Original Article

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Anatomy Section

Morphometric Dimensions of Superior Orbital Fissure: A Cross-sectional Study

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ABSTRACT

Introduction: Superior Orbital Fissure (SOF) is located between the roof and lateral wall of the orbit. SOF exhibits complex anatomy because of abundant neurovascular structures running through or near it and it connects the orbit with cranial cavity. Variant anatomy, in terms of morphology of SOF is well documented in literature, but data regarding morphometrical study of SOF is limited.

Aim: To provide a baseline data on morphometry of SOF.

Materials and Methods: A cross-sectional study was conducted from April 2010 to September 2010, on 60 SOF in 30 dry adult human skulls of unknown age and sex collected from Government Medical College, Amritsar, Punjab, India. A Vernier caliper with least count of 0.02 mm, a large scale with least count of 1 mm, a divider and probes were used to measure maximum anteroposterior and transverse diameters of parts of SOF, and distance from spina-rectalis to anterior and posterior end of SOF. Data was collected on right and left-sides and mean with standard deviation and range of measurements and p-value were calculated.

Results: A total of 60 SOFs were analysed from 30 adult human skulls. Maximum anteroposterior diameter of inferomedial part was 6.335±1.56 mm on right-side and 5.81±1.34 mm on left-side. Maximum transverse diameter of inferomedial part was 5.82±1.69 mm on right-side and 5.19±2.04 mm on left-side. Maximum anteroposterior diameter of superolateral part was 10.59±2.48 mm and 11.32±2.09 mm on right and left-side, respectively. Maximum transverse diameter of superolateral part was 3.57±0.82 mm and 3.68±1.23 mm. Distance of spina-rectalis from anterior end was 8.37±2.42 mm and 8.03±2.59 mm on right and left-sides. Distance of spina-rectalis from posterior end was 9.39±2.59 mm and 10.62±3.41 mm.

Conclusion: Mean of different diameters on right and left-side were compared to each other and it was found, that, there was no statistically significant difference.

Keywords: Compression, Maximum anteroposterior diameter, Maximum transverse diameter, Neurovascular structures

INTRODUCTION

A detailed knowledge of orbit and relationship of orbital structures with each other is imperative for surgeons in recent medical advancements. Now-a-days orbital anatomy is addressed with emphasis on procedures and clinical applications in otolaryngology [1]. SOF has a complex anatomy because of abundant neurovascular structures running through or near it and there are many changes in the anatomical relationships of these structures, as they pass from one compartment to another within a very confined space [2].

Superior Orbital Fissure (SOF) also known as sphenoidal fissure lies between the roof and lateral wall of the orbit. It is bounded by lesser wing of sphenoid, greater wings of the sphenoid and frontal bone. It has a wider medial part and narrow lateral part [3]. It connects cranial cavity with the orbit [4]. A bony projection called as spina recti lateralis is present at the lower border of SOF at the junction of wider medial and narrow part, to which lateral rectus muscle and common tendinous ring is attached. This tendinous ring of zinn divides the SOF into three parts- superolateral narrow, intermediate and inferomedial broad part [5]. Shukla A et al., has reported mean length of SOF on right and left-side to be 1.39 mm and 1.4 mm on left and right-side respectively [6].

Govsa F measured distance of SOF from superomedial to superolateral edge of SOF [7]. In another study, mean width of SOF was determined to be 3.7 mm and 3.73 mm on left and right-side, respectively. The author suggested that narrow size of SOF could be a risk factor for SOF syndrome [8]. Though no study has provided data on diameters of superolateral and inferomedial compartments of SOF, hence, present study was conducted to provide the data regarding dimensions of further compartments of SOF.

MATERIALS AND METHODS

The present study was a cross-sectional study conducted on 60 orbits in 30 dry adult human skulls of unknown age and sex over a period of six months from April 2010 to September 2010 collected from Department of Anatomy, Government Medical College, Amritsar, Punjab, India.

