

Anatomic and morphometric features of the accessory infraorbital foramen

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Abstract

The infra-orbital foramen (IOF), due to the infra-orbital artery, vein and nerve which pass through it, is an important anatomic landmark and its location needs to be known for the maxillofacial interventions. However, there might be an accessory branch of the infra-orbital nerve that are taken care during these interventions. This accessory nerve passes through the accessory infra-orbital foramen (AIOF). In the current study, in order to perform anatomic and morphometric analyses of AIOF, 112 skulls have been used. Appearance and frequency of AIOF, its direction with respect to IOF have been determined and distances to certain specified points have been measured by a digital caliper. It has been determined that the frequency of AIOF is 7% and often locates on the left (66.5%) and in the superomedial of IOF (93.3%). The average longest diameter of AIOF has been measured as 1.93 mm and the shortest diameter has been measured as 1.56 mm. It has been found that AIOF locates 22.18 mm away from the mid-line, 39.92 mm away from the supraorbital foramen/ the supraorbital notch, 21.95 mm away from the lower end of the nasomaxillary suture, 34.45 mm away from the lower end of the alveolar juga of the canines, 5.61 mm away from the infra-orbital margin, 3.95 mm away from IOF at the same side and 51.18 mm away from IOF at the opposite side. AIOF should be taken into consideration especially in oral and maxillofacial interventions on the left side of face.

Keywords: morphometry, maxilla, accessory infra-orbital foramen.

1 Introduction

The infra-orbital foramen (IOF) is an opening by which the infra-orbital canal, giving passage to the infra-orbital artery, vein and nerve, communicates with the face. It locates below the infra-orbital margin in the maxilla and is present bilaterally in the facial skeleton (WARWICK and WILLIAMS, 1973).

IOF is an important landmark for oral and maxillofacial surgery when looked from the perspectives of surgery and local anesthesia. Precise location of IOF is essential for the success of intervention. However, the accessory infra-orbital foramen (AIOF), the frequency of which changes between 2.2-18.2% (BERRY and BERRY, 1967; KADANOFF, MUTANOFF and JORDANOV, 1970; FINNEGAN, 1972; GUADARRAMA, 1973; BERRY, 1975; HINDY and ABDEL-RAOUF, 1993; SAYLAM, ASIM, OKAN et al., 1999; AZIZ, MARCHENA and PURAN, 2000; KAZKAYASI, ERGIN, ERSOY et al., 2001; BRESSNAN, GEUNA, MALERBA et al., 2004; ELIAS, SILVA, PIMENTEL et al., 2004) and through which a branch of the infra-orbital nerve passes, should be taken into consideration during these interventions. There are studies concerning accessory foramen frequency but their morphometric analyses are inadequate.

The aim of the present study is to investigate the frequency of AIOF, to measure the distances to certain specified points and to make morphometric analyses and to provide convenience to clinical applications.

2 Material and methods

In order to investigate anatomic and morphometric features of AIOF, we examined 112 adult skulls which belong to the Departments of Anatomy of the Istanbul Faculty of Medicine and Faculty of Dentistry of the Istanbul University and which are used in student practices. 110 complete skulls and two left hemispheres separated from the mid-line in the sagittal plane belonging to a total of 112 skulls have been evaluated. Among the complete skulls, because right sagittal halves of 7 skulls and left sagittal halves of 8 skulls have been ruined, they were excluded but other halves have been included in the study. As a result, 95 complete, 9 left, 8 right hemisphere have been used in the study (n = 104 left, n = 103 right hemispheres). It has been evaluated if there is AIOF in these skulls or not. Among the cases in which AIOF is present, as canine tooth area has been ruined in 9 of them, these could not be measured. As the age and the gender of the skulls were not known, we did not take these factors into consideration. We have marked the points on the skulls and have measured the distances between the specified points by using a digital caliper with 0.01 mm sensitivity. All measurements have been performed by authors.

We identified the forms (either oval, circular, semicircular) of AIOF and we determined the frequency and the localization of AIOF with respect to IOF. The shortest and longest diameters of AIOF, the shortest distances between AIOF and the specified points; the mid-line (ML), the supraorbital foramen/ the supraorbital notch (SOF), the

lower end of the nasomaxillary suture (LENS), the lower end of the alveolar juga of the canines (LAJC), the infra-orbital margin (IOM), and IOF both at the same and the opposite sides were measured. (Figure 1)

3 Results

The frequency of AIOF on one side of the face has been observed as 7% (15/207), 66.5% (10/15) of foramens has been placed on the left and 33.5% (5/15) of them has been placed on the right. The frequency of AIOF on the left side of the face and on the right side of the face have been found as 9% (10/104) and 4% (5/103), respectively.

When evaluated in terms of their forms, AIOF have been observed to be 46.7% (7/15) oval and 53.3% (8/15) circular.

When the localization of AIOF with respect to IOF is evaluated, 93.3% (14/15) of them have been observed to place in the superomedial and 6.7% (1/15) have been observed to place in the inferomedial.

The measurements of the distances between AIOF and the specified points were summarized in Table 1.

