm 3.72$ ,  $26.85 \pm 3.55$  and  $6.25 \pm 0.65$  mm, respectively.

**Conclusion:** A sound knowledge on variation of the course and termination of facial vein is very useful for oral and maxillofacial sur-

## Contact information:

Humberto Ferreira-Arquez.

**Address:** University Campus, Kilometer 1. Via Bucaramanga. Pamplona. Norte de Santander, Colombia, Suramérica.

**Tel:** 75685667.

 [humfear@unipamplona.edu.co](mailto:humfear@unipamplona.edu.co)

geons, plastic surgeons, otorrhinologists and radiologists, is essentially important in the clinical examination and surgical procedures of the head and neck region.

### Keywords

Anatomical Variation; Facial Vein; External Jugular Vein.

## Introduction

The veins of the head and neck have a complex developmental pattern which predisposes them to variations in formation and drainage. Usually, the anterior facial vein begins at the medial angle of the eye as the angular vein, formed by the union of the supratrochlear and the supra-orbital veins. The superficial temporal vein unites with the maxillary vein to form the retromandibular vein. The retromandibular vein divides into the anterior and the posterior divisions within the substance of the parotid gland. The anterior division joins with the anterior facial vein to form the common facial vein and it drains into the internal jugular vein. The posterior division, after union with the posterior auricular vein, continues as the external jugular vein which drains into the subclavian vein [1].

The external jugular vein is used for cannulation to conduct diagnostic procedures or intravenous therapies. The external jugular vein may give a reliable estimate of central venous pressure. During superficial parotidectomy and open reduction of mandibular condylar fractures, the retromandibular vein is used as a guide to expose the facial nerve branches [2]. The practice of modern-day medicine has created new needs. One of these is the necessity to access the circulation, which is needed in diverse groups of patients. On the one hand are patients with multiple organ failure whose care requires monitoring of vital functions and body chemistry, while at the other end of the spectrum are those on therapy,

such as hemodialysis, home parenteral nutrition and drug infusion. In short, countless lives depend on temporary or permanent access to the circulation. To make an appropriate choice for each patient's needs, the clinician must be familiar with the many veins available. The majority of venous catheters are percutaneously inserted using anatomic landmarks, and the success of their placement depends on the vein being in the expected position, its caliber and patency [3]. Superficial veins of the head and neck are utilized for central venous cannulation, oral reconstruction and parenteral nutrition in debilitated patients. Clinical and sonological examination of these veins may provide clues toward underlying cardiac pathology [4, 5].

When pedicle skin flaps are raised, partial necrosis due to congestion is an important complication. Knowledge of the arterial anatomy is not only important when considering the design of a skin flap, but it is also necessary to consider the venous anatomy to avoid complications related to congestion. With regard to pedicle skin flaps on the face, forehead flaps have featured in most reports on complications associated with congestion, and there have been some reports on the venous anatomy of the forehead region and procedures for designing skin flaps [6]. The aim of the present study was to describe an anatomical variation and determine the position of the facial vein in relation to neighboring structures.

