"OVIDIUS" University of Constanţa
Doctoral School of Medicine
Field: Medicine

MORPHOLOGY OF OPHTHALMIC ARTERY

ABSTRACT OF Ph. D. THESIS

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CONSTANŢA
2021

INTRODUCTION

The ophthalmic artery is intended for the eye, its appendages contained in the orbital cavity, the eyelids, the soft parts of the eyebrow and frontal regions, a portion of the mucosa of the nasal fossae and ethmoid cells. It is the major collateral branch of the internal carotid artery and has numerous anastomoses, between its own collateral branches and the external carotid system. The latter are performed both at the level of the collateral branches and at the terminal level, through the facial, temporal superficial and especially maxillary arteries, anastomoses located at the level of the orbit, nasal fossae, face and eyelids [Ducasse].

According to [Testut], the ophthalmic artery, although it has a small caliber at the origin, gives a large number of collateral branches in relation to the volume of the trunk of origin, but explicable by the number of organs it vascularizes.

It has a special importance in the vascularization of the eyeball and its appendages, being the main artery of these organs, according to [Moore], intervening in various and less serious diseases (inflammation of the eyelid glands, conjunctival hyperemia, subconjunctival hemorrhages, uveitis, etc.), but also in severe diseases (hemorrhage from the anterior chamber of the eye, occlusion of the central artery and vein of the retina, as well as in various benign but especially malignant tumors).

[Raoul] states that neuroradiological imaging allows the visualization of increasingly fine structures with a precision close to that obtained by anatomical dissection. But the ophthalmic artery is an arterial element that is difficult to highlight due to its small caliber, the very sinuous arterial trajectory and the multiple collaterals it gives. All these considerations lead [Ducasse] to state that the ophthalmic artery has a great variability, which makes any systematization of it difficult. This explains the contradictions that exist among different authors or the contradictions that exist between authors and Anatomical Terminology, regarding the morphology of the ophthalmic artery.

The thesis is a study of fundamental medical scientific research, and it is known that without fundamental research, which means knowledge, there can be no applied research and no correct surgical therapy. The studies have an important role in the development of new investigations and therapies, the normal results

obtained from the undertaken research serving as a term to assess the anatomical vascular changes (morphometry, branching, trajectory), occurring in various organic diseases. These are the reasons why I chose the ophthalmic artery as a subject of study, wanting to complete the knowledge about this artery incompletely described in the literature.

PURPOSE OF THE PAPER

The normal morphological study of the ophthalmic artery from its origin to its completion, appreciating its morphometry (the caliber of the ophthalmic artery and its branches, especially the dorsal artery of the nose), these measurements being made comparatively right and left by sex; the size of the ophthalmic trunk was also compared with the diameter of the internal carotid artery, below and above the ophthalmic artery. The arterial trajectory and the relationships of the main trunk were studied, and the ophthalmic-facial anastomosis was especially studied among the anastomoses.

I mention that the personal results were capitalized by the publication of two articles “in extenso”: one “Considerations on the origin of the ophthalmic artery from the internal carotid artery”, in “Ars Medica Tomitana”, 2018, 4 (24): 179-183, a BDI cataloged magazine; the second article, “Morphological characteristics of the ophthalmic-facial anastomosis” in “Romanian Journal of Functional and Clinical, Macro and Microscopic Anatomy and Anthropology” 2019, XVIII (2): 71-75, a B+ cataloged magazine. I also mention a paper communicated at the Congress of French Morphology in 2019 in Reims and published in abstract in the volume of abstracts of the congress: „La morphométrie de l’artère ophtalmique en comparaison de l’artère carotide interne”.

I want to thank all those who helped me in writing my Ph. D. thesis: the general manager of the Medimar Imaging Center, the dean of the Faculty of Medicine Constanta, members of the anatomy subject, especially to Mr. s.l. Bulbuc Ionuţ, who helped me select the imagery and Mr. Ionescu Constantin, who helped me in the technical editing of the thesis. Last but not least, I thank Prof.Univ.Dr. Bordei Petru, the scientific supervisor of the Ph. D. thesis, who guided me and from whose advice I benefited throughout the realization of the Ph. D. thesis.

MATERIAL AND WORK METHODS

The study performed on the ophthalmic artery and its larger collateral branches, consists in following some anatomical characteristics of these vessels related to their morphology: origin, trajectory, morphometry. The origin of the ophthalmic artery was studied in relation to the segment of the internal carotid artery and in relation to the level (in millimeters) of the completion of the corresponding internal carotid artery. Morphometric results (diameter, length) were compared with each other (right/left), but also with gender morphometry, the anatomical characteristics being presented on the total number of cases, but also in relation to the sex of the explored individual. The diameter of the ophthalmic artery at its origin in the internal carotid artery was studied in comparison with the diameter of the corresponding internal carotid artery, both above and below the origin of the ophthalmic artery, both in millimeters and as a percentage.

A more detailed study was performed on ophthalmic-facial anastomosis and anastomosis between the dorsal arteries of the nose.

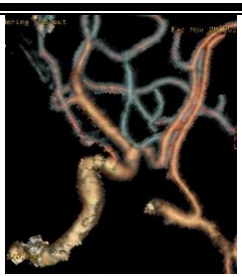
The anatomical landmarks followed were determined on a characteristic number of cases, seeking to be the same number of cases or a number as close as possible between the arteries of the two sexes or between the right and left arteries.

