Original article:

Morphometeric analysis of infraorbital foramen in north indian skulls

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Abstract:

Introduction: The objective of this work was to study the morphology and biometry of the infraorbital foramen, variations in its location, shape and size as well as to obtain measurements of its location. **Methods:** 70 dry skulls collected from IIMS & R and KGMU, Lucknow were analyzed for infraorbital foramen under various parameters.

Observations and results: 81.4% of IOF on right side and 87.1% of IOF on the left side were in line of first premolar. Oval shape of IOF was found to be most common, in 71.4% of skulls on both sides. Average vertical diameter of infraorbital foramen on the left side was 3.08±0.85mm and on the right side was 2.93±0.78mm. The average transverse diameter was 3.27±0.85mm on the left side and 3.05±0.79mm on the right side. Mean distance of IOF from zygomaticomaxillary suture was 14.83±2.36 on the left side and 14.71±2.54 mm on the right side. Distance between IOF and midpoint of infraorbital margin was 6.92±1.81 mm on the left side and 6.75±1.85 on the right side. Distance of IOF from pyriform aperture was 16.14±1.72 on the left side and 15.79±1.76 on the right side.

Conclusion: The findings of the present study can be helpful for clinicians utilizing the infraorbital nerve block for various procedures in localizing the infraorbital foramen.

Key words: infraorbital foramen, morphometery, infraorbital nerve block

Introduction:

Infraorbital foramen (IOF) is an opening present in maxillary bone, 1 cm inferior to the infraorbital margin, providing passage to infraorbital vessels and nerve[1]. These vessels and nerve fibers are responsible for innervation of the inferior eyelid, nasal wing, superior lip and vestibular gum of the anterior and premolar teeth. Morphometry of infraorbital foramen is relevant for surgeons, anesthetist, and dental surgeons, while performing procedures in which the infraorbital foramen is used as a reference point. Infraorbital nerve is a prime candidate for a regional nerve block on account of its large area of innervations[2]. Infraorbital nerve block is the local analgesic technique of choice for the regional anesthesia of the face[3]. It is a convenient alternative for situations such as facial laceration in which tissue distortion would be unacceptable[4]. The position of the infraorbital foramen helps to locate the infraorbital plexus region which we believe a risk zone during plastic

surgery[5]. Location of this foramen is also helpful to decrease risk of orbital surgery[6].The purpose of this study was to find out the incidence of variations in location, shape, dimensions and distance of the infraorbital foramen from various bony landmarks on both the sides of the same skull. The findings of this study were also compared with the findings of other authors.

Materials and methods:

Present study was a cross-sectional study conducted in the Department of Anatomy, Integral Institute of Medical Sciences and Research, Integral University, Dasauli, Kursi Road, Lucknow and King George's Medical University, Lucknow. A total of 70 dry skulls were collected and examined for infraorbital foramen. After aligning the skull in Frankfurt horizontal plane, using rulers, thread, double-tipped compass, digital varnier calipers, tape and manipulating following parameters were measured to evaluate the location of infraorbital on both sides of skull.

Shape of infraorbital foramen (IOF).

Vertical diameters (VD) and transverse diameters (TD) of IOF

Distance from centre of IOF to Infraorbital margin along sagittal plane.

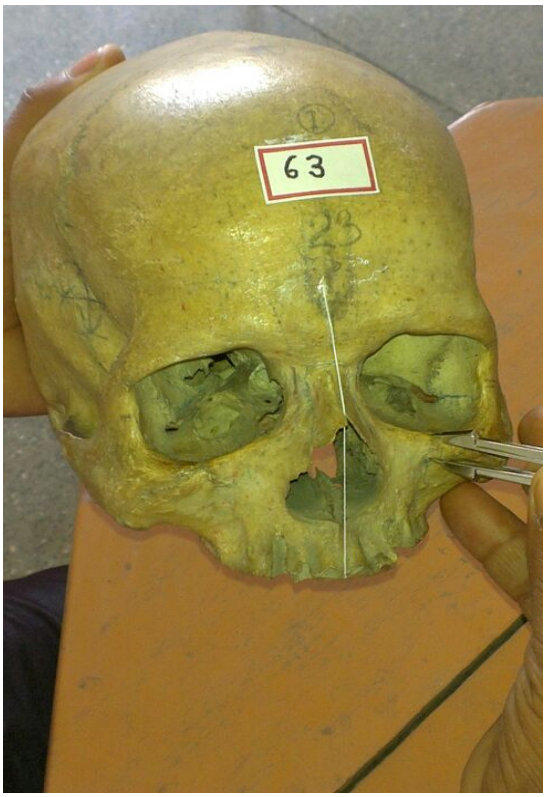
Distance from centre of IOF to Piriform aperture (PA) along transverse plane.

Position of IOF in relation to zygotomaxillary suture along with sagittal plane.

Measurements related to infraorbital foramen were taken with double tipped compass and then transferred to digital varnier calipers (least count 0.01 mm) to measure the distances. The dimensions were taken three times by the same person and mean was taken, thus increasing the accuracy of the measurements.

4.5 Statistical analysis

The results are presented in mean ±SD and percentages. The continuous measurements were compared by using unpaired t-test between left and right sides. The Pearson correlation coefficient was calculated among the study parameters separately for left and right side. The p-value<0.05 was considered significant.



Photographs No. 1- Measurement of Distance from Infraorbital foramen to midpoint of Infraorbital margin

Photographs No. 2- Measurement of Distance from Infraorbital foramen to Zygomatico –Maxillary suture.

Photographs No. 3- Measurement of Distance from Infraorbital foramen to piriform apparture.

Observation and results:

A total of 70 skulls were studied with 140 infraorbital foramen.

