DOI: https://doi.org/10.53350/pjmhs221610670

ORIGINAL ARTICLE

Morphometric Analysis of Infraorbital Foramen in Human Dry Skulls

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ABSTRACT

Background and aim: The infraorbital foramen morphometric and anatomical variations is the critical factor for avoiding iatrogenic nerve injuries during surgery on the middle third of the face with safe regional anesthesia. The present study aimed to carry out the morphometric analysis of infra orbital foramen in human dry skull.

Material and Methods: This morphometric study was carried out on 72 dry human skulls in the Department of Anatomy, Surayya Azeem Teaching Hospital, Lahore from January 2022 to June 2022. Research and ethical committee approved the study protocol. Skulls of identified age and gender with no apparent pathology, traumatic lesions, and deformity were enrolled. Skulls (>18 years) with bone resorption in the alveolar region and had orbital and nasal cavities damaged were excluded. Vernier caliper was used for the measurement of infra orbital foramen exact location on both sides. Transverse and sagittal diameter were measured. Infraorbital foramen and inferior margins of infraorbital margin were measured in order to determine the sagittal diameter. Infraorbital foramen medial margin to lateral margin of pyriform aperture was measured transversely. This study examined the relationship between the infraorbital foramen and the 1st premolar as well as its shape. There was also an indication of accessory foramen. SPSS version 26 was used for descriptive statistics.

Results: Of the total 72 dry human skulls, there were 58 (80.6%) male and 14 (19.4%) females. The incidence of oval, triangular, semilunar, and round shape infra orbital foramen (left versus right) was (38.4% vs. 40.3%), (17.8% vs. 16.9%), (26.7% vs. 28.6%), and (17.1% vs. 14.2%) respectively. The occurrence of single and accessory intra orbital foramen was 91.8% and 8.2% respectively. The intra orbital foramen opening was directed medially downward, medially in, and downward was 34 (47.2%), 32 (44.4%), and 6 (8.3%) respectively. In association with upper teeth, the intra orbital foramen on the right and left side was 38.4% and 54.9% respectively; the buccal cusps of the maxillary second premolar teeth were located on the same vertical axis.

Conclusion: The present study concluded that accurate localization of the IOF is essential to prevent infraorbital nerve injury. Additionally, foramen oval shape was the most prevalent shape followed by round shape. Knowledge regarding IOF location is critical in maxillofacial region during numerous surgery procedures which might lead to infraorbital vessels and nerve. Thus careful approach should be followed to avoid damage to foramen.

Keywords: Infra orbital foramen, human skulls, morphometric analysis

INTRODUCTION

The morphometric and anatomical variations of infraorbital foramen is the critical factor for avoiding iatrogenic nerve injuries during surgery on the middle third of the face with safe regional anesthesia [1]. A small channel is located within the infraorbital foramen (IOF) on the maxilla of anterior face, about a centimeter below the infraorbital border [2, 3]. The nerve and artery of infraorbital are accounted for the vascular-nervous supply to the face vital zones through IOF [4]. Several branches of the infraorbital nerve that innervate midface mucous membrane and skin, including nose lateral aspect, cheek, the lower eyelid, labial gum, and upper lip [5]. Hypoesthesia and bleeding might be caused by an infraorbital neurovascular bundle in traumatic or iatrogenic injury in their supply region [6]. Anatomical precise location detailed knowledge and infraorbital foramen possible variations are fundamental for safe regional anesthesia to prevent neurovascular bundle damaging risk in this region [7].

Numerous studies have established the IOF relative position and dimension variations with genders and among population groups [8, 9]. The IOF precise location and bony landmarks with various soft tissues were ascertained. Regarding IOF position, numerous studies reported significant variations in association to infraorbital margin [10, 11]. Furthermore, there were significant variations in IOF position in association to maxillary teeth among different population groups [12, 13]. There is paucity of data on IOF positioning, clinical relevance, and dimensionally available information. Therefore, the present study aimed to morphometrically analysis of infraorbital foramen.

METHODOLOGY

This morphometric study was carried out on 72 dry human skulls in the Department of Anatomy, Surayya Azeem Teaching Hospital, Lahore from January 2022 to June 2022. Research and ethical committee approved the study protocol. Skulls of identified age and gender with no apparent pathology, traumatic lesions, and deformity were enrolled. Skulls (>18 years) with bone resorption in the alveolar region and had orbital and nasal cavities damaged were excluded. Vernier caliper was used for the measurement of infra orbital foramen exact location on both sides. Transverse and sagittal diameter were measured. Infraorbital foramen and inferior margins of infraorbital margin were measured in order to determine the sagittal diameter. Infraorbital foramen medial margin to lateral margin of pyriform aperture was measured transversely. This study examined the relationship between the infraorbital foramen and the 1st premolar as well as its shape. There was also an indication of accessory foramen. There was also an indication of accessory foramen. IOF direction, accessory foramen presence, shape, and skulls visual assessment of both sides were recorded. The IOF shape might be triangular, round, oval, and semilunar. The infraorbital canal opening direction through maxilla anterior surface was measured by insertion of flexible wire and measured as being medially downward, downward, and medially.