The results obtained were also expressed graphically, and the comparisons during the discussions were presented in explicit tables.

My study was mostly performed on the tomography computer (General Electric Brightspeed Select 16 slice), existing in the radiology clinic "Medimar Imagistic Services SRL" of the Emergency Clinical Hospital "St. Andrei" from Constanţa, totaling a number of 189 cases, making over 1500 images.

Only angiographies that did not show pathological signs were studied, my study representing fundamental medical scientific research, which does not require a referral diagnosis for the holders of the angiographies.

TABEL No. 1. WORK METHODS USED

No.	METHOD	No. OF CASES	PHOTO
1.	CT	189	
2.	OCT	22	
	Total	**211**	

For the study of angiographies, I had the approval of the general manager of the Medimar Imaging Center within the Emergency Clinical Hospital "St. Apostle Andrei, dr. Bărdaş Mariana, to consult the existing archive in the clinic she owns and runs. I did not need the confirmed consent of the applicant, because when performing angiography, the applicant signs an information note on the processing of personal data, agreeing that the investigations be used for the transmission of CAS, as well as for scientific research.

On a smaller number of cases (22 cases), for the study of the fundus (central retinal artery and its branches), I obtained images on an optical coherence tomograph (OCT), Optopol brand, Revo Nx model (OCT Optopol Revo Nx), of Polish manufacture, personal property, which I have at the ophthalmology office.

PERSONAL RESULTS AND DISCUSSIONS

ORIGIN OF OPHTHALMIC ARTERY

All the cases of ophthalmic arteries described by me originated in the internal carotid artery, at the level of the posterior part of the carotid segment II, which angiographically corresponds to segment VI (after the exit of the carotid artery from the cavernous sinus). In 82% of cases, the origin of the ophthalmic artery was located at a distance of 0.1-3.0 mm from the cavernous sinus, in the rest of the cases the origin of the ophthalmic artery in the internal carotid artery was at a distance of over 3 mm (3,01-5,0 mm).

In the literature, the origin of the ophthalmic artery in the internal carotid artery is described in relation to the number and orientation of the corresponding internal carotid artery segments.

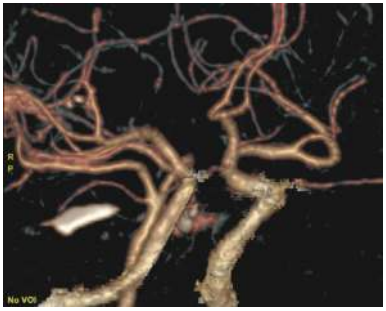


Fig. 12. Origin of ophthalmic arteries, right and left, in the second segment of the internal carotid artery.

LEVEL OF ORIGIN OF THE OPHTHALMIC ARTERY IN RELATION TO THE END OF THE INTERNAL CAROTID ARTERY

I followed the level of origin of the ophthalmic artery in relation to the end of the internal carotid artery from which it originated, on a number of 44 cases, finding it located between 10.2-21.9 mm, the difference between the extreme values being 11.7 mm.

Chart no. 1. Level of origin of the ophthalmic artery in relation to the end of the internal carotid artery.

At the level of the left arteries, on 22 cases (50% of cases), the origin of the ophthalmic artery in relation to the end of the internal carotid artery was located at 11.1-17.4 mm, and ***at the level of the right arteries,*** also on a number of 22 of cases (50% of cases), the origin of the ophthalmic artery in relation to the end of the internal carotid artery was located at 10.2-21.9 mm.

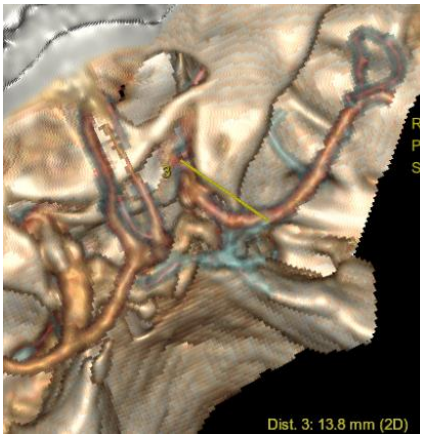


Fig. 13. The distance between the origin of the right ophthalmic artery and the end of the right carotid artery is 13.8 mm (males).

In males, I followed the level of the origin of the ophthalmic artery in relation to the end of the internal carotid artery from which it originated, on a number of 24 cases, finding it located between 10.2-21.9 mm.

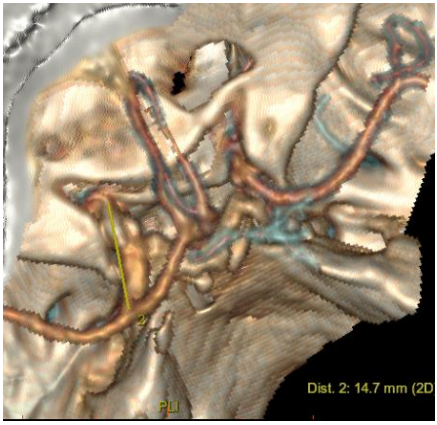


Fig. 14. The distance between the end of the left internal carotid artery and the origin of the left ophthalmic artery is 14.7 mm (females).

