Morphometric analysis of Infra orbital foramen in human skulls

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Abstract

Aim: The infra orbital foramen is an anatomical structure with an important location, through which the infra orbital vessels and nerve exits. The present study was conducted to determine the mean distance between the infra orbital foramen and infra orbital margin, mean distance between piriform aperture and infra orbital foramen, mean distance between the anterior nasal spine and infra orbital foramen on both side and as well as shape of foramen.

Materials and Methods: 43 skulls were studied The following parameters were taken.(A)-The distance between the most superior point of the infraorbital foramen (IOF) up to the infraorbital margin (IOM) ,(B), The distances between the center of the infraorbital foramen (IOF) and the piriform aperture (PA) were also measured,

Results: The mean distance between IOF-IOM was 6.85 mm ±1.72 (6.75 mm -Right Side (RS) and 6.95 mm -Left side (LS)) and between IOF-PA was 18.43 mm ±2.38(18.50 mm (RS) and 18.30 mm (LS). Statistical analysis of the data showed significant differences between the right side and the left side distances of IOF and IOM, verified by the Student's-*t* Test. (C)-The mean distance between infra orbital foramen and the anterior nasal spine(ANS) was 33.68+3.63mm, on right was 33.35+3.25mm and left was 34.23+3.75mm (Table 1). (D)-The transverse diameter of infra orbital foramen was 2.68+0.72mm and(E)-vertical diameter is 2.58+0.74mm.

Conclusion: Knowledge of infra orbital foramen is very helpful for neurovascular surgeons.

Keywords: Infra orbital foramen, Infraorbital margin, Piriform aperature, Anterior nasal spine.

Introduction

The infraorbital foramen (IOF) is present on anterior aspect of skull below the orbit. Which the infraorbital vessels and nerve pass. The IOF is situated near important structures such as the orbital, nasal and buccal regions. Therefore, it is relevant for surgeons to know its location, when performing procedures in which the infraorbital foramen is used as a reference point in surgeries and anaesthesias.

The infra orbital foramen is situated bilaterally on the maxilla bone, lower to the edge of the orbital cavity, Infra orbital nerve and vessels pass through this foramen. The infra orbital nerve is sensory and is branch of maxillary nerve, which crosses the infra orbital foramen and branches to feed the skin in the upper portion of the face, the maxillary sinus mucosa, the maxillary incisor, the canine and premolar teeth and the adjacent gum portion; the lower eyelid skin and conjunctiva, part of the nose, skin and mucosa of the upper lip.[(1)]

Precise knowledge of the location of reference points in this area provides important data in local anaesthesia and in maxillofacial and plastic surgical operations[(2)]. There are several reference points on each wall with respect to infra orbital foramen, oral and maxillofacial surgery and local anesthesia.[(3)]

Modern surgical procedures, anesthesia (Zide, 1998)[(4)], as well as acupuncture practice (Chonghuo,1993)[(5)], require more precise understanding of the surrounding anatomy (Bolini, 1990)[(6)]. The IOF is an important anatomical landmark that provides excellent analgesia for the closure of simple lacerations, biopsies, scar revisions, maxillofacial procedures, as well as various endoscopic and cosmetic cutaneous procedures. The importance of determining a more precise location of the IOF, in the present study 43 skulls (total 86 sides) were measured, thus contributing to the use of this foramen as a reference point in surgeries and anesthesias.

Material and Methods

In the preset study, dry adult human skulls were obtained from IIMSR Warudi, Tq, Badnapur Dist. Jalna Skulls that had fractures in the piriform aperture (PA), infraorbital foramen (IOF) or at the infraorbital margin (IOM), which made it impossible to measure them correctly, were not included in this study. Out of all the skulls, 43 were selected, which were studed on both sides (right and left) total 86 sides. The distance between the most superior point of the infraorbital foramen (IOF) up to the infraorbital margin (IOM) was measured, The distances between the center of the infraorbital foramen (IOF) and the piriform aperture (PA) was also measured, (Fig. 1). The mean distance between infra orbital foramen and the anterior nasal spine (ANS) was measured. The vertical and transverse diameters of IOF were measured. These measurements were made by means of a compass astheo meter. The

Compass opening was measured through a caliper finishing the data collection by the notes on the data collection form. The measurements were taken by two different operators, on both sides, in all the skulls. The collected data were submitted to statistical analysis by means of the Student's-*t* Test. Ref. Table 2

Results

Table 1: The mean distances between Infra orbital foramen and others

Distances between	Right side	Left side	Mean +S.D
IOF – IOM	6.75* +1.76mm	6.95*+1.68mm	6.85*+1.72mm
IOF – PA	18.50+2.52mm	18.30+2.35mm	18.43+2.38mm
IOF – ANS	33.35+3.25mm	33.23+3.75mm	33.68+3.63mm

IOF- infraorbital foramen IOM- infraorbital margin PA- Piriform aperture ANS- Anterior nasal spine *statistically significant value; and SD: standard deviation.

