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Anatomy

ZYGOMATICO-FACIAL AND ZYGOMATICO -ORBITAL FORAMINA: MORPHOLOGICAL STUDY IN DRY ADULT HUMAN SKULLS

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ABSTRACT

Background: The zygomatico-facial and zygomatico-orbtial foramina are traversed by branches of trigeminal nerve which is responsible for sensory perception of head and neck. This study was done to quantify the variations of these foramina for better surgical outcome.

Methods: The cross sectional study was done on dry adult human skulls. The location of these foramina from inferior orbital fissure and zygomatico–frontal suture were measured using vernier calipers(Castroviejo and Sliding).

Results: The types of foramina present in the sample were maximum for type I with 47.30% followed by 34.02% of type II. Type IV foramen was absent. The mean distance from IOF being 1.86 for ZO and 2.26cm for ZF foramina.

Conclusions: The entrapment of trigeminal nerve induces severe pain, during surgeries like, the manipulation of the lateral obital wall and endoscopic subperiosteal facelift procedures, hence its exact location is of value.

KEYWORDS : Trigeminal nerve, zygomatico-facial foramen, zygomatico-orbital foramen.

INTRODUCTION

The human skull is studied in two parts. These are, the neurocranium and the viscerocranium. The neurocranium surrounds the brain, eyes and inner and middle ears. The viscerocranium, which is neural crest derived, consists of fourteen bones. Seven of which form the bony orbit [1].

Each orbital opening is quadrangular with pyramidal shaped cavity. The lateral wall is the thickest wall of the orbit, separating the orbit from the middle cranial fossa. Anteriorly it separates the orbit from the infratemporal fossa.

The lateral orbital wall is triangular in shape, formed by the sphenoid bone posteriorly and zygomatic bone anteriorly [2]. The zygomatic bone contains zygomatico-facial and zygomatico–orbital foramina through which respective nerves traverse. These nerves are branches of the maxillary division of trigeminal nerve which is the fifth cranial nerve giving sensory supply to head and neck region. These nerves when traumatized, causes enormous pain and discomfort to the patient.

The lateral orbital wall is preferred by neurosurgeons for retro-orbital surgeries and other maxillo-facial surgeries. Headaches and temporary or permanent loss of sensation in the area are caused by neurovascular compromise, inappropriate intraneural anesthetics, nerve traction during surgical maneuvers or compression of nerve by scar tissue.

These foramina show variation in number and locatio indicating embryological processes. In adults partially or complete bipartite and tripartite zygomatic bones are not uncommon occurrence [3].

The variation in number, morphology and location of foramina, notches, ossicles and various such features have been used as anthropological marker for differentiating population and races [4].

Figure: Showing zygomatico-facial foramina in dry adult human skull

MATERIALS AND METHOD

The study was conducted in the department of Anatomy, Shri Guru Ram Rai Institute of Medical & Health Sciences (SGRRIM &HS) Patel Nagar, Dehradun over a period of 18 months.

The morphometric study was cross sectional type with sample size of 60 dry adult human skulls which were examined randomly using vernier calipers (Castroviejo and Sliding).

The number and location of ZO and ZF foramina were recorded on each side from inferior orbital fissure and zygomatico–frontal suture using vernier calipers.

The foramina were classified according to their number into following types for simplification.

Type I - one foramen
Type II -two foramina
Type III - three foramina
Type IV - four foramina
Type V - zero foramina

After examination, images of specimen were recorded. The data collected was analyzed using Descriptive or Exploratory Analysis. The data collected was analyzed under following categories

- Percentage distribution of type of foramina present in sample.
- Mean distance of foramina from inferior orbital fissure (IOF).
- Mean distance of foramina from zygomatico-frontal suture (ZFS).

RESULTS

The types of foramina present in the sample were maximum for type I with 47.30% followed by 34.02% of type II, 10.37% of type V and 8.30%type III foramina. Type IV foramina was found to be absent (Table 1).

Table 1: Type of Foramina present in the sample.

Type of foramina	No.	Percent
Type I	114	47.30
Type II	82	34.02
Type III	20	8.30
Type IV	0	0
Type V	25	10.37

The mean distance of ZO foramina from IOF on right and left side was observed to be 1.88cm and 1.85cm with a SD of 0.63. ZF foramina from IOF were seen to be 2.27cm and 2.26cm with a SD of 0.41 respectively. On an average mean distance being 2.04cm with SD+/-0.56 from IOF (Table 2).

