VIA MEDICA

ORIGINAL ARTICLE

Folia Morphol.
Vol. 71, No. 3, pp. 198–204

ISSN 0015–5659
www.fm.viamedica.pl

The location of the infraorbital foramen in human skulls, to be used as new anthropometric landmarks as a useful method for maxillofacial surgery

A. Przygocka[1], M. Podgórski[1], K. Jędrzejewski[2], M. Topol[2], M. Polguj[1]

[1]*Department of Angiology, Chair of Anatomy, Medical University of Lodz, Poland*
[2]*Department of Normal and Clinical Anatomy, Medical University of Lodz, Poland*

[Received 28 May 2012; Accepted 17 July 2012]

Background: *The aim of the study was to determine the localisation of the infraorbital foramen in relation to chosen anthropometric landmarks as novel reference points: nasion, rhinion, and frontomalare orbitale, and to verify their symmetry.*
Material and methods: *Sixty-four sides of thirty-two human skulls were investigated. The distances between the infraorbital foramina and nasion, rhinion, and frontomalare orbitale, and the distances between two contralateral infraorbital foramens were measured. The symmetry was analysed and statistical analysis was performed.*
Results: *The mean distance and standard deviation (mean ± SD) between the right infraorbital foramen and the nasion, rhinion, and right frontomalare orbitale were 45.23 ± 3.20 mm, 39.84 ± 1.72 mm, and 36.28 ± 1.50 mm, respectively, and between the left infraorbital foramen and the nasion, rhinion, and left frontomalare orbitale were 44.38 ± 2.76 mm, 38.88 ± 2.01 mm, and 36.31 ± 2.19 mm, respectively.*
Conclusions: *The results presented in this study may be particularly helpful for surgery in patients with oedema of the infraorbital region when the other landmarks are difficult to localise.* (Folia Morphol 2012; 71, 3: 198–204)

Key words: human, morphometry, infraorbital foramen, nasion, rhinion, frontomalare orbitale

INTRODUCTION

The infraorbital foramen (IOF) is located in the maxilla under the infraorbital rim (IOR); however, its position varies among different populations with respect to gender and side [1, 3]. The infraorbital artery, vein, and nerve pass by the IOF. The branches of the human infraorbital nerve supply the skin of the upper cheek, the skin and conjunctiva of the inferior eyelid, part of the nose, the skin of the upper lip, the mucosa of the upper lip, the mucosa of the maxillary sinus, the maxillary incisor, canine, premolar teeth, and adjacent upper gingivae [11]. The IOF and infraorbital neurovascular bundles are important structures that need to be considered in surgical and anaesthetic procedures on the oral and maxillofacial areas: closure of post-traumatic facial wounds, biopsies, revisions of scars, cosmetic cutaneous procedures, endoscopic procedures, orbital procedures, and anaesthesia during rhinoplasty. Localisation of the IOF is crucial to avoid clinical complications such as entrapment neuropathies, neuralgias, bleeding, and loss of sensation in corresponding regions if the face [8, 11, 12, 30].

Address for correspondence: M. Polguj, Department of Angiology, Chair of Anatomy, Medical University of Lodz, ul. Narutowicza 60, 90–136 Łódź, Poland, tel: +48 42 630 49 49, e-mail: michal.polguj@umed.lodz.pl

Several studies show the importance of the proper localisation of the IOF [15, 19, 20, 23, 29, 32]. It seems that locating and preserving the infraorbital neurovascular bundle may be difficult in fractures involving the IOR with significant oedema [12, 15, 35].

Large variations in measurements have been reported in the literature with regard to the distance between the IOF and the IOR and the facial midline. Several hard-tissue and soft-tissue landmarks (nasal spine, maxillary teeth, supraorbital foramen or notch, the lateral margin of nasal aperture, or ala nasi) are also used to determine the localisation of the IOF [1, 3, 7, 11, 14–17, 19, 20, 25, 29, 30, 32, 33].

The aim of this study was to analyse the topographical anatomy and the symmetry of the IOF in human skulls using the nasion, rhinion, and frontomalare orbitale (FMO) as novel reference points. Our method, based on palpable points, can be used even in the case of oedema in the infraorbital area.

