

## Morphometric Study of Supra Orbital and Frontal Exits in Skulls of Dharwad and Bijapur Area of South India

Bhat Shivaram<sup>1</sup>, C.H. Shivaram<sup>2</sup>

Department of Anatomy, Yenepoya Medical College, Mangalore, Karnataka, India.

### Abstract

**Introduction:** The supra orbital margin of skull presents supra orbital notch or foramen for the supra orbital nerve and vessels. Similarly medial to that there is frontal notch or foramen which transmits supra trochlear nerve and vessels.

**Purpose:** To study the characteristics and location of the supra orbital and frontal exits in south Indian skulls of Dharwad and Bijapur area and to compare these findings with other previous studies. This study may be useful for clinicians, plastic surgeons, ophthalmologists and acupressure therapists.

**Methods:** The anatomy of the supra orbital exits and frontal exits were studied in 91 number of adult skulls (46 male and 45 female skulls) which are collected from the old graveyard of Dharwad and Bijapur area of South India. These exits may occur as foramina or notches. The characteristics and location of the supra orbital exits and frontal exits were determined. Analysis was performed to compare differences between sexes and both sides. Data was then compared with those of the other previous studies.

**Results:** Supra orbital exits were found in all 182 orbits. Among these, 70(38.5%) were foramina and 112(61.5%) were notches. Frontal foramina were found in 8 of the 182 (4.4%) orbits, 82(45%) showed notches, and 92(50.5%) had no frontal exits. The location of the supra orbital foramina showed a skewed distribution toward the medial aspect of the superior orbital rim. The mean distance between the supra orbital foramina and the nasion is 27.91mm and supra orbital notch is 24.99mm. The mean distance for frontal foramina was 20.38 mm and frontal notch is 19.1 mm. The location of the supra orbital foramen is highly variable in all studied populations.

**Conclusion:** In a significant proportion of South Indian skulls of above mentioned geographic area, the Supra orbital foramina are more lateral in position than supra orbital notches. The location of these exits are similar in both male and female skulls. Extra care should be taken during surgical procedures around this region to avoid damage to the supra orbital nerve and vessels. The nature and location of these exits might be determined radiologically before any procedures.

**Key words:** variations, foramina of skull, supra orbital foramen, supra orbital notch, supra orbital exit, Frontal exit.

### Introduction

The supra orbital margin of skull presents supra orbital notch or foramen for the supra orbital nerve and vessels. Similarly medial to that there is frontal notch or foramen which transmits supra trochlear nerve and vessels. They are quoted as supra orbital exit and frontal exits respectively. Marked anatomic variations occur in these like occurrence, number, form, location, asymmetry. In addition to this accessory foramina may be present.

The aim of present study is to describe the features and location of these exits in the skulls of Dharwad and Bijapur area of South India and to compare with previous studies. There is significant sexual, ethnic and racial variations are seen in the anatomy of human cranium.

### Methods

Total 91 numbers of dried, clean adult human skulls were collected from the anatomy department of Yenepoya Medical College, Mangalore. The exact age, other information regarding the person and mode of death are not known as the skulls were collected from old grave yards of Dharwad and Bijapur areas of Karnataka state of South India to supply to medical colleges and students for study purpose. The sex of the skull was determined by its gross osteological features. The number skulls taken for this study was 46 male and 45 female skulls. The study was conducted in the anatomy department of Yenepoya medical college, Mangalore. Necessary ethical clearance was taken for this study from the institutional ethical committee of Yenepoya Medical College.

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#### Address for correspondence

Dr. Bhat Shivaram. Dept. of Anatomy,  
Yenepoya Medical College, Mangalore, Karnataka, India.  
E mail: bhat\_shivarama@hotmail.com

All the observations and measurements were carefully made by the authors. For each orbit non metric features of these exits like occurrence, number and nature were noted. The location of the supraorbital and frontal exits (foramen/notch) from the facial midline (nasion) was measured. The verniers callipers, steel scale, divider and measuring tape were used as measuring instruments. The statistical analysis was done to compare between sexes and between 2 sides (right and left ), using Microsoft excel spreadsheet. The duplication of supra orbital foramina and accessory foramina were recorded.

