Original Article

Anatomical Variations & Surgical Relevance of Infraorbital Foramen in Human Dry Adult Skulls Among South Indian Population

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Abstract

Background: The infraorbital nerve and arteries are transmitted via the infraorbital foramen, which is situated on the maxillary bone under the orbit. The infraorbital nerve is therapeutically important in periorbital, dental, and maxillofacial treatments because it supplies sensory innervation to the nasal vestibule, upper lip, and lower eyelid. Variations in its location and the presence of accessory foramina may lead to ineffective anesthesia or nerve injury. Hence, precise anatomical knowledge is essential. The objective is to study variations in the location of the infraorbital foramen, determine the incidence of accessory foramina, and measure distances between the infraorbital foramen and key anatomical landmarks such as the infraorbital margin and piriform aperture. **Material and Methods:** This observational study included 40 dry adult human skulls obtained from PSG Institute of Medical Sciences and Research, Coimbatore. Intact skulls without deformities were included. Measurements were taken bilaterally using a digital vernier caliper (accuracy 0.01 mm). The presence of accessory foramina was noted macroscopically. Data were analyzed using SPSS software. **Results:** The mean distance between the infraorbital foramen and infraorbital margin was 6.33 ± 1.36 mm on the right and 6.73 ± 1.37 mm on the left. The mean distance between the infraorbital foramen and piriform aperture was 15.23 ± 1.97 mm on the right and 14.49 ± 1.93 mm on the left. Accessory foramina were observed more frequently on the left side. The findings were consistent with previous Indian studies, indicating population-based variation. **Conclusion:** The location of the infraorbital foramen shows variation influenced by ethnicity. Accessory foramina are clinically significant and more common on the left side. Knowledge of these variations is essential for accurate nerve blocks and to prevent neurovascular injury during surgical procedures.

Keywords: Infraorbital foramen, Accessory infraorbital foramen, Morphometry, Anatomical variation, Infraorbital margin, Piriform aperture, Maxillofacial surgery.

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Introduction

Infra Orbital Foramen being situated in the maxillary bone, serves as a pathway for the transmission of infra orbital nerves and vessels. After passing through the maxilla's infraorbital foramen, the infraorbital nerve supplies sensory innervation to the upper lip, lower eyelid, and a portion of the nasal vestibule. For periorbital, dental, plastic, and oromaxillofacial procedures, infraorbital nerve blocks are the recommended method of anaesthesia. The purpose of this study was to identify the most accessible anatomical landmarks, determine the location of the infraorbital foramen, and investigate the existence of supernumerary foraminae for efficient nerve blockade, which will help reduce the risk of injury during periorbital surgeries.

Background of the study: "Infra Orbital Foramen" is situated along the lower margin of the orbit in the maxillary bone. Maxillary nerve after completing its course inside the viscerocranium, it passes through the canal in the floor of orbit and exits the infraorbital foramen as the infraorbital nerve. Here, it splits up into branches, the inferior palpebral branch, external nasal branch, internal nasal branch and the superior labial branch which are collectively referred as the "Infraorbital boquet' or "Infraorbital plexus" (Testut and latarjet, 1954). Through its branches infraorbital nerve provides sensory innervations to the lower eyelid, upper lip and part of the nasal vestibule. Thus, it is the Nerve of choice to anaesthetize during periorbital, dental, plastic and oromaxillofacial procedures (Hwang and Baik, 1999; Aziz et al., 2000). Previous studies has documented the variations in the range of position and symmetry of the infraorbital foramen (Testut and Latarjet, 1954; Bergman et al., 1988., Bolini and Del Sol, 1990; Berge and Bergman, 2001), and also the incidence of accessory infra orbital foraminae (Berry, 1975; Bergman et al., 1988; Aziz et al., 2000). The location of infraorbital boquet is of greater importance as injury can lead to sensory deficit in the nasal,labial and orbital region. This study was conducted keeping this in consideration.

