Journal of Pakistan Association of Dermatologists. 2024;**34(1)**:57-62.

Original Article

Morphometric localization of infra-orbital foramina in relation to supra-orbital foramina in dried Pakistani skulls

Aisha Zafar, Ummarah Z. Farid, Saelah Batool*, Hira Tariq*, Azam Bukhari*

Department of Anatomy, Fatima Jinnah Medical University, Lahore.
* Department of Dermatology, Services Institute of Medical Sciences, Lahore.

Abstract

Background The location of infraorbital and supraorbital foramina is critically important for avoiding iatrogenic nerve damage during surgery or cosmetic procedures on the mid-face. This study aimed to conduct the morphometric analysis of infra orbital and supraorbital foramina in dry human skulls in Pakistani population.

Objective To evaluate precise anatomical position of infraorbital foramina in reference to supraorbital foramina in adult human skulls.

Methods Out of 40 skulls, 35 met the criteria of selection. Measurements were taken three times and mean was calculated to increase accuracy. Mean and standard deviations, median, range and mode were calculated and analyzed using SPSS ver. 27.0.

Results The mean vertical and horizontal distances of IOF on right side were 43.2±2.5 (SD) mm and 3.7±2.7 (SD) mm respectively. The mean vertical and horizontal distances of IOF on left side were 43.2±2.7 (SD) mm and 3.46±1.8 (SD) mm respectively.

Conclusion The study adds information to the literature concerning morphometric value of infraorbital foramen in view of racial variations.

Key words
Morphometric localization; Infra-orbital foramen; Supra-orbital foramen.

Introduction

Cosmetic dermatology is gradually becoming advanced with an increase in limit of average age. This has developed an ever growing desire to get rid of signs of aging.[1] To fulfill their requirement many type of non-surgical aesthetic procedures are in practice now a days. For a good clinician it is mandatory to have a thorough knowledge of anatomy of the face.

Address for correspondence
Dr. Hira Tariq
Department of Dermatology,
Services Institute of Medical Sciences,
Lahore.
Email: kemcolianhira46@gmail.com

To perform aesthetic procedures in the middle part of face including tear trough and naso-labial folds, a good knowledge of anatomical bony landmarks along with course of nerves and vessels is required.[2,3] These procedures like tear trough correction, injection of dermal fillers, PRP etc. are quite painful. To give a good anesthesia, infra orbital nerve can be blocked at its exit from infra orbital foramen, giving a complete anesthesia of face at area of its distribution starting from lower eyelid (including tear trough) till the upper lip, ala of the nose and alveolar margin of premolar teeth.[2,4,5] Thus knowledge of most frequent location of infra-orbital foramen with reference points in this area

provides important data for local anesthesia.

Infra-orbital foramen/notch (IOF/ION) is located in front of face below orbit above alveolar margin of second molar tooth and lateral to ala of nose.[2,4,5] Supra-orbital foramen/notch (SOF/SON) lies at a junction between sharp lateral two thirds and rounded medial one third of the supra-orbital margin[2,4-6] about 22 to 22.5 mm away from midline[3]. It can easily be palpated against bony margin. Although the occurrence of accessory supra-orbital foramina is very common but is more frequently seen lateral to the main SOF.[3-5] Infra-orbital neurovascular bundle emerges through infra-orbital foramen with artery always lying supro-medial and vein infromedial to the nerve.[8] Direction of bundle before breaking down into respective branches is lateral to medial side. Infra-orbital nerve is the continuation of maxillary nerve which is purely sensory and is branch of trigeminal nerve.[2-5] It emerges out of the orbit from the infra-orbital foramen and gives 4 branches, the inferior palpebral, the external nasal, the internal nasal and the superior labial branches for the sensory innervation to the skin of the eyelid, nose, cheek and upper lip.[7] Infra-orbital artery is a terminal branch of third part of maxillary artery which enters into orbit through inferior orbital fissure. It leaves via infra-orbital canal and then infra-orbital foramen on to the face along with infra-orbital nerve. It supplies lower eyelid and upper lip.[7,8]

Extensive data of work done globally was revealed in literature search regarding localization of infra-orbital foramen in different populations with large racial variations in their results.[1] But a lot of work still needs to be done in this regard locally.