In females, I found the level of the origin of the ophthalmic artery in relation to the end of the internal carotid artery followed in 20 cases, located between 11.1-21.9 mm.

At the level of the left ophthalmic arteries, on 10 cases, the origin of the ophthalmic artery was located at 11.3-15.2 mm, and

at the level of the right arteries, also on a number of 10 cases at 11.1-15.0 mm.

The greatest distance of the origin of the ophthalmic artery from the end of the corresponding internal carotid artery (21.9 mm), was found in one case (2.27% of cases), the next distance being 17.4 mm, met also in one case. ***At the level of the left ophthalmic artery, the greatest distance*** of the origin of the ophthalmic artery from the end of the corresponding internal carotid artery (17.4 mm), was found in only one case (4.55% of cases), the next distance being 15.9 mm, the difference between them being 1.5 mm, and ***at the level of the right ophthalmic artery, the largest distance*** (21.9 mm), was also found in one case (4.55% of cases), the next distance being 15.0 mm, the difference between them being 6.9 mm.

The smallest distance of the origin of the ophthalmic artery from the end of the corresponding internal carotid artery (10.2 mm), was found in one case (2.27% of cases), the next distance being 11.1 mm, also met in one case, the difference between them being 0.9 mm.

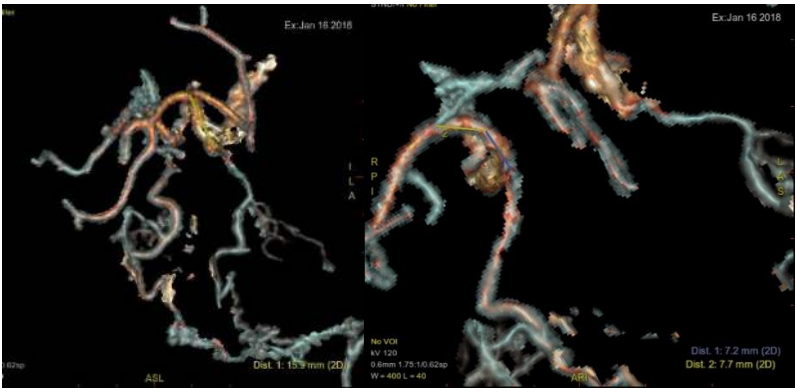
The most frequent, in 20 cases (83.33% of cases), the distance between the origin of the left ophthalmic artery and the end of the corresponding internal carotid artery was between 13.6-15.9 mm.

COMPARISON BETWEEN THE LEVEL OF ORIGIN OF THE OPHTHALMIC ARTERIES, RIGHT AND LEFT, IN RELATION TO THE TERMINATION OF THE CORRESPONDING INTERNAL CAROTID ARTERIES

It was done on a number of 24 cases, 12 cases for each sex (50% of cases). In 16 cases (66.67% of cases), the ***right ophthalmic artery had its origin in the carotid artery closer to its end***, being closer than the origin of the left ophthalmic artery by 0.2-1.5 mm. In 12 cases (75% of cases), the right ophthalmic had its origin closer by 0.2-0.9 mm, and in 4 cases (25% of cases) it was closer by 1.4-1.5 mm.

In 8 cases (33.33% of cases), the ***left ophthalmic artery had its origin in the carotid artery closer to its end***, being closer than the origin of the right ophthalmic artery by 0.2-4.5 mm. In 5 cases (62.5% of cases), the left ophthalmic had its closest origin by

0.2-0.8 mm, in 2 cases (25% of cases) by 1.4-1.5 mm, and in one case (12.5% of cases) by 4.5 mm.



A B

Fig. 15. The distance from the end of the left internal carotid artery to the origin of the left ophthalmic (A: 15.9 mm) is 1 mm longer than the same distance on the right side (B: 14.9 mm), in males.

DIAMETER OF THE INTERNAL CAROTID ARTERY UNDER THE ORIGIN OF THE OPHTHALMIC ARTERY

It was followed on a number of 126 cases, 63 cases (50% of cases) for each internal carotid artery, right and left, finding it between 3.23-5.41 mm, the difference between the extreme values being of 2.18 mm. Distribution by value groups.

The diameter of the left internal carotid artery under the origin of the left ophthalmic artery was found to be between 3.42-5.39 mm, and the ***diameter of the right internal carotid artery*** was found to be between 3.23-5.41 mm. ***The diameter of the left internal carotid artery in males, under the origin of the left ophthalmic artery,*** followed on 32 cases, was found between 3.56-5.39 mm, and ***the diameter of the right internal carotid artery*** was found between 3, 57-5.41 mm.

Fig. 17. The diameter of the internal carotid artery under the origin of the right ophthalmic artery is 5.3 mm (males).

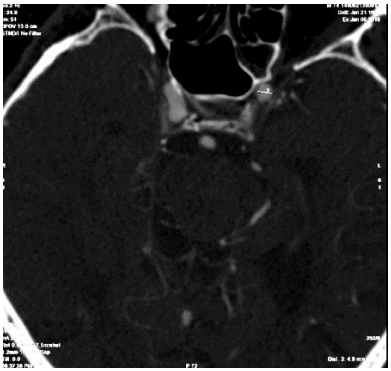


Fig. 18. The diameter of the left carotid artery under the origin of the ophthalmic is 4.9 mm (females).