## Results

Total of 91 numbers of dried, clean adult human skulls ( 182 orbits) were taken for study. The exact age of the skulls were not determined. The skulls were in good condition without any fractures or defects. The skulls were classified into male and female by its gross osteological features. There were 46 male and 45 female skulls in the collected sample. The adult skulls of both the sexes in good physical condition of the above mentioned geographical area was taken for study. The fractured, mutilated, darkened skulls and skulls of children and adolescents were excluded from this study. The skulls of unknown geographical area were also excluded.

The distribution of both supraorbital and frontal exits on bilaterally is shown in Table – 1. The number of supraorbital notch is 112(61.54%), supraorbital foramen is 70(38.46%), frontal notch is 82(45.05%), frontal foramen is 8(4.4%) and 92 orbits(50.55%) do not have any exits. These values are projected in Chart – 1. The number of notches are more compared to foramina. The Table – 1A and 1B shows observed number of these exits in male and female skulls. The same is projected in Chart – 1A and 1B respectively. Both male and female skulls showed

either supra orbital notch or foramina. The 50% (46/92) orbits of skulls of males and 51% (46/90) orbits of female skulls had no frontal exits.

The location of these exits were determined by measuring the distance from the nasion to the centre of the notch/ foramina. The average distances of two sides are shown in Table – 2(Chart – 2). This chart shows supraorbital foramina are farther away compared to supraorbital notches. The distance value for frontal foramina on the right side was more compared to left side, where as on the other hand for frontal notches there is no much comparison. The average distance of the exits ( foramina and notches ) are presented in Table – 2A ( Chart – 2A ). The table – 3(Chart – 3) shows comparison between sexes on right side. As per the table the distances of these exits are similar to previous chart, with higher values for supra orbital foramina in both the sexes. Table – 4 (Chart – 4) shows no significant variation in distance for frontal exits between sexes on left side. The supra orbital notch has slight distance variation, where as for supra orbital foramen the distance is more in males than females.

On over all observation, with lateral shift of location of supraorbital exits, correspondingly there is lateral shift of frontal exits from nasion. There is asymmetry between right and left sides in the location of these exits. The percentage of occurrence of supra orbital and frontal notches are more. The presence of foramina results in shift of course of the neurovascular bundles away from supra orbital margin. In one skull there was duplication of supra orbital foramen on left side. In 1 skull with duplication, there were both supraorbital foramen and supraorbital notch on left side orbit. Accessory foramen was found in 2 of the skulls on left side orbit.

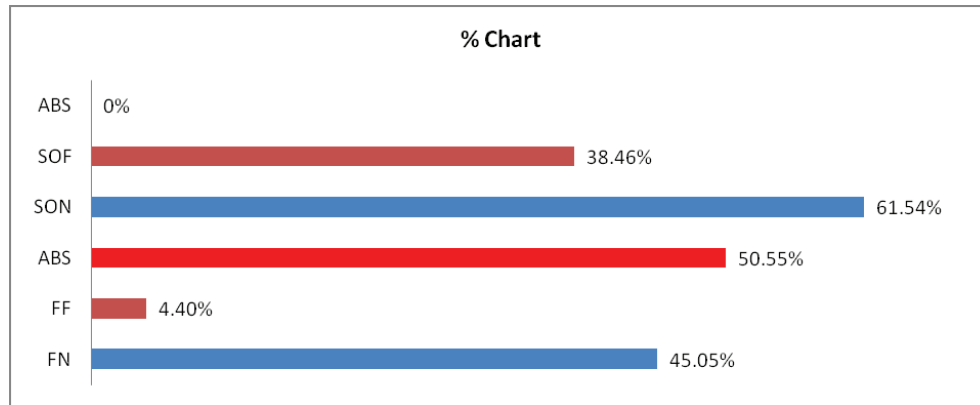
Key to Chart 1.

