

Morphology and Morphometry of Cranio-Orbital Foramen in Dry Skulls and its Clinical Relevance

By

Arvind Kumar Pankaj, Archana Rani, Anita Rani,
R.K. Verma, Navneet Kumar and R.K. Diwan

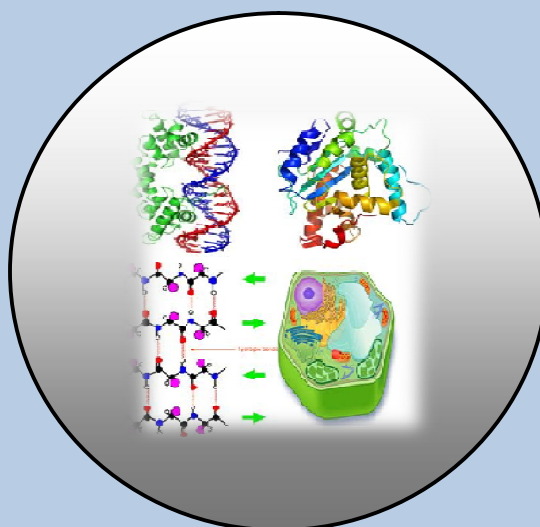
ISSN 0970-4973 (Print)

ISSN 2319-3077 (Online/Electronic)

J. Biol. Chem. Research
Volume 31 (1) 2014 Pages No. 202-207

**Journal of
Biological and
Chemical Research**

(An International Journal of Life Sciences and Chemistry)



Published by Society for Advancement of Sciences®



Dr. Arvind Kumar Pankaj

[http:// www.jbcr.in](http://www.jbcr.in)

jbicchemres@gmail.com

info@jbcr.in

RESEARCH PAPER

Received: 19/12/2013

Revised: 03/01/2014

Accepted: 04/01/2014

Morphology and Morphometry of Cranio-Orbital Foramen in Dry Skulls and its Clinical Relevance

**Arvind Kumar Pankaj, Archana Rani, Anita Rani,
R.K. Verma, Navneet Kumar and R.K. Diwan**

Department of Anatomy, King George's Medical University, UP, Lucknow, India

ABSTRACT

The cranio-orbital foramen may be present in the postero superior part of orbit, lateral to superior orbital fissure. The incidence of the cranio-orbital foramen is variable in different reports. We studied 68(136 orbits) dry human skulls of adult age in which cranio-orbital foramen was observed in 49 orbits (36.02%). Out of these, 26.83% foramen was found in roof while 73.17% on lateral wall. In 14 skulls, these foramina were present in both orbits while 21 skulls exhibited such foramen only on one side. In an attempt to locate the foramen from orbital margin, two points were selected i.e. supraorbital notch/foramen and frontozygomatic suture. The mean distance of foramina in roof from supraorbital notch/foramen and frontozygomatic suture on right side was 29.19 mm and 20.06 mm respectively whereas it was measured as 32.83 mm and 23 mm on left side. Mean distance of foramina in lateral wall from above reference points was 35.67 mm and 25.83 mm on right side while it was 35.5 mm and 23.89 mm on left side.

This foramen is a link between orbit and middle cranial fossa and serves as a conduit to connect external carotid artery and internal carotid artery. Unawareness of such connections during surgeries may lead to severe bleeding. A higher prevalence of such foramina in studied population as compared to others is a warning to native ophthalmologists and neurosurgeons.

Key words: Cranio-Orbital Foramen, Orbit, Skull, Morphology and Morphometry and Middle Meningeal Artery.

INTRODUCTION

The cranio-orbital foramen creates an additional link between the orbit and the cranial cavity. The location of this foramen is not very definite but usually lies on or around the superolateral suture leading from superior orbital fissure. The foramen may occur in the posterosuperior part of the lateral orbital wall or in the posterolateral part of the orbital roof (Brien and McDonald 2007). The cranio-orbital foramen may be single or multiple. This foramen is not a consistent feature and its incidence is variable in different reports. Incidence varies from 6% (Santo et al. 1984) to 82.9% (Erturk et al. 2005). The cranio-orbital foramen usually provides the passage for anastomosing branch of middle meningeal artery and lacrimal artery. Also, this bony canal may contain a branch from the middle meningeal artery, providing an accessory blood supply to the orbit. The anatomy of this foramen should be well known by surgeons reconstructing the anterior base of the skull, the orbit after orbital base surgery, and during excision of meningiomas (Erturk et al. 2005). The knowledge of this foramen and structures related with it has a great significance for ophthalmologists and neurosurgeons. High variation in the incidence of above foramen in different population and lack of documentation representing our population compelled us to envisage incidence, location and morphometry in North Indian population.