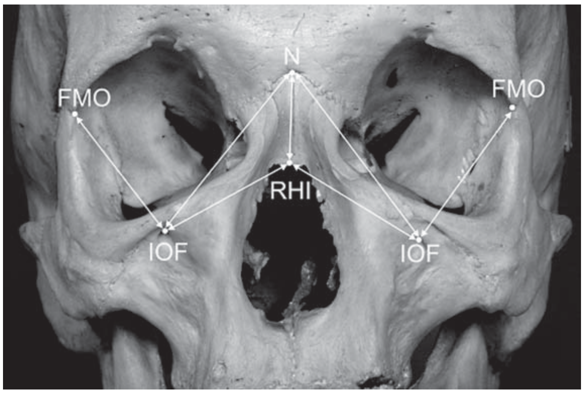

Figure 1. The human skull. Osteometric points: IOF — infraorbital foramen; FMO — frontomalare orbitale; N — nasion; RHI — rhinion. Osteometric measurements: IOF-FMO — distance between the infraorbital foramen and the frontomalare orbitale; IOF-N — distance between the infraorbital foramen and the nasion; IOF-RHI — distance between the infraorbital foramen and the rhinion; IOF-IOF — distance between two contralateral infraorbital foramens; N-RHI — distance between the nasion and rhinion.

MATERIAL AND METHODS

Measurements were made on 64 sides of 32 human dry skulls from the Chair of Anatomy of the Medical University of Lodz, Poland. The samples were from the Polish population. The variables of age and gender were not considered.

The foramen with the largest dimensions was considered to be the primary foramen and was included in the data. The accessory infraorbital foramina (AIOF) were excluded from the study. All measurements were calculated twice by two independent observers and the mean values were noted. The osteometric measurements were carried out according to standard definitions and using procedures, precision, and equipment as described in various studies [5, 26–28, 31]. The distances were measured bilaterally, and the symmetry was documented.

The following morphometric measurements were collected (Fig. 1):

- IOF-FMO — distance between the infraorbital foramen and frontomalare orbitale;
- IOF-N — distance between the infraorbital foramen and nasion;
- IOF-RHI — distance between the infraorbital foramen and rhinion;
- IOF-IOF — distance between the collateral infraorbital foramens;
- N-RHI — distance between nasion and rhinion.

All measurements were tabulated and separated by side.

Statistical analysis

The Shapiro-Wilk test was used to determine whether the parameters were normally distributed and the Brown-Forsythe test was employed for testing the equality of group variations. The dependent t-test for paired samples and the Wilcoxon singled-rank test were used to compare the distances between craniometrical points on the left and the right side, the Krushal-Wallis one-way analysis of variance and the multiple sample contrast test were performed to evaluate differences in the asymmetry of the analysed parameters, while the Mann-Whitney U test was used to evaluate the dominance of right or left side asymmetry. $P < 0.05$ was taken to be significant.

RESULTS

Thirty-two adult human skulls (64 sides) were studied. All the skulls studied displayed an IOF on both sides. The mean distance between two contralateral IOFs of the same skull was 53.98 mm with a standard deviation (SD) of 3.78 mm. The maximal and minimal IOF-IOF distances were 47.50 and 59.50 mm, respectively.

The average IOF-N value on the right side was 45.22 ± 3.20 mm and 44.38 ± 2.76 mm for the left side. The mean values for the right IOF-RHI and left IOF-RHI were 39.84 ± 1.72 mm and 38.88 ± ± 2.01 mm, respectively. The average IOF-FMO values on the right and left sides were 36.28 ± ± 1.51 mm and 36.31 ± 2.19 mm, respectively (Table 1).