FN-Frontal notch, FF- Frontal foramina, SON- Supraorbital notch, SOF- Supraorbital foramina, ABS-Absent

**Table 1. Distribution of supra-orbital and frontal exits.**

Total number of Exits	Number of Notch (%)	Number of Foramina (%)	Absent (%)
Frontal-182	82 (45.05%)	8 (4.40%)	92 (50.55%)
Supraorbital-182	112 (61.54%)	70 (38.46%)	0 (0%)

**Chart 1. Graphic representation of distribution of supra-orbital and frontal exits.**



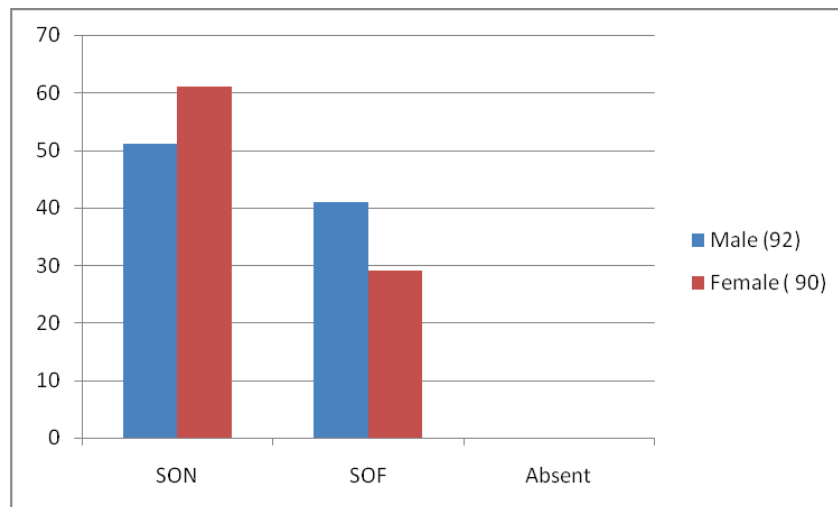
**Key to Chart 1.**

**FN-Frontal notch, FF- Frontal foramina, SON-Supraorbital notch, SOF- Supraorbital foramina, ABS-Absent**

**Table 1A. Number of Supra orbital Notches and Foramina (SON/ SOF).**

Orbits - Total	SON	SOF	Absent
Male (92)	51	41	0
Female (90)	61	29	0

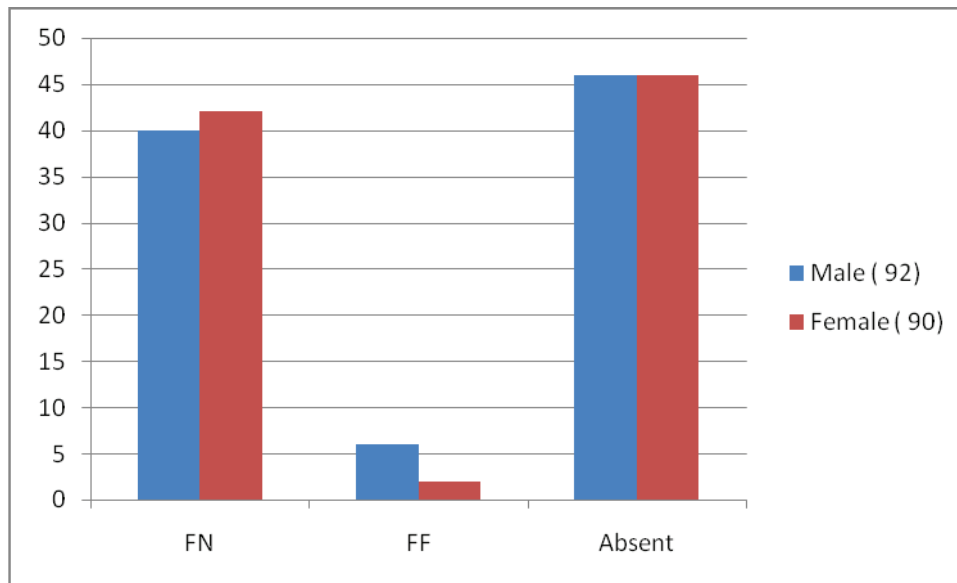
**Chart 1 A. Distribution of Supra orbital notches and foramina**