In females, the diameter of the left internal carotid artery under the origin of the left ophthalmic artery, followed on 31 cases, was found between 3.42-4.97 mm, and ***the diameter of the right internal carotid artery*** was found between 3.23-4.94 mm.

OPHTHALMIC ARTERY MORPHOMETRY

The diameter of the ophthalmic artery at its origin in the internal carotid artery followed on a number of 118 cases, was found between 1.01-2.21 mm.

At the level of the left ophthalmic artery, the diameter followed on a number of 59 cases (50% of the total cases), was found between 1.03-1.91 mm, and ***at the level of the right ophthalmic artery*** was found between 1.01-2.21 mm.

The diameter of the ophthalmic artery at its origin ***in males,*** followed on 60 cases (50.84% of total cases), was found between 1.01-2.21 mm, at the level of the ***left ophthalmic artery*** it was found between 1.03-1.91 mm, and ***at the level of the right ophthalmic artery*** it was found between 1.01-2.21 mm.

Chart no. 15. The diameter of the right ophthalmic artery at the origin.

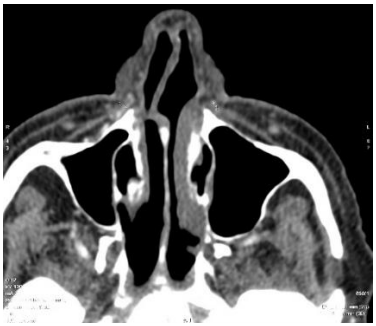


Fig. 23. The diameter of the right ophthalmic artery is 1.1 mm, and the diameter of the left ophthalmic is 1.4 mm, between the two arteries there is a diameter difference of 0.3 mm, diameter of the right ophthalmic artery representing 78.57% of the diameter of the left ophthalmic (males).

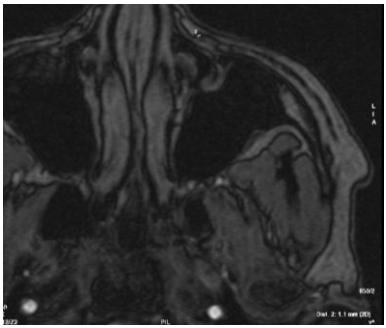


Fig. 26. The diameter of the left ophthalmic artery is 1.1 mm (females).

The diameter of the ophthalmic artery in females, followed on a number of 58 cases (49.16% of the total cases), was found between 1.01-1.83 mm, ***at the level of the left ophthalmic artery*** it was between 1.03-1.79 mm, and ***at the level of the right ophthalmic artery)*** it was between 1.01-1.83 mm.

Fig. 27. The diameter of the right ophthalmic artery is 1.7 mm (females).

DISCUSSIONS

The maximum value of the diameter of the ophthalmic artery was originally found in only one case, both for the left artery (1.91 mm) and for the right artery (2.21 mm), at this artery, between the last and penultimate value of the diameter (1.85 mm), the difference in diameter being 0.36 mm, larger than the same difference in the left ophthalmic artery (0.02 mm), the previous value being 1.89 mm, also in one case. In 109 cases (98.31% of cases), the diameter of the ophthalmic artery was between 1.01-1.89 mm, the most common diameter being between 1.20-1.29 mm, found in 22 cases (18, 64% of cases).

At the level of the left ophthalmic artery, on 59 cases, in 57 cases (96.61% of cases) the diameter was between 1.03-1.79 mm, the most common being 1.20-1.28 mm (in 20.34% of cases), followed by the diameter between 1.41-1.49 mm (in 16.95% of cases). ***At the level of the right ophthalmic artery,*** on 59 cases, in 56 cases (94.92% of cases), the diameter was between 1.01-1.76 mm, the most common being 1.40-1.49 mm (in 16.95% of cases), followed by the diameter between 1.21-1.29 mm (in 15.25% of cases).

In males, the maximum value of the diameter of the ophthalmic artery at origin was found in only one case, both for the left artery (1.91 mm) and for the right artery (2.21 mm), in this artery,

between last and penultimate value of diameter (1.85 mm), the difference in diameter being 0.36 mm, larger than the same difference in the left ophthalmic artery (0.02 mm). ***At the level of the left ophthalmic artery,*** the diameter was between 1.12-1.76 mm, most frequently being 1.20-1.28 mm (in 26.67% of cases), and ***at the level of the right ophthalmic artery*** the diameter was between 1.01-1.69 mm, the most common being 1.21-1.29 mm (in 23.33% of cases).

The smallest diameter of the ophthalmic artery in males was found in 2 cases (6.67% of cases), at the level of the left ophthalmic artery being 1.03 mm, and at the level of the right ophthalmic arteries being 1,01.

In females, on 58 cases, the maximum value of the diameter of the ophthalmic artery at origin was found in one case for the right artery (1.83 mm), and for the left artery (1.79 mm), also in one case, at this artery, between the last and penultimate value of the diameter (1.77 mm), the difference in diameter being 0.02 mm.

In 57 cases (98.28% of cases), the diameter of the ophthalmic artery was between 1.01-1.79 mm, most frequently, in 22.41% of cases) the diameter being between 1.40-1, 49 mm. ***At the level of the left ophthalmic artery***, on 29 cases, in 26 cases (85.66% of cases) the diameter was between 1.03-1.57 mm, the most common being 1.41-1.57 mm (in 39.29% of cases). ***At the level of the right ophthalmic artery***, in females, also on 29 cases, in 27 cases (93.10% of cases), the diameter was between 1.01-1.68 mm, the most common being 1.40- 1.49 mm (in 24.14% of cases).