Table 1. Anthropometric measurements of human skulls collected in the current study

Distances		No.	Min [mm]	Max [mm]	Mean ± SD [mm]	Median	Modal
IOF-FMO	Right	32	33.0	40.0	36.28 ± 1.51	36.00	36.00
	Left	32	32.0	41.0	36.31 ± 2.19	36.00	36.00
IOF-N	Right	32	40.0	53.0	45.22 ± 3.20	45.00	47.00
	Left	32	39.0	49.0	44.375 ± 2.76	45.00	46.00
IOF-RHI	Right	32	37.0	45.0	39.84 ± 1.72	40.00	40.00
	Left	32	34.0	42.0	38.875 ± 2.01	39.00	39.00
IOF-IOF		32	47.5	59.5	53.98 ± 3.78	55.00	55.00
N-RHI		32	15.0	31.0	20.03 ± 4.67	19.00	19.00

Abbreviations as in Figure 1

Table 2. Symmetry/asymmetry of anthropometric measurements

Distances		Asymmetry					
		0 mm	1 mm	2 mm	3 mm	4 mm	5 mm and more
IOF-FMO	Right	10 (31.250%)	8 (25.0%)	4 (12.5%)	–	–	–
	Left		6 (18.75%)	2 (6.25%)	1 (3.125%)	1 (3.125%)	–
IOF-N	Right	5 (15.625%)	3 (9.375%)	5 (15.625%)	6 (18.75%)	3 (9.375%)	1 (3.125%)
	Left		3 (9.375%)	4 (12.5%)	–	1 (3.125%)	1 (3.125%)
IOF-RHI	Right	8 (25.0%)	11 (34.375%)	4 (12.5%)	2 (6.25%)	2 (6.25%)	1 (3.125%)
	Left		3 (9.375%)	–	1 (3.125%)	–	–

Abbreviations as in Figure 1

No IOF-FMO asymmetry was observed in 31.3% of the samples, no IOF-N asymmetry in 15.6% of the samples, and no IOF-RHI asymmetry in 25% of the samples.

An asymmetry of 1–2 mm was found in 37.5% for the right IOF-FNO and in 25.0% for the left IOF-FMO; in 25.0% for the right IOF-N distances and in 12.5% for the left IOF-N distances; in 65.625% for the right IOF-RHI distances and in 9.4% for the left IOF-RHI distances.

An asymmetry of 3–4 mm was found in 6.3% of samples for the left IOF-FMO, in 28.1% for the right IOF-N; in 3.1% for the left IOF-N, in 12.5% for the right IOF-RHI; and in 3.1% for the left IOF-RHI, but not for the right IOF-FMO values.

An asymmetry of 5 mm or more was found for the right and left IOF-N in 3.1% for each distance for the right IOF-RHI. No difference was found for either the right and left IOF-FMO nor for the left IOF-RHI values. The complete analysis of the symmetry of the position of the IOF is summarised in Table 2. The distance between the rhinion and IOF was significantly greater on the left side. However, no statistically significant differences were found in other measurements when comparing right and left sides.

DISCUSSION

The topography of the IOF is very important in clinical practice especially in head and neck surgery, plastic surgery, otorhinolaryngology, ophthalmology, and dental surgery [2, 3, 6, 8, 12]. To the best of our knowledge, our study is the first to look specifically at relationships between the nasion, rhinion, and frontomalare orbitale, which can be used together to localise the IOF. These novel landmarks were chosen as easily identifiable reference points even when a fracture or oedema of the maxillofacial region exists [35].

The observation made in the present study that the IOF is present in all skulls is consistent with other studies [2, 17]. The IOF can itself be used as a landmark [18, 34]. The average distance to the IOF from the contralateral IOF was 53.98 ± 3.78 mm in our study and was similar to results described by Song et al. [32]. In their study, the average distance between two contralateral IOFs was 54.9 ± 3.4 mm.

There is a large variation in the results in measurements related to the IOF reported in the literature, as the position of the IOF is characterised by great anatomical variation [4, 6]. Differences related to the gender and side are described in the litera-

Table 3. Comparative mean distances with standard deviations (mean ± SD) between the infraorbital foramen and the infraorbital rim (IOF-IOR) or infraorbital margin (IOF-IOM) where it is crossed by the zygomaticomaxillary suture (ZMS); between the infraorbital foramen and facial midline (IOF-FM) in different populations