**Table 1B. Number of Frontal Notches and Foramina ( FN/ FF).**

Total - Total	FN	FF	Absent
Male ( 92)	40	06	46
Female ( 90)	42	02	46

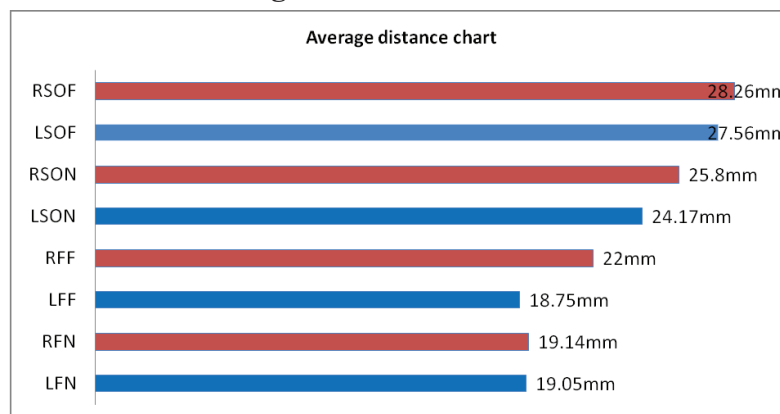
**Chart – 1B. Distribution of Frontal Notches and Foramina ( FN/ FF).**



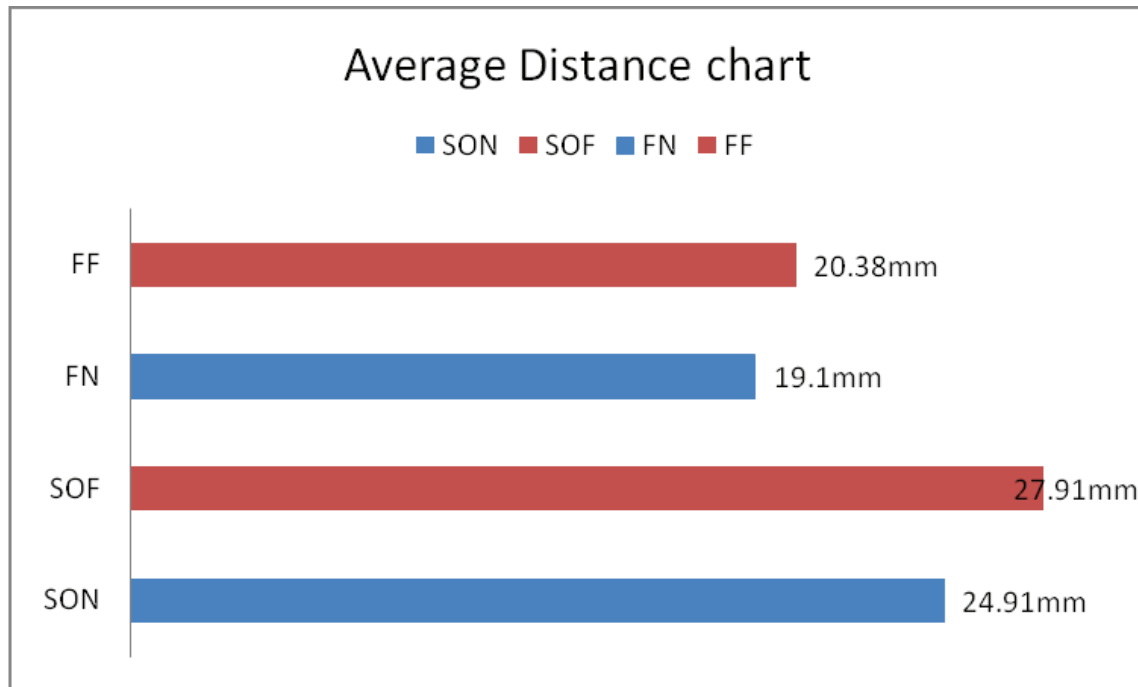
**Table 2. Average distance from the nasion to the centre of notch / foramina**

