Original article

Foramen meningo-orbitale : its incidence and clinical significance in Indians

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Abstract:

Introduction: The Foramen Meningo-Orbitale (FMO) is an opening situated in greater wing of the sphenoid which connect the orbit with the middle cranial fossa and rarely with the anterior cranial fossa. Study was carried out to find incidences and variations of FMO in Indian population and the distances between its orbital opening & lateral margin of superior orbital fissure was measured.

Material and Methods: 42 Adult human skulls were investigated from the bone banks of department of Anatomy, S.M.S. Medical College, Jaipur, Rajasthan and Teerthanker Mahaveer Medical College and Research Centre, Moradabad, Uttar Pradesh (India). Each skull was assessed for the presence of one or more FMO under good lighting. Patency was confirmed by 0.1mm diameter flexible probe.

Results: FMO was found to be present in 19 skulls (45.24%). Multiple foramens were also reported. FMO was commonly present towards right side in 12 skulls as compared to left (7skulls). Average distance between FMO and superior orbital fissure was 6.05 mm. Range: 2-11mm.

Conclusion: Variations in incidence of meningo-orbitale foramen may be due to genetic, racial or environmental differences and also, incidence appears to be region specific. These differences can be used as an anthropological tool for identification of skulls. The location of the FMO should be well known to surgeons reconstructing the anterior base of the skull, orbital surgery, and during excision of meningiomas as FMO is often present near an operating area (orbital, pterional and subfrontal areas) in surgical interventions.

Key Words: Orbit, Foramina, Anatomic Variation

Introduction:

Skull, the most complex bony structure in the body houses the most vital organ, the brain. Minor variations in the Skull bones/ ossicles, skull foramina and ridges of the cranium have aroused the curiosity of anatomist worldwide for many decades. Foramina in the skull are very important as they allow passage of important structures likes nerves and blood vessels through them. The knowledge of normal and abnormal variant in the skull foramina is important for various treatment modalities.[1]

The Foramen Meningo-Orbitale (FMO) is an opening situated in greater wing of the sphenoid which connect the orbit with the middle cranial fossa and rarely with the anterior cranial fossa.[2,3] It provide route for an anastomosis between the orbital branch of the middle meningeal artery and recurrent meningeal branch of ophthalmic artery. It is not consistently present and occupies a somewhat variable position relative to superior orbital fissure. It can be located to the lateral end of the superior orbital fissure or may confluent with lateral end of the superior orbital fissure. The

foramen may be single or multiple. It may be present unilaterally or bilaterally. The prevalence of the FMO varies apparently from 28 to 82.9%.[4-7]

With the increasing higher imaging capabilities of magnetic resonance imaging and computed tomography, foramina of the skulls are being seen as never before in living individuals. Evaluation of these foramina is becoming an important part of diagnostic medicine.[8] Knowledge of the incidence, location of FMO of the human skull will aid in the diagnostic evaluation of radiologic films as it masquerading as an intraocular foreign body.[9] Considering its clinical importance, very few studies were done on Indian dry human skulls. Therefore, this study was carried out to find out incidences and variations of FMO in Indian population and the distances between its orbital opening & lateral margin of superior orbital fissure was measured which can be of significance for clinical applications.

Materials & Methods: 42 Adult human skulls were investigated from the bone banks of department of Anatomy, S.M.S. Medical College, Jaipur, Rajasthan and Teerthanker Mahaveer Medical College and Research Centre, Moradabad, Uttar Pradesh (India). All the skulls collected were completely macerated, defatted, cleaned and made dry. No information regarding the age or sex of the skulls was available. Then the FMO were investigated carefully. Each skull was assessed for the presence of one or more FMO under good lighting. A small, dry paintbrush was used to remove residual soil and dust. Only those foramina which were patent were included in the observation. Patency was confirmed by 0.1mm diameter flexible probe. A conduit between the middle cranial fossa and orbital cavity was also confirmed by this probe which excluded nutrient branches to the greater wing of sphenoid bone. Following observations were made:-

1. Presence or absence of FMO. If present then patency of foramen was confirmed.
2. Number of foramen.
3. Whether unilateral/bilateral.
4. Position of Foramen.
5. Distance of orbital opening of FMO from lateral margin of superior orbital fissure.

Results: The results of our study are summarized in Table 1. FMO was found to be present in 19 skulls (45.24%) of the total number of 42 skulls studied. Multiple foramens were also reported. Double foramens were present in 6 cases (14.3%) and a triple one in two orbits. In total this was a 19.1% occurrence of multiple foramina for all the orbits studied. FMO was commonly present towards right side in 12 skulls as compared to left (7skulls).