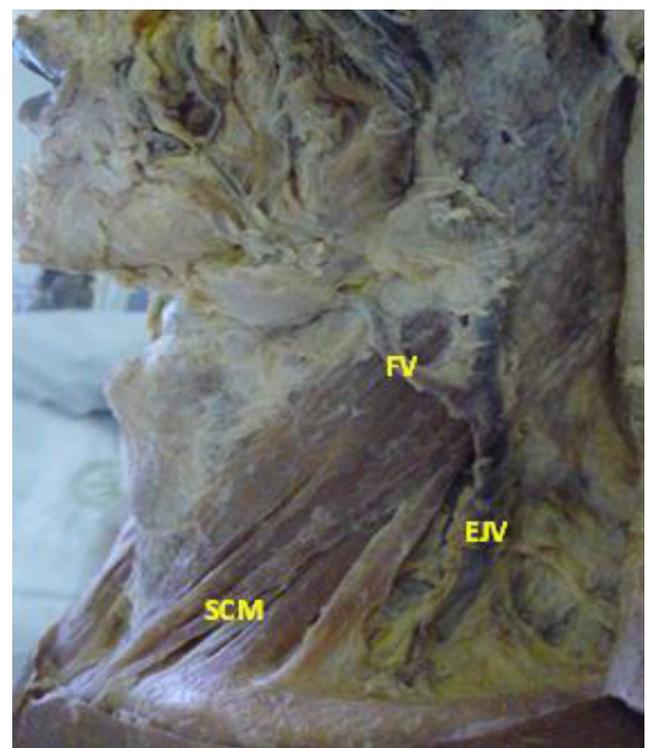
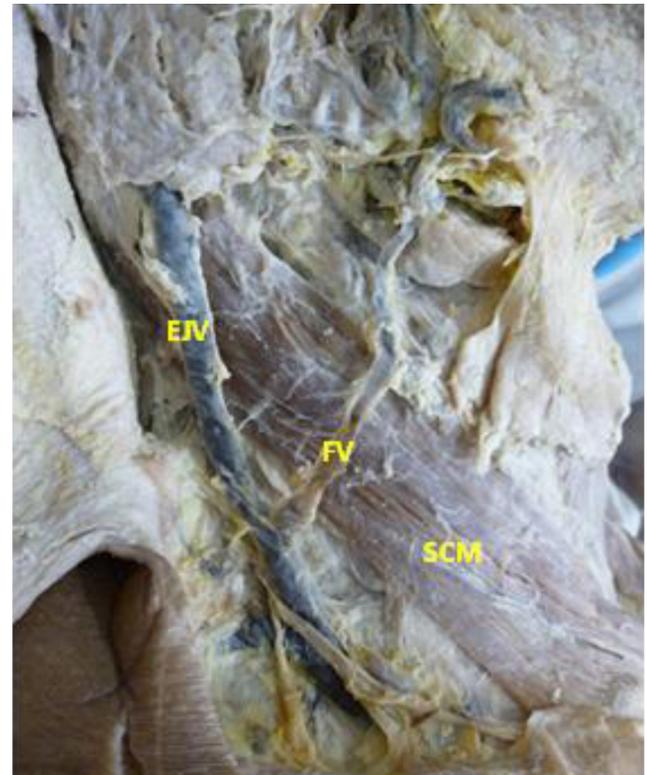
## Methods

This work was previously approved by the Ethics Committee in Research and Environmental Impact of the University of Pamplona, conformed by resolution 030 of January 16 of 2014 and Resolution No. 008430 of 1993 of October 4 of the Ministry of Health of Republic of Colombia which regulates the scientific, technical and administrative norms for health research. This descriptive cross-over study was designed to determine the morphologic features and anatomical variations of the facial vein. Head and neck region were carefully dissected as per standard dissection procedure, studied serially during the years 2013-2017 in 16 male and 2 females, i.e. 36 sides, embalmed adults cadavers with different age group, in the laboratory of Morphology of the University of Pamplona. None of the cadavers utilized for the present study had previous facial surgery or any relevant disease affecting the integrity of the facial anatomy. The cadavers had no trace of scars, adhesions or signs of trauma. This study was carried out by routine dissection classes for undergraduate medical students. Measurements were taken with assistance of a sliding Vernier caliper with an accuracy of 0.01 mm during the course of the anatomical dissection. The bony landmarks employed were the angle of the mandible and the midclavicular point. The data thus obtained were recorded in a physical matrix and were consigned in digital media using Excel tables. Topographic details of the variations were examined, recorded and photographed.

## Results

In 34 sides (94.5%) of the cases the facial vein (FV) terminated into the internal jugular vein via the common facial vein (CFV) as per standard anatomic description. The facial vein on two sides (5.5%) was found to drain into the external jugular vein with different degree of angulations and variable distance from the angle of the mandible. A typical

**Figure 1:** Superficial dissection on the right and left side of the neck region in same cadaver showing.



SCM: Sternocleidomastoid Muscle; FV: Facial Vein, EJV: External Jugular Vein.

Y-shaped pattern of veins was seen on the right and the left (bilateral). **Figure 1.**

In all the cadavers studied the EJV was formed as usual by joining of posterior auricular and posterior division of retromandibular vein. EJV started at the apex or lower pole of the parotid gland, within its substance as it lay in the carotid triangle, at about the angle of the mandible, and took a vertical course. The external jugular vein (EJV) terminated in the subclavian vein (SCV). On the right side the facial vein draining into EJV, 63.6 mm below the angle of the mandible. On the left side the facial vein draining into EJV, 42.4 mm below the angle of the mandible. The length of the neck was 137.8 mm.