MATERIAL AND METHODS

68 dried North Indian human skulls of unknown sex of adult age group were procured from Anthropology lab of Anatomy Department of King George's Medical University, Lucknow (U.P.). Both orbits of each skull were observed carefully for presence of foramina communicating orbit and cranial cavity in the posterior parts of roof and lateral wall. The patency of minute foramina was confirmed by passing fine bristle. To describe location of foramen, supra-orbital notch and fronto-zygomatic suture were taken as reference points and the distance of foramina from above points were measured by using a gauge with a minimal scale of 0.1 mm. Data was stored and analyzed statistically.

RESULTS

Out of 136 orbits, 49 (36.02%) exhibited foramen either in its roof or lateral wall. Single foramen was noted in 20 orbits on right side while 21 on left side. Double foramina were seen in 2 orbits on right side and 3 orbits on left side. More than 2 foramina were present in 2 orbits on right and 1 orbit on left side (Table 1). In 14 skulls (28 orbits), this foramen was bilateral. Whereas in 10 skulls it was only present on right side, as compared to 11 skulls which showed its presence on left side only. The unilateral cranio-orbital foramen was observed in 10 skulls of right orbit and in 11 skulls of left orbit. Shape of foramina varied from round to oval and size from 0.1-0.2 mm. Number of foramina ranged between 1-5. Single foramen was present in 41 orbits (Table 2). None of the skull showed double foramen bilaterally. Double cranio-orbital foramina were found in two orbits of right side, in one orbit these were located one each in roof and lateral wall whereas in other orbit both foramina were present in lateral wall.

Three orbits of left side displayed double foramina, in one orbit these were present in roof, in other orbit both were located on lateral wall, whereas in the third orbit one opened in roof while other in lateral wall. Triple cranio-orbital foramina were observed in right orbit of one skull only and all of them were present on lateral wall. There was no orbit with four foramina. But a bunch of five foramina was present in right side of one skull. Out of these, 2 foramina were present in roof while rest was present in lateral wall.

Except for 2 foramina, which were opening in anterior cranial fossa near posterior margin of lesser wing of sphenoid, all other foramina were communicating with middle cranial fossa.

The mean distance of foramina in roof from supraorbital notch/foramen and frontozygomatic suture on right side was 29.19 mm and 20.06 mm respectively whereas it was measured as 32.33 mm and 23 mm on left side. Mean distance of foramina in lateral wall from above reference points was 35.67 mm and 25.83 mm on right side while it was 35.5 mm and 23.89 mm on left side (Table 3, Fig.1).

DISCUSSION

Literature suggests that position, incidence, morphogenesis and morphometry of cranio-orbital foramen are highly variable. Although, textbooks of basic anatomy described it as rare occurrence, some current data suggest a more frequent incidence of this foramen and hence necessitates the attention of ophthalmologists and neurosurgeons.

In the present observational study of North Indian skulls, 36.02% orbits showed the presence of these foramina which is not in concurrence with the data reported by Krishnamurthy et al. (2008) from southern part of India who reported a very high incidence (80.4%). Mysorekar and Nandedkar (1987) also observed 76% incidence in 100 human skulls of Maharashtra region of India. Erturk et al. (2005) also reported high incidence of this foramen i.e. 82.9% in Turkish population. Brien and McDonald (2007) found 30 foramina in 22 skulls in a Scottish population. In contrast to these studies, Santo et al. (1984) reported only 6% incidence in 50 orbits of Brazilian skulls. Data pertaining to occurrence of such foramen in roof or lateral wall is still lacking in literature. Kwiatkowski et al. (2003) documented the mean distance of this foramen from supraorbital notch was 35 mm and the minimal distance from the cross-point of the entrance to the orbit and the fronto-zygomatic suture was 21.3-35.5 mm. Krishnamurthy et al. (2008) calculated mean distance of cranio-orbital foramen from supraorbital notch as 34.14 mm and from the fronto-zygomatic suture as 26.10 mm. Data pertaining to occurrence of this foramen in roof or lateral wall is still lacking. As above authors have not mentioned the location of cranio-orbital foramina, for which they have mentioned the distances from reference points on orbital margin, therefore the present findings could not be compared as documented by them. As far as communication of cranio-orbital foramina is concerned, our observations confirmed the findings of Brien and McDonald (2007) who described that these foramina usually communicate orbit with middle cranial fossa but occasionally communicate with the anterior cranial fossa also.