Name of the first author of the study	Country of origin	No. of samples	Distance to the IOR/IOM (ZMS) [mm]	Distance to the FM or the maxillary midline [mm]
Agthong et al. [1]	Thailand	110	7.8 ± 0.2 right; 8.0 ± 0.2 left	24.4 ± 0.3 right; 25.1 ± 0.4 left
Apinhasmit et al. [2]	Thailand	106		28.43 ± 2.29
Aziz et al. [3]	USA	47	8.5 ± 2.2 males; 7.8 ± 1.6 females	27.7 ± 4.3 males; 26.2 ± 3.2 females
Boopathi et al. [6]	India	80	6.57 ± 1.28	–
Bressan et al. [9]	Italy	1064	10.9 males; 8.3 females	–
Chrcanovic et al. [11]	Brazil	80	6.63 ± 1.75 males; 6.35 ± 1.67 females (6.64 ± 1.89 males; 6.49 ± 1.58 females)	25
Cutright et al. [12]	USA	80	(6.4)	27
Gupta [15]	India	79	(7.0)	28.5
Hindy and Abdel-Raouf [16]	Egypt	30	6.1 ± 2.4	–
Ilayperuma et al. [17]	Sri Lanka	108	10.56 ± 1.74 males; 9.02 ± 1.58 females	–
Karakas et al. [18]	Turkey	31	6.7 ± 1.9	–
Kazkayasi et al. [20]	Turkey	35	7.16 ± 1.39	–
Kumar et al. [22]	India	75	5.6	27
Macedo et al. [25]	Brazil	295	6.37 ± 1.69; 6.28 ± 1.79 right; 6.45 ± 1.76 left	–
Rahman et al. [29]	USA	11	8.0	26
Singh [30]	India	55	6.12 right; 6.19 left	–
Wilhelmi et al. [35]	USA	14	9.8 ± 1.0	–

ture and they differ based on the type of population [1, 2]. Differences within the data can be also caused by inconsistencies in the chosen landmarks and methods of measurements. The chosen landmarks and mean distances described in previous studies are shown in Tables 3–5.

A common way of finding the IOF is its localisation in relation to the IOR. The mean distances of 2.47 ± 1.56 mm for males and 1.76 ± 1.48 mm for females were shown [17]. The mean distances between the IOF and IOR were generally comparable in different studies, but huge differences can be found; a minimal distance of 2 mm and a maximal of 11.5 mm have been described [4, 30].

Some authors use the zygomaticomaxillary suture as a reference point at the IOR [2, 11, 12, 15, 17]. It is unclear if the same point was chosen or the shortest distance to the IOR was measured in other studies [4, 29, 30]. These distances are easy to measure in normal conditions but not when a fracture of the IOR and oedema of soft tissues exists. The high range of measurements may also cause problems in practice.

The mean distance between the IOF and the facial midline ranged between 24.4 mm and 28.5 mm in previous studies [1–3, 11, 12, 15, 22]. The described mean distance between the IOF and the nasal spine in males was 32.8 ± 0.3 mm on the right and 33.1 ± 0.3 mm on the left, and in females it was 34.8 ± 0.3 mm on the right and 35.0 ± 0.3 mm on the left [1].

The supraorbital foramen (SOF) or supraorbital notch (SON) was chosen as a reference point in some cases. The mean distance of the IOF from the SOF/ /SON was found to be 40.9–43.3 mm [3, 11, 15]. However, the measurements can be different depending on whether the centre of the SOF or the margin of the SON is chosen as a landmark. The mean distance between the IOF and the piriform aperture was 15.31 mm on the right and 15.80 mm on the left [30].

Table 4. Reference points used to localise the infraorbital foramen (IOF)