In all the cases studied the facial vein was identified posterior to the facial artery and deep to the marginal mandibular branch of the facial nerve. The facial vein was identified to cross the mandible at the anterior margin of the masseter muscle. A 2.09 - 112 mm overlap was measured between the most anterior attachment of the masseter muscle and the facial vein.

From the inferior margin of the orbit: The facial vein, the inferior and superior labial veins branched off; a mean distance of  $41.89 \pm 3.01$  mm for the superior labial vein and  $52.31 \pm 3.72$  mm for the inferior labial vein, the facial vein gave off in a posterior direction, the deep facial vein at a mean distance of  $26.85 \pm 3.55$  mm. The distance between the angular vein and the inferior orbital margin was of  $6.25 \pm 0.65$  mm.

In all the cases studied the angular vein gave off the external nasal vein in an inferior direction, which ran in the medial boundary of the premaxillary space. The angular vein was attached by means of the dorsal nasal vein to the contralateral side at the level of the root of the nose. At the level of the superior orbital edge, the angular vein joined with the superior ophthalmic vein, which ran within the superior portion of the orbit. The angular vein collected blood from supratrochlear and supraorbital venous branches and from the central frontal veins. The

facial vein, the supratrochlear vein, and the frontal branch of the superficial temporal vein connected to each other with no decrease in diameter, and formed a loop with the top located below the corrugator supercilii and orbicularis oculi muscles.

## Discussion

The development of the veins of the face, scalp and neck has not been clearly understood, nor has the cause of the variations. The principal cephalic vein formed early in embryonic life disappears, necessitating the formation of venous spaces which connect and form channels leading to the origin of the facial and pharyngeal veins [7]. Their enlargement at some places and diminution at others results in a retiform arrangement. Some primitive channels evolve and enlarge to form definitive ones [8]. Two main venous channels have been observed in this region in an embryo of 5 mm length. The first to appear is the ventral pharyngeal vein. (VPV) draining the rapidly growing mandibular and hyoid arches into the common cardinal vein. The formation and elongation of the neck in a 10 mm embryo results in a VPV terminating into the pre-cardinal vein, the latter forming the internal jugular vein (IJV) [9]. VPV extends its drainage and receives tributaries from tongue and face and is now called the linguofacial vein (LFV) [7]. The second venous channel is located more cranial and lateral to the VPV. It is the primitive maxillary vein (PMV) draining the area supplied by the trigeminal nerve. These two primitive channels anastomose and the LFV is now known as the facial vein. The retromandibular vein (RMV) from the temporal region drains into the FV, the common trunk of which is the common facial vein (CFV), which empties into the IJV. The cranio-dorsal loop of the jugulocephalic vein posterosuperior to the developing clavicle secondarily forms the EJV when the embryo is about 22 mm long [10, 11]. How and when in embryonic life the lingual branch of the linguofacial trunk separates

from this trunk and transfers itself to the IJV is not explained by any author. In adults the lingual vein drains into the IJV. It terminated near the tip of the greater cornu of the hyoid bone after crossing the common carotid artery [12].

The embryologic explanation of drainage of the FV into the EJV may be explained with basis in the 40 mm embryo the EJV at its cranial end has two important venous connections in the face. The anterior connection is with the FV and the posterior connection with the RMV. The developing EJV thus annexes essentially the major tributaries of the CFV. This process is always found in the 40 mm embryo (Stage 7) but sometimes occurs earlier, i.e., at 22 mm length (Stage 6). In the normal course of development the entire anterior connection retrogresses and the posterior connection forms the posterior division of the RMV. The FV thus drains into the IJV via the CFV. However, if the anterior connection persists, it becomes the main drainage channel while on the other hand the terminal parts of the FV, RMV and the entire CFV retrogress. The posterior connection receives the posterior auricular vein (PAV) to form the EJV; thus the entire RMV becomes the other formative tributary in all such cases. The CFV as a tributary of the IJV is a constant feature in mammals and other vertebrates except certain primates, as confirmed by extensive investigations in rabbits [12, 13].

The various modes of formation of the EJV have classically been described and illustrated with special reference to the FV being a major tributary, presenting as Y, U and N shapes [14-16]. As in the present study, researchers found the Y-shaped pattern to be the dominant one; they also showed a bilateral presentation [15, 17], but have not further sub-typed this anomaly. In addition a U-shaped pattern with connection to the AJV forming an N-shaped and a stepladder appearance has been depicted. The two channels of the latter, however, drained into the SCV separately, which had a common stem [3].

