https://doi.org/10.3329/cbmj.v15i2.91366

Dimensional Analysis of Infraorbital Foramen in Dry Adult Human Maxilla

*Shom T[1], Mili DA[2], Haque SMA[3], Jannat RA[4], Latif MS[5], Alam MT[6], Sultana A[7]

Abstract

The infraorbital foramen (IOF) is a critical structure on the maxilla transmitting the infraorbital nerve and vessels. Precise knowledge of its dimensions is essential for clinical procedures. This study investigated the vertical and horizontal diameters of the IOF and their correlation in a Bangladeshi population. This cross-sectional, analytical study examined 300 dry human maxillae (148 left and 152 right) collected from the Department of Anatomy of Mymensingh Medical College (MMC) and Community Based Medical College, Bangladesh (CBMC,B), Mymensingh, Bangladesh. Maximum vertical and horizontal diameters were measured using digital Vernier calipers. Pearson's correlation coefficient assessed the relationship between dimensions. The mean vertical diameter was 2.98±0.51 mm (left) and 2.95±0.50 mm (right), with ranges of 1.76–4.89 mm and 1.83–4.17 mm respectively. The mean horizontal diameter was 4.39±0.92 mm (left) and 4.44±0.96 mm (right), ranging from 2.13–7.28 mm. A significant positive correlation was observed between vertical and horizontal diameters on both sides (left: $r=0.442$, $p<0.001$; right: $r=0.386$, $p<0.001$). This study establishes baseline dimensional data for the IOF in the Bangladeshi population. The significant correlation between dimensions suggests predictable morphological patterns that may assist clinicians in surgical planning and regional anesthesia procedures.

CBMJ 2026 July: Vol. 15 No. 02 P:44-48

Keywords: Infraorbital foramen, morphometry, maxilla, Bangladeshi population

Introduction

The maxilla serves as a cornerstone of the facial skeleton, contributing to the formation of the orbital floor, nasal cavity walls, hard palate, and maxillary sinus. Among its various anatomical features, the infraorbital foramen represents a clinically significant structure located on the anterior surface of the maxilla. This foramen serves as the exit point for the infraorbital nerve and vessels, which provide sensory innervation and blood supply to the lower eyelid, lateral nose, cheek, and upper lip.[1] The infraorbital nerve, a terminal branch of the maxillary division of the trigeminal nerve, is of particular clinical importance due to its role in sensory perception of the midface region.[2] Accurate knowledge of the dimensional characteristics of the infraorbital foramen is essential for various clinical procedures. During infraorbital nerve block procedures, which are commonly performed for dental surgeries, rhinoplasty, and maxillofacial operations, the dimensions of the foramen influence the technique and efficacy of anesthesia delivery. Similarly, in reconstructive and aesthetic surgeries of the midface, understanding the dimensional parameters helps surgeons avoid iatrogenic injury to neurovascular

1. *Dr. Tumpa Shom, Assistant Professor, Department of Anatomy, Community Based Medical College, Bangladesh.
2. Dr. Dilruba Afrose Mili, Assistant Professor, Department of Anatomy, Community Based Medical College, Bangladesh.
3. Dr. Shah Md. Atiqul Haque, Assistant Professor, Department of Anatomy, Mymensingh Medical College, Mymensingh, Bangladesh.
4. Dr. Rumman Al Jannat, Lecturer, Department of Anatomy, Community Based Medical College, Bangladesh.
5. Dr. Md. Safat Latif, Lecturer, Department of Anatomy, Mymensingh Medical College, Mymensingh, Bangladesh.
6. Dr. Md. Towhidul Alam, Assistant Professor, Department of Anatomy, Jashore Medical College, Jashore.
7. Dr. Abeda Sultana, Assistant Professor, Department of Anatomy, Dhaka Medical College, Dhaka.

