

Original Article

# Anthropometric Analysis of Infraorbital Foramen in Adult Indian Dry Skull

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Abstract :

Introduction: Normally infra orbital foramen (IOF) is situated on the anterior surface of maxilla about 1cm below the infra orbital margin (IOM) bilaterally. Infra orbital vessels and nerves emerge out through this foramen. Infra orbital nerve (ION) terminates by supplying skin over the lower eyelid, conjunctiva, lateral aspect of external surface of nose, upper lip, ala of the nose and the premolar teeth. Infra orbital vessels supply the area surrounding the IOF.

Objective: To measure distance between superior part of the rim of the IOF to IOM (DIM) and the distance between the medial part of the rim of the IOF to lateral margin of the piriform aperture (DIP). Compare the measurements of both sides. Compare our studies with other authors.

Materials and methods: Sixty adult dry skulls of unknown sex were studied. Those skulls with damaged foramen were excluded. Measurements were done in millimetres.

Result: The mean DIM on right side is 5.96 mm and on left side it is 6.07. Mean DIP on right side is 16.70 mm and on left side it is 16.63mm. We have observed that there is no much significant variations in respect to sides. Our values were within the range of many others value.

Conclusion: Knowing exact location of IOF using different land mark is important for providing local anaesthesia in maxillofacial, plastic surgical operations and radio ablative neurotomy procedures. Thus information obtained is very useful IOF to avoid iatrogenic injury in the infra orbital area.

## Introduction

The infra orbital foramen (IOF) is situated on the anterior surface of maxilla about 1cm below the infra orbital margin (IOM) bilaterally. Infra orbital vessels and nerves emerge out through IOF<sup>1</sup>. The Infra orbital nerve (ION) is a continuation of maxillary division of trigeminal nerve. It is entirely sensory in nature. It emerges out from IOF after passing through infra orbital canal and appears on the face. It terminates by dividing into palpebral, nasal and labial branches to supply skin over the lower eyelid, conjunctiva, lateral aspect of external surface of nose, upper lip, ala of the nose and the premolar teeth. Infra orbital vessels are branches of maxillary artery which supplies the area surrounding IOF<sup>2</sup>. Large variations in the location of IOF have been reported by many authors with regard to the

different landmarks on the skull varying from 4- 12mm<sup>3</sup>. Knowing the exact location of IOF is very important for giving local anesthesia in maxillofacial, plastic surgeries and radio ablative neurotomy procedures<sup>4</sup>. Zygomatic complex fractures are one of the most common facial injuries which involve ION<sup>5,6</sup>. In these cases, earlier the surgical intervention, more the recovery of the nerve injury<sup>7</sup>. A major factor that inhibits dentists from using the ION block is the fear of injury to the patient's eye<sup>3</sup>. Since there are very few studies done on the Indian population, the present study was undertaken.

## Materials and Method

Sixty adult dry skulls of unknown sex were collected from the department of Anatomy. Those skulls with damaged

foramen or fractures were excluded from the study. All the measurements were done in millimetres using a digital vernier caliper (Mitutoyo Corp, Japan) with an accuracy of up to 0.1 mm.

After placing the skull in anatomical position, the distance between superior parts of the rim of the IOF to IOM (DIM) in sagittal plane was measured (Fig. 1) and the distance between the medial parts of the rim of the IOF to lateral margin of the pyriform aperture (DIP) was measured in the horizontal plane (Fig. 1). All the readings were taken and the mean of the two were calculated on right and left side separately. All the measurements were tabulated and statistically analyzed for significance.

Results

The mean DIM on right side was between 3.2 mm to 10.42 mm and 2.6 mm to 10.1 mm on the left side (Table 1). The mean DIP on right side was between 10.1 mm to 22.7mm and 8.3 mm to 23.1 mm on the left side. There was no statistically significant difference in the mean DIM & DIP between the right and left side.

Fig. 1 : Measurements a) Distance between IOM and rim of IOF (A) b) Distance between PA and rim of IOF (B).



Table 1 : Mean DIM and DIP on right and left side.

Side	DIM (mm)	DIP (mm)
Right	5.96	16.70
Left	6.07	16.63
Both	6.02	16.67

Discussion

Table 2: Comparison of mean DIM between present study and the previous studies.

Study	No. of skulls	Mean DIM on right side (Mean in mm ± SD)	Mean DIM on left side (Mean in mm ± SD)
Present Study 2014	60	5.96±1.59	6.07±1.73
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	6.28±1.79	6.45±1.76
Lopes et al. 2009	99	6.57 ± 1.70	6.76± 1.64
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
Bruno et al. 2011	80	6.30±1.67	6.52±1.72
Shaiket al. 2012	125	7.06±1.81	7.20±1.71
Lokanayaki, 2013	100	6.12±1.43	6.53±1.53
Elsheikh et al. 2013	59	6.12±1.4	6.50±1.3

Table 3 : Comparison of the mean DIP of both sides between present and the previous studies.