Anatomical variations of the facial veins and arteries are of great importance for facial transplantations because they are the main vascular pedicles that will be connected to the patient. A good arterial inflow and venous outflow are essential for the free flap survival. Several authors recommend preoperative investigations in a brain-dead donor before performing any facial transplantation [18].

Knowledge of the anatomy of the facial vasculature and its most relevant clinical applications is crucial for a plethora of surgical and minimally invasive procedures in the face. Access pathways, pedicled and free flap transfer, and explantation and transplantation of total faces are based on the proper assessment and use of the facial veins and arteries. With the increasing popularity of volumizing facial procedures for rejuvenating purposes, the understanding of the facial fat compartments is essential for long-lasting and safe applications [19]. The facial vein has been previously shown to form the lateral boundary of the deep medial cheek fat [20-23], the lateral boundary of the pre-maxillary space (containing the deep nasolabial fat compartment) [24,25], and the medial boundary of the sub-orbicularis oculi fat [20, 26]. This pivotal role of the facial vein as a hallmark structure in the face is of great importance when trying to understand the detailed anatomy of the facial fat compartments and to avoid complications. Of those, irreversible blindness resulting from filler or autologous fat transfer procedures is considered the most dangerous one [19, 27].

The external jugular vein is a peripheral vein that does neither generally collapse (the patient being in Trendelenburg's position), nor does it become thrombosed. It may represent the extreme solution when the patient requires a peripheral venous access and the other veins are useless. It can also be used for administering non-sclerosing agents. In order to avoid any minor or major complications in dealing with these veins, a safe central venous access is preferred, by sectioning the external jugu-

lar, a method that can be used both during medullar transplant and in parenteral nutrition and chemotherapy treatment [28, 29]. Youngberg, (1982) described that the pulmonary artery catheterization via external jugular vein is safe and reliable [30]. Facial vein acts as draining site of shunt procedure involving lateral ventricle in hydrocephalus surgery. The common facial veins are used as a patch material for carotid endarterectomies [1, 3, 28].

## Conclusion

A sound knowledge on variation of the course and termination of facial vein is essential for avoiding unnecessary bleeding during radical neck dissection surgeries and also effective usage of these veins for grafting, safe elevation of several flaps, including the degloving flap employed in craniofacial surgery involving microvascular anastomosis especially in oral reconstruction procedures and has immense clinical importance for clinical and diagnostic procedures in the face and neck region.

## Acknowledgement

The author thanked to the University of Pamplona for research support and/or financial support; at National Institute of Legal Medicine and Forensics Sciences and Erasmo Meoz University Hospital in Cucuta, North of Santander, Colombia for the donation of cadavers identified, unclaimed by any family, or persons responsible for their care, process subject to compliance with the legal regulations in the Republic of Colombia.

## Competing interests

None

## Fundings

This study was supported by University of Pamplona.