Address of Correspondence:
Email: aurpyta@gmail.com

structures. Furthermore, dimensional analysis provides valuable information for the design and placement of maxillofacial implants and surgical navigation systems. The vertical and horizontal diameters of the infraorbital foramen represent fundamental dimensional parameters that characterize its size and shape.[2,3] The vertical diameter, measured from the superior to inferior margin of the foramen, and the horizontal diameter, measured from the medial to lateral margin, together define the overall dimensions and morphology of this anatomical structure. Understanding the relationship between these dimensions may provide insights into the morphological patterns and developmental characteristics of the infraorbital region.

Previous studies have documented variations in infraorbital foramen dimensions across different ethnic and geographic populations.[2-10] However, comprehensive data specific to the Bangladeshi population remains limited, with most reference values derived from studies conducted on other ethnic groups. This knowledge gap necessitates the establishment of population-specific dimensional standards to enhance clinical practice and surgical outcomes. The present study aims to address this gap by conducting a comprehensive dimensional analysis of the infraorbital foramen, investigating both vertical and horizontal diameters and their correlation in dry human maxillae from the Bangladeshi population.

Methods

This cross-sectional, descriptive study was conducted in the Department of Anatomy, Mymensingh Medical College, Bangladesh, from July 2024 to June 2025. A total of 300 fully ossified dry human maxilla bones were included in the study, comprising 148 left-sided and 152 right-sided specimens. The maxillae were obtained from the osteology collections of the Department of Anatomy of Mymensingh Medical College (MMC) and Community Based Medical College, Bangladesh (CBMC,B), Mymensingh, Bangladesh. Specimens with visible pathological conditions, fractures, or significant structural deformities affecting the infraorbital region were excluded from the study. All measurements were obtained using calibrated digital Vernier calipers with an accuracy of 0.01 mm. In case of first dimensional parameter (maximum vertical diameter), the fixed jaw of the slide calipers was positioned on the upper margin and the movable jaw on the lower margin of the infraorbital foramen. Measurement points were selected by identifying the midpoint between the medial end and lateral end of the foramen to ensure consistent measurements across all specimens (Fig. 1). For the second dimensional parameter (maximum horizontal diameter), the sliding jaw of the calipers was positioned on the medial end, and the fixed jaw on the lateral end of the infraorbital foramen. The distance between these two points was measured and recorded in millimeters (Fig. 2). Each measurement was recorded three times, and the mean value was calculated to minimize observer bias and ensure measurement reliability. All measurements were performed under standardized lighting conditions to ensure optimal visualization of anatomical landmarks.

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 25.0 (IBM Corporation, Armonk, NY, USA). Descriptive statistics including mean, standard deviation and range were calculated for all variables. Independent samples t-test was employed to compare measurements between left and right sides. Then, Pearson correlation coefficient was used to assess the relationship between vertical and horizontal dimensions. A p-value of less than 0.05 was considered statistically significant.

This study was approved by the Institutional Review Board of Mymensingh Medical College, Mymensingh, Bangladesh.

Fig. 1: Photograph showing vertical diameter of the infraorbital foramen

Fig. 2: Photograph showing horizontal diameter of infraorbital foramen

Results

The first dimensional measurement (vertical diameter) of the infraorbital foramen was recorded in all 300 specimens. On the left side, this dimension ranged from 1.76 mm to 4.89 mm with a mean of 2.98±0.51 mm. On the right side, the measurement ranged from 1.83 mm to 4.17 mm with a mean of 2.95±0.50 mm. The difference between left and right side measurements was not statistically significant (p=0.62), indicating relative bilateral symmetry (Table-I). Then the second dimensional measurement (horizontal diameter) of the infraorbital foramen was recorded in all 300 specimens. On the left side, this dimension ranged from 2.58 mm to 7.28 mm with a mean of 4.39±0.92 mm. On the right side, the measurement ranged from 2.13 mm to 7.18 mm with a mean of 4.44±0.96 mm. The difference between left and right side measurements was not statistically significant (p=0.63) (Table-I). A significant positive correlation was observed between the two dimensional parameters of the infraorbital foramen. On the left side, the Pearson correlation coefficient was r=0.442 (p<0.001), (Table-II, Fig. 3) indicating a moderate positive correlation. Similarly, on the right side, the correlation coefficient was r=0.386 (p<0.001) also indicating a moderate positive correlation (Table-II, Fig. 3). These findings suggest a consistent proportionality in the dimensional characteristics of the infraorbital foramen across both sides, with specimens demonstrating larger values in the first dimension also tending to have larger values in the second dimension.