Reference point	First author of the study and country of origin		Distance between IOF and the reference point [mm]
Nasal spine	Agthong et al. [1]	Thailand	Males: 32.8 ± 0.3 right and 33.1 ± 0.3 left; females: 34.8 ± 0.3 right and 35.0 ± 0.3 left
Lateral edge of the anterior nasal aperture	Macedo et al. [25]	Brazil	17.67 ± 1.95; 17.75 ± 2.10 right and 17.60 ± 2.04 left
	Rahman et al. [29]	USA	
	Singh [30]	India	15.31 right and 15.8 left
Ala nasi	Bosenberg and Kimble [7]	South Africa	Neonates
	Song et al. [32]	Korea	1.6 ± 2.7 lateral and 14.1 ± 2.8 superior
	Takahasi et al. [33]	Japan	4.9; males: 5,2; females: 4.4
Nasion	Bosenberg and Kimble [7]	Turkey	Neonate
Supraorbital foramen	Aziz et al. [3]	USA	Males: 43.3 ± 3.1 and females: 42.2 ± 2.4
	Chrcanovic et al. [11]	Brazil	42.92 ± 3.11; males: 43.43 ± 3.24 and females: 42.67 ± 3.03
	Gupta [15]	India	40.9 ± 4.1 right and 42.4 ± 3.2 left
The lateral process of the canine tooth in vertical direction	Kazkayasi et al. [20]	Turkey	33.94 ± 3.15
The lateral nasal border in horizontal direction	Hindy and Abdel-Raouf [16]	Egypt	14.7 ± 2.7
	Kazkayasi et al. [20]	Turkey	17.23 ± 2.64
The line drawn from the angle of the mouth to the midpoint of the palpebral fissure	Bosenberg and Kimble [7]	South Africa	Neonates
Nasal notch	Ghaus and Faruqi [14]	India	Foetuses

Table 5. Frequency of location of infraorbital foramen in relation to the maxillary teeth shown in previous studies

		Localisation			
Study		Opposite the 2nd premolar	Opposite the 1st premolar	Between the 1st and 2nd premolar	Between the 2nd premolar and 1st molar
Agthong et al. [1]	Thailand	53.8%	–	31.6%	12.7%
Hindy et al. [16]	Egypt	50%	15%	15%	–
Ilayperuma et al. [17]	Sri Lanka	55.56%	–	29.63%	11.11%

A particularly useful way of identifying the IOF is its position in reference to the maxillary teeth (Table 5). The IOF is described as situated opposite the 2nd premolar tooth in 50–55.56% of cases, and between the 1st and the 2nd premolar tooth in 15–31.6% of cases [1, 15, 16]. The average distance from the first premolar tooth alveolus top to the IOF was 33.4 ± 5.2 mm [8].

Also the ala nasi are used as soft tissue landmarks [7, 32, 33]. The vertical vector of the infraorbital nerves from the canthus along the horizontal vector of the orbit can be used [35]. A line drawn from the angle of the mouth to the midpoint of the palpebral fissure has also been suggested [7]. The IOF was described as being located 1.6 ± 2.7 mm laterally and 14.1 ± 2.8 mm superiorly to the ala nasi, and the distance between the ala of the nose and the IOF was measured as 15.9 ± 2.8 mm [32]. The total horizontal distances from the vertical line through the lateral margin of the ala nasi to the medial margin of the IOF were 4.9 mm and 4.4 mm in male and female subjects, respectively [33].

There are several descriptions of accessory infraorbital foramina in the scientific literature [1–4, 6, 9, 10, 13, 20, 21, 24, 34]. Although the frequency of multiple IOF ranges from 2.2% to 18.2% [1, 6, 16, 20], the presence of supernumerary IOF may cause post-operative complications such as sensory deficit and partial nerve blockade [3]; therefore, the possibility of accessory infraorbital foramina being present should be taken into consideration. The highest frequency of multiple foramina IOF, as high as 18.2%, was noted in Mexican males [6].

In our opinion, when taken together, measurements of three parameters or more will help to locate the IOF more accurately. Both hard-tissue and soft-tissue landmarks can be used together [1, 32], which is valuable not only in surgical manipulations in this region but also for the performance of local anaesthesia.

The results of this and previous studies indicate that parameters used to locate the IOF should be applied with great caution when evaluating patients from different populations. A comparison of the results of studies originating from Europe, Asia, Africa, and North and South Americas (Tables 3, 4) is difficult or even impossible in some situations as the measurements were often taken in different ways.

The risk associated with manipulations in the maxillofacial region may be reduced if anatomic morphometry is taken into consideration; this will allow the surgeon to avoid injuring the neurovascular bundles, and it will make invasive procedures in this region safer by identifying the dangerous zone. This new method of localising the IOF shown in our study should be considered in clinical practice.