## References

1. Bertha A, Rabi S. Anatomical Variations in Termination Of Common Facial Vein. *J Clini Res.* 2011; 5(1):24-7. Available from: [http://www.jcdr.net/articles/pdf/1174/1592\\_1554\\_E\(C\)\\_F\(J\)\\_R\(S\)\\_PF\(A\)\\_P\(24-27\)\\_LowRes.pdf](http://www.jcdr.net/articles/pdf/1174/1592_1554_E(C)_F(J)_R(S)_PF(A)_P(24-27)_LowRes.pdf)
2. Abhinitha P, Rao MKG, Kumar N, Nayak SB, Ravindra SS, Aithal PA. Absence of external jugular vein and an abnormal drainage pattern in the veins of the neck- a case report. *OA Anatomy.* 2013; 1(2): 15. Available from: <http://www.oapublishinglondon.com/article/577>
3. Gupta V, Tuli A, Choudhry R, Agarwal S, Mangal A. Facial vein draining into external jugular vein in humans: its variations, phylogenetic retention and clinical relevance. *Surg Radiol Anat.* 2013; 25: 36-41. Available from: <https://link.springer.com/article/10.1007/s00276-002-0080-z>
4. Ferreira- Arquez H. Unusual venous drainage of the head and neck. *Int J Pharm Bio Sci.* 2014 Oct; 5(4): (B) 965-70. Available from: [http://www.ijpbs.net/cms/php/upload/3710\\_pdf.pdf](http://www.ijpbs.net/cms/php/upload/3710_pdf.pdf)
5. Ferreira-Arquez H. Variaciones anatómicas en el drenaje venoso del cuello. *Rev CES Med.* 2016; 30(2): 238-43. Available from: <http://revistas.ces.edu.co/index.php/medicina/article/view/3187/2685>
6. Onishi S et al. Venous drainage of the face. *J Plast Reconstr Aesthet Surg.* 2017; 70(4):433-40. Available from: <http://www.sciencedirect.com/science/article/pii/S1748681516305514>
7. Frazer JE. *A manual of embryology: The development of the human body.* London: Baillière Tindall and Cox, 1931.
8. Romanes GJ. *Cunningham's textbook of anatomy.* 12th edn. London: Cumberlege Oxford University Press, 1981.
9. Markowski J. Ueber die Entwicklung der Sinus durae matris und der Hirnvenen bei menschlichen Embryonen von 15.5-49 mm Scheitel-Steisslänge. *Juillet: Bull Acad Sci Cracovie,* 1911.
10. Brook WH, Smith CJD. Clinical presentation of a persistent jugulocephalic vein. *Clin Anat.* 1989; 2: 167-73. Available from: <http://onlinelibrary.wiley.com/doi/10.1002/ca.980020306/pdf>
11. Padget DH. The development of the cranial venous system in man, from the viewpoint of comparative anatomy. *Contr Embryol.* 1957; 247: 79-140. Available from: <https://embryology.med.unsw.edu.au/embryology/index.php/Paper>
12. Choudhry R, Tuli A, Choudhry S. Facial vein terminating in the external jugular vein: an embryologic interpretation. *Surg Radiol Anat.* 1997; 19: 73-7. Available from: <https://link.springer.com/article/10.1007/BF01628128>
13. Lewis FT. The intra-embryonic blood-vessels of rabbits embryos from 8 to 13 days. *Am J Anat* 3: 12-13 (*Proc Am Asst Anat*) (1904) as quoted by Keibel F, Mall FP (1912) *Manual of human embryology*, vol 2. London: Lippincott Philadelphia, 1906.