Table 2: Mean distance of foramina from IOF

Foramina	Mean distance from IOF	No. of foramina from IOF	SD
ZOR	1.88	93	0.63
ZFR	2.27	76	0.41
ZOL	1.85	96	0.61
ZFL	2.26	73	0.37

The mean distance of ZO foramina from ZFS on right and left side was measured to be 2.26 cm and 2.31 cm respectively with a SD of +/- 0.49. The mean distance of ZF foramina was found to be 2.46 cm and 2.56 cm respectively with SD of +/- 0.75. The above data has been tabulated in (Table 3). The majority of specimens had more than one type of foramina.

Table 3: Mean distance of foramina from ZFS

Foramina	Mean distance	No.	SD
ZOR	2.26	93	0.49
ZFR	2.46	76	0.62
ZOL	2.31	96	0.49
ZFL	2.51	73	0.75
All Groups	2.39	338	0.60

DISCUSSION

The zygomatic foramina (ZO and ZF), which serve as exit sites for respective terminal maxillary nerve branches, have been reported as important landmarks used by neurosurgeons, plastic surgeons and oral and maxillofacial surgeons in osteotomies across the zygoma as stated by Chanda & Nanda, 2002;[5] Gonzalez et al., 2002[6].

In case of both ZO and ZF foramina, the presence of one foramen was most common (47%) and no specimens were noted with four ZT foramina. The variation of the ZF foramen was also reported by Martins et al. 2003. In their study, a single ZF foramen was reported in 50% of the specimens, while the frequencies of two, three, four and zero foramina were reported as 25%, 0.04%, 0.001% and 21.5%, respectively[7]. However, in the present study the occurrence of zero ZF foramina was approximately double. This discrepancy can be attributed to the different sample sizes used in the studies. A study by Kim et al. 1997 [8], examined the variations of the ZF and ZT foramina in 192 skulls of exclusively Korean descent. The absence of the ZF and ZT foramina were noted as 12.0% and 7.3%, respectively, which is similar to our finding of 10.37% of ZF foramina. This can be attributed to the differences in shape, contour and size of the zygomatic bone, which contributes to the unique facial structures in individuals among all races. It has been observed that the zygomatic bones are larger particularly among individuals of Asian descent, contributing to their more prominent cheekbones, in comparison to those of European decent as stated by Comas, 1960[9] .

The incidence of foramina, is one of a non-metrical variants that are often used by anthropologists as markers in differentiating populations and races as observed by Mangal et al., 2004[10]. Skulls with absent ZF foramina have been reported in archeological sites in Argentina by José et al., 2000[11], while those with double ZF foramina were common in Drimolen, South Africa by Keyser, 2000[12]. This variation in the zygomatic foramina can play potentially important role in different races. Embryological studies by DuBrul, 1988[13] , have reported that the division of the maxillary nerve may occur before entering the zygomatic bone, contributing to ZO, ZF, and ZT foramina and their respective nerves

In Gray's Anatomy there is a dispute concerning the complete absence of the zygomatic nerve, which may lead to the absence of a respective foramen altogether as observed by Williams et al., 1995[14]. In the present study absent foramina were not uncommon. The variation in the number of zygomatic foramina is also linked embryologically to a varying number of ossification centers in zygomatic bone. Although Keibel & Mall, 1910[15] describes only one center while LeDouble, 1906 [16], have reported as many as three, which appear in the 8th week and fuse at approximately 22 weeks of fetal life. The occurrences of multipartite zygomatic bones are common in adults. This can lead to the entrapment of the ZO, ZF and ZT nerves into individual channels within the head mesenchyme, accounting for the variation in frequency of their respective exit foramina in the zygomatic bone Mangal et al., 2004[11] . The zygomatic nerve may pass through the sphenomaxillary or inferior orbital fissure and divide into a temporal and facial branch before entering into the temporal fossa and exiting through a specific foramen, Deaver, 1926 [17]; Huber, 1930 [18].

The location of the ZF foramen is also important during the stabilization of zygomatic fractures for placement of screws above the zygomatico-frontal suture as stated by Zide & Wu, 1990 [19]. Preservation of the ZO, ZF and ZT nerves is important during orbito-facial procedures, to avoid injury to the nerves, which may lead to paresthesia in their area of nerve distribution, as stated by Hwang et al., 2004 [20]. Entrapment of this nerve has been reported to induce protracted pain, which can occur during the manipulation of the orbital lateral wall and endoscopic subperiosteal facelift procedures, as reported by Ramirez, 1996 [21].

CONCLUSION

Understanding human anatomy for various therapeutic and preventive measures is vital. The location and number of zygomatic foramina discussed in the study are important for various surgical procedures involving zygomatic bone. The zygomatic foramina are used as landmark in surgical procedures as pointed out by Hollier et al 2003 [22]. Thus proper localization of the ZF and ZO nerves can greatly minimize such side-effects. We suggest study on larger sample size on subjects of diverse geographical areas for its anthropological evaluation.

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