

MORPHOMETRIC ANALYSIS OF INFRA- ORBITAL FORAMEN IN DRY HUMAN SKULLS IN NORTH KARNATAKA REGION

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ABSTRACT

Background: Maxillary bones constitute the front of face and upper jaw. The orbital surface is marked by the ridge of bone which form the lower and inner half of the orbital opening. Just below the outer part of this ridge is the infra-orbital foramen through which the infra-orbital branch of the second division of 5th cranial nerve passes to the skin of the face. The present study was conducted to know the precise location of Infra- orbital foramen in dry human skulls in North Karnataka region.

Materials and Methods: Fifty dry adult human skulls of unknown age and sex were examined at the Department Of Anatomy, Mahadevappa Rampure Medical college, Kalaburgi. Both sides of skull were assessed by inspection. Following certain inclusion and exclusion criteria, total foramen studied were 100. The shape, direction, diameters and orientation of the foramen with respect to upper teeth was noted. Distance of IOF from IOM, PA and UAM were recorded. The measurements were carried out using Vernier calipers. Data collected was subjected to various statistical analysis.

Results: Majority of IOF's were Oval in shape and many were vertically oval. Most of the foramen were directed Infero- medially, rest of them were directed vertically downwards. IOF in many skulls were present at the level of 2nd premolar. Mean value of distance of IOF from IOM is 6.6mm +/- 1.5mm on right and 6.02mm +/- 1.6mm on left, from PA is 14.9 mm +/- 2.3mm on right and 14.1mm +/- 2.4 on left side and from UAM is about 24.8mm +/- 2.9mm on right and 21.9mm +/- 4.7mm on left side. Median value of distance of IOF from IOM is 7mm & 6mm, from PA is 14.5mm & 13mm, from UAM is 25mm & 22mm, on right and left side respectively. Mode value of IOF from IOM is 6mm & 7mm, from PA is 14mm & 13mm, from UAM is 24mm & 22mm, 24mm on right and left side respectively.

Conclusion: Results of the present study may help in Maxillofacial surgeries, Rhinoplasty, Treatment of Trigeminal Neuralgia and Cryotherapy in North Karnataka population.

KEY WORDS: Infra-orbital foramen, Infra-orbital margin, Pyriform aperture, Upper alveolar margin.

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INTRODUCTION

The orbital surface is marked off from the the facial surface by a ridge of bone which forms the lower and inner half of the orbital opening.

Just below the outer part of this ridge is the the infra- orbital foramen through which the infra- orbital branch of the second division of fifth cranial nerve passes to the skin of face [1]. The

infra- orbital foramen can be seen when the skull is viewed from anterior. The infra- orbital foramen, which transmits the infra- orbital vessels and nerve, lies about 1cms below the infra- orbital margin [2]. The infraorbital artery, branch of maxillary artery enters the orbit through the inferior orbital fissure. It runs on the floor of the orbit in the infraorbital groove and infraorbital canal and emerges onto the face at the infraorbital foramen to supply the lower eyelids, part of the cheek, the side of external nose and upper lip. Within the canal it gives of anterior superior alveolar artery, which runs downwards to supply the anterior teeth and anterior part of maxillary sinus. The infraorbital nerve can be regarded as the terminal branch of the maxillary nerve [2].

It leaves the pterygo- palatine fossa to enter the orbit at inferior orbital fissure. It emerges onto the face at the infraorbital foramen, where it lies between levator labii superioris and levator anguli oris. It gives of palpebral, nasal and superior labial branches. The palpebral branch ascends up to supply the skin of lower eyelid, nasal branches supply the skin of the nose and movable part of nasal septum, superior labial branches which are large and numerous descend to supply the skin of the anterior part of the cheek and upper lip. They are joined by the facial nerve to form the infraorbital plexus. The infraorbital nerve is commonly implicated in trigeminal neuralgia, and is amenable to cryotherapy where medical therapy fails. Thus, the precise location of Infra- orbital foramen is important not only as acupuncture point used in trigeminal neuralgia treatment but also to locate infra-orbital plexus, which is a risk zone during plastic surgery. It also provides an important data for local anaesthesia during rhinoplasty [3] and maxillofacial surgeries [4]. Presence of accessory infra- orbital foramen's were also encountered during different studies [5]. The present study was conducted to know the precise location of Infra- orbital foramen in dry human skulls in North Karnataka region.

MATERIALS AND METHODS

Fifty dry adult human skulls of unknown age and sex were examined at the Department Of Anatomy (from the departmental collection and 1st MBBS students of 2018- 19 batch),

Mahadevappa Rampure Medical college, Kalaburgi. Both sides of skull were assessed by inspection. Skulls with fractures at piriform aperture, infraorbital margin or other destroyed parts affecting the foramen were excluded. Total foramen studied were 100. The parameters observed and recorded were:

- 1). The shape of the foramen, Round or Oval.
- 2). The direction of the foramen.
- 3). Orientation of the foramen with respect to upper teeth.
- 4). Distance of IOF from IOM, PA and UAM were recorded as shown in fig: (1) .
- 5). Diameters of the foramen and presence of accessory foramens recorded.