CONCLUSIONS

1. The anthropometric points: FMO, nasion, rhinion, or the contralateral IOF can be used as points of reference in localisation of the IOF.
2. The mean distances with SD to the IOF from the nasion, rhinion, and FMO in the Polish population were 45.23 ± 3.20 mm, 39.84 ± 1.72 mm, and 36.28 ± 1.5 mm on the right and 44.38 ± ± 2.76 mm, 38.88 ± 2.01 mm, and 36.31 ± ± 2.19 mm on the left, respectively.
3. The distance between the IOF and rhinion was significantly higher on the left side, but no statistically significant differences were found in other measurements when comparing the right and left sides.
4. The method described in the present study can be used as a single method if there is oedema of the infraorbital region or as an additional method to verify the localisation when using other reference points.

REFERENCES

1. Agthong S, Huanmanop T, Chentanez V (2005) Anatomical variations of the supraorbital, infraorbital, and mental foramina related to gender and side. J Oral Maxillofac Surg, 63: 800–804.
2. Apinhasmit W, Chompoopong S, Methathrathip D, Sansuk R, Phetphunphiphat W (2006) Supraorbital notch/foramen, infraorbital foramen and mental foramen in thais: anthropometric measurements and surgical relevance. J Med Assoc Thai, 89: 675–682.
3. Aziz S, Marchena J, Puran A (2000) Anatomic characteristics of the infraorbital foramen: a cadaver study. J Oral Maxillofac Surg, 58: 992–996.
4. Berry AC (1974) Factors affecting the incidence of non-metrical skeletal variations. J Anat, 120: 519–535.
5. Bolanowski W, Śmiszkiewicz-Skwarska A, Polguj M, Jędrzejewski K (2005) The occurrence of the third trochanter and its correlation to certain anthropometric parameters of human femur. Folia Morphol, 64: 168–175.
6. Boopathi S, Chakravarthy Marx S, Dhalapathy S, Anupa S (2010) Anthropometric analysis of the infraorbital foramen in South Indian population. Singapore Med J, 51: 730–735.
7. Bosenberg AT, Kimble FW (1995) Infraorbital nerve block in neonates for cleft lip repair: anatomical study and clinical application. Br J Anaesth, 74: 506–508.
8. Brandao FH, Carvalho de S.Machado MR, Evandro P. de Aquino J, Gaia Coelho Junior R, Honorio de Paula Pereira S, Pereira Fabi R (2008) The Foramen and Infraorbital nerve relating to the Surgery for External Access to the Maxillary Sinus (CALDWELL-LUC). Intl Arch Otorhinolaryngol, 12: 342–346.
9. Bressan C, Geuna S, Malerba G, Giacobini G, Giordano M, Robecchi MG, Vercellino V (2004) Descriptive and topographic anatomy of the accessory infraorbital foramen. clinical implications in maxillary surgery. Minerva Stomatol, 53: 495–505.
10. Canan S, Asim OM, Okan B, Ozek C, Alper M (1999) Anatomic variations of the infraorbital foramen. Ann Plast Surg, 43: 613–617.
11. Chrcanovic BR, Nogueira MH, Abreu G, Custodio LN (2011) A morphometric analysis of supraorbital and infraorbital foramina relative to surgical landmarks. Surg Radiol Anat, 33: 329–335.
12. Cutright B, Quillopa N, Schubert W (2003) An anthropometric analysis of the key foramina for maxillofacial surgery. J Oral Maxillofac Surg, 61: 354–357.
13. Elias MG, Silva RB, Pimentel MI, Cardoso VTS, Rivello T, Babinski MA (2004) Morphometric analysis of the infraorbital foramen and acessories foraminas in brazilian skulls. Int J Morphol, 22: 273–278.
14. Ghaus F, Faruqi NA (2009) Bilateral variations and sexual dimorphism in morphometric parameters of infraorbital groove, canal and foramen in human foetuses. Int J Morphol, 27: 475–480.