Aims:

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1. To study the variations in the location of infraorbital foramen.
2. To find the incidence of accessory foraminae among the infraorbital foramen.

Objectives of the study:

1. To estimate the incidence of accessory infra orbital foramen among the right and left infraorbital foramen.
2. To calculate the mean distance between infraorbital foramen and infra orbital margin.
3. To calculate the distance between infraorbital foramen and piriform aperture.

Materials and Methods

Study design: Observational Study.
Sample size: 40
Sample collection: 40 dry adult skull specimens were obtained from anatomy and forensic department, PSG Institute of Medical Sciences and Research.
Study location: Department of Anatomy, PSG Institute of Medical Sciences and Research, Coimbatore.
Inclusion criteria: Dry, Complete, Intact adult Skulls, free from osteophytes and metastatic tumors.
Exclusion criteria:

1. Damaged and eroded skulls.
2. Deformed or anomaly skulls

Methodology: After obtaining IHEC approval, the parameters were measured using digital vernier calliper with an accuracy of 0.01mm and the incidence of accessory foramen was noted macroscopically. The collected data was statistically analysed using SPSS Software.
Measurements:

Figure 1: Measuring distance between infraorbital foramen and infraorbital margin

Figure 2: Measuring distance between infraorbital foramen from piriform fossa.

Figure 3: Accessory foraminae

Results

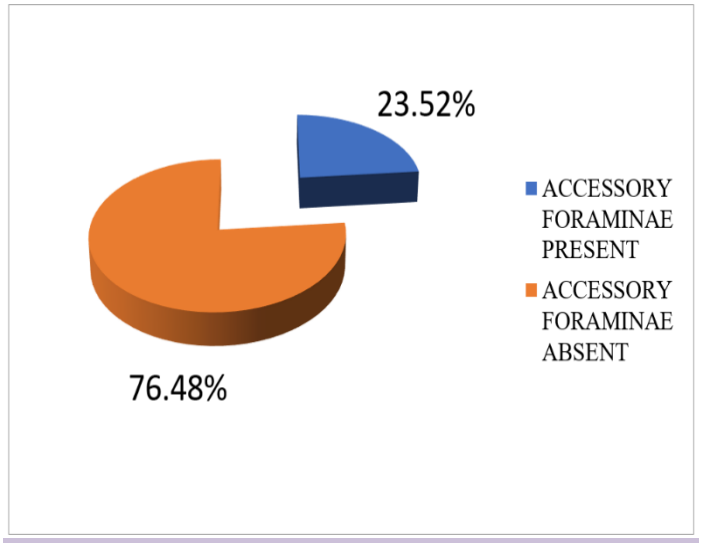

Chart 1: Incidence of accessory infraorbital foramen among 40 adult dry skulls.

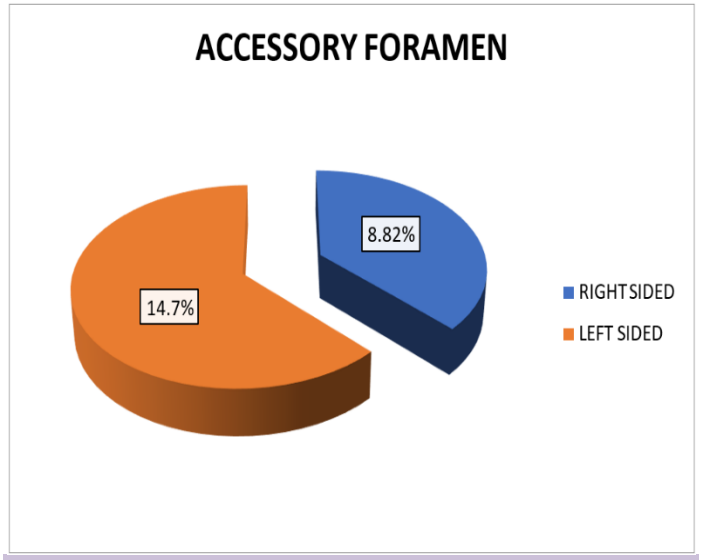

Chart 2: Incidence of right sided and left sided accessory foramen.