The measurements were carried out using Vernier calipers. All the values were taken in millimeters (mm).Data collected was subjected to various statistical analysis. The observations from the study are as follows:

Fig. 1: Showing the Measurement procedures.



a-IOF-IOM, b- IOF- PA, c- IOF- UAM.

RESULTS

Fifty adult human skulls, 100 Infra orbital foramen's were examined. The shape, direction, location in relation with teeth, vertical and transverse diameters of the foramen, distance of foramen from infra orbital margin, pyriform aperture and upper alveolar margin were noted and recorded. Measurements were taken using vernier caliper's and analysed statistically. The

results obtained are as follows:

Majority of IOF's were Oval in shape with total of 62% - Transversely oval being 26% & Vertically oval: 36% on right side and 64% - Transversely oval: 22% & Vertically oval: 42% on left side, rest being round in shape with 38% & 36% on right & left side respectively. Most of the foramen were directed Infero- medially- 76% on right and 78% on left side. Rest of them were directed vertically downwards 24% being on right and 22% on left side . Orientation of IOF with teeth on right side are 50% at 2nd premolar , 24% b/w 1st & 2nd premolar,10% b/w 2nd premolar and 1st molar and 16% at 1st molar and on left side are 46% at 2nd premolar, 20% b/w 1st & 2nd premolar,12% b/w 2nd premolar and 1st molar and 22% at 1st molar (Table 1).

Foramen's with more vertical diameters (36% on Rt & 42% on Lt) were encountered than with transverse diameters (26% on Rt & 22% on Lt). Mean value of Vertical diameter on Rt is 3.1mm +/- 0.74mm SD (min- 2mm & max- 4mm) & on Lt is 3.18mm +/- 0.68mm SD (min- 2mm & max- 4mm). Mean value of Transverse diameter is 2.98mm +/- 0.73mm (min-2mm & max- 4mm) & 3.02mm +/- 0.88mm (min- 2mm & max- 5mm) on right and left respectively (Table 2), Median & Mode value of vertical and transverse diameter on both sides is 3 .

Mean value of distance of IOF from IOM is 6.6mm +/- 1.5mm on Rt with min distance being 3mm and max distance 10mm and 6.02mm +/- 1.6mm on Lt with min distance 3mm and max 9mm. Mean value of distance of IOF from PA is 14.9 mm +/- 2.3mm with min distance of 11mm and max 20mm on rt side and 14.1mm +/- 2.4 with min distance of 11 mm and max 19mm on Lt side. Mean value of distance of IOF from UAM is about 24.8mm +/- 2.9mm with min value 18mm and max value 30mm on rt side and 21.9mm +/- 4.7mm with min value 12mm and max value 31mm on Lt side. Median value of distance of IOF from IOM is 7mm & 6mm, from PA is 14.5mm & 13mm, from UAM is 25mm & 22mm, on rt and Lt side respectively. Mode value of IOF from IOM is 6mm & 7mm, from PA is 14mm & 13mm, from UAM is 24mm & 22mm, 24mm on rt and Lt side respectively (Table 3). No accessory IOF's were found in the present study.

Table 1 : Percentage of Orientation with Teeth.

Orientation with Teeth	Right	Left
2 nd premolar	50%	46%
b/w 1 st & 2 nd premolar	24%	20%
b/w 2 nd premolar and 1 st molar	10%	12%
1 st molar	16%	22%

Table 2: Measurements of IOF.

Diameters	> % of occurrence		Mean +/- SD in mm	
	Rt	Lt	Rt	Lt
Vertical	36%	42%	3.1+/-0.74 (2mm-4mm)	3.18+/-0.68 (2mm-4mm)
Transverse	26%	22%	2.98+/-0.73 (2mm-4mm)	3.02+/-0.88 (2mm-5mm)

Table 3: Statistical Analysis Of Distance of IOF from IOM, PA & UAM.

Distance of IOF in mm from	Mean +/- SD		Median		Mode	
	Rt	Lt	Rt	Lt	Rt	Lt
IOM	6.6+/-1.4	6.02+/-1.5	7	6	6	7
PA	14.9+/-2.3	14.08+/-2.4	14.5	13	14	13
UAM	24.8+/-2.9	21.9+/-4.7	25	22	24	22.0 & 24.0

DISCUSSION

Maxilla consist of a hollow body, zygomatic, frontal, alveolar and palatine processes. The body on its anterior surface shows ridges, just below its infra orbital margin, the infra orbital foramen transmits infra orbital vessels and nerve [6]. Therefore the knowledge of its location is very essential for surgeons and anesthetists. Very few studies have been conducted on North Karnataka population, thus the data available is very scanty. Present study was conducted on skulls of North Karnataka population, which forms a source of information for surgeons treating the population of the particular area, whether residing here or anywhere in the world. The data recorded were Mean+/- standard deviation (Mean, the average value & SD provides variability of the foramen around Mean value), Median (middle value of the data), Mode (value which appears often in the data collected) [Table 3].

