Infraorbital foramen location in dry human skulls

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Abstract

The objective of this study was to determine the mean distance between the infraorbital foramen and the infraorbital margin, as well as the mean distance between the infraorbital foramen and the piriform aperture on both sides of dry human skulls, with the aim of improving the efficiency in clinical situations, such as surgery and anesthetic procedures. Two hundred ninety-five skulls were used (590 sides), located in the Frankfurt Plane through a craniostat. The measurements were collected by two distinct operators, with a dry tip compass and carried to a caliper. The general mean obtained between the infraorbital foramen and the infraorbital margin was 6.37 mm (±1.69 mm), with a mean of 6,28 mm (±1.79 mm) on the right side and 6.45 mm (±1.76 mm) on the left side. The general mean obtained between the infraorbital foramen and the piriform aperture was 17.67 mm (±1.95 mm), being 17.75 mm (±2.10 mm) on the right side and 17.60 mm (±2.04 mm) on the left side. There were statistically significant differences between the right and left distances of the infraorbital foramen and the infraorbital margin, verified by the Student's-*t* test. The results of this study allow a more precise location of the infraorbital foramen, particularly as regards the infraorbital margin, since this distance is of relevant importance as a repair point during surgical procedures involving this anatomical structure.

Keywords: infraorbital foramen, infraorbital margin, block infraorbital nerve.

1 Introduction

The infraorbital foramen (IOF) is an anatomical structure with an important location, through which the infraorbital vessels and nerve fibers of the infraorbital nerve pass. These vessels and nerve fibers are responsible for the sensitive innervation of the inferior eyelid, nasal wing, superior lip and vestibular gum of the anterior and premolar teeth. Moreover, from the surgical point of view, the IOF is located near important structures such as the orbital, nasal and buccal regions. Therefore, it is relevant for professionals in the area of dentistry to know its location, when performing procedures in which the infraorbital foramen is used as a reference point in surgeries and anesthesias.

The IOF has been analyzed in several studies in order to determine its location in dry skulls, by direct or indirect means. One of these studies (KAZKAYASI, 2001), attempted to determine and standardize the correct IOF anatomical relationship, course and location in 35 dry adult skulls. Others authors referred to the location of the IOF according to sex, and obtained different mean distances between men and women (AZIZ, MARCHENA and PURAN, 2000; CANAN, ASIM, OKAN et al., 1999).

Some authors show the IOF relationship with other anatomical structures in studies with different purposes, which shows the importance of the IOF as a point reference for anatomical and surgical repair (BÖSENBERG and KIMBLE, 1995; HWANG, HAN, BATTUVSHIN et al., 2004; MOZSARY and MIDDLETON, 1983; RONTAL, RONTAL and GUIFORD, 1979; YOU, BELL and FINN, 1992).

Aware of the importance of determining a more precise location of the IOF, in the present study 295 skulls (totalizing 590 sides) were measured, thus contributing to the use of this foramen as a reference point in surgeries and anesthesias.

2 Material and methods

In order to perform the work, dry human skulls obtained from the Anatomy Discipline of the Faculty of São José dos Campos – UNESP were used. 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 discarded. Out of all the skulls, 295 were selected, which were measured on both sides (right and left) totaling 590 sides.

For the purpose of standardization to take the measurements, the skulls were placed in a device (craniostat). This device consists of a metal base with a fixed column that supports an arch, in which the posterior part of the skulls was placed. It also has to mobile metal stems, formed by a base that allowed these stems to be held perpendicular to the metal base of the craniostat. These stems also had an adjustable and mobile tip parallel to the metal base. The mobile tip of the stems was fitted into the internal acoustic pore, both on the left and right sides, thus supporting the skulls laterolaterally, which were afterwards supported by the arch. This arch had screws that allowed the inclination of the skulls to be adjusted.

The skulls were placed in accordance with the Frankfurt plane by means of another device, consisting of a metal base and a fixed perpendicular stems that had a sharp-tipped, mobile and adjustable stems. This mobile stems was placed in the most upper acoustic pore, locked in this position and at this height. The tip kept in this position was transferred up to the most inferior part of the infraorbital margin, and the inclination of the skulls was adjusted by the screws of the craniostat arch, to obtain the correct position in the Frankfurt Plane (Figure 1).

After the skulls were correctly positioned, the distances between the most superior point of the infraorbital foramen (IOF) up to the infraorbital margin (IOM) was measured, in a manner perpendicular to the Frankfurt plane. The distances between the center of the infraorbital foramen (IOF) and the piriform aperture (PA) were also measured, in a manner parallel to the Frankfurt Plane (Figure 2). The two measurements were made by means of a dry double tip compass. The compass opening was measured through a caliper (Pomicno Mjerilo), 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.

Figure 1. Skull in position according to the Frankfurt Plane.

