MORPHOMETRIC ANALYSIS AND CLINICAL PERSPECTIVE OF THE PERIORBITAL REGION IN A NORTHERN PAKISTANI POPULATION

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ABSTRACT

Objective: Anesthetizing the face by periorbital nerve block during periorbital and facial surgery requires precise knowledge of the location and variations of the periorbital foramina.

Material and Methods: Human skulls of unknown age and sex were examined from which the location, size, shape and position of the periorbital foramina with respect to the maxillary teeth were determined. Parameters determined were the dimensions of the supraorbital foramen (SOF), supraorbital notch (SON), infraorbital foramen (IOF), frontal foramen (FF) and frontal notch (FN),and the distances of these landmarks from the nasal midline (NM), angulus oculi medialis (AOM), temporal crest of the frontal bone, pyriform aperture and zygomaticomaxillary suture. In addition the distances between the FF or FN and supraorbital notch SON or SOF were also determined, as well as the angle between a line passing from the anterior nasal spine to the IOF and the horizontal plane (goniometric angle).

Results: No difference in the size, shape or location of the SOF/SON, IOF, FF/FN between the left and right sides was observed; however there was a significant difference between the right and left IOF-NM distance ($p=0.001$). Accessory SOFs, IOFs and FFs were observed on both sides. The vertical orientation of the SON and FF/FN were mainly above the canine, while the IOF was abovethe 2nd premolar.

Conclusion: There is no difference in the size, shape and location of the right and left SOF and SON in a Northern Pakistani population. However, the right and left IOF-NM distance in this Northern Pakistani population were significantly different ($p=0.001$).

Key Words: Supraorbital foramen, supraorbital notch, infraorbital foramen, frontal foramen, frontal notch, skull.

INTRODUCTION

The forehead can be anesthetized by infiltration of the supraorbital nerve: similarly infraorbital nerve block is used to anesthetize the cheek. It is therefore important to know the location of these foramina to avoid damage to the neurovascular bundles they transmit.

The supraorbital nerve (lateral branch) runs through supraorbital notch/foramen (SON/SOF) to provide cutaneous innervation to the scalp and forehead[1]. In clinical settings the SON/SOF is not always palpable: consequently the upper margin of the supraorbital rim is considered an alternate anatomical landmark for supraorbital nerve block[2]. A supraorbital nerve block is commonly performed in the SOF region during surgical procedures such as facial wound closure, biopsies and scar revisions[3].

The infraorbital nerve provides sensory innervation to the upper aspect of the face, mucosa of themaxillary sinus, the maxillary incisor, canine and premolar teeth and adjacent gum, the lower eyelid skin and conjunctiva, part of the nasal vestibule and skin and mucosa of the upper lip[4]. The infraorbital foramen (IOF) is an important landmark to facilitate surgical, local anesthetic and other invasive procedures in maxillofacial surgery. It is therefore important to have a sound knowledge of regional anatomy of the IOF to avoid injury to the neurovascular bundle passing through it[5].

The frontal nerve (medial branch of the supraorbital nerve) emerges from the frontal notch/foramen (FN/FF) and is sensory to the upper eyelid, conjunctiva and forehead[6].

Periorbital foramina are important anatomical landmarks to facilitate surgery with respect to trauma, tumors, inflammation and infection, as well as for aesthetic procedures[7]. The location of reference points in the periorbital region is important for local anesthesia as well as in neurological, ophthalmic, maxillofacial and plastic surgery[8]. Modern surgical procedures, anesthesia and acupuncture also require a precise understanding of the surrounding anatomy[9].

The periorbital region surrounding the upper face is known to be an aesthetic center of the face. This area is clinically important as there might be aesthetic and medical problems related to this region[10]. Therefore, the main aim of this study was to collect morphometric data

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related to periorbital foramina in a Pakistani population which would be useful in locating these foramina to avoid damaging their contents.