Table-I: Dimensional measurements of infraorbital foramen (N=300)

Parameter	Side	Range (mm)	Mean± SD (mm)
First Dimension	Left (n=148)	1.76–4.89	2.98± 0.51
	Right (n=152)	1.83–4.17	2.95± 0.50
Second Dimension	Left (n=148)	2.58–7.28	4.39± 0.92
	Right (n=152)	2.13–7.18	4.44± 0.96

Table-II: Correlation between the two dimensional parameters of infraorbital foramen (N=300)

Side	Variables	Correlation (r)	p-value
Left (n=148)	First vs. Second Dimension	0.442	<0.001
Right (n=152)	First vs. Second Dimension	0.386	<0.001

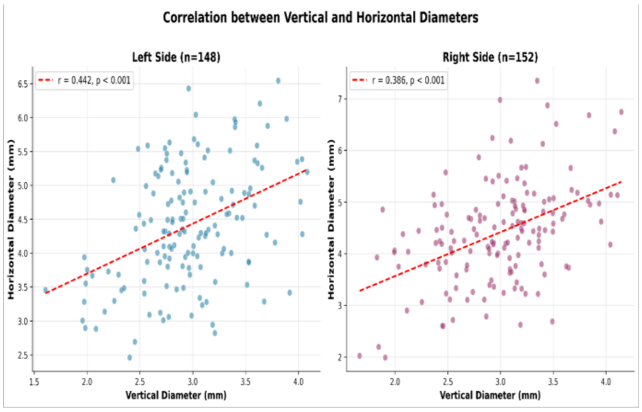

Fig. 3: Scatter diagram showing the correlation between vertical and horizontal diameters

Discussion

This comprehensive morphometric study provides valuable baseline dimensional data on the infraorbital foramen in the Bangladeshi population, addressing a significant gap in the existing anatomical literature. The findings demonstrate consistent dimensional characteristics with important clinical implications for regional anesthesia and maxillofacial surgery.

The mean first dimensional values obtained in our study were 2.98 mm (left side) and 2.95 mm (right side). Those values are comparable to the findings of Elsheikh *et al.,*[2] as studied on Egyptian population, Nanayakkara *et al.,*[3] on Sri Lankan population, Potu *et al.*[4] and Mahajan *et al.*[5] on Indian populations, Dagistan *et al.,*[6] on Turkish population, and Raeisi *et al.,*[7] on Iranian population. However, our findings are lower than that of Thilakumara *et al.,*[8] as studied on Sri Lankan population, Ebogo *et al.,*[9] on Senegalese population, and Singh,[10] on Indian population. Those slight variations observed between different populations may be attributable to the difference in genetic factors, ethnicity, environmental factors, and methodological techniques.

The second dimensional values were found 4.39 mm (leftside) and 4.44 mm (right side). Those values align with previous studies done by Elsheikh *et al.,*[2] Nanayakkara *et al.,*[3] Potu *et al.,*[4] Mahajan *et al.,*[5] Dagistan *et al.,*[6] and Raeisi *et al.*[8] indicating a relative consistency in infraorbital foramen dimensions across different ethnic groups around the world. However, our findings are lower than that of Thilakumara *et al.,*[8] Ebogo *et al.,*[9] and Singh.[10] The larger magnitude of the second dimension compared to the first dimension confirms the predominantly oval shape of the infraorbital foramen, which is consistent with morphological studies that identify oval as the most common shape configuration.[1,10] This dimensional relationship has practical implications for surgical planning and implant placement procedures.[2,3,7]

The significant positive correlations between the two dimensions in both sides suggest predictable morphological patterns in infraorbital foramen shape. This finding has a clinical implication for surgical planning and implant placement, as practitioners can reasonably estimate the second dimension based on observed values of the first dimension.[2,3] The moderate strength of the correlation reflects natural biological variation, while still providing useful predictive value for clinical applications.