The IOF relative size and position were analyzed on the left and right sides by a digital Vernier caliper (0.01 mm). The IOF maximum vertical diameter, maximum horizontal diameters, distance between IOF and inferior orbital margin (IOM), nasion and IOF, anterior nasal spine (ANS) and IOF, and were measured. SPSS version 26 was used for data analysis. The quantitative variables were expressed as mean and standard deviation. All the descriptive statistics was carried out using 95% confidence interval and 5% level of significance.

RESULTS

Of the total 72 dry human skulls, there were 58 (80.6%) male and 14 (19.4%) females. The incidence of oval, triangular, semilunar, and round shape infra orbital foramen (left versus right) was (38.4% vs. 40.3%), (17.8% vs. 16.9%), (26.7% vs. 28.6%), and (17.1% vs. 14.2%) respectively. The occurrence of single and

accessory intra orbital foramen was 91.8% and 8.2% respectively. The intra orbital foramen opening was directed medially downward, medially in, and downward was 34 (47.2%), 32 (44.4%), and 6 (8.3%) respectively. In association with upper teeth, the intra orbital foramen on the right and left side was 38.4% and 54.9% respectively; the buccal cusps of the maxillary second premolar teeth were located on the same vertical axis. The location of IOF at mean distance was 6.32± 2.01 mm and 7.29± 1.61 mm vertically below on the right and left side below IOM respectively. Figure-1 illustrates the gender's distribution. The prevalence of different shapes of infraorbital foramen (left versus right side) is depicted in Figure-2. The incidence of single and accessory IOF is shown in Figure-3. The direction of IOF opening is shown in Figure-4. Data on crania's infraorbital foramen right and left sides is shown in Table-I. The IOF's relative position in association to the SOF/N is represented in Table-II.

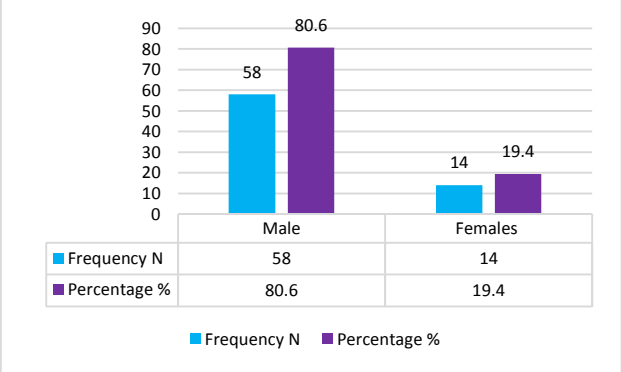

Figure-1: Gender's distribution (n=72)

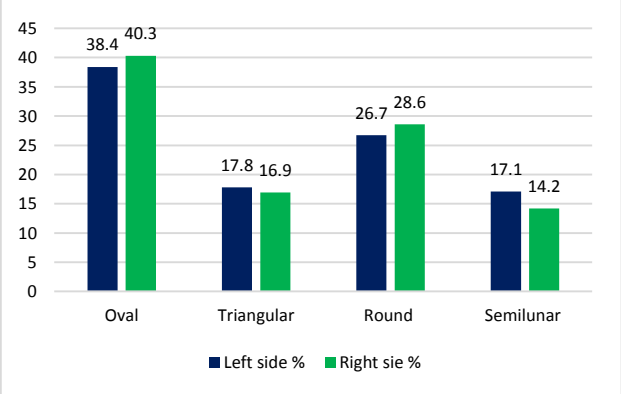

Figure-2: prevalence of different shapes of infraorbital foramen (left versus right side)