At the level of the left ophthalmic artery, in females, on 29 cases, in 26 cases (85.66% of cases) the diameter was between 1.03-1.57 mm, the most common being 1.41-1, 57 mm (in 39.29% of cases).

At the level of the right ophthalmic artery, in females, on 29 cases, in 27 cases (93,10% of cases), the diameter was between 1,01-1,68 mm, the most common being 1,40-1,49 mm (in 24,14% of cases).

The smallest diameter of the ophthalmic artery in females was found in a single case (3.45% of female cases), being 1.83 mm (17.86% of cases), at the level of the right ophthalmic artery, and at the level of the right ophthalmic arteries it was 1.77 mm, also in one case.

In the literature, I found the diameter of the ophthalmic artery at the origin of the internal carotid between 0.52-2.20 mm.

TABLE No. 2. DIAMETER OF OPHTHALMIC ARTERY AT ITS ORIGIN IN THE INTERNAL CAROTID ARTERY.

AUTHOR	DIAM. OF OPHTHALMIC A.
Bouchet	1.5 mm
Ducasse	2 mm
Orge	2.2 mm
Hedges	2 mm
Michelson	0.52-1.88
Jimenez	right ofth. artery: 1.5-2.0 mm left ofth. artery: 1.0-2.0 mm
Lang	M: 1.54 mm; F: 1.31 mm
Zhang	M: 1.37 mm; F: 1.35 mm
Personal results	*right ofth. artery: 1.01-2.21 mm; M:101-2.21 mm; F: 1,01-1.83 mm; left ofth. artery: 1.03-1.91 mm; M:1.03-1.91 mm; F: 1.03-1.79 mm.*

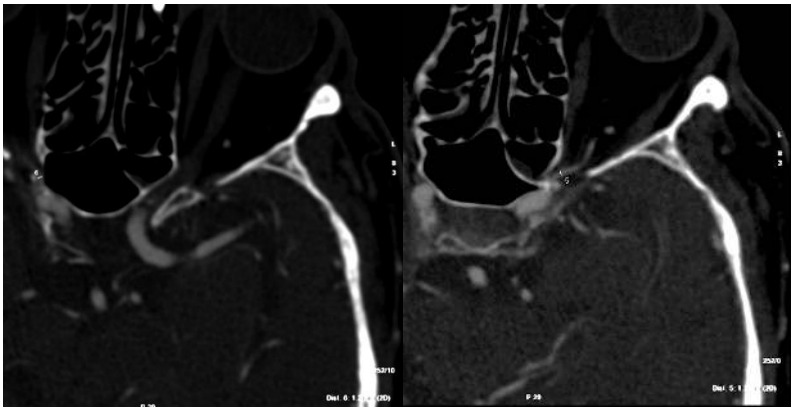
COMPARISON (in mm) BETWEEN THE DIAMETERS OF RIGHT AND LEFT OPHTHALMIC ARTERIES

It was done on 59 cases, finding that in 29 cases (49.15% of cases) the ***diameter of the right ophthalmic artery was larger***, by 0.01-0.48 mm, and ***the diameter of the left ophthalmic artery*** was found to be larger in 28 cases (47.46% of cases), by 0.01-0.27 mm.

In 2 cases (3.57% of cases), ***the diameter of the left ophthalmic artery was equal to the diameter of the right ophthalmic artery***.

Chart no. 18. Comparison between the diameter of the right ophthalmic artery and the diameter of the corresponding left ophthalmic artery.

In males, on a number of 29 cases (49.15% of cases), ***the diameter of the right ophthalmic artery was larger*** in 14 cases (48.28% of cases), by 0.02-0.48 mm, ***the diameter left ophthalmic artery*** being larger in 15 cases (51.72% of cases), by 0.01-0.12 mm, ***in females,*** on a number of 30 cases (50.85% of total cases), ***the diameter of the right ophthalmic artery was larger*** in 14 cases (46.67% of cases), with differences between 0.01-0.37 mm.



A B

Fig. 31. The diameter of the right and left ophthalmic arteries are equal, being 1.2 mm (males).

The diameter of the left ophthalmic artery in females was found to be larger than the diameter of the right ophthalmic artery in 14 cases (46.67% of cases), by 0.01-0.27 mm, and in 2 cases (6.67% of female cases), in females, ***the diameter of the left ophthalmic artery was equal to the diameter of the right ophthalmic artery on the opposite side***.

Fig. 33. The diameter of the left ophthalmic artery (1.2 mm) is equal to the diameter of the right ophthalmic at origin in the internal carotid artery. (females).

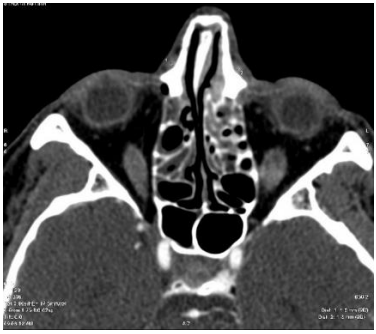


Fig. 34. The diameter of the left ophthalmic (1.3 mm) is 0.3 mm larger than the diameter of the right ophthalmic (1.0 mm). The diameter of the right ophthalmic represents 76.92% of the diameter of the left ophthalmic (males).