All FMO were located lateral to the lateral end of superior orbital fissure (Fig.1, 2). We did not found any FMO which is confluent with superior orbital fissure. The minimum and maximum distance between FMO and superior orbital fissure were 2 mm and 11 mm respectively, average distance was 6.05 mm.

Discussion: Various workers have tried to explore the qualitative as well as quantitative variation in the skull using geographically bound population as material and tried to make use of that information for various purposes. The variations of skull foramina are important for their disease associations and surgical implications. In general, research in the earlier stages was descriptive, with little inclusion of sophisticated techniques. With the technical advances in the field of radio anatomy, voluminous amount of research has been done in skull base foramina using high-resolution computerized tomography, magnetic resonance imaging and positron emission tomography.[10,11]

In present study, we examined the occurrence of FMO in 42 dry adult skulls. The incidence of the foramen in 45.24% of skulls is almost equal to incidence reported by Lee and Chung[12]- 45% in Korean population; Babu, Sivanandan and Saraswathy et al.[13] -44.32% in South Indians; Jadhav, Roy and Ambali et al.[8] -44.33% in Maharastra (Indians). Other authors have reported a

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variable prevalence as shown in Table 2. Much higher figures were reported by Krishnamurthy, Nayak and Prabhu et al.[7] -80.4% in south Indians; O'Brien et al.[3] -73.3% in Scottish population. From our study we can conclude that variations may be due to genetic, racial or environmental differences and incidences of the foramen appears to be region specific as our results are comparable to some studies done so far and also results are much lower as reported by Krishnamurthy, Nayak and Prabhu et al. on south Indian population.[7] [Table-2, Figure-1]

In present study, FMO was found more commonly unilaterally in 12 skulls (28.6%). This observation was supported by O'Brien & McDonald,[3] Babu, Sivanandan and Saraswathy et al.[13] We observed FMO bilaterally present in 7 skulls (16.7%). Babu, Sivanandan and Saraswathy et al.[13] found in 14.4% in south Indians; Kwiatkowski, Wysocki and Nitek[5] in 13.04% cases in Polish population, while Jadhav, Roy and Ambali et al.[8] found in only 4% of skulls. Also much higher incidence was reported by Erturk, Kayalioglu and Govasa et al.[14]–50.6% in Turkish population. Also FMO was reported more commonly towards right side (28.6%) as compared to left (16.7%). Similar findings were reported by Jadhav, Roy and Ambali et al.[8][Table-1,2]

Multiple foramens (double or triple) were also found in 14.3% (7 orbits). More than one foramens were also reported by some workers in past. The measurement of distance of FMO from lateral end of superior orbital fissure was comparable with those of other authors.[8,12] [Table-3, Figure-2]

The anatomy of orbital foramina appears to vary depending on population studied.[15]Although, that there are different data in the literature about the FMO incidence between different populations, Berry and Berry[16] suggests that wide spectrum of bone variations can be used to calculate statistical distance between different population specimens. Also this variation may become useful tool for identification of skulls in anthropology.[5] FMO has been known in human anatomical literature by a variety of names (the lacrimal foramen, Hyrtl's foramen, opthalmo-lacrimal foramen) and in comparative anatomy literature (the cranio-orbital foramen, spheno-frontal foramen, sinus canal, anastomotic foramen).[2,6,7]

The FMO represents an embryonic conduit between the supraorbital division of stapedial artery and permanent stem of the ophthalmic artery. In adults it may be represented by connecting vessel between the orbital branch of the anterior division of the middle meningeal artery and the lacrimal branch of the ophthalmic artery. According to previous studies in this area incidence of FMO is known to vary between 28-82.9% [5,6,7] In present study it was 45.24%. Kuru[17] stated that orbital branch of the middle meningeal artery passing through the cranio-orbital foramen is thought to become main vascular supply of meningiomas in the anterior cranial fossa. The vascular supply of meninges is important in the excision of meningiomas, and the surgeon needs to have pre-operative knowledge of its pattern. Gabriele and Bell[18] stated that if meningiomas are supplied by meningeal branches that anastomose with branches of the lacrimal artery, there may be striking and clinically important enlargement of the ophthalmic artery and its branches. The anatomy of the FMO and the course of the orbital branch should be well known by surgeons reconstructing the anterior base of the skull, orbital base surgery, and during excision of meningiomas.[14,15] The localisation of the FMO and its distance from the superior orbital fissure has clinical importance. Injuries to the arterial branch coming through the foramen during operations on the orbit makes surgical interventions longer and augments the operating risk, especially for the structures of the superior orbital fissure.[6]

Orbital branch passing through the cranio-orbital foramen might be clinically important as an accessory blood supply to the orbital contents. During reconstruction, the orbital branch can be damaged and a

large part of the blood supply to the orbital contents can be lost. [19,20] We hope that the current work will alert neurosurgeons to the position of local arteries. We also hope that it will be useful to colleagues with scientific interests in the osteology and blood supply of the orbit. The present study also suggests that small blood vessels might be passing into the orbital roof more frequently than is generally realized. Present data may be useful for ophthalmologist, radiologist, anthropologist and neurosurgeons operating in orbital, pterional and subfrontal areas and for anatomist. This data may be good references for Indian subjects.