This study was conducted to localize infra-orbital foramen in dry Pakistani skulls, to help dermatologists and plastic surgeons in localizing neurovascular bundle. This will improve their vision before giving local anesthesia as well as direct injections for different aesthetic purposes in Pakistani population.

Material and Methods

This descriptive cross-sectional study was conducted by collecting data from dissection halls of two medical colleges of Lahore (Allama Iqbal Medical College and Fatima Jinnah Medical College). For this study 40 skulls were collected. Out of them, 35 skulls fulfilled the criteria of inclusion. Skulls of children, those which had ruptured one/ both infra-orbital foramina or one/both supra-orbital foramina or pyriform aperture, and those which had accessory infra-orbital foramina were excluded.

Skulls were aligned in Frankfurt horizontal plane by setting them on the edge of a tray fixing them there behind the posterior alveolar margin and in the scaphoid fossa. All measurements were carried out using a double tipped compass and transferred to the metal sliding scale which was capable of measuring with an accuracy of 0.5mm **(Figure 1)**. Measurements were taken thrice by the same researcher and mean was calculated to increase the accuracy of measurement.

A horizontal line (AB) was drawn from the upper margin of infra orbital foramen to the

Figure 1 Measurements being taken using double tipped compass.

lateral margin of pyriform aperture. Vertical line (CD) was drawn from SOF intersecting the line AB. Here a point (E) was marked. Then distance between that mark (E) and upper margin of infra-orbital foramen was measured in a horizontal plane while distance between that mark (E) and supra-orbital foramen/ notch was measured in a vertical plane. Mean and standard deviation, median, range and mode were calculated and analyzed by using SPSS (statistical package for social sciences) version 27. P<0.05 was considered statistically significant.

Results

Out of 40 skulls, 35 skulls (70 sides) were included in the study while 5 were excluded due to one or the other of the exclusion criteria.

Most of IOF were located lateral to the SOF/SON. Among these, 29 skulls (82.8%) had it on lateral side while in 6 skulls (17.1%), it was found exactly in same vertical plane as that of SOF/SON on right or the left side. Only one skull (2.8%) had it in the same plane bilaterally. No accessory IOF was found in any skull.

Dimensions of IOF in relation to SOF/SON and the mark E, and the distances between IOF and infraorbital margin (IOM) are given in **Table1**, detailed descriptive statistics are given in **Table 2**.

Figures 2-6 represent the frequency distribution of relative distances of infraorbital foramina.

The mean vertical and horizontal distances of IOF on right side were 43.2±2.5 (SD) mm and 3.7±2.7 (SD) mm respectively. Median and mode vertical distance on right side were 43.2mm and 45mm respectively, with range of 13mm(min:37 and max:50). While median and mode horizontal distances on the right side were 4mm and 1mm respectively, with the range of 8.5mm (min:0 and max:8.5).

The mean vertical and horizontal distances of IOF on left side were 43.2±2.7 (SD) mm and 3.46±1.8 (SD) mm respectively. Median and mode vertical distances on left were 43.0mm

Table 1 Mean distances of infraorbital foramina.