Table 2: Transverse and Verticle diameters of Infra Orbital foramen

Measurements IOF- infraorbital foramen	
Transverse Diameter	2.68+0.72mm
Vertical diameter	2.58+0.74mm

43 skulls (total 86 sides) were used for this study. Total 86 sides. The mean distance between IOF-IOM was 6.85 mm ± 1.72 (6.75 mm -Right Side (RS) and 6.95 mm -Left side (LS) and between IOF-PA was 18.43 mm ± 2.38(18.50 mm (RS) and 18.30 mm (LS), as it can be observed. Statistical analysis of the data showed significant differences between the right side and the left side distances of

IOF and IOM, verified by the Student's-t Test.

The mean distance between infra orbital foramen and the anterior nasal spine(ANS) was 33.68+3.63mm, on right was 33.35+3.25mm and left was 34.23+3.75mm (Table 1). The transverse diameter of infra orbital foramen was 2.68+0.72mm and vertical diameter is 2.58+0.74mm (Table 2)

Table 3: Comparative distances between IOF and IOM

Authors	Distances (mm)
Hindy and Raouf (1993)	6.10
Chung (1955) 8.60	8.60
Silva (1998)	6.80
Canan (1999)	8.30 (women); 10.90 (men)
Aziz (2000)	7.80 (women); 8.50 (men)
Kaskayasi (2001)	7.19
Karakas (2002)	6.70
Macedo**(**2008)	6.37
persent study	6.85

Table 3: Comparative distances between IOF and PA

Authors	Distances (mm)
Hindy and Raouf (1993	17.23
Kaskayasi (2001)	14.70
Macedo**(**2008)	17.67
Present study	18.43

Fig 1: Measurements taken A: The distance between the infraorbital foramen (IOF) most superior point and the infraorbital margin (IOM). B: The distance between the center of the infraorbital foramen (IOF) and the piriform aperture (PA)

Discussion

Several authors have been studying IOF location and its relation to other anatomical structures in direct or indirect way. The distances between IOF e IOM have been quoted in several works, using different methodologies. The Infra orbital foramen is the way to the infraorbital nerve, vessels and the knowledge of its position is very useful to the professionals who manipulate the maxilar region like in acupuncture (Esper *et al*., 1998)[(7)], zygoma's frature surgery (DuTolt, 2003)[(3)], practical of intra and extra oral anesthesia (Figun, 1994)[(8)]. The dentist and surgeons of head and neck should know the exactly position of Infra orbital formen (Figun, 1994)[(8)], because theanesthsia must be put on the foramen in order that it diffuses by the canal and causes the anterior superior alveolar nerve block and in consequence, the block of the branches that supply the central superior incisive teeth, lateral incisive and superiorcanine, ipsilateral to the blocked nerve (Zide,1998)[(4)]. Related to the distance between IOF and IOM the mean we found is inferior to the data informed in four studies (Aziz, Marchena and Puran, 2000[(2)]; Canan, Asim, Okan et al., 1999[(9)]; Chung, Kim, Kang et al., 1995[10]; Kazkayasi, Ergin, Ersoy et al.,