I did not find the comparison between the diameter of the two ophthalmic arteries at their origin in the internal carotid artery in the literature I had the opportunity to consult, it shows us that in equal proportions the two arteries are larger relative to each other, the difference between the extreme values of the values being higher at the level of the right ophthalmic artery by 0.21 mm in relation to the difference between the extreme values at the level of the left ophthalmic artery. Only in two cases, in females, the two ophthalmic arteries had the same diameter (3.45% of all cases).

The right ophthalmic artery had the most differences between 0.01-0.07 mm, in 64.29% of cases, which at the same time represented the smallest difference values, the largest of the differences being 0, 48 mm, which I encountered in one case (3.57% of cases). ***The left ophthalmic artery*** had the most differences between 0.01-0.09 mm, in 82.14% of cases, which also represented, at the same time, the lowest difference values, the largest difference being 0.27 mm, which I encountered in one case (3.57% of cases).

DIAMETER OF OPHTHALMIC ARTERY AT ORIGIN DEPENDING ON AGE

I studied it on the following age categories: 40-49 years: 50-59 years: 60-69 years: 70-79 years, 80-89 years and 90-98 years. Each group was studied on a characteristic number of cases and according to sex.

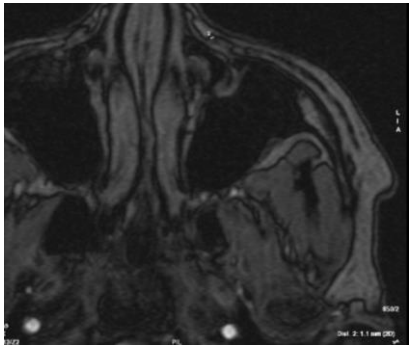


Fig. 39. The left ophthalmic artery is 1.1 mm (female, 88 years old).

Fig. 40. The left ophthalmic artery is 1.0 mm and the right ophthalmic artery is 1.1 mm.

TABLE No. 3. DIAMETER OF OPHTHALMIC ARTERY AT ORIGIN ON AGE GROUPS.

		<40	40-49	50-59	60-69	70-79	80-89	90-98
Zhang Taoran		1.38	1.37	1.36	1.38	1.34	-	-
Personal results	**M**	-	1.73	1.42	1.38	1.33	1.42	1.20
	F	-	1.31	1.43	1.32	1.48	1.12	1.22

DORSAL ARTERY OF THE NOSE

It was followed on a number of 36 cases, 18 cases for each of the two parts of the arteries, right and left. I found it to be 0.8-1.5 mm in diameter.

At the level of the left arteries, on a number of 18 cases (50% of cases), the diameter of the dorsal artery of the nose was between 0.9-1.4 mm, and ***at the level of the right arteries,*** also on a number of 18 cases, the diameter the dorsal artery of the nose was between 0.8-1.5 mm.

COMPARISON BETWEEN RIGHT AND LEFT DORSAL ARTERIES OF THE NOSE

It was performed on 36 cases, of which 6 cases (16.67% of cases) in females and 30 cases (83.33% of cases) in males.

Fig. 75. The left dorsal artery of the nose has a diameter 0.2 mm larger than the right dorsal artery of the nose, the diameter of the right artery representing 85.71% of the diameter of the left artery (males).

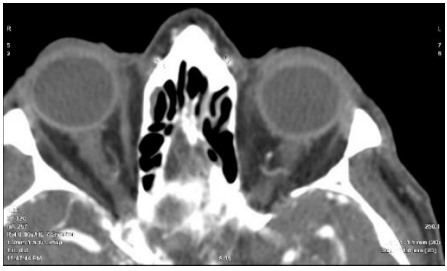


Fig. 76. The diameter of the right dorsal artery of the nose is 0.5 mm larger than the diameter of the left artery, its diameter representing 66.67% of the diameter of the right artery. (males).

I found that in 16 cases (44.44% of cases), ***the left dorsal artery of the nose had the diameter at its origin in the ophthalmic artery***, 0.2-0.3 mm larger than the diameter of the right dorsal artery of the nose.

In 12 cases (33.33% of cases), ***the right dorsal artery of the nose had a diameter at its origin in the ophthalmic artery***, 0.2-0.5 mm larger than the left dorsal artery of the nose.

In 8 cases (22.22% of cases), the two dorsal arteries of the nose had the same diameter.

Fig. 77. The two dorsal arteries of the nose have an equal diameter: 1.4 mm (males).

COMPARISON (in mm) BETWEEN THE DIAMETER OF OPHTHALMIC ARTERIES AND THE CORRESPONDING RIGHT AND LEFT DORSAL ARTERIES OF THE NOSE

In the 36 cases in which I compared the diameter of the two arteries, ophthalmic and dorsal of the nose, I always found the diameter of the ophthalmic artery larger than the diameter of the dorsal artery of the nose which had its origin in the corresponding ophthalmic, the differences in caliber were between 0.1-0.5 mm.

Regarding the diameter of the dorsal artery of the nose, I found the smallest value (0.8 mm) at the level of the right arteries, and the highest value (1.5 mm) was also found at the level of the right arteries. In males, I found the smallest value of diameter (0.9 mm) in both arteries (right and left), and the highest value was 1.4 mm in the left arteries and 1.5 mm at the level of the right arteries.