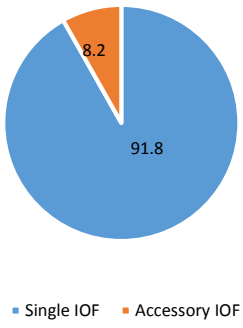

Figure-3: incidence of single and accessory IOF

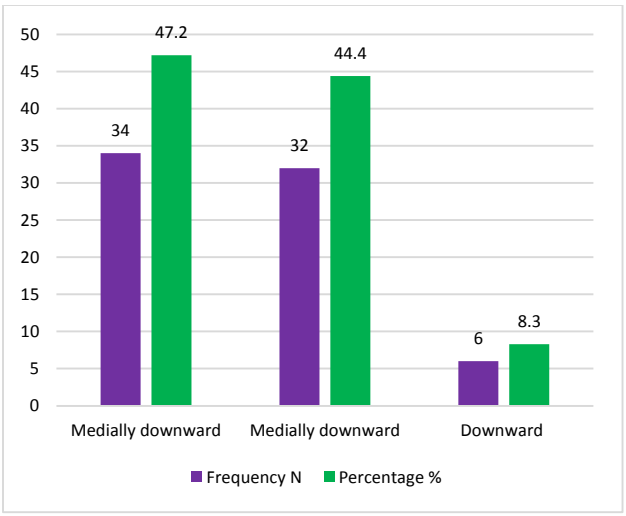

Figure-4: direction of IOF opening

Table-1: Data on the right and left sides of the crania's infraorbital foramina

Measurement parameters	Right side (mean ± SD)	Left side (mean± SD)
Vertical diameters (max)	3.09±0.59	3.29± 0.56
Transverse diameter (max)	3.31±0.57	3.31 ± 0.58
IOF to IOM distance	6.49±2.01	7.28 ± 1.61
IOF to ANS distance	32.94±1.84	33.41 ± 2.62
IOF to Na distance	41.81±3.49	42.61 ± 3.32

Table-2: IOF's relative position in relation to the SOF/N

Positioning	Left %	Right %
SON/F (vertical plane)	8.7	4.9
Medial to SON/F	0.0	2.4
Lateral to SON/F	91.3	92.7

DISCUSSION

The present study mainly focused on infraorbital foramen morphometric analysis and found that IOF anatomical variations and characteristics may significantly contribute to infraorbital neurovascular plexus sequelae and reducing injury risk during surgical procedures. The neurovascular plexus injury might lead to nose ala, upper incisors, lower eyelid numbness, canines, and profuse bleeding [14, 15]. The incidence of IOF multiplicity varies from 4% to 11% [16, 17]. There were no significant differences found between gender and maxilla sides and IOF to IOB distance. According to earlier study conducted by Borghei-Razavi et al [18] found that the right side had significantly higher distance on male cranial right side. In contrast, Polermo et al [19] found left sides to have greater IOF to IOB distance.

A Brazilian based study found that 5.7mm was the mean distance whereas Nanayakkara [20] found 6.7 mm distance. These measurements were lower than the 7 mm seen in the current study. Based on another study conducted by Tomaszewska et a; [21] found that IOF was considerably nearer to the right side in both genders regardless of comparison made for both genders. Chracronovic et al [22] and Sheikh et al [23] reported means of 5.92 mm and 9.53 mm respectively. Another study by Bjelakovic et al [24] assess the asymmetric craniofacial occurrence in four distances showed that fetus had asymmetry facial bones.

Tuncer et al [25] showed asymmetry presence in the skull base. This study found that all age groups' skulls were asymmetric, and that the right side was more prevalent than the left side in most measures. A previous study by Polo et al [26] found that the distance between IOF and IOM on 47 cadaveric heads was 8.5 ± 2.2 mm however Chahed et al. [27] investigated the IOF location on dry skulls and found that IOF mean distance was 6.57 ± 1.28 mm. Additionally, IOF in Tai adult skulls was located below infraorbital foramen at 9.23 ± 2.03 mm.

In the current investigation, differences in distance of IOF-ANS, IOF-IOM, and IOF-Na was associated with gender resembling the previous studies findings which show that male had greater dimension than females [28, 29]. Additionally, some previous studies [30, 31] found these differences to be statistically significant, while others found them to be non-significant [32]. This gender dimorphism is the normal finding as reported in craniofacial complex other parts [33].

The present investigation reported that IOF and IOM distance on the left side was statistically greater in males (6.49±2.01 mm) compared to females (7.28 ± 1.61 mm). Additionally, IOF-ANS, IOF-IOM, and IOF-Na mean distances were lesser on the right side compared to the left side. Comparing the difference in IOF-IOM distance was statistically significant in both genders. These observations resembled the findings of previous studies [34, 35].

Another study investigated 1400 dry human skulls and found that the prevalence of foramina (>3), double, and triple foramina was 4 (0.3%), 131 (9%), and 7 (0.5%) respectively [36]. Agarwal et al [37] reported that the incidence of AIOF was 6.4% vs. 8.7%, 12.5% vs. 7.9%, and 18.2% vs. 12.5% in males and females respectively. In our study, infraorbital foramen in the majority of skulls are located in the vertical plane through SOF/N. The incidence of right and left side was 92.7% and 91.3% respectively. Similar observations were reported in a previous study [38].

CONCLUSION

The present study concluded that accurate localization of the IOF is essential to prevent infraorbital nerve injury. Additionally, foramen oval shape was the most prevalent shape followed by round shape. Knowledge regarding IOF location is critical in maxillofacial region during numerous surgery procedures which might lead to infraorbital vessels and nerve. Thus careful approach should be followed to avoid damage to foramen.

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