MATERIAL AND METHODS

This study was conducted on 126 human skulls of unknown age and gender from anatomy departments of ten medical schools of Khyber Pakhtunkhwa Pakistan. The parameters determined were: supraorbital foramen length, width and transverse diameter, distance from the supraorbital notch and foramencenter to the nasal midline, angulus oculi medialis and temporal crest of the frontal bone (Figure 1); length and width of the infraorbital foramen, distance from the infraorbital foramen center to the nasal mid-line, pyriform aperture, zygomaticomaxillary suture and infraorbital margin; frontal foramen length and width, frontal foramen and notch center to the nasal mid-line, angulus oculi medialis, supraorbital notch and supraorbital foramen. Distances were measured using standard a digital caliper micrometer (eSecure® UK). The angle (goniometric angle) between a line passing between the anterior nasal spineand infraorbital foramen and the horizontal plane[22] was measured using a standard goniometer. Evaluation of data entry into an Excel spreadsheet was performed using validity checks. Following data entry the data was exported to Minitab® version 17 (Minitab corporation Illinois, USA) for analysis. Right and left side distances were compared using paired sample t-tests.

RESULTS

The supraorbital foramen (SOF) was present on the right and left sides in 64.5% and 66.1% of the population studied: it was mainly oval (41.7% right, 51.9% left) and situated above the first premolar (24.4% right, 21.2% left). Accessory SOFs (ASOF) were present on both sides (15.7% right, 20.4% left) being mainly oval (10.2% right, 14.9% left). No significant difference was found between the right and left side SOF length, width and the distances to various anatomical landmarks (Table 1). Similarly, no significant difference was observed in the mean length and width of right and left side ASOFs (Table 1). The shape of the right and left ASOF was oval (68.4% right, 70.37% left) or round (31.6% right, 29.6% left). Vertical orientation was mainly over the 2nd premolar on the right (8/20) and 1st (8/26) or 2nd premolar (7/26) on the left.

A supraorbital notch (SON) was present in 73.2% of skulls on both sides, mainly above the canine (30.7% right and left) and first premolar (37% right and left). The means and associated standard deviations of the distances from the supraorbital notch were: SON-TD (5.2 ± 6.8 mm right, 4.3 ± 7.4 mm left), SON-NM (24.3 ± 20.9 mm right, 23.83 ± 14.7 mm left), SON-AOM (12.3 ± 13.9 mm right, 12.3 ± 9.6 mm left), SON-TOF (29.4 ± 17.9 mm right, 29.8 ± 16.5 mm left) with no significant difference observed between the sides (Figure 2).

The infraorbital foramen (IOF) was mainly oval (55.6% right, 62.7% left) situated above the second premolar (43.7% right,46.0% left) (Figure 3). The means and associated standard deviations for the right and left goniometric angles were 33.9 ± 2.9° and 34.1 ± 2.8°, respectively. The distances measured from the IOF are presented in Figure 4, which shows a significant difference between the right and left IOF-NM ($p=0.001$). Accessory infraorbital foramen was observed on both sides, being mainly round (6% right, 3.9% left).

A frontal notch (FN) was present in 47.6% (right) and 56.3% (left) of skulls located above the canines (31.7% right, 37.3% left), incisors (0.79% right, 4.76% left), first premolar (1.58% right, 2.38% left), and between the incisor and canine (1.58% right, 0.79% left). The means and associated standard deviations for right and left side distances from the FN to the NM were 18.33 ± 2.98 mm (right) and 17.97 ± 2.55 mm (left), AOM 7.78 ± 2.9 mm (right) and 7.05 ± 2.76 mm (left), SON 7.65 ± 2.12 mm (right) and 8.08 ± 2.81 mm (left), SOF 10.84 ± 3.40 mm (right) and 11.82 ± 4.09 mm (left). A frontal foramen (FF) was present in 32.5% (right) and 25.3% (left) of skulls situated above the canines (16.6%

Table 1: Parameters and distances (mm) of related the right and left supraorbital and accessory supraorbital foramen