Position of Infraorbital foramen The position of infraorbital foramen was observed in relation to 1st and 2nd premolar. 81.4% of IOF on right side and 87.1% of IOF on the left side were in line of first premolar.

Shape of Infraorbital foramen

The shape of infraorbital foramen on both sides was observed. Oval shape was found in 71.4% of skulls on both sides. The other types of shape observed were round and semilunar. Frequency of different types of skull was tabulated in table 1.

Table-1: Shape of Infraorbital foramen

	Left side		Rt side	
	Number	**%**	**Number**	**%**
Oval	50	71.4	50	71.4
Round	11	15.7	10	14.3
Semilunar	9	12.9	10	14.3
Total	70	100.0	70	100.0

Size of the infraorbital foramen

The transverse and vertical diameter of IOF was measured with the help of compos and digital calipers. The mean, standard deviation were calculated and compared on both sides. There is no significant (p>0.05) difference in the vertical diameters of infraorbital foramen between left (3.08±0.85) and right (2.93±0.78) side of skulls. The transverse diameter is higher between left side (3.27±0.85) compared with right side (3.05±0.79). However, the difference is statistically not significant (p>0.05). The findings were displayed in table 2.

Table-2: Comparison of vertical and transverse diameter of Infraorbital foramen on left and right side

	Vertical diameter	Transverse diameter
	Mean±SD	**Mean±SD**
Left	3.08±0.85	3.27±0.85
Right	2.93±0.78	3.05±0.79
t and p-value[1]	1.11, 0.26	1.54, 0.12

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Distance of infraorbital foramen from various nearby bony landmarks

The distance of infraorbital foramen from different bony landmarks was measured and tabulated in table 3.

Table-3: Comparison of distance of infraorbital foramen from various nearby bony landmarks on left and right side

	Distance b/w IOF to ZM suture (mean ±SD)	Distance b/w IOF to mid point of IOM (mean ±SD)	Distance b/w IOF to PA (mean ±SD)
Left	14.83±2.36	6.92±1.81	16.14±1.72
Right	14.71±2.54	6.75±1.85	15.79±1.76
t and p-value	0.30, 0.76	0.56, 0.57	1.17, 0.24

There was no significant ($p>0.05$) difference found between the various distances while comparing on right and left side.

There was mild correlation ($r=0.35$, $p=0.002$) between vertical and transverse diameter on left side and was statistically significant. A significant strong correlation was observed between transverse diameter and vertical diameter ($r=0.70$, $p=0.0001$) on right side. The mild correlation was also found between distance from infraorbital foramen to piriform apparture and distance from infraorbital foramen to midpoint of infraorbital margin. The correlation between other parameters was poor.

Discussion:

Infraorbital foramen is located near important anatomical structures like orbit, nose and oral cavity. The location of the infraorbital foramen assumes great importance because an infraorbital nerve block is essential during surgical procedures around the orbit, nose and buccal regions.

The most common position of infraorbital foramen is in line of long axis of the second upper premolar. According to Hindy et al 1993; 50% and Varshney 2013; 64% of infraorbital foramen was opposite the 2nd maxillary premolar[7,8]. In present study, the location of IOF was found in line of second premolar in 81.4% of skulls which was higher than what mentioned by Hindy 1993 and Varshney 2013.

Most common shape of infraorbital foramen

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mentioned in the literatures is oval type. Oliveira et al in 2012 and Hindy 1993 found that infraorbital foramen was predominantly of oval shape in 65% of the skulls on both sides, followed by round shape[7,9]. In present study also oval shape was observed to be most common type but the percentage was higher (71.4%). It was followed by round (14.3%) and semilunar (14.3%). The size of IOF found in present study was almost similar to what described in previous studies. Vertical and horizontal diameter of IOF measured in present study is compared from findings of other studies in table 4.

Table 4: Comparison of vertical and transverse diameter of IOF found in this study from finding of different studies

	Vertical diameter		Horizontal diameter	
	right	left	right	left
Singh 2011[2] (n=55)	3.75 mm,	3.39 mm	3.52mm	3.19mm
Bharti 2013[12] (n=100)	3.23±0.98mm	3.25±1.03mm	3±0.76mm	3.28±0.99mm
Present study 2014 (n=70)	2.93±0.78	3.08±0.85mm	3.05±0.79mm	3.27±0.85mm

The distance between the Infra orbital foramen and midpoint of the inferior orbital margin has been reported to be from 4 mm to over 10 mm in several studies[11, 12]. In present study it was found in the range of 6mm on both the sides. Distance between IOF to pyriform aperture was ranged between 14 to 16 mm in different studies. In present study it is slightly higher than what mentioned by Singh 2011 but slightly lower than that mentioned by Bharti 2013. Distance of IOF from various bony landmarks in present study is compared from the findings of previous studies in table 5.

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Table 5:Comparison of distance IOF from various bony landmarks in present study from different studies.

	Distance b/w IOF to mid point of IOM (mean ±SD)in mm		Distance b/w IOF to PA (mean ±SD) in mm	
	Right	left	Right	Left
Hindy 1993[7] (30 skull and 15 cadavers	6.1± 2.4	6.1± 2.4	14.7 ± 2.7	14.7 ± 2.7
Singh 2011[2](55 skull)	6.12	6.19	15.31	15.80
Varshney 2013[8] (100 skull)	7.65 ± 1.35	7.11 ± 1.73	-	-
Bharti 2013[10] (100 skull)	7.82	7.82	16.01	16.01
Present study (70 skull)	6.75±1.85	6.92±1.81	15.79±1.76	16.14±1.72

Conclusion: The results highlighted the differences of the various parameters regarding infra orbital foramen from different studies and emphasized the need for meticulous preoperative evaluation of the infraorbital foramen in patients who are candidates for maxillofacial surgeries and regional block anesthesia.

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