Study	No. of skulls	Mean DIP (mm)
Present Study 2014	60	16.67
Kaskayasi et al. 2001	35	14.31
Elias et al. 2004	210	13.29
Macedo et al. 2009	295	17.68
Singh S. 2011	55	15.56
Bruno et al. 2011	80	14.72
Shaiket al. 2012	125	18.13
Lokanayaki, 2013	100	16.48

On comparison of mean DIM between the present and previous studies it was observed that the mean DIM was less than all the other studies. The data listed in the table. 2 are done in different regions and populations, like Brazil, India, Thailand, Egypt and different ethnic groups in New York. The studies done on Thai skulls<sup>8</sup> and different ethnic groups in New York<sup>4</sup> shows higher value than rest of the others. Our value is comparable with all the studies done in the region of Brazil<sup>9, 10, 11, 12,</sup> and India<sup>2, 3, 13, 14</sup> except a study done in southern part of India<sup>6</sup> which shows higher value compared to our study.

On comparison of the mean DIP of the present study with the previous studies, it was observed that the mean DIP of the present study was higher when compared to the data obtained by Elias MG et al.<sup>9</sup> and Rajani Singh<sup>13</sup> and lower

when compared to the studies by HS Shaik<sup>6</sup> and Macedo VC et al<sup>10</sup>.

Lokanayaki, 2013 distance between rim IOF and PA, authors have shown quite wide variation ranging from 13 mm to 18 mm (Table. 3). Here the data listed in table. 3 are obtained from different geographical areas like Turkey, Brazil and India. In this our value is 16.67mm which is comparable with one of the Indian study<sup>14</sup>.

The present results of this study provide valuable information to assist the maxillofacial surgeon to locating the infraorbital nerves and vessels. This will help to avoid damage to these structures<sup>15</sup>. Previous studies of different researchers have shown that distance between rim IOF and IOM are quite variable which are listed in table. 2. There are many surgical procedures are done over the maxilla such as rhinoplasty, Caldwell-Luc operations, tumor surgery, reduction of the orbital floor (blow-out) and malar fractures, and the LeFort I type osteotomies may result in an iatrogenic injury to ION. Even in trigeminal neuralgia of second division knowledge of exact location of ION is essential to inject neurolytic solutions<sup>16,17</sup>.

The closest estimation of the location of the IOF should be used when designing access incisions to the orbital floor and rim and planning regional nerve blockade. However presence of multiple IOF should be kept in mind. Study quotes that higher frequency of multiple foramina was noted in Mexicans<sup>4,18</sup>.

Nerve localization for this block ideally relies on a landmark-based approach using palpation of the foramina. However, occasionally it can be challenging to identify each foramen by relying on palpation alone. In these cases, many experts search for the foramina by gently probing with a small-gauge needle. Ultrasound imaging is a safe simple non-invasive modality through which soft tissues and nerve structures can be visualized and identified when combined with a thorough knowledge of regional

anatomy<sup>19</sup>.

Infra orbital nerve blocks are performed in children for management of postoperative pain associated with cleft-lip surgery and endoscopic sinus surgery. The main aspect in determining the placement of the needle is to locate the IOF and to access the nerve through an intraoral route or through a transcutaneous route<sup>20</sup>.

ION sensory disturbances are diagnosed based on patients' symptoms, which includes hyperalgesia or hypoalgesia of the skin. Hyperalgesia was diagnosed in 11.9% of patients and hypoalgesia in 52.5% of patients<sup>5</sup>. Hu SH et al., described the areas supplied by the different branches of ION<sup>21</sup>.

Locating and preserving the infra orbital neurovascular bundle can be difficult with a comminuted fracture of the anterior maxillary wall and inferior orbital rim. The data show only small significant differences between males and females. Therefore, knowledge of the distance from the inferior orbital rim may be valuable in identifying the danger zone of its location during dissection of these fractures as well as during other surgical procedures<sup>15</sup>.

Studies conducted in different geographical areas showed a large dispersion and variability in the various distances pertaining to the location of the IOF due to different osteoblastic and osteoclastic activity in different individuals<sup>13</sup>.

### Conclusion

Thus, the data obtained in this study is at par with studies conducted by different authors of various geographical areas. So the information derived here in identifying the precise location IOF will help surgeons to reduce the adverse outcome of the surgeries centered on IOF in patients of Indian origin. This information is also useful for morphologists who conduct their research on people of different populations and geographical regions.

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