Parameter	Right side	Left side	p-value
	Mean (SD)	Mean (SD)	
SOF-length	1.39 (0.66)	1.30 (0.69)	0.689
SOF-width	2.14 (1.07)	2.13 (1.10)	0.428
SOF-NM	29.51 (4.59)	28.73 (5.35)	0.121
SOF-AOM	17.48 (4.44)	17.10(4.304)	0.188
SOF-TOF	25.34 (5.45)	25.81 (4.94)	0.323
ASOF Lengthen	0.93 (0.57)	0.93 (0.54)	1.000
ASOF width	1.39 (0.76)	1.30 (0.36)	0.482

Key: SOF-NM, Supraorbital foramen-nasal midline; SOF-AOM, Supraorbital foramen-angulus oculi medialis; SOF-TOF, Supraorbital foramen-temporal crest of frontal bone; ASOF, Accessory supraorbital foramen; SD, standard deviation; NM, nasal midline; AOM, angulus oculi medialis; TOF, temporal crest of the frontal bone.

Figure 1: Distance measured from supraorbital fissure to the temporal crest of the frontal bone.

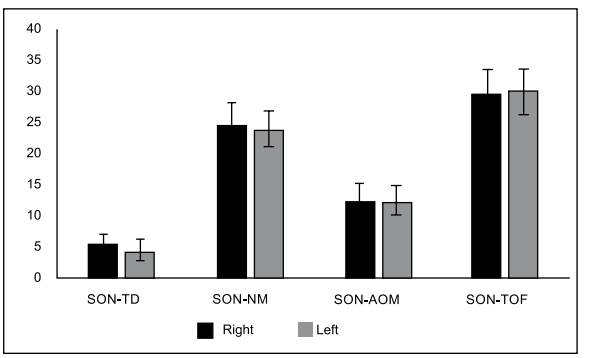

Figure 2. : Comparison of the supraorbital notch transverse diameter (SON-TD), the distance between the supraorbital notch and nasal mid-line (SON-NM), angulus oculi medialis (SON-AOM) and the temporal crest of the frontal bone (SON-TOF) on the left and right sides.

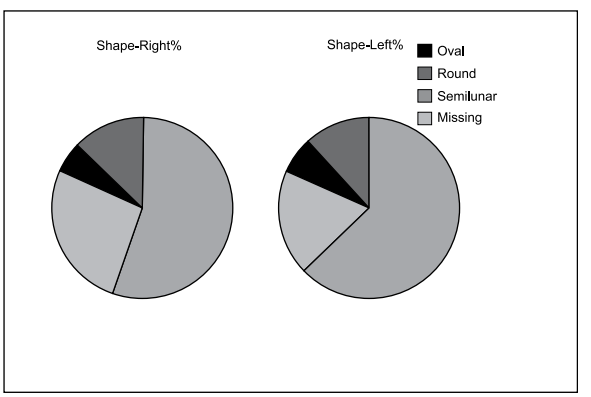

Figure 3: Comparison of the shape of infraorbital foramen on the right and left sides.

right, 15.07% left) and were mainly round (18.25% right, 12.69% left). Distances from the frontal foramen to the

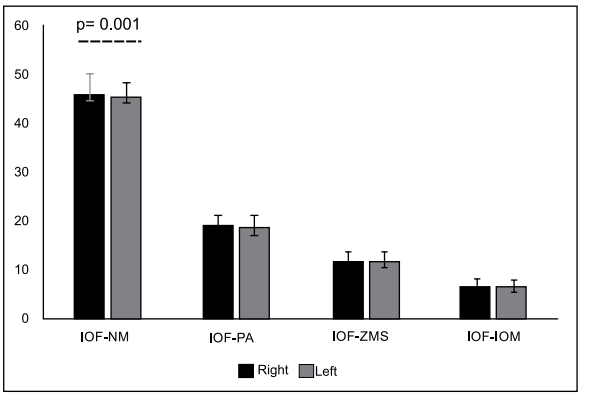

Figure 4. : Comparison of the distance between infraorbital foramen to nasal mid-line (IOF-NM), pyriform aperture (IOF-PA), zygomatic maxillary suture (IOF-ZMS) and infraorbital margin (IOF-IOM) on the right and left sides.

