

## Variations in the Form of the Inferior Orbital Fissure

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The inferior orbital fissure is a gaping cleft which extends from the temporal fossae to the orbital cavity through which the orbit communicates with the temporal, infratemporal, and pterygopalatine fossae. The outline of the IOF could be linear, narrow, moderate or wide or it may have the form of a narrow or moderate slit with a greatly enlarged lateral extremity. So, the aim of the present study was to investigate the outline of the IOF and to assess the sexual and bilateral differences of its distribution.

It was found that the outline of the IOF most commonly ranged from a narrow to a moderately wide slit as the rounded IOF was relatively rare. In most of the cases the rounded IOF was observed bilaterally, as the unilateral rounded IOF was found in few cases only on the left side. There were no significant bilateral or intergroup differences.

*Key words:* inferior orbital fissure; sphenomaxillary fissure; cranial series.

### Introduction

The inferior orbital (sphenomaxillary) fissure is a gaping cleft which extends from the temporal fossae to the orbital cavity [4]. The inferior orbital fissure (IOF) is bounded superiorly by the lower border of the orbital surface of the great wing of the sphenoid bone. Inferiorly, IOF is enclosed by the lateral border of the orbital surface of the maxilla and the orbital process of the palatine bone. Laterally, the IOF borders on a small part of the zygomatic bone and medially IOF joins at right angles with the pterygomaxillary fissure. Through the IOF the orbit communicates with the temporal, infratemporal, and pterygopalatine fossae. The fissure transmits the maxillary nerve and its zygomatic branch, the infraorbital vessels, the ascending branches from the sphenopalatine ganglion, and a vein which connects the inferior ophthalmic vein with the pterygoid venous plexus [3]. The IOF serves as an important anatomic landmark during endonasal endoscopic approaches to the skull base and orbit [1].

It was reported that the outline of the IOF could be linear, narrow, moderate or wide or it may have the form of a narrow or moderate slit with a greatly enlarged lateral extremity [8]. Thus, the aim of the present study was to investigate the outline of the IOF and to ascertain whether there were significant bilateral and sexual differences.

## Materials and Methods

The study was performed on a total of 438 adult skulls from both sexes. The skulls were grouped into three series: a contemporary male series (CMS), a medieval male series (MMS) and a medieval female series (MFS). The CMS consisted of 198 skulls from the Military Mausoleum with Ossuary, National Museum of Military History (Bulgaria). The MMS (122 skulls) and MFS (118 skulls) were part of the osteological collection of the Institute of Experimental Morphology, Pathology and Anthropology with Museum, Bulgarian Academy of Sciences. The age and sex of the individuals from the medieval series were previously determined.

The form of the IOF was macroscopically observed on both sides using the criteria suggested by Movsesyan et al. [11], i.e. slit (**Fig. 1a**) or rounded IOF (**Figs. 1b, c**). We preferred to use these simplified criteria to reduce the subjectivity in accounting of



**Fig. 1.** Forms of the inferior orbital fissure: a) bilaterally narrow inferior orbital fissure in a skull from the medieval male series; b) bilaterally rounded inferior orbital fissure in a skull from the contemporary male series; c) bilaterally rounded inferior orbital fissure in a skull from the medieval male series

the numerous borderline cases between the forms suggested by Wood-Jones [8]. The statistical significance of the bilateral and intergroup (CMS-MMS and MMS-MFS) differences in the IOF outline was assessed by chi-square ( $\chi^2$ ) test at  $p < 0.05$ .

## Results

The results showed that among the three investigated series the outline of the IOF ranged predominantly from a narrow to a moderately wide slit. The rounded IOF was relatively rare. Among the CMS, rounded form of IOF was observed in total of 20 (10.10%) cases: 9 (4.55%) on the right side and 11 (5.56%) on the left one. Out of them, IOF was found to be rounded bilaterally in 9 (4.54%) cases and unilaterally in only 2 (1.01%) cases on the left side.

Among the MMS, the IOF was observed to be rounded in 6 (4.92%) cases: by 3 (2.46%) for each side, as all of them were accounted only bilaterally.

The MFS showed a rounded IOF in a total of 4 (3.39%) cases: 1 (0.85%) on the right side and 3 (2.54%) on the left one. The rounded IOF was observed unilaterally in 2 (1.69%) cases on the left side and bilaterally in only 1 (0.85%) case.

There were not established statistically significant bilateral or intergroup (CMS-MMS, MMS-MFS) differences in the form of the IOF.

## Discussion

In comparative aspect, the IOF in human and the higher mammals represents the wide communication between the orbit and the temporal fossa found in lower vertebrates [7]. According to Duckworth [2], among the Hominoids the IOF is more commonly reduced and narrower. In the Gibbon, the IOF is widely open and the infraorbital suture does not persist on the facial aspect, while in the Orang-utan it is a mere cleft of small dimensions as the infraorbital suture rarely persists long on the facial surface. In the Chimpanzee, the IOF is reduced to a narrow cleft as well. The IOF in the Gorilla is much narrowed and sometimes the malar bone does not provide the end-boundary of the fissure and then a sphenomaxillary suture occurs. In human the IOF is typically wider. In this respect, the human skull showed a more primitive feature compared to the other Hominoids, which are highly specialized and possess a narrower IOF [2].

Ontogenetically, the width of the IOF depends on the development of the maxillary sinus [5], thus the IOF is relatively large and wide in fetuses and infants [6, 7]. Furthermore, the IOF is relatively larger in the aged due to absorption of its bony margins. Either from this cause or from mal-development, the anterior end of the IOF may be abnormally large and encroach upon the lateral wall of the orbit [7].

An investigation performed by Wood-Jones [9] showed that among Hawaiian skulls from both sexes (n = 100), the IOF was narrower compared to that considered as normal in the European skull in 45% of cases and conformed to the type usual in Europeans in 15%. However, we could not find any data concerning the outline of the IOF among the different racial types. Nevertheless, according to Wood-Jones [9] the IOF in Hawaiian was wider than the normal in 15% and in 25%, although the medial portion and upper extremity of the fissure were unduly narrow, the lower lateral termination was expanded into a well-marked, often recurved, rounded dilatation. In addition, the forms for both sexes showed exact equality.

Another investigation of Wood-Jones [10] among the skulls of prehistoric inhabitants of Guam (n = 92) showed that the IOF was narrower than the European normal one in 59%. It was of normal width in 32%, wider than the average in only 2% and of the narrower type but with expanded extremity in 7%.

Our results were not exactly comparable to those of Wood-Jones [9, 10], but it could be inferred that among the investigated cranial series the outline of the IOF most commonly ranged from a narrow to a moderately wide slit and the rounded IOF was a relatively rare finding. Furthermore, in most of the cases the rounded IOF was observed bilaterally, as in few cases it was found unilaterally only on the left side. There were not established significant bilateral or intergroup (CMS-MMS; MMS-MFS) differences.

The knowledge of IOF morphology is not only of scientific interest, but it is of practical importance for both neurosurgeons and otolaryngologists who navigate in the region [1]. Obviously, further precise morphometric investigations of the IOF are necessary for a more detailed examination of its anatomy and outline.

## Conclusion

Most commonly the outline of the IOF ranged from a narrow to a moderately wide slit as the rounded IOF was a relatively rare finding. In most of the cases the rounded IOF was observed bilaterally and only in few cases it was found unilaterally on the left side. There were no significant bilateral or intergroup differences.

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