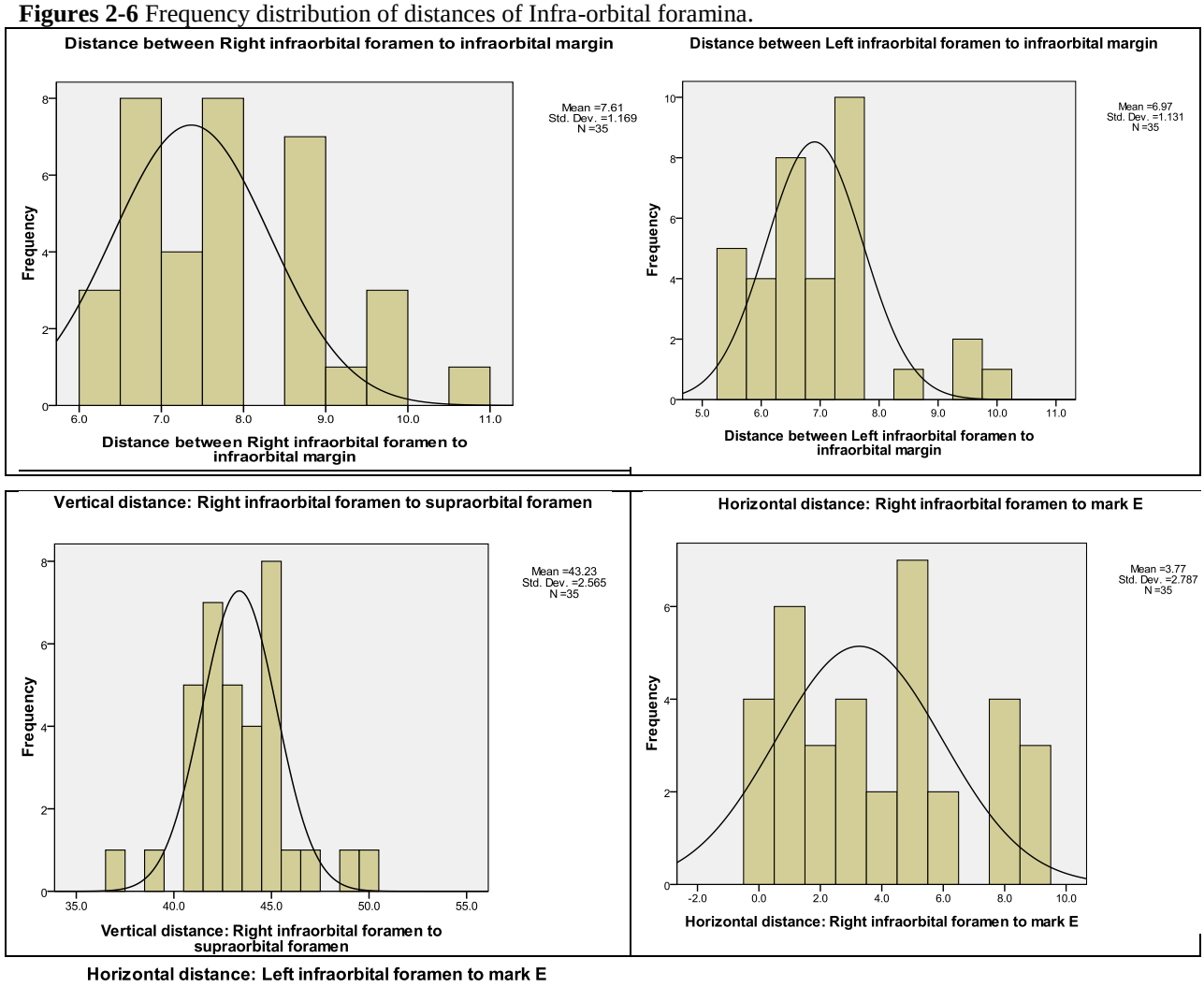
	Right infra orbital n (35)	*Left infra orbital n (35)*	*Mean (N=70)*
Horizontal distance (IOF-Mark E)	3.77±0(SD)	3.46±1.81(SD)	3.61±0.90(SD)
Vertical distance (SOF/SON-Mark E)	43.22±2.56(SD)	43.28±2.42(SD)	43.25±2.49(SD)
Distance (IOF-IOM)	7.85±1.38(SD)	7.10±1.4(SD)	7.48±1.39(SD)

Mark E= A point on horizontal line from IOF to pyriform aperture intersected by a vertical line drawn from supraorbital foramen.

Table 2 Descriptive statistics of distances of infraorbital foramina.

		Vertical distance		*Horizontal distance*		*Distance between*	
		Right supraorbital foramen to mark E	*Left supraorbital foramen to mark E*	*Right infraorbital foramen to mark E*	*Left infraorbital foramen to mark E*	*Right infraorbital foramen to infraorbital margin*	*Left infraorbital foramen to infraorbital margin*
N	Valid	35	35	35	35	35	35
	Missing	0	0	0	0	0	0
Mean		43.229	43.286	3.771	3.463	7.606	6.974
Median		43.000	43.000	4.000	3.000	7.500	7.000
Mode		45.0	41.5a	1.0	3.0	6.5	7.5
Std. Deviation		2.5649	2.4262	2.7874	1.8169	1.1689	1.1309
Minimum		37.0	39.0	0	0	6.0	5.5
Maximum		50.0	48.5	8.5	7.5	10.5	10.0

Figures 2-6 Frequency distribution of distances of Infra-orbital foramina.



and 41.5 respectively, with range of 9.5mm (min:39 and max:48.5). While median and mode horizontal distance values on left were 3mm each, with the range of 7.5mm (min:0 and max:7.5).