14. Krmpotic-Nemanic J, Draf W, Helms J. Surgical anatomy of head and neck. New York: Springer, Berlin Heidelberg, 1989.
15. Pikkieff E. On subcutaneous veins of the neck. *J Anat.* 1937; 74: 119-27. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1252446/pdf/janat00526-0142.pdf>
16. Tandler J. Das Gefäß-System. Lehrbuch der systematischen Anatomie, vol 3. Leipzig: Vogel, 1926.
17. Jansky M, Plucnar B, Svoboda Z. Beitrag zum Studium von Varietäten der subkutanen Halsvenen des Menschen. *Acta Anat.* 1959; 37: 298-310. Available from: <https://www.karger.com/Article/PDF/141476>
18. Bondaz M, Ricard AS, Majoufre-Lefebvre C, Caix P, Laurentjoye M. Facial vein variation: implication for facial transplantation. *Plast Reconstr Surg Glob Open.* 2014 Aug 7; 2(7):e183. Available from: [http://journals.lww.com/prsgo/Citation/2014/07000/Facial\\_Vein\\_Variation\\_Implication\\_for\\_Facial.13.aspx](http://journals.lww.com/prsgo/Citation/2014/07000/Facial_Vein_Variation_Implication_for_Facial.13.aspx)
19. Cotofana S, Steinke H, Schlattau A, Schlager M, Sykes JM, Roth MZ, Gaggl A, Giunta RE, Gotkin RH, Schenck TL. The Anatomy of the Facial Vein: Implications for Plastic, Reconstructive, and Aesthetic Procedures. *Plast Reconstr Surg.* 2017 Jun; 139(6):1346-53. Available from: <https://ucdavis.pure.elsevier.com/en/publications/the-anatomy-of-the-facial-vein-implications-for-plastic-reconstru>
20. Wong CH, Mendelson B. Facial soft-tissue spaces and retaining ligaments of the midcheek: Defining the premaxillary space. *Plast Reconstr Surg.* 2013; 132:49–56. Available from: [http://journals.lww.com/plasreconsurg/Abstract/2013/07000/Facial\\_Soft\\_Tissue\\_Spaces\\_and\\_Retaining\\_Ligaments.9.aspx](http://journals.lww.com/plasreconsurg/Abstract/2013/07000/Facial_Soft_Tissue_Spaces_and_Retaining_Ligaments.9.aspx)
21. Rohrich RJ, Pessa JE. The fat compartments of the face: Anatomy and clinical implications for cosmetic surgery. *Plast Reconstr Surg.* 2007; 119:2219-27. Available from: [http://journals.lww.com/plasreconsurg/documents/updates\\_in\\_aesthetic\\_surgery\\_0512\\_article.7.pdf](http://journals.lww.com/plasreconsurg/documents/updates_in_aesthetic_surgery_0512_article.7.pdf)
22. Cotofana S, Schenck TL, Trevidic P, et al. Midface: Clinical anatomy and regional approaches with injectable fillers. *Plast Reconstr Surg.* 2015; 136(Suppl):219S–234S. Available from: <https://ucdavis.pure.elsevier.com/en/publications/midface-clinical-anatomy-and-regional-approaches-with-injectable->
23. Gierloff M, Stöhring C, Buder T, Wiltfang J. The subcutaneous fat compartments in relation to aesthetically important facial folds and rhytides. *J Plast Reconstr Aesthet Surg.* 2012; 65:1292–97. Available from: <http://www.sciencedirect.com/science/article/pii/S1748681512002550?via%3Dihub>
24. Nagase T, Kobayashi S, Sekiya S, Ohmori K. Anatomic evaluation of the facial artery and vein using color Doppler ultrasonography. *Ann Plast Surg.* 1997; 39:64–7. Available from: [http://journals.lww.com/annalsplasticsurgery/Abstract/1997/07000/Anatomic\\_Evaluation\\_of\\_the\\_Facial\\_Artery\\_and\\_Vein.11.aspx](http://journals.lww.com/annalsplasticsurgery/Abstract/1997/07000/Anatomic_Evaluation_of_the_Facial_Artery_and_Vein.11.aspx)
25. Pils U, Rosmarin W, Anderhuber F. The premaxillary space: A location for filler injection? *Dermatol Surg.* 2014; 40: 301-4.
26. Mendelson BC, Muzaffar AR, Adams WP Jr. Surgical anatomy of the midcheek and malar mounds. *Plast Reconstr Surg.* 2002; 110:885–96. Available from: [https://pdfs.semanticscholar.org/bed1/1890ea4fcfe48574f277f31f925262a1b5f2.pdf?\\_ga=2.255684672.915328937.1507562679-644639894.1507562679](https://pdfs.semanticscholar.org/bed1/1890ea4fcfe48574f277f31f925262a1b5f2.pdf?_ga=2.255684672.915328937.1507562679-644639894.1507562679)
27. Beleznav K, Carruthers JD, Humphrey S, Jones D. Avoiding and treating blindness from fillers: A review of the world literature. *Dermatol Surg.* 2015; 41: 1097-117. Available from: <https://www.semanticscholar.org/paper/Avoiding-and-Treating-Blindness-From-Fillers-A-Rev-Beleznav-Carruthers/f4ddf17632ca9f55e14b4e3d6bbf10dd08724fae>
28. Selvi P, Kumar S. Variations in the venous drainage pattern of face and neck. *Int J Pharm Bio Sci.* 2013 Oct; 4(4): (B) 150-4. Available from: [http://www.ijpbs.net/cms/php/upload/2804\\_pdf.pdf](http://www.ijpbs.net/cms/php/upload/2804_pdf.pdf)
29. Vaida MA, Niculescu V, Motoc A, Bolinteanu S, Sargan I, Niculescu MC. Correlations between anomalies of jugular veins and areas of vascular drainage of head and neck. *RJME.* 2006; 47(3):287–89. Available from: <http://www.rjme.ro/RJME/resources/files/470306287290.pdf>
30. Youngberg JA. Pulmonary artery catheterization via external jugular vein. *South Med J.* 1982; 75(3):289-90. Available from <https://www.ncbi.nlm.nih.gov/pubmed/7>

### Publish in International Archives of Medicine

International Archives of Medicine is an open access journal publishing articles encompassing all aspects of medical science and clinical practice. IAM is considered a megajournal with independent sections on all areas of medicine. IAM is a really international journal with authors and board members from all around the world. The journal is widely indexed and classified Q2 in category Medicine.