Exits	Frontal notch ( FN )	Frontal foramina ( FF )	Supra orbital notch ( SON )	Supra orbital foramina ( SOF)
Right ( R)	19.14 mm	22 mm	25.8 mm	28.26 mm
Left ( L)	19.05 mm	18.75 mm	24.17 mm	27.56 mm

**Chart 2. Graphic representation of average distance from the nasion to the centre of notch / foramina**



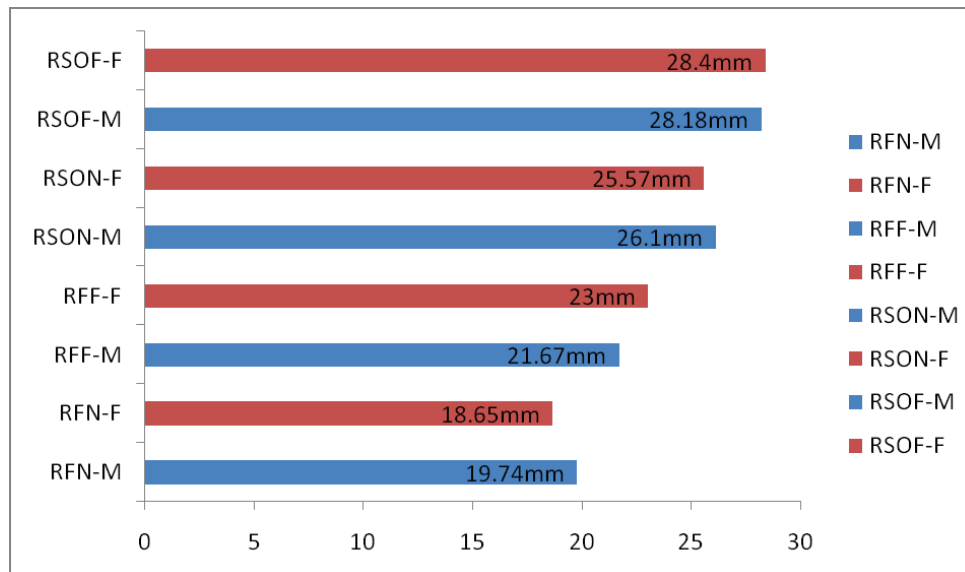
**Chart 2A. Average distance of exits ( foramina /notches)**



**Table 3. ( Average Distance – Right Side)**

Exits (Right side-R)	Frontal notch ( FN)	Frontal foramina ( FF)	Supra orbital notch ( SON)	Supra orbital foramina ( SOF)
Male ( M)	19.74 mm	21.67 mm	26.2 mm	28.18 mm
Female ( F)	18.65 mm	23 mm	25.57 mm	28.4 mm

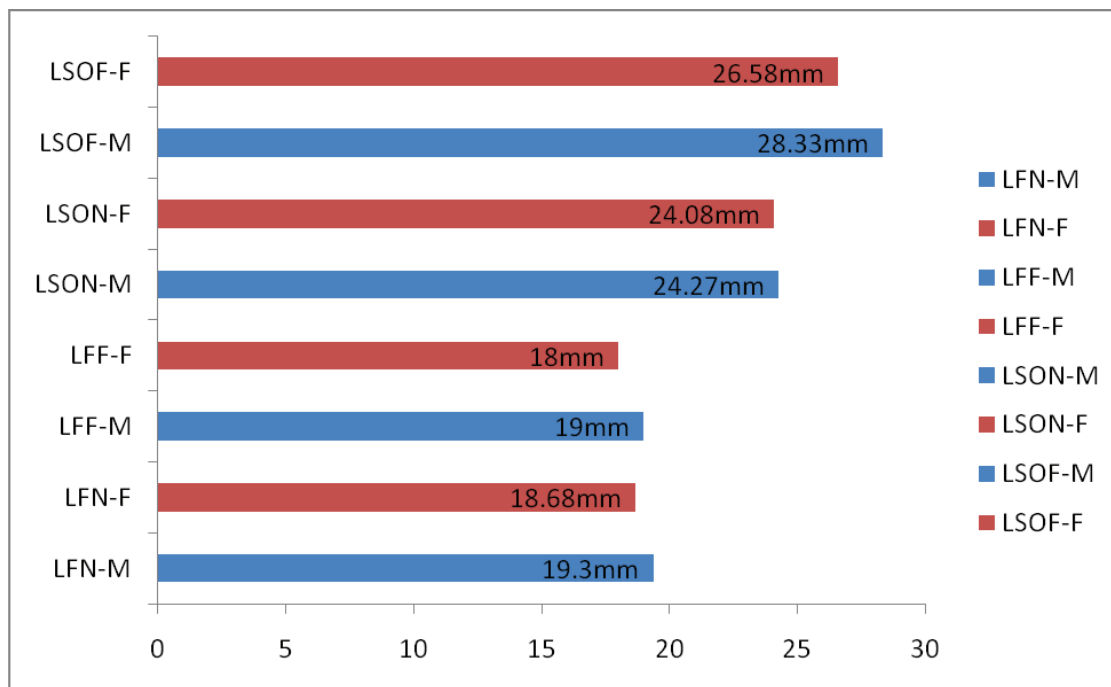
**Chart 3. Average distance-Right Side**