The cranio-orbital foramen represents an embryonic conduit between the supraorbital division of the stapedial artery and the permanent stem of ophthalmic artery. In adult this may be represented by a connecting vessel between the orbital branch of anterior division of middle meningeal artery and the lacrimal branch of the ophthalmic artery (Georgiou and Cassell 1992). Intra cranial branches of middle meningeal artery are considered as nutrient artery of skull bones therefore probably these openings may be termed as nutrient foramina. However, if any opening leads through orbit it is thought to represent the path by which the anterior division of middle meningeal artery anastomoses with lacrimal branch of ophthalmic artery. Hayreh (2006) reported 2 cases, out of 170 specimens, where ophthalmic artery was arising from middle meningeal artery. In lower animals, the ophthalmic artery is derived from the external carotid artery, but as we go up the evolutionary ladder of the animal kingdom, the ophthalmic artery tends to arise from the internal carotid instead of the external carotid. In rhesus monkeys, a large lacrimal artery connects the ophthalmic artery and the middle meningeal artery, so that the middle meningeal artery contributes a significant blood supply to the orbit, in addition to the ophthalmic artery (Hayreh 1964). It seems from the ongoing discussion that these cranio-orbital foramina give way to additional source of blood to orbit and are potential sites of hemorrhage, if not taken care of properly.

Table 1. Incidence of cranio orbital foramen.

Frequency of foramina	Single foramina		Double foramina		More than two foramina		Total
Side	Right	Left	Right	Left	Right	Left	49
No. of orbits	20	21	2	3	2	1	
% of orbits	40.82	42.86	4.08	6.12	4.08	2.04	

The presence of the cranio-orbital foramen and other accessory foramina represents a source of hemorrhage that surgeons should be aware of when operating along the lateral orbital wall. In the absence of foramen spinosum the middle meningeal artery may partially (i.e. only the anterior branch) or completely arise from the ophthalmic artery. Under such circumstances it passes through the lateral end of the superior orbital fissure or the cranio-orbital foramen. Practical importance is emphasized when the middle meningeal artery has abnormal origin in the case of subtemporal epidural hematoma, tumors, vascular malformations and in case when the foramen spinosum is absent (McLenn et al. 1974). It is described as an alternative transorbital pathway (Diamond 1991).

Table 2. Location of single cranio orbital foramen.

Location	Roof			Lateral wall			Total
Side	Right	Left	Total	Right	Left	Total	41
No. of orbits	8	3	11	12	18	30	
% of orbits	19.51	7.32	26.83	29.27	43.90	73.17	

Table 3. Distance of cranio orbital foramina from supraorbital notch and frontozygomatic Suture.

Side	Right				Left			
Location	Roof		Lateral wall		Roof		Lateral wall	
	Min-max	Mean	Min-max	Mean	Min-max	Mean	Min-max	Mean
Supraorbital notch (mm)	25-35	29.19	31.5-41	35.67	28-35	32.33	31-40	35.5
FZ Suture (mm)	11.5-25	20.06	19.5-34	25.83	20-27.5	23	12-30	23.89