In females, the smallest value of the diameter (0.8 mm) was found in both arteries (right and left), and the highest value was 1.0 mm in the left arteries and 1.2 mm at the level of the right arteries.

A B

Fig. 79. The diameter of the right ophthalmic (A) is 1.4 mm, and that of the left ophthalmic (A) is 1.3 mm, representing 92.85% of the diameter of the right ophthalmic artery. The diameter of the right dorsal artery of the nose (B) is 1.9 mm, and the diameter of the left dorsal of the nose is 0.8 mm, representing 80% of the diameter of the right. The diameter of the right dorsal artery of the nose represents 71.43% of the diameter of the corresponding ophthalmic, and the diameter of the left dorsal artery of the nose represents 61.54% of the diameter of the ophthalmic artery. (males).

TABLE No. 4. DIAMETER OF THE DORSAL ARTERIES OF THE NOSE.

AUTHOR	DIAM OF DORS. ARTERIES OF NOSE
Ducasse	2,0 mm;
Raoul	up to 2,0 mm;
Lang	male: 0,45-0,96 mm; average: 0.68; fem: 0,36-0,81 mm; average: 0,65.
Personal results	***male: 0,9-1,5 mm; right: 0,9-1,5; left: 0,9-1,4 fem: 0,8-1,2 mm; right: 0,8-1,2; left: 0,8-1,0***

OPHTHALMIC-FACIAL ANASTOMOSIS

It was followed on 36 cases, 30 cases in males and only 6 cases in females, the anastomosis between the dorsal arteries of the nose being followed on 18 cases, 15 male cases and 3 female cases.

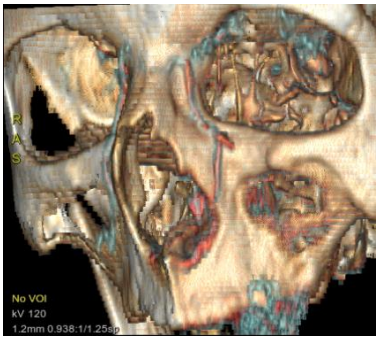


Fig. 82. The ophthalmic-facial anastomoses, right and left, are located on the medial wall of the orbit at a distance from the orbital edge of the nasal bone. Anastomosis between the upper concave dorsal arteries of the nose (females).

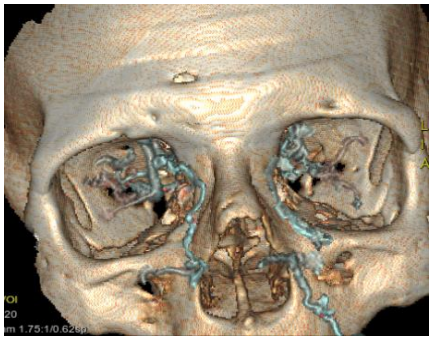


Fig. 83. Bilateral ophthalmic-facial anastomosis. On the right side it is located in the middle part of the medial edge of the orbit. The dorsal artery of the nose has a terminal dilation, which corresponds to the terminal dilation of the angular artery. The angular and dorsal arteries of the nose have a wavy trajectory (males).

The ophthalmic-facial anastomosis was located on the medial side of the orbit, at a distance more or less close to the nasal bone, in 11 cases (61.11% of cases) at the middle of the medial edge of the orbit, in the other 7 cases (38.89% of cases), the anastomosis being located above the middle of the medial edge of the orbit.

In approximately 50% of cases, the two anastomosed arteries showed a terminal dilatation, the anastomosis being performed at the level of the two dilatations.

In 13 cases (72.22% of cases), I encountered a transverse anastomosis between the two dorsal arteries of the nose, located above the root of the nose, this being both inferior-superior and latero-medial oblique. It is usually curved with a lower or upper concavity, or having a wavy trajectory. I rarely found it almost rectilinear, in cases where they had an oblique trajectory. From this anastomosis, ascending, frontal branches (right and left), for the frontal region and descending branches, nasal (right and left), for the superior-medial region of the nasal pyramid were detached.

In only one case (12.5% of cases) I found that the ophthalmic-facial anastomosis was performed with the participation of the angular artery, and the dorsal arteries of the nose and the

frontal branch on the right side participated from the ophthalmic artery, the dorsal arteries of the nose, frontal branch and supratrochlear artery participated on the left side.

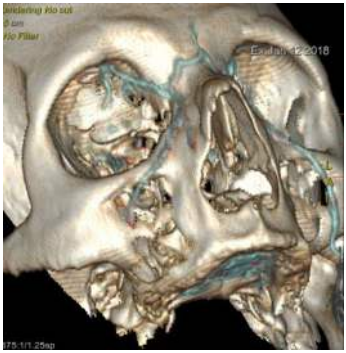


Fig. 84. Bilateral dorsal nose anastomosis -angular. Terminal rectilinear trajectory of bilaterally anastomosed arteries. Anastomosis between the two dorsal arteries of the nose), from which a frontal branch arises.