**Table 4. (Average Distance – Left Side)**

Exits (Left side-L)	Frontal notch (FN)	Frontal foramina (FF)	Supra orbital notch (SON)	Supra orbital foramina (SOF)
Male (M)	19.3 mm	19 mm	24.27 mm	28.33 mm
Female (F)	18.68 mm	18 mm	24.08 mm	26.58 mm

**Chart 4. Average Distance – Left Side**



**Discussion**

Anatomically, the supra orbital nerve originates from the frontal nerve, which is a branch of the ophthalmic division of the trigeminal nerve. In the orbit, this nerve lies below the orbital roof, proceeding anteriorly between the orbital roof and the levator palpebrae superioris muscle. It exits from the orbital cavity either through the supra orbital foramen or winds around the supra orbital notch. It then divides in medial and lateral branches, supplying the forehead region up to the lambdoid suture for somato sensory sense[1]. Occasionally, it divides early within the orbital cavity; the lateral branch exits from the orbital cavity as usual through the supra orbital exit, whereas the medial branch exits the orbital cavity through the

frontal foramen or winds around the frontal notch[2,3]. This explains the anatomic variation of the occurrence of the frontal exits for the medial branch of the supra orbital nerve. A significant number of anatomy textbooks or journals do not mention the presence of frontal exits of the supra orbital nerve at the superior orbital rim, but when they do, they erroneously attribute a relatively constant location of both the supra orbital and frontal exits on the superior orbital rim[5]. Berry (1975) has recorded presence of frontal exits in 50% of skulls[1]. The frontal foramen occurs in 15 – 87% in various ethnic groups[1,6]. Studies performed nearly a century ago showed differences in the occurrences of frontal exits among different populations. In the Chinese

population, 26.3% of the orbits contained frontal exits[8]. In contrast, Chinese had the highest proportion of orbits harbouring frontal foramina[8]. Thus, the basic intention of this study is to establish whether the anatomy of skulls of South Indian people of Dharwad and Bijapur area differ in this regard. The data reported here suggest that there are important individual differences within the study population. Moreover, existing data attest to important population differences. In our study the statistics was similar to that of conducted by Berry in 1975[1,9].

The distribution of the occurrence of supra orbital foramina or notches varies in different ethnic populations[1,6]. Asians, including Chinese (45.9%) and Thai (42.3%) populations, appear to have a higher proportion of foramina as the exit route for the supra orbital nerve and vessels than others[1]. In Mexicans 51% of skulls show equal number of supra orbital notches and foramina[1]. The highest rate of supra orbital foramina is found in the skulls from British Columbia in North America[1]. This is in agreement with a previous observation that Northeast Asian and

North American peoples in the arctic region show a higher frequency of supra orbital foramina than other populations[7]. This may imply that the origin of the supra orbital neurovascular bundle, which is the site where the nerve and vessels are relatively fixed in position to the cranium (and thus at higher risk to be damaged), will be encountered in a much higher position relative to the superior orbital rim in these populations. Hence, extra care should be exercised during surgical dissection even before reaching the supra orbital rim. Also, similar to those of Thai population, Chinese orbits appear to have a higher frequency of multiple supra orbital exits than other ethnic populations [6].