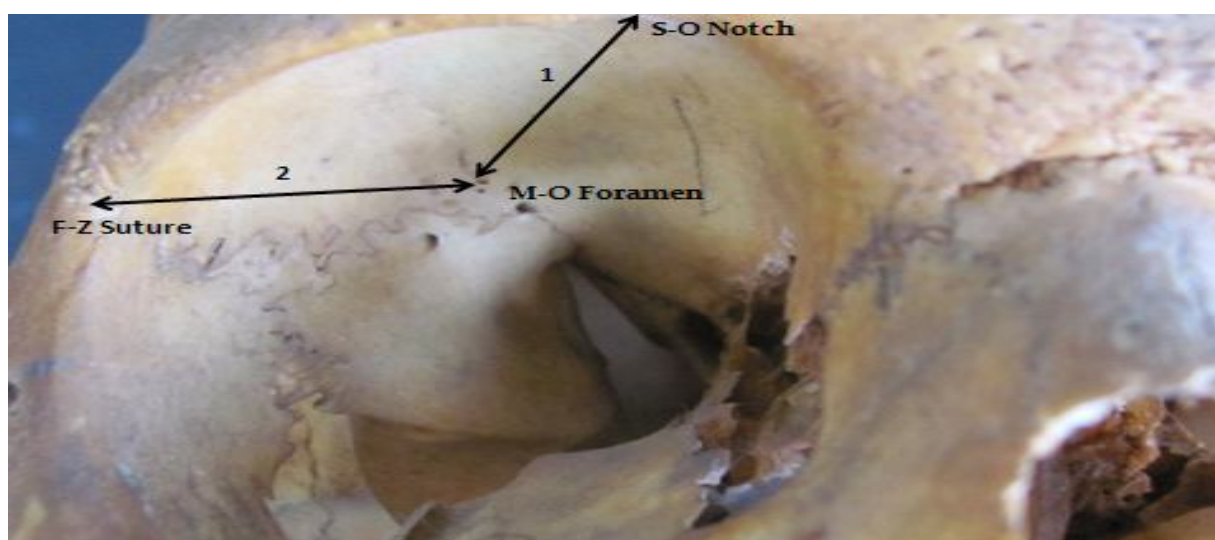


Figure 1. Distance of MO foramen from supra-orbital notch (1) and fronto-zygomatic suture (2).

CONCLUSION

Cranio-orbital foramen is found in more than 30% cases in the present study and as it is an important vascular link between orbit and cranium, so clinically very significant.

ACKNOWLEDGEMENTS

The author is indebted to Head of the department Dr. A.K.Srivastava for providing all the necessities required for completing this work.

REFERENCES

Brien, A.O. and McDonald, S.W. 2007. The meningo-orbital foramen in a Scottish population. *Clin. Anat.* 20: 880–885.

- Diamond, M.K. 1991. Homologies of the meningeal-orbital arteries of humans: a reappraisal. *J Anat.* 178: 223-241
- Erturk, M., Kayalioglu, G., Govsa, F., Varol, T. and Ozgur, T. 2005 .The cranio-orbital foramen, the groove on the lateral wall of the human orbit, and the orbital branch of the middle meningeal artery. *Clin. Anat.* 18 (1): 10–14.
- Georgiou, C. and Cassell, M.D. 1992. The foramen meningo-orbitale and its relationship to the development of the ophthalmic artery. *J Anat.* 180 (1): 119–125.
- Hayreh, S.S. 1964. The orbital vessels of rhesus monkeys. *Exp Eye Res.* 3: 16–30.
- Hayreh S. S. 2006. Orbital vascular anatomy. *Eye* 20 (10): 1130–1144.
- Krishnamurthy, A., Nayak S.R., Prabhu, L.V., Mansur, D.I., Ramanathan, L., Madhyastha, S., Saralaya, V. 2008. The morphology of meningo-orbital foramen in south Indian population. *Bratisl Lek Listy* 109(11): 517-519.
- Kwiatkowski, J., Wysocki, J., Nitek, S. 2003. The morphology and morphometry of the so- called "meningo-orbital foramen" in humans. *Folia. Morphol.* 62(4): 323-325.
- McLennan, J.E., Rosenbaum, A.E., Haughton, V.M. 1974. Internal carotid origins of the middle meningeal artery. *Neuroradiology* 7: 265-275.
- Mysorekar, V.R. and Nandedkar A.N. 1987. The groove in lateral wall of the human orbit. *J. Anat.* 151: 255-257.
- Santo Neto, H., Penteado, C.V., de Carvalho, V.C. 1984. Presence of a groove in the lateral wall of the human orbit. *J. Anat.* 138: 631-633.

Corresponding Author: Dr. Arvind Kumar Pankaj, Assistant Professor, Department of Anatomy, King George's Medical University, UP, Lucknow, India
Mobile: + 91 8004872858
Email: drarvindpankajcsmmu@yahoo.com