The study conducted on 100 adult dried human skulls of both sexes of Bhopal region on Infra orbital foramen, found majority were oval in shape (54.6% in males & 52.8% in females), most of them were directed inferomedially (65.8% in males & 67.8% in females), majority of them were oriented to 2nd premolar teeth,

mean distance of infra orbital foramen to infra orbital margin was 7.43mm+/-1.68 (R), 7.37mm+/-1.59 (L) and accessory foramen were noticed in 4% skulls [7].

Study of 60 dried human skulls of unknown age, sex and race on Infra orbital foramen noted that, the Mean distance of Infra orbital foramen with Infra orbital margin was 6.67+/-2.10mm (R), 6.90+/-1.84 (L), commonest location being 2nd premolar and direction being inferomedial(8), Almost nearing to the values of present study .

100 human dry macerated skulls of Maharashtra region were studied and found the Mean distance between infra orbital foramen and Infra orbital margin was 6.54+/-1.28mm(R), 7.02+/-1.42mm(L), Mean distance between Infra orbital foramen and pyriform aperture was 16.20+/-2.72mm(R), 15.82+/-2.75(L). Mean distance between Infra orbital foramen and Upper Alveolar margin was 28.93+/-4.11mm(R), 28.42+/-4.43mm(L).

Mean vertical diameter of the foramen on right was 3.23+/- 0.76mm and on left was 3.25+/-1.03mm [Present study- 3.1+/-0.74mm(R), 3.18+/-0.68mm(L)], the Mean horizontal diameter being 3.0+/-0.76 on right and 3.28+/- 0.99 mm on left [Present study-2.98+/-0.73mm (R), 3.02+/-0.88 (L)], majority were directed inferomedially [9]. The study on 47 cadavers, found Mean distance between infra orbital foramen and infra orbital rim to be 8.5+/- 2.2mm in males and 7.8+/- 1.6mm in females [4].

The study on 590 IOF's Mean distance between infra orbital foramen and Infra orbital margin was 6.28+/-1.79mm (R), 6.45+/-1.76 mm(L). Mean distance between Infra orbital foramen and pyriform aperture was 17.75+/-2.0mm(R), 17.60+/-2.04(L) [10].

The study conducted on 110 IOF's show Mean distance between infra orbital foramen and Infra orbital margin to be 6.12+/-1.79mm (R), 6.12+/-1.81 mm(L) Mean distance between Infra orbital foramen and pyriform aperture was 15.31+/-1.77mm(R), 15.80+/-2.86mm(L). Mean vertical diameter of the foramen on right was 3.39+/- 0.96mm and on left was 3.75+/- 1.07mm, the Mean horizontal diameter being 3.19+/-1.19 on right and 3.52+/- 1.35 mm on left [11].

Our present study also shows similar results, oval foramen's being most common, directed inferomedially and oriented to 2nd premolar (Table 1). Comparison of mean values of distances of IOF and IOM, PA and UAM of present study with other studies is shown in Table 4.

Study of 11 cadavaric skulls was done to know the anatomy of infra orbital canal and foramen as a guide for determining the angles at which Radiofrequency probe must be directed for the radiofrequency ablation of infra orbital nerve for the patients with relative or absolute contraindications to lesions of trigeminal neuralgia [12].

Table 4: Comparison of mean values and standard deviation with different authors.

Study	Size	IOF-IOM		IOF- PA		IOF- UAM	
		RT	LT	RT	LT	RT	LT
Present	100	6.6+/-1.4	6.02+/-1.5	14.9+/-2.3	14.08+/-2.4	24.8+/-2.9	21.9+/-4.7
K K Gour [7]	200	7.43+/-1.68	7.37+/-1.59				
Janghu Poonam Kharb [8]	120	6.67+/-2.10	6.90+/-1.84				
Amrita Bharti [9]	200	6.54+/-1.28	7.02+/-1.42	16.20+/-2.72	15.82+/-2.75	28.93+/-4.11 28.42+/-4.43	
Macedo VC [10]	590	6.28+/-1.79	6.45+/-1.76	17.75+/-2.10	17.60+/-2.04		
Rajani Singh [11]	110	6.12+/- 1.79	6.19+/-1.81	15.31+/-1.77	15.80+/-2.86		

CONCLUSION

The present study was done on the skulls of North Karnataka population and precise location

and morphometry of Infra- orbital foramen measured and subjected to various statistical analysis. It is important to know morphometry

and precise location of IOF, not only as acupuncture point used in trigeminal neuralgia treatment but also to locate infra-orbital plexus, which is a risk zone during plastic surgery. It also provides an important data for local anaesthesia during rhinoplasty, maxillofacial surgeries. Thus, the present study provides a source of information for surgeons treating the population of the North Karnataka region, whether residing here or anywhere in the world.

ABBREVIATION

IOF- Infra- Orbital Foramen

IOM- Infra Orbital Margin

PA- Pyriform Aperture

UAM- Upper Alveolar Margin

Conflicts of Interests: None

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