15. Gupta T (2008) Localization of important facial foramina encountered in maxillo-facial surgery. Clin Anat, 21: 633–640.
16. Hindy AM, Abdel-Raouf F (1993) A study of infraorbital foramen, canal and nerve in adult Egypyians. Egypt Dent J, 39: 573–580.
17. Ilayperuma I, Nanayakkara G, Palahepiyiya N (2010) Morphometric analysis of the infraorbital foramen in adult sri lankan skulls. Int J Morphol, 28: 777–782.
18. Karakas P, Bozkir MG, Oguz O (2003) Morphometric measurements from various reference points in the orbit of male Caucasians. Surg Radiol Anat, 24: 358–362.
19. Kazkayasi M, Batay F, Bademci G, Bengi O, Takdemir I (2008) The morphometric and cephalometric study of anterior cranial landmarks for surgery. Minim Invasive Neurosurg, 51: 21–25.
20. Kazkayasi M, Ergin A, Ersoy M, Bengi O, Takdemir I, Elhan A (2001) Certain anatomical relations and the precise morphometry of the infraorbital foramen — canal and groove: an anatomical and cephalometric study. Laryngoscope, 111 (4 Part 1): 609–614.
21. Kazkayasi M, Ergin A, Ersoy M, Tekdemir I, Elhan A (2003) Microscopic anatomy of the infraorbital canal, nerve, and foramen. Otolaryngol Head Neck Surg, 129: 692–697.
22. Kumar AJ, Ravindran C (2011) An anthropometric analysis of the key foramina for maxillofacial surgery in Indian population: a skull study. Res Rev J Dent, 2: 1.
23. Lee UY, Nam sh, Han SH, Choi KN, Kim TJ (2006) Morphological characteristics of the infraorbital foramen and infraorbital canal using three-dimensional models. Surg Radiol Anat, 28: 115–120.
24. Lopes PTC, Pereira GAM, Santos AMPV, Freitas CR, Abreu BRR, Malafaia AC (2009) Morphometric analysis of the infraorbital foramen related to gender and laterality in dry skulls of adult individuals in southern Brazil. Braz J Morphol Sci, 26:19–22.
25. Macedo VC, Cabrini RR, Faig-Leite H (2009) Infraorbital foramen location in dry human skulls. Braz J Morphol Sci, 26: 35–38.
26. Malinowski A, Bożiłow W (1997) Podstawy antropometrii (metody, techniki, normy). PWN, Łódź.
27. Malinowski A, Wolański N (1988) Metody badań w biologii człowieka. Wybór metod antropologicznych. PWN, Warszawa.
28. Polguj M, Jędrzejewski K, Podgórski M, Topol M (2011) Correlation between morphometry of the suprascapular notch and anthropometric measurements of the scapula. Folia Morphol, 70: 109–115.
29. Rahman M, Richter EO, Osawa S, Rhoton AL (2009) Anatomic study of the infraorbital foramen for radiofrequency neurotomy of the infraorbital nerve. Neurosurgery, 64 (suppl. 5): 423–427.
30. Singh R (2011) Morphometric analysis of infraorbital foramen in Indian dry skulls. Anat Cell Biol, 44: 79–83.
31. Sitek A, Szkudlarek A, Antoszewski B (2007) Secular changes in the physical development of student sof the Medical University of Lodz. Folia Morphol, 66: 62–68.
32. Song WC, Kim SH, Paik DJ, Han SH, Hu KS, Kim HJ, Koh KS (2007) Location of the infraorbital and mental foramen with reference to the soft-tissue landmarks. Plast Reconstr Surg, 120: 1343–1347.
33. Takahashi Y, Kakizaki H, Nakano T (2011) Infraorbital foramen: horizontal location in relation to ala Nasi. Anat Physiol, 27: 295–297.
34. Tezer M, Ozturk A, Akgul M, Gayretli O, Kale A (2011) Anatomic and morphometric features of the accessory infraorbital foramen. J Morphol Sci, 28: 95–97.
35. Wilhelmi BJ, Mowlavi A, Neumeister MW, Blackwell SJ (2003) Facial fracture approaches with landmark ratios to predict the location of the infraorbital and supraorbital nerves: an anatomic study. J Craniofac Surg, 14: 473–477.