From a clinical perspective, the established baseline dimensional data from this study can guide the administration of infraorbital nerve blocks, which are commonly performed in dental procedures, rhinoplasty, and various maxillofacial surgeries.

Knowledge of the typical dimensions can assist clinicians in selecting appropriate needle sizes and estimating the depth of penetration required for effective anesthesia delivery. Additionally, the dimensional data provides valuable reference values for the design of surgical instruments and implants used in maxillofacial reconstruction procedures.[2,3,7]

Several limitations of this study should be acknowledged. The use of dry skeletal specimens precludes the determination of soft tissue relationships that are clinically relevant during procedures. Additionally, the age and sex of the specimens could not be reliably determined, which may introduce uncontrolled variability in the measurements.

Conclusion

This study establishes important baseline dimensional data for the infraorbital foramen in the Bangladeshi population. The findings reveal mean first dimensional (vertical diameter) values of approximately 2.96 mm and second dimensional (horizontal diameter) values of approximately 4.42 mm, with no significant bilateral asymmetry. The significant positive correlation between the two dimensions suggests predictable morphological patterns that may assist clinicians in surgical planning and regional anesthesia procedures. These measurements provide valuable reference values that can assist clinicians in performing safe and effective interventions in the maxillofacial region. Future studies with larger sample sizes and incorporation of imaging modalities may further enhance our understanding of infraorbital foramen dimensions and their clinical applications.

References

1. *Cunningham CA, Fernandez-Miranda JC. The Skull. In: Standring S, Anand N, Catani M, Collins P, Crossman AR, Gleeson M, et al. eds. Grays Anatomy: The Anatomical Basis of Clinical Practice. 42nd ed. London: Elsevier; 2021.*
2. *Elsheikh E, Nasr WF, Ibrahim AA. Anatomical variations of infraorbital foramen in dry human adult Egyptian skulls, anthropometric measurements and surgical relevance. Otorhinolaryngol Clin. 2013;5(3):1-6.*
3. *Nanayakkara D, Peiris R, Mannapperuma N, Vadysinghe A. Morphometric analysis of the infraorbital foramen: the clinical relevance. Anat Res Int. 2016;2016:7917343.*
4. *Potu BK, Srungavarapu GC, Pulakunta T. Morphometric evaluation of the infraorbital foramen in human dry skulls of South Indian population. Ital J Anat Embryol. 2019;124(3):382-91.*
5. *Mahajan A, Verma R, Razdan SK, Passey J. Morphological and morphometric relations of infraorbital foramen in North Indian population. Cureus. 2023;15(2):e34525.*
6. *Dagistan S, Miloğlu Ö, Altun O, Umar EK. Retrospective morphometric analysis of the infraorbital foramen with cone beam computed tomography. Niger J Clin Pract. 2017;20(9):1053-64.*
7. *Raeisi M, Jafari SH, Karimi F, Namazi MR. Location of infraorbital and accessory infraorbital foramina in Iranian population: a retrospective radiological study with crucial clinical implications. Surg Radiol Anat. 2024;46(7):1047-55.*
8. *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.*
9. *Ebogo M, Mouhammad K, Ndiaye A, Sarr N, Diop F, Ndiaye A, et al. Sexual dimorphism and infraorbital foramen: a computerized tomography-scan study in a cohort of Senegalese population. Minerva Dent Oral Sci. 2021;70(5):184-9.*
10. *Singh R. Morphometric analysis of infraorbital foramen in Indian dry skulls. Anat Cell Biol. 2011;44(1):79-83.*