Mean distance of infraorbital foramen from infraorbital margin on right side was found to be 7.6±1.1mm with median and mode values of 7.5mm and 6.5mm respectively. In contrary to that, mean distance on the left side was 6.9±1.1mm, with median and mode being 7mm and 7.5mm respectively.

Discussion

An exact knowledge of the location of maxillofacial foramina is crucial for clinicians while performing aesthetic procedures and

regional nerve blocks. Regional nerve block makes these procedures more comfortable for patients and more convenient for clinicians to decide the area and the dose of material injected into that required area.

Literature revealed extended work done to show morphological and morphometric variations regarding infraorbital foramen among various ethnic groups with reference to many different adjacent structures.[3,5,9-13]

Our study showed presence of infraorbital foramina bilaterally in all the skulls examined and this is also agreed upon by previous studies.[8-11]

We could not find accessory infraorbital foramen in any skull however it was claimed to have been present by Siriwat *et al;*[10] Polo *et al.*[14] and others.

In our study, most common site of IOF was found to be 43.2±2.5 mm below and 3.7±2.7 mm lateral to the supra-orbital foramina on right side while 43.2±2.4mm below and 3.4±1.8 mm lateral to the supra-orbital foramina on left side. This is a bit closer to the American population is mean value of 43.3±3.1[15] but less than Sri Lankan[5] population. Still we cannot claim these measurements to be the precise representation of the entire population due to small cohort size.

It is claimed by most studies that IOF is located lateral to or in line with SOF, as is seen in our study, but an Indian study claims that it can be present even medial to SOF, although percentage of patients is very less (7.41%).[16]

Results of distance between IOF-IOM have shown great variations among different ethnic groups. It was found 7.8mm below infraorbital margin on right side and 7.1mm on left side. This result is almost the same as the Indian population[16] but much less than Srilankan[13] and Chinese[17] skulls, however it is more than Egyption[6] and Brazillian[18] skulls.

As far as local studies are concerned, Rasheed *et al.*[19] also claimed significant variations among various ethnic groups and they too did not find any accessory IOF. However Jafri *et al.*[20] observed accessory IOF in 8.2% patients and also found IOF to lie medial to SOF in 2.4% patients on right side. A larger sample size is required to prove significance of these findings.

We selected SOF/SON as a primary reference point because while doing aesthetic procedures, it is easier to palpate it at the end of round part of supraorbital margin, and also because it is comparatively less hidden under the facial soft pad of fat and musculature. Infraorbital margin at mid-pupillary line is also considered for more accurate localization of infraorbital foramen. This will help dermatologist not only in blocking infraorbital nerve for regional anesthesia but it will also help them to avoid accidental injection of fillers in infraorbital vessels leading to necrosis of their respective area of supply (a grave complication of injectable fillers).

A limitation of our study is that ages and genders of skulls were not determined. Also, further studies on larger sample size are required to confirm the findings.

Conclusion

The study added information to the literature concerning morphometric value of infraorbital foramen in view of racial variations. The data are of direct relevance to clinical practice and teaching. More studies are warranted in Pakistani population, to have an accurate measurements of facial foramina in relation to other bony landmarks.