Figure 2. Reference arrows of the measurements taken - 1: The distance between the infraorbital foramen (IOF) most superior point and the infraorbital margin (IOM). 2: The distance between the center of the infraorbital foramen (IOF) and the piriform aperture (PA).

The collected data were submitted to statistical analysis by means of the Student's-*t* Test.

3 Results

The mean distance between IOF-IOM was 6.37 mm ± 1.69 (6.28 mm -Right Side (RS) and 6.45 mm - Left side (LS)) and between IOF-PA was 17.67 mm ± 1.95 (17.75 mm (RS) and 17.60 mm (LS), as it can be observed (Table 1).

Statistical analysis of the data showed significant differences between the right side and the left side distances of IOF and IOM (Figure 5), verified by the Student's-*t* Test.

4 Conclusion

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 told in several works, using different methodologies (APRILE, FIGUN and GARINO, 1971; CHUNG, KIM, KANG et al., 1995; HINDY and RAOUF, 1993; KAZKAYASI, ERGIN, ERSOY, et al., 2001).

Figure 3. Skull showing great distance between the most superior point of the infraorbital foramen (IOF) and the infraorbital margin (IOM).

Figure 4. Small distance between the most superior point of the infraorbital foramen (IOF) and the infraorbital margin (IOM).

Table 1. The mean distance between IOF-IOM and between IOF-PA, as well as the maximum distance found.

Distances (mm)	Right side (RS) (N = 295)	Left side (LS) (N = 295)	General mean (N = 590)	
			Maximum	Mean
IOF – IOM	6.28* ± 1.79 (SD)	6.45* ± 1.76 (SD)	11.78	6.37 ± 1.69 (SD)
IOF – PA	17.75 ± 2.10 (SD)	17.60 ± 2.04 (SD)	24.70	17.67 ± 1.95 (SD)

*Statistically significant value; and SD: standard deviation.

Figure 5. Significant difference between the right side and the left side distances of IOF and IOM.

Table 2. Comparative distances between IOF and IOM.

Authors	Distances (mm)
Hindy and Raouf (1993)	6.10
Chung (1955)	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
This study	6.37

Table 3. Comparative distances between IOF and PA.

Authors	Distances (mm)
Hindy and Raouf (1993)	17.23
Kaskayasi (2001)	14.70
This study	17.67

The IOF location according to the sex, although little studied, was found in the work of two authors (AZIZ, MARCHENA and PURAN, 2000; CANAN, ASIM, OKAN et al., 1999), the first related to IOF and IOM and the second related to the IOM, facial line mean and supraorbital incisure.

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); to locate the infraorbital plexus region, considered by the author as a risk zone in the plastics surgeries (HWANG, HAN, BATTUVSHIN et al., 2004); as access form for surgeries reconstruction of the infraorbital nerves (MOZSARY and MIDDLETON, 1983); to determine the morphometric variations from reference points to decrease risks in orbital surgery (KARAKAS, BOZKIR and OGUZ, 2002) and during anesthesia techniques of regional block in the infraorbital nerve (CHUNG, KIM, KANG et al., 1995; GOTO, ISHIZAKI, YOSHIKAWA et al., 1999; RADWAN, SAITO and GOTO, 2001; SALOMÃO, SALOMÃO and SALOMÃO COSTA, 1990).

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); inferior orbital fissure and the more inferior portion of the optical channel (RONTAL, RONTAL and GUIFORD, 1979); medium facial line on an imaginary line that passes through the supraorbital incisure; eyes pupil and second premolars (MOLLIEX, NAVEZ, BAYLOT et al., 1995); medium sagittal plane and supraorbital incisure (CHUNG, KIM, KANG et al., 1995); and finally related to the piriform aperture (HINDY and RAOUF, 1993; KAZKAYASI, ERGIN, ERSOY et al., 2001).

According to this work results, IOF is an mean distance of 6,37 mm ± 1,69 (SD) in relation to the infraorbital margin and 17,67 ± 1,95 (SD) in relation to PA.

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; CANAN, ASIM, OKAN et al., 1999; CHUNG, KIM, KANG et al., 1995; KAZKAYASI, ERGIN, ERSOY et al., 2001). Analyzing three other studies (HINDY and RAOUF, 1993; KARAKAS, BOZKIR and OGUZ, 2002; SILVA, JULIANO, YAMAMURA et al., 1998) 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, 1993; KAZKAYASI, ERGIN, ERSOY et al., 2001) (Table 3).

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 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.

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; CANAN, ASIM, OKAN et al., 1999; CHUNG, KIM, KANG et al., 1995; 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. Intending to minimize possible intercurrences due to the quantity of samples used, in the study we tried to define a significant number of samples, 295 human dry skulls (590 sides) located in a craniostat in accordance to the Frankfurt Plane, what made possible to get more precise and accurate results.

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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Received April 7, 2008
Accepted June 8, 2009