2001)[11]. Analyzing three other studies (Hindy and Raouf, 1993[12]; Karakas, Bozkir and Oguz, 2002[13]; Silva, Juliano, Yamamura et al., 1998[14]. Macedo, VC., Cabrini, RR et. all 2009[15] we can confirm the proximity of the results obtained by these authors in accordance with the results described in this study (Table 2). The IOF position obtained in this study, in relation to PA, is higher than the data informed in other studies (Hindy and Raouf[12], 1993; Kazkayasi, Ergin, Ersoy et al.,2001[11]. Macedo, VC., Cabrini, RR et. al 2009[15] (Table 3). Making an analysis of the clinical point of view, anesthetic and/or surgical, IOF location related to IOM in works: that determine the orientation of an acupuncture point, used in the trigeminal neuralgia treatment (Silva, Juliano, Yamamura et al., 1998[14]; to locate the infraorbital plexus region, considered by the author as a risk zone in the plastics surgeries (Hwang, Han, Battuvshin et al., 2004[16]; as access form for surgeries reconstruction of the infraorbital nerves (Mozsary and Middleton, 1983[17]; to determine the morphometric variations from reference points to decrease risks in orbital surgery (Karakas, Bozkir and Oguz, 2002[13] and during anesthesia techniques of regional block in the infraorbital nerve (Chung, Kim, Kang et al., 1995[5]; Goto, Ishizaki, Yoshikawa et al., 1999[18]; Radwan, Saito and Goto, 2001[19]; Salomão, Salomão and Salomão Costa, 1990[20]. Some authors show the relation between IOF and the other anatomical structures, in studies with different purposes, what shows its importance as a repair point: distance between IOF and an imaginary horizontal line in the piriform aperture base (You, Bell and Finn, 1992[21]; inferior orbital fissure and the more inferior portion of the optical channel (Rontal, Rontal and Guiford, 1979[22]; medium facial line on an imaginary line that passes through the supraorbital incisure; eyes pupil and second premolars (Molliex, Navez, Baylot et al., 1995[23]; medium sagittal plane and supraorbital incisure (Chung, Kim, Kang et al., 1995[5]; and finally related to the piriform aperture (Hindy and Raouf, 1993[12]; Kazkayasi, Ergin, Ersoy et al., 2001[11]. Many publications describe IOF location using anatomical accidents of difficult identification in vivo, as for example the medium facial line, the medium sagittal plane, the imaginary horizontal line that passes by the piriform aperture base, lateral margin of the lacrimal gland fossa, inferior orbital fissure and optical channel, little applicable in clinical situations, what in first place was not this work intention. We chose the IOM and the PA points due to its easiness location in vivo. Another characteristic observed in relation to the studies used as reference in this research, explores the great diversity in the results obtained by authors (Aziz, Marchena and Puran, 2000[2]; Canan, Asim, Okan et al., 1999[9]; Chung, Kim, Kang et al., 199510; Hindy and Raouf, 1993; Karakas, Bozkir and Oguz, 2002, Kazkayasi, Ergin, Ersoy et al., 2001; Silva, Juliano, Yamamura et al., 1998) varying from 6,10 mm to 10,90 mm to the distance between IOF and IOM and from 14,70 mm to 17,23 mm between IOF and PA. These results are quite contradictory, possibly due to the variable quantity of samples of these works, being used between 24 and 124 skulls and between 10 and 47 corpses studied.

Conclusion

Many study shows IOF location using anatomical accidents of difficult identification in vivo, as for example the medium facial line, the medium sagittal plane, the imaginary horizontal line that passes by the piriform aperture base, lateral margin of the lacrimal gland fossa, inferior orbital fissure and optical channel, little aplicable in clinical situations, what in first place was not this work intention. We chose the IOM and the PA points due to its easiness location in vivo.

The importance of the incidence and lateralization of the Infra orbital foramen is also evident in facial surgical procedures. The recognition of the presence of double or triple foramens is essential when the appropriate amount of anesthesia is applied, or it can be inappropriate. The study of the Infra orbital foramen is also basic to prevent the potential risk for iatrogenic injury during facial surgeries due to the presence of additional branches of the infra orbital nerve (Kazkayasi, 2001[11]. Previous studies show the relation between infra orbital foramen and the other anatomical structures, in studies with different purposes, what shows its importance as a repair point: distance between infra orbital foramen and an imaginary horizontal line in the piriform aperture base, inferior orbital fissure and the more inferior portion of the optical channel (Rontal, 1979[22] medium facial line on an imaginary line that passes through the supraorbital incisure; eyes pupil and second premolars (Molliex et al.,1995[23] medium sagittal plane and supraorbital incisure (Chung, 1995[10] and finally related to the piriform aperture (Kazkayasi et al., 2001[11]. Statistically we could verify significant differences of the right and left sides in relation to the distance between IOF and IOM. This statistical result is important, mainly because there are just a few researches found in the subject literature that mention the statistical aspect of its data. The results in this study, help to determine the more precise location of the IOF mainly in relation to the IOM, since that this distance has a relevant importance during clinical procedures that use the IOF as an anatomical repair point.

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