Table 1: Parameters for defining the location of infraorbital foramen (IOF – Infraorbital foramen, POM – Piriform fossa)

S.no	Parameters	Right (Mean mm)	LEFT (Mean mm)
1	Distance between IOF to IOM	6.33± 1.36	6.73± 1.37
2	Distance between IOF to POM	15.23± 1.97	14.49 ±1.93

Discussion

Table 2: Comparing the mean distance between infraorbital foramen and infra orbital margin with the data from previous studies

Study	No of skulls	Mean distance between IOM and IOF on Right side (Mean in mm ±SD)	Mean distance between IOM and IOF on Left side (Mean in mm ±SD)
Aziz et al (2000)	47	8.3±1.9	8.1±1.9
Elias et al (2004)	210	6.71± 1.7	6.83± 1.83
Agthong et al (2005)	110	7.8±0.2	8.0±0.2
Macedo et al (2009)	295	8.0±0.2	6.45±1.76
Boopathi et al (2010)	80	6.49±1.26	6.65±1.30
Gour et al (2010)	100	6.52±1.79	6.42±1.70
Singh S (2011)	55	6.12±1.79	6.19±1.81
Lokanayaki (2013)	100	6.12±1.43	6.53±1.53
Present study (2019)	40	6.33± 1.36	6.73± 1.37

The mean distance between the infraorbital foramen and infraorbital margin ranged between 4 and 11 mm. The distance was highest in the American population, ranging from 6.4 to 10.5 mm (Aziz et al., 2000), and in the Indian population, ranging from 4 to 9 mm. Regarding the South Indian population, our results coincided with those of Lokanayaki et al., and the range was 5–8mm.Thus, ethnicity plays a major role in locating the infraorbital foramen, and knowledge of its variations is essential for safe surgery.

Table 3: Comparing the mean distance between the infraorbital foramen and the piriform fossa with the data from previous studies

Study	No of skulls	Mean Distance between IOF to POM on Right side (Mean in mm ± SD)	Mean Distance between IOF to POM on left side (Mean in mm ± SD)
Hindy et al (1993)	30	14.7 ± 2.7	14.7 ± 2.7
Singh et al (2011)	55	15.31	15.8
Bharti et al (2013)	100	16.01	16.01
Tilak Raj et al (2014)	70	15.79±1.76	16.14±1.72
Ukoha ukoha ukoha et al (2014)	130	19.36±3.54	18.27±2.94
Present study (2019)	40	15.23± 1.97	14.49 ±1.93

Prior studies on the distance between the Infraorbital foramen and the Piriform fossa ranged from 14- 20mm, with the highest observed in the study by Ukohaukoha ukoha 2014 in the South Nigerian population, and the lowest in the Egyptian population at 16mm (Hindy et al). Our study results coincided with other Indian studies, with the mean distance ranging between 13 and 16.42mm (Singh et al., Bharti et al., Tilak Raj et al.). This concludes that there are population specific changes in the location of infra orbital foramen.

Berry et al. reported the frequency of the accessory infraorbital foramen as 4.7% in Egyptians, 6.4% in Nigerians, 6.4% in Modern Palestinians, 6% in North Americans, 7.5% in Burmese, 6.7% in North Indians (Punjabi), and 24.28% in the South Indian population. This shows that there is regional variation in the incidence of Accessory infraorbital foramen. Our study supports this fact.

Conclusion

Accessory foraminae were more common on the left side; injury to them during maxillofacial intervention may lead to sensory deficit.

Ethnicity and race play a key role in the morphometric localization of the infraorbital foramen. Knowledge of these variations may help surgeons avoid injury to underlying neurovascular bundles. They also facilitate surgical and anesthetic interventions.

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Conflicts of interest

There are no conflicts of interest.

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