Conclusion: From our study on, we can conclude that the variations in incidence of meningo-orbitale foramen may be due to genetic, racial or environmental differences and also, incidence appears to be region specific. Results indicate that FMO is more commonly present unilaterally as well as shows greater incidence towards right side. Measurement of distance of FMO from lateral margin of superior orbital fissure to assess the localization, we confirmed that FMO is often present near an operating area in some surgical interventions and requires more research attention.

Table 1: Incidence of Foramen Meningo-orbitale in present study.

Side	Unilateral		Bilateral		One side triple	One side triple, other side double
	single	Double	single	Double		
Right	5(11.9%)	1(2.4%)	3(7.1%)	2(4.8%)	-------	1(2.4%)
Left	3(7.1%)	2(4.8%)	1(2.4%)	------	1(2.4%)	-------
Total	8(19.04%)	3(7.1%)	4(9.5%)	2(4.8%)	1(2.4%)	1(2.4%)

Table 2: Comparison of Variations in incidence of Foramen Meningo-orbitale (FMO) in different populations.

Study /population	Year	Population	n	Sex	% of FMO	Unilateral	Bilateral
Mysorekar & Nandedkar[15]	1987	Pune, Indian	100	Unknown	38	--	7.86
Georgiou & Cassell[6]	1992	Asian	50	Unknown	49	--	--
Lee & Chung[12]	2000	Korean			45	--	38
Kwiatkowski, Wysocki & Nitek[5]	2003	Polish	46	Known	28	--	13.04
Erturk, Kayalioglu and Govasa et al.[14]	2005	Turkish	170	Unknown	82.9	32.4	50.6
O'brien and Mcdonald[3]	2007	Scottish	30	Male	73.3	46.7	26.7
Krishnamurthy, Nayak and Prabhu et al.[7]	2008	South Indian	138	Known	80.4	37	43.5
Babu, Sivanandan and Saraswathy et al.[13]	2011	South Indian	97	Unknown	44.32	27.8	14.4
Singh and Raibagkar[1]	2011	Gujrat, Indian	103	Unknown	59	29	--
Jadhav, Roy and Ambali et al.[8]	2012	Indian	150	Known	44.33	--	4
Present Study	2013	Indian	42	Unknown	45.24	28.6	16.7

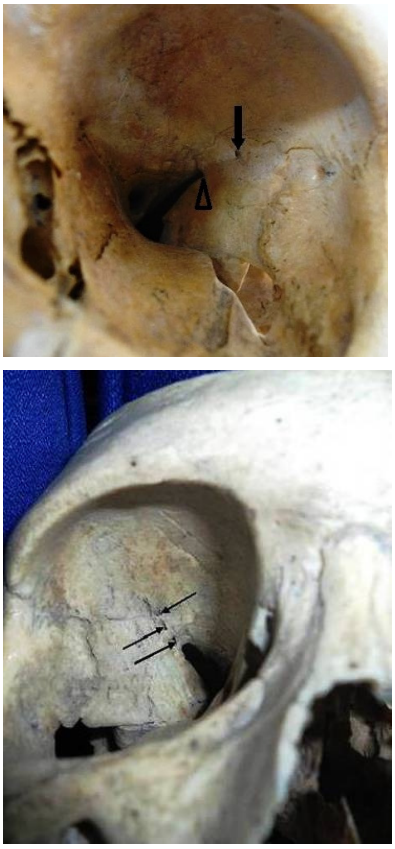
Table 3: Comparison of Variations in incidence of FMO in different population and distance from lateral end of Superior orbital fissure.

Study /population	Year	Double	Triple	Distance *
Georgiou,Asian[6]	1991	15	--	-----
Lee & chung, Korean[12]	2000	9	--	6.1+/-4.7mm
Kwiatkowksi, Polish[5]	2003	6.5	2.1	-----
Brien AO, Scottish[3]	2007	18.3	1.7	-----
Jadhav et-al, Indian[8]	2012	--	--	6.22mm(3-11)
Present Study	2013	14.3	4.8	6.05(2-11mm)

*Distance of orbital opening of FMO from lateral end of Superior orbital fissure.

Figure 1. Anterior view of left orbit showing FMO (Bold Arrow), Lateral end of superior orbital fissure (Triangle).

Figure 2. Anterior view of right orbit showing triple FMO (Arrows).



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