References

1. King EH.Acceptance of cosmetic surgery: Scale development and validation. *Body Image*. 2013;**2(2)**:137-49.
2. Varshney R, Sharma N. Infraorbital foramen–morphometric study and clinical application in adult Indian skulls. *Saudi J Health Sci*. 2013;**2**:151-5.
3. Ashwini LS, Mohandas Rao KG, Sharmila Saran, and Somayaji SN Morphological and Morphometric Analysis of Supraorbital Foramen and Supraorbital Notch: A Study on Dry Human Skulls. *Oman Med J*. 2012; **27(2)**:129–31.
4. Standring S, Ellis H, Healy JC, Johnson D, Williams A, Collins P, *et al;* eds. Gray's Anatomy: The Anatomical Basis of Clinical Practice. 39th Edition, Elsevier, Churchill Liwingstone, London. 2005: 511-13.
5. Ilayperuma, I. Nanayakkara, G. Palahepitiya, N. Morphometric analysis of the infraorbital foramen in adult Sri Lankan skulls. *Int J Morphol*. 2010;**28(3)**:777-82.
6. Elsheikh E, Nasr WF, Ibrahim AAS. Anatomical Variations of infraorbital foramen in dry human adult Egyptian skulls; anthropometric measurements and surgical relevance. *Int J Otorhinolaryngol Clin*. 2013;**5(3)**:125-9.
7. Kyung-Seok Hu, Jinny kwak, ki-Seok Koh, Schinichi Abe, Christian fontaine, Hee-Jinn Kim Topographic distribution area of the infraorbital nerve. *Surg Radiol Anat*. 2007;**29(5)**:383-8.
8. Kazkayasi M, Ergin A, Ersoy M, Tekdemir I, Elhan A. microscopic anatomy of infra orbital canal, nerve and foramen. *Otolaryngol Head neck Surg*. 2003; **129**:692-701.
9. Nanayakkara D, Peiris R, Mannapperuma N, Vadysinghe A. Morphometric Analysis of the Infraorbital Foramen: The Clinical Relevance. *Anat Res Int*. 2016;**2016**:7917343.
10. Siriwat T, Phruksachat Y, Pasuk M. Morphometric Studies of Supraorbital Foramen, Infraorbital Foramen and Mental Foramen in a Thai Population Related with Nerve Blocks. *Int J Morphol*. 2022;**40(1)**:181-7.
11. Mahajan A, Verma R, Razdan S K, *et al*. (February 01, 2023) Morphological and Morphometric Relations of Infraorbital Foramen in North Indian Population. *Cureus*. **15(2)**:e34525.
12. Thilakumara IP, Hettiarachchi PVKS, Jayasinghe RM, Fonseka MCN, Jayasinghe RD, Nanayakkara CD. Morphometric analysis of infraorbital foramen using cone beam computed tomography in a cohort of Sri Lankan adults. *Int J Morphol*. 2021;**39(2)**:489-96.
13. Akshaya S, KR Dakshayani. Morphometric analysis of infraorbital foramen in human dry skull of south Indian population and its clinical implications. *Indian J Clin Anat Physiol*. 2022;**9(1)**:54-61.
14. Polo CL, Abdelkarim AZ, von Arx T, Lozanoff S: The morphology of the infraorbital nerve and foramen in the presence of an accessory infraorbital foramen. *J Craniofac Surg*. 2019;**30**:244-53.
15. Apinhasmit W, Chompoopong S, Methathrathip D, Sansuk R, Phetphunphiphat W. Supraorbital Notch/Foramen, Infraorbital Foramen and Mental Foramen in Thais: anthropometric measurements and surgical relevance. *J Med Assoc Thai*. 2006;**89(5)**:675-82.
16. Poonam Kharb Janghu, Prajna P. Samanta, Nirupma Gupta. Morphometric Analysis Of Infraorbital Foramen In Dry Adult Skulls And Its Surgical Relevance. *JARBS*. 2015; **4(2)**:83-7.
17. Hin-Lun liu, Yu-Wai Chan, Raymond Wai-ManNg, The clinical landmark of infraorbital foramen in Chinese population: A prospective measurement study. *Eur J Plast Surg*. 2014;**37(10)**:517-22.
18. Macedo, VC, Cabrini, RR. Faig-Leite, H. Infraorbital foramen location in dry human skulls. *Braz J Morphol Sci*. 2009;**26(1)**:35-8.
19. Rasheed A, Hina M, Tafweez R. Morphometric Measurements of Supraorbital and Infraorbital Foramen in Dry Skulls of Local Population. *JSM Anat Physiol*. 2019;**4(1)**:1021.
20. Jafri SR, Muneeb A, Qureshi F, Sikander H, Arif A, Arshad A. Morphometric Analysis of Infraorbital Foramen in Human Dry Skulls. *PJMHS*. 2022;**16(10)**:670-2.