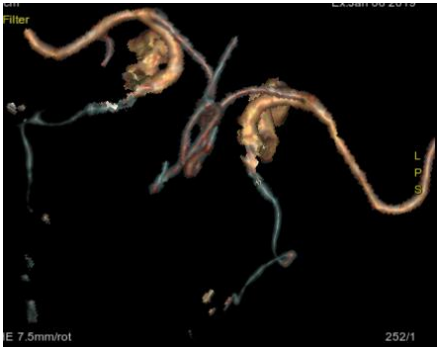


Fig. 86. The left dorsal artery of the nose describes a complete loop on the medial wall of the orbit above the anastomosis, after which it has a rectilinear trajectory. The right dorsal artery of the nose describes a curve with the medial concavity on the medial wall of the orbit, after which it has a rectilinear trajectory.

Also in one case, I found that the left dorsal artery of the nose described a complete loop on the medial wall of the orbit, after which it had a rectilinear trajectory. In the same case, the right dorsal artery of the nose presented a curve with the inferior-medial concavity, further the artery presenting a rectilinear trajectory.

CONCLUSIONS

The ophthalmic artery is an arterial element that is difficult to highlight due to its small size, sinuous trajectory and the many branches it gives. The caliber of its branches is smaller than that of the artery from which they arise, and the sinuosities are more numerous and more accentuated than at the level of the ophthalmic artery, in order not to be stretched by the movements of the eyeball. There is a disproportion between the caliber of the ophthalmic artery

and the large number of collateral branches, which ensure the vascularization of a very variable territory in terms of extent.

The origin of the ophthalmic artery in the internal carotid depends on its segmental division, some authors taking into account the segmentation in the direction of blood flow or contrary to its flow, thus explaining the specification of ophthalmic origin in two segments, segments VI and II.

Regarding the trajectory of the ophthalmic artery, the ophthalmic and its branches have a sinuous trajectory, but not entirely, presenting, either initially or towards the end, rectilinear segments, variable in length, shorter or longer, these segments can be descending, transverse or describe a curve with a differently oriented concavity: lower, upper, medial or lateral. This curve can be single or double, in the latter case it can have the appearance of number „3".

Frequently, the extreme morphometric values were present in only one, or were present in one of the two sexes, usually the smallest being present in females, and the maximum dimensions being present in males. For example, the maximum value of the left ophthalmic artery diameter was higher in males than in females, in the right artery by 0.38 mm, and in the left ophthalmic artery by 0.20 mm. This finding is also valid depending on age, except for the age group 70-79 years, in which the left ophthalmic artery in males had a larger diameter than in males by 0.03 mm.

The morphometric equality of the diameters of the two arteries, right and left, was met less often. For example, in the case of the diameter of the two dorsal arteries of the nose, in 22.22% of cases, the diameter of the right artery was equal to the diameter of the left artery.

There are situations in which the extreme values, minimum or maximum, were more numerous than a single case, for example, in the case of differences in millimeters between the diameter of the ophthalmic artery and the diameter of the dorsal artery of the nose. At the level of left arteries, the minimum differences between the diameters of the two arteries (right and left) were in the same number of cases (6 cases, 33.33% of cases), and the maximum differences were in the same proportion.

The differences between my statistics and those of the authors in the literature consulted would be due to several aspects:

- the number of cases on which the finding was made:
- the type of angiograph that was worked on:

- professional experience and degree of attention of the specialist who performed the angiographic examination.

Numerical angiography remains the exploration of choice for the study of the trajectory and collateral branches of the ophthalmic artery, as well as their anastomoses, which are essential in the clinic before the embolization of an aneurysm originating in the ophthalmic artery, which if thrombosed, being possible a vascularization in countercurrent through the facial artery. Some anatomical variations (for example, the ophthalmic artery originating in the middle meningeal artery), can have annoying consequences on the orbital vascularization in case of injuries [Hayreh].

Numerical angiography is the method adapted to the study of the branches of the ophthalmic artery, the scanner providing information on the trajectory of the ophthalmic artery, but it does not allow a good visualization of the collateral branches.

Knowledge of possible variations in the patterns of origin, course, and distribution of the lacrimal artery is necessary for diagnosis and important for the treatment of orbital disorders [Ducasse].

ORIGINALITY OF THE THESIS

The content of the thesis presents morphological characteristics, especially morphometric, of the ophthalmic artery and its branches which are described less in the literature, some aspects being described for the first time.

First of all, the work was performed on a large number of cases that I worked on, with some small exceptions, the number of cases studied being close between the two parties (right and left) and for the two sexes (male and female), and this allows a good comparison of the results according to sex and between the right and left arteries.

Complex and very detailed morphometry, comparing the diameter of the ophthalmic artery in relation to the diameter of the internal carotid artery (above and below the ophthalmic artery), as well as comparing the diameter of the dorsal artery of the nose and the diameter of the ophthalmic artery; right / left and gender comparisons.

The differences were measured both in percentages and in millimeters, up to tenths of a millimeter, the percentage differences representing a novelty.

The forms of the ophthalmic-facial anastomosis and especially the description of the forms of the anastomosis between the dorsal arteries of the nose and the detachment of the internal frontal artery from this anastomosis.

The morphological features presented are supported by a large number of personal images (over 80 personal images), representing the anatomical features of the ophthalmic arteries and their collateral branches and its terminal branch.

The personal results are supported by a significant number of charts (40 charts), beautifully executed, and also by a small number of tables (4 tables), given the small number of papers dedicated to the normal morphological appearance of the ophthalmic artery, the comparison with data from literature being relatively poor.

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