Inclusion criteria: All the specimens were observed carefully and only the dentulous skulls complete in all aspects, were included in the study.

Exclusion criteria: Edentulous, damaged, or pathological skull was excluded from the study.

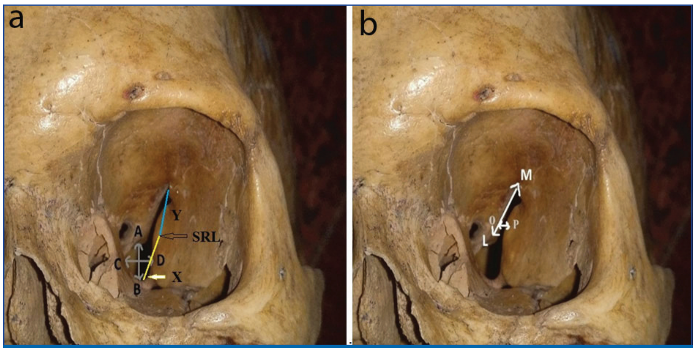
Study Procedure

Superior Orbital Fissure (SOF) were numbered from 1-60 with suffix R (right) and L (left). A Vernier calliper with least count of 0.02 mm, a large scale with least count of 1 mm, a divider and probes were used to measure the morphometric parameters. The following parameters were measured.

Maximum anteroposterior diameter of inferomedial part of SOF, (AB in [Table/Fig-1a]); Maximum transverse diameter of inferomedial part of SOF, (CD in [Table/Fig-1a]); Distance from spina-rectalis to anterior most end of SOF, (X in [Table/Fig-1a]); Distance of spina-rectalis from posterior most end of SOF, (Y in [Table/Fig-1a]); Maximum anteroposterior diameter of superolateral part of SOF, (LM in [Table/Fig-1b]); Maximum transverse diameter of superolateral part of SOF, (OP in [Table/Fig-1b]).

STATISTICAL ANALYSIS

Data was collected on right and left-sides and mean with standard deviation and range of measurements were calculated. An attempt



[Table/Fig-1]: a) Showing: 1. Anteroposterior diameter of inferomedial part (AB), 2. Transverse diameter of inferomedial part (CD), 3. Distance from spina-rectalis to anterior most (X), 4. Distance of spina-rectalis from posterior most end (Y). (SRL-Spina recti lateralis); b) 5. Anteroposterior diameter of superolateral part (LM), 6. Transverse diameter of superolateral part (OP).

was made to find any statistically significant difference in right and left-side by applying Student's t-test using Medcalc software 20.0 version. The p-value less than 0.05 was considered significant.

RESULTS

In the present study, it was found that mean values of anteroposterior diameter of inferomedial part of SOF and distance of spina-rectalis from its anterior end were higher on right-side as compared to the left-side. Whereas anteroposterior diameter of superolateral part of SOF and distance of spina-rectalis from its posterior end were higher on left-side than on right-side. However, on statistical analysis, this difference was found to be insignificant [Table/Fig-2].

Parameter	Mean±SD (mm) (Range)		p-value
	Right	Left	
Maximum anteroposterior diameter of inferomedial part	6.335±1.56 (1-10 mm)	5.81±1.34 (1.1-9 mm)	0.16
Maximum transverse diameter of inferomedial part	5.82±1.69 (0.7-9 mm)	5.19±2.04 (0.8-8 mm)	0.19
Maximum anteroposterior diameter of superolateral part	10.59±2.48 (1.1-13 mm)	11.32±2.09 (1.5-14 mm))	0.22
Maximum transverse diameter of superolateral part	3.57±0.82 (0.6-5 mm)	3.68±1.23 (0.8-6 mm)	0.69
Distance of spina-rectalis from anterior end	8.37±2.42 (1.2-12 mm)	8.03±2.59 (1.5-14 mm)	0.60
Distance of spina-rectalis from posterior end	9.39±2.59 (0.8-12 mm)	10.62±3.41 (0.8-16 mm)	0.12

[Table/Fig-2]: Various metric parameters of Superior Orbital Fissure (SOF).
Student's t-test was applied; SD: Standard Deviation

DISCUSSION

Knowledge regarding morphology and morphometry of SOF is imperative as it allows the surgeons to anticipate the topography for the intraoperative surgeries. Numerous variations in the size and morphology of the SOF have been described in the literature [9-11]. Though a few studies were reported on SOF, but unfortunately no similar study could be traced in accessible literature for comparison.