4 Discussion

4.1 The frequency of the accessory infra-orbital foramen

The frequency of AIOF was reported as 5.7% by Kazkayasi, Ergin, Ersoy et al. (2001), 10% by Kadanoff, Mutanoff and Jordanov (1970), 10% by Hindy and Abdel-Raouf (1993), 12.78% by Saylam, Asim, Okan et al. (1999), 14% by Elias, Silva, Pimentel et al. (2004) and 15% by Aziz, Marchena and Puran (2000).

The frequency of AIOF shows change with respect to race. Berry and Berry (1967) reported the frequency of AIOF as 4.7% in Egyptians, 6.4% in Nigerian, 6.4% in Palestinian, 6.7% in Indians, 6% in North Americans, 13.2% in South Americans.

The frequency of AIOF was reported to be 6.4% in Burmese males, 8.7% in females; 12.5% in North American males, 7.9% in females; 18.2% in Mexican males, 12.5% in females, 2.2% in English males, 4.8% in females (BERRY and BERRY, 1967; FINNEGAN, 1972; GUADARRAMA, 1973; BERRY, 1975).

The frequency of AIOF may change in terms of sides (right-left). In the study of Bresnan et al. (2004), the frequency of AIOF was identified to be 4.7%. It was reported that the identified AIOF located more often on the left side (2.16%) than on the right side (1.22%).

In the current study, as the other sides of the skulls that were evaluated as halves were not known and the maxillofacial interventions regarding infra-orbital nerve were usually one-sided, frequency evaluation was calculated with respect to half faces (skulls). According to this, the frequency of AIOF on one side of the face was found to be 7% (15/207). It was observed that among the identified foramens, 66.5% of them located on the left (10/15) and 33.5% (5/15) located on the right. Similarly, the frequency of AIOF on the left side of the face was 9% (10/104) and on the right side of the face was 4% (5/13). The finding that AIOF locates more often on the left side resembles to that of Bressnan, Geuna, Malerba et al. (2004).

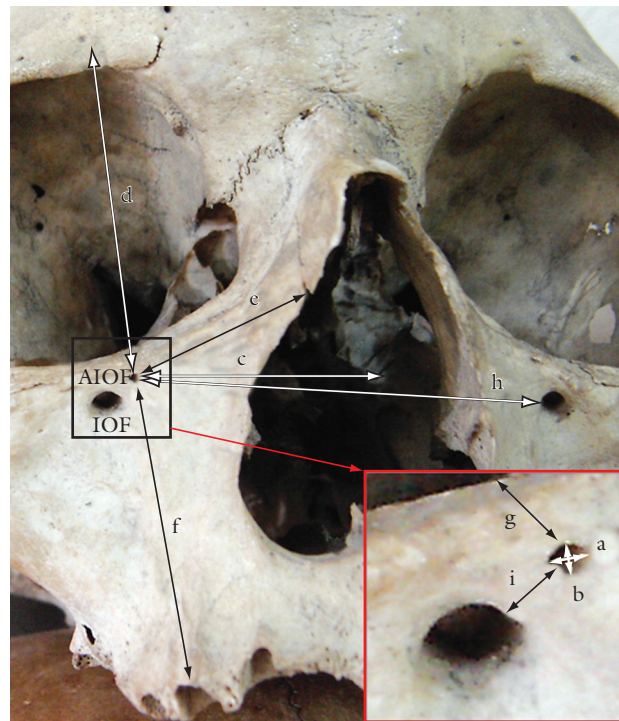


Figure 1. Diameters of the accessory infra-orbital foramen (AIOF) and the shortest distances between AIOF and the specified points; a) The longest diameter of the AIOF; b) The shortest diameter of the AIOF; c) The shortest distance between AIOF and the mid-line; d) The shortest distance between AIOF and the supraorbital foramen/ the supraorbital notch; e) The shortest distance between AIOF and the lower end of nasomaxillary suture; f) The shortest distance between AIOF and the lower end of the alveolar juga of the canines; g) The shortest distance between AIOF and the infra-orbital margin; h) The shortest distance between AIOF and the IOF at the opposite side; and i) The shortest distance between AIOF and IOF at the same side. (IOF: Infra-orbital foramen).

Table 1. The longest and shortest diameters of the accessory infra-orbital foramen (AIOF), the shortest distances between AIOF and the specified points; the mid-line (ML), the supraorbital foramen/ the supraorbital notch (SOF), the lower end of nasomaxillary suture (LENS), the lower end of the alveolar juga of the canines (LAJC), the infra-orbital margin (IOM) and the infra-orbital foramen (IOF).