The distance measurements of these exits show slight sexual dimorphism, i.e. in males distance is more compared to females. These dimorphism might explain the difference in ossification during development of skull due to hormonal influence[1]. This is less assessed in most of the studies than ethnic differences[1]. (Figure 1 and 2)

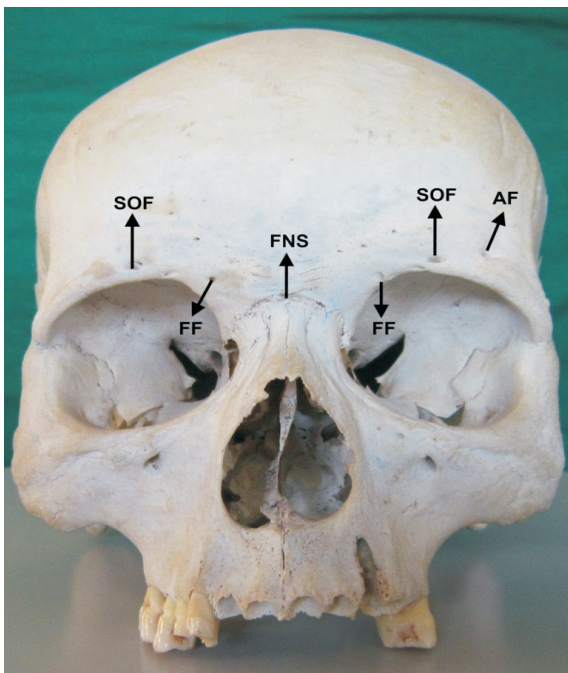


Figure 1

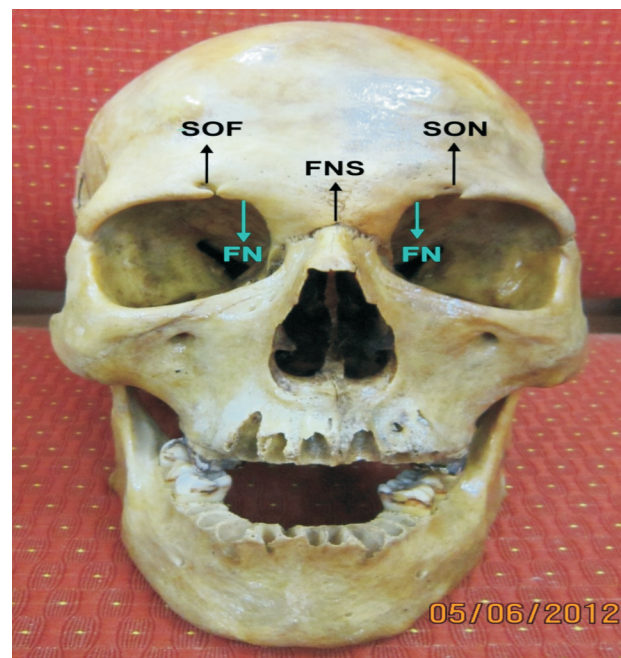


Figure 2

Figure 1 and 2 Frontal views of the skull

### Conclusion

In conclusion, the present study elucidated the characteristics and location of supra orbital nerve exits in skulls of South Indian people of above mentioned area, with wide variations.

Together with the prominent intra ethnic and interethnic variations shown in the position of the supra orbital nerve exits, extra care should be taken during surgical dissection in the superior orbital region especially toward the medial aspect of the

superior orbital rim. This anatomical knowledge might be useful for plastic surgeons, head and neck surgeons, physiotherapists and acupressure therapists. Future studies focusing on the ethnic variations of the location of supra orbital nerve exits should also consider the distribution of the location of the exits so that comparisons can be made between different populations. The radiological determination of these exits in patients might be developed to minimise neurovascular damage during surgeries involving supraorbital margin.

SOF-Supraorbital foramina, SON-Supra orbital notch, FF- Frontal foramina, FN- Frontal notch, FNS-Frontonasal suture, AF- Accessory foramina.

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