Raymond J et al., measured length and width of SOF in skulls of adult cadavers and found that some fissures were significantly narrower, and the author explained that position of contents present in SOF varies with it's morphological types [12]. Most of the studies provided data on the shapes of SOF and the dimensions reported were from one end to other end. Burdan F estimated areas of SOF of Caucasian patients using Computed Tomography (CT) scan [13]. Fujiwara T et al., investigated width of SOF using both cadavers and CT scan of orbits [14]. The authors determined the anteroposterior and transverse length of both superolateral and inferomedial parts and then distance of spina-rectalis from anterior and posterior ends which are shown in results which could be more precise and useful for the surgeons operating in this area. The authors could not come across this type of morphometry in previous studies. The advantage in collecting these data is that, this provides information about the course of nerves and vasculature in the SOF [15] and good knowledge regarding structures passing through SOF is helpful for diagnosing and treating lesions at the apex of orbit [11].

In the present study, the authors encountered with asymmetrical dimensions of SOF on both sides which is an important indicator of cranial asymmetry in local population. Asymmetry may be the result of various factors which influence the growth of body in prenatal and postnatal period. In prenatal period, asymmetrical foetal position influences the development of skull and brain [16] and postnatally some pathological states or dietary deficiency affecting mineralisation of bone resulting in cranial asymmetry and it is mainly seen in development of temporal and sphenoid bones [16,17]. Other important factors also include customs, prevalent in each population, which may significantly change the morphology of the skeleton like tying up the selected parts of the body and for the skull, the practice of using a pillow or any other object which supports the head while sleeping is also important [18,19]. Burdan F et al., studied the diameters of SOF and foramina ovale during CT examination of 60 individuals and confirmed skull asymmetry and the author stressed that SOF is an important parameter to know the asymmetrical calvaria in local population [13].

Predisposing factor for SOF syndrome depends on its size. Unusually, narrow SOF can cause compression of nerves and vessels passing through the SOF after trauma or surgery in this region. Pressure builds up due to oedema after injury or surgery led to compression of nerves and vessels with in rigid orbital walls [20]. In case congenital narrowing of SOF, the surgeon should try to avoid excessive pulling of the bone fragment and compression of the orbital tissue during repair of the facial bone fractures [14]. Desai SD and Sreepadma S reported abnormally narrowed SOF by a thin bony fragment resulting in compression of neurovascular structures leading to SOF syndrome. However, no such variation was seen in the present study. But, it is essential to know such variations to understand the underlying cause for the clinical conditions and operate in those areas [21].

The present study was aimed at providing the precise measurements using dried anatomical skulls which could be beneficial to surgeons operating in this area regarding anatomical variations so, that chances of injuries to important neurovascular and muscular structures related to this area could be minimised.

Though SOF transmits important neurovascular structures which can be compressed due to narrowing of the fissure or needed to be approached by surgeons for various clinical conditions. But studies providing normal or aberrant morphometric features are only a few. Thus, the data provided in the present study, will be helpful for planning approach to access the structures passing though it. In addition to this, present study will provide baseline data for the future researchers, intending to do more exploratory researches in this area.

Limitation(s)

Due to dropping number of cadavers in the Department and less availability of intact skulls, the sample size was limited to 30 skulls. For more accuracy, study should be carried on larger sample size.

CONCLUSION(S)

The present study provides information about the course of nerves and vasculature in the SOF which may be of interest for neurosurgeons, ophthalmologists, and radiologists to approach the SOF to prevent inadvertent damage to the intra-orbital structures.

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