	N	Mean ± SD (mm)	Min (mm)	Max (mm)
Longest diameter of AIOF	15	1.93 ± 0.67	1.09	3.59
Shortest diameter of AIOF	15	1.56 ± 0.45	1.01	2.52
AIOF-ML	15	22.18 ± 2.56	16.03	25.91
AIOF-SOF	15	39.92 ± 2.86	33.55	45.43
AIOF-LENS	15	21.95 ± 6.59	13.74	41.76
AIOF-LAJC	6	34.45 ± 1.73	32.22	36.70
AIOF-IOM	15	5.61 ± 1.82	2.48	8.26
AIOF-IOF at the opposite side	15	51.18 ± 2.93	46.92	55.26
AIOF-IOF at the same side	15	3.95 ± 1.60	1.91	6.53

4.2 The localization of the accessory infra-orbital foramen with respect to the infra-orbital foramen

In the study of Saylam, Asim, Okan et al. (1999), AIOF often (79.6%) locates in superomedial with respect to IOF. In the current study, we have observed that 93.3% of AIOF locates in the superomedial of IOF and 6.7% locates in the inferomedial.

Saylam, Asim, Okan et al. (1999) found the horizontal, vertical and oblique distance between IOF and AIOF to be in the range of 0-16 mm and often 5 mm, in the range of 0-9 mm and often 4 mm and in the range of 1-12 mm and often 7 mm, respectively. In the current study, we measured the shortest distance from AIOF to IOF at the same side as 3.95 ± 1.60 mm.

4.3 Other measurements

In clinical practices, knowing that the diameters of AIOF located in the superomedial and approximately 4 mm away from IOF may be enough. For more precise localizations, the distances from AIOF to ML, to IOM, to LAJC, to SOF may be taken into consideration, however, these measurements are important for anatomic features of AIOF with distances to LENS and to opposite side IOF.

5 Conclusion

The frequency of AIOF on one side of the face is 7% and it is especially on the left half of the face. It is 1.5×2 mm in size and often locates 4 mm superomedial to IOF. AIOF locates 5.5 mm away from IOM, 4 cm away from SOF, 2.2 cm away from ML, 2.2 cm away from LENS, 3.5 cm away from LAJC. Especially in oral and maxillofacial surgical interventions on the left side, in order to protect accessory infra-orbital nerve, the fact that there may be AIOF and its possible location should be taken into consideration.

References

AZIZ, SR., MARCHENA, JM. and PURAN, A. Anatomic characteristics of the infraorbital foramen: a cadaver study. *Journal of Oral and Maxillofacial Surgery*, 2000, vol. 58, n. 9, p. 992-996. PMID:10981979. <http://dx.doi.org/10.1053/joms.2000.8742>

BERRY, AC. Factors affecting the incidence of non-metrical skeletal variants. *Journal of Anatomy*, 1975, vol. 120, n. 3, p. 519-535. PMID:129447. PMCID:1231693.

BERRY, AC. and BERRY, RJ. Epigenetic variation in the human cranium. *Journal of Anatomy*, 1967, vol. 101, n. 2, p. 361-379. PMID:4227311. PMCID:1270890.

BRESSNAN, C., GEUNA, S., MALERBA, G., GIACOBINI, G., GIORDANO, M., ROBECCCHI, MG. and VERCELLINO, V. Descriptive and topographic anatomy of the accessory infraorbital foramen. *Minerva Stomatologica*, 2004, vol. 53, n. 9, p. 495-505. PMID:15499301.

ELIAS, MG., SILVA, RB., PIMENTEL, ML., CARDOSO, VTS., RIVELLO, T. and BABINSKI, MA. Morphometric analysis of the infraorbital foramen and accessories foramina in Brazilian skulls. *International Journal of Morphology*, 2004, vol. 22, n. 4, p. 273-278.

FINNEGAN, M. *Population definition on the North-West coast by analysis of discrete character variation*. Boulder: University of Colorado, 1972. [Dissertation].

GUADARRAMA, LA. *Estudio de los caracteres craneanos discontinuos en la poblacion de Tlatilco, Mexico*. Universidad Nacional Autónoma de México, 1973. [Tesis Mestro an Antropología].

HINDY, AM. and ABDEL-RAOUF, F. A study of infraorbital foramen, canal and nerve in adult Egyptians. *Egyptian Dental Journal*, 1993, vol. 39, n. 4, p. 573-580. PMID:9588126

KADANOFF, D., MUTANOFF, ST. and JORDANOV, J. Über die Hauptöffnungen resp. incisurae des Gesichtsschädels. *Morphologisches Jahrbuch*, 1970, vol. 115, p. 405-407.

KAZKAYASI, M., ERGIN, A., ERSOY, M., BENGI, O., TEKDEMIR, I. and ELHAN, A. Certain anatomical relations and the precise morphometry of the infraorbital foramen, canal and groove: an anatomical and cephalometric study. *Laryngoscope*, 2001, vol. 111, n. 4, pt. 1, p. 609-614.

SAYLAM, C., ASIM, OM., OKAN, B., OZEK, C. and ALPER, M. Anatomic variations of the infraorbital Foramen. *Annals of Plastic Surgery*, 1999, vol. 43, n. 6, 613-617. PMID:10597821

WARWICK, R. and WILLIAMS, PL. *Gray's anatomy*. 35th ed. Edinburgh: Longman Group, 1973. p. 110-312.

Received October 16, 2010

Accepted June 8, 2011