NM were 18.11 ± 4.01 mm (right) and 17.67 ± 3.32 mm (left), AOM 12.31 ± 3.02 mm (right) and 12.29 ± 3.48 mm (left), SON 10.37 ± 3.86 mm (right) and 10.23 ± 2.44 mm (left) and SOF 12.96 ± 6.30mm (right) and 14.29 ± 5.60 mm (left). No significant difference was found between the two sides. Accessory FF were observed on the right and left in 3.96% and 5.55% of skulls respectively.

DISCUSSION

In the current study, undertaken on skulls of the same race, an SON was present in 73.2%, similar to the 69.9% observed by Chung et alin Mongoloid skulls[11]. The mean distance of the SON/SOF to the nasal mid-line was greater than reported in South Indian skulls by Ashwini et al[3]; the SOF-AOM and SON-AOM distances were also greater than reported by Saylam et al[6]. The SOF/SON-TOF distance supports the observations of Boyan et al[22] in Turkish Anatolian skulls. The transverse diameters of the were 5.2 mm on the right and 4.3 mm on the left, not too dissimilar to llayperuma et al[12] in Sri Lankan skulls (Australoid race) which were 4.52 ± 1.80 mm on the right and 4.31 ± 1.62 mm on the left side. The mean SOF length and width were less than reported in a Negroid population in South Nigeria by Osunwoke et al[13], even though they presented values for males and females for both the right and left sides. The vertical orientation of the SOF was above the 1st premolar similar to Boyan et al[22]. However accessory SOFs on both sides were larger than those reported by Boyan et al[22], which were 8.9% and 6.7% on the right and left sides respectively.

The IOF were mainly oval (55.6% on the right and62.7% on the left), which is similar to Boopathi et al[14] for the right, (55%), but greater than on the left (51.25%) in South Indians. They were situated mainly above the second premolar, similar to both Swaminathanet al[16] (Dravidian population) and Ukoha et al[16] (Negroid population). The IOF-PA distance was similar to those reportedby Ukoha et al[16] (19.36 ± 3.54 mm on the right

and 18.27 ± 2.94 mm on the left). In the current study the mean length and width of the IOF were greater than reported in South Indian skulls (Shaik et al[17]. Length 2.98 ± 0.69 mm, width 2.89 ± 0.71 mm). Similarly, the goniometric angles were greater than those reported by Agthong et al[18] in a Siamese population in Thailand (25.1° and 26.8°). An accessory IOF was less common than the 19.1% reported in Indian population by Janghu et al[19]. The IOF-NM and IOF-ZMS distances were greater, while IOF-IOM distance was smaller than observed by Boyan et al[22].

The FN-NM and FF-NM distances were less than reported by Beer et al[20] in European skulls (Austrian and German), while the FN-AOM and FF-AOM were greater than observed by Saylam et al[6] at 7.78 ± 2.9 mm and 7.05 ± 2.76 mm FN-AOM) and 12.31 ± 3.02 mm and 12.29 ± 3.48 mm (FF-AOM). Furthermore, the FN-SON, FN-SOF, FF-SON and FF-SOF distances were greater than reported by Webster et al[21]. FNs were present in 47.6% (right) and 56.3% (left) and FFs in 32.5% (right) and 25.3% (left) of skulls, being much less than in Boyan et al[22], who observedan FN in 96.3% and an FF in 80.8%. However, in agreement with Boyan et al[22] the FN/FF were mainly located above the canine.

CONCLUSION

There is no difference in the size, shape and location of the right and left SOF and SON in a Northern Pakistani population. Similarly, no differences in right and left FF and FN were observed, with accessory FF being observed on both sides. However, the right and left IOF-NM distance in this Northern Pakistani population were significantly different (p=0.001). The data presented in the current study is important in the planning of operative procedures involving the periorbital region in the population investigated.

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