Varying Positions and Anthropometric measurement of Supraorbital and Supratrochlear canal /foramen in adult human skulls

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ABSTRACT

The supratrochlear and supraorbital notches and foramina have been studied in 312 adult skulls of known age and sex. Out of them, in males 49.4 % had bilateral supraorbital notches and 13.5% had bilateral foramina, 18.91% had a notch on one side and a foramen on the other side. Bilateral supratrochlear notch was present in 5.4% skulls, 9.65% skulls had bilateral supratrochlear canals and 8.49% had unilateral supratrochlear foramina/ notch on one or the other side. In females, 32% had bilateral supraorbital foramina and 30.18% had bilateral supraorbital notches. 37.7% had unilateral foramen/notch .Supratrochlear canal was present in 13.2%skulls on one or the other side. Bilateral notch was present in 2 skulls (3.77%) only. There was a significant difference between the frequency of supraorbital foramina and notches in males whereas there was no significant difference between the two in females. The distances of the notches/foramina from the midline and also from the temporal crest were measured. The distance of the supraorbital ansd supratrochlear foramen from the supraorbital rim was measured. There was no significant difference between the two genders. Knowledge of the anatomy of the region is important for those doing forehead and brow lift surgery in order to avoid injuring the neurovascular bundles passing through these notches and foramina, hence the gender wise present study. The methods of study and clinical relevance are discussed.

Keywords: Supraorbital, supratrochlear, notch, foramen

INTRODUCTION

The supratrochlear and supraorbital notches or foramina are important anatomical landmarks to facilitate surgical, local anesthetic and other invasive procedures for oral and maxillofacial surgeons. The anatomy of the forehead generally has been studied without giving much attention to the exact localization of these foramina and notches even though knowledge of the regional anatomy is important in order to avoid injuring the neurovascular bundles passing through these.

The positions of supratrochlear and supraorbital nerve/ foramen (SON/F) may vary among racial groups and genders.[1-6] Kimura[1] in a study of the skull of whites, American Indians and Japanese found that the relative position of SON/F showed differences between these racial groups and between genders.

Despite the significance of the supratrochlear and supraorbital Notch/Fotamen little attention has been given to the study of the morphology and the most common locations of these foramina and their associated anatomical characteristics in the Japanese population. The position of these foramina and notches in relation to midline of face and temporal crest were ascertained.

MATERIALS AND METHODS

Three hundred and twelve adult skulls of known age and sex were selected from the Department of Anatomy, Hokkaido University School of Medicine, Japan. The age of the subjects ranged from eighteen to ninety years in both males and females. All the skulls were examined for the presence of notches or foramina in the supraorbital region which were differentiated and recorded. Their horizontal dimension, transverse distance from the nasal midline and zygomatico temporal crest and the vertical distances of the foramina from the supraorbital rim were measured. Both sides of each skull were assessed by using direct inspection measurements and location of supratrochlear and supraorbital notch and foramen (SON/F). The greatest horizontal width of each SON/F was measured.

The midline of the forehead was established by extending a line which passed through the nasion to the anterior nasal spine and intermaxillary suture line. The transverse distances between the midline and the medial edges of the notches or foramina and from the lateral margin of the foramina to the temporal crest were determined. The vertical distance from the inferior edge of the supraorbital rim to the inferior margin of the SOF, when present and the horizontal dimensions of the foramina

Legend

Figure showing the presence of supraorbital foramen (SOF), supraorbital notch(SON), temporal crest of frontal bone (TCFB) and nasal midline (NM) and distance between them

Table 1: Distribution of Supraorbital and Supratrochlear Notches and Foramina

	No	Bilateral Notches	Bilateral Foramen	Total Notches		Total Foramen	
				Right	Left	Right	Left
MALES Supraorbital	259	128 (49.4%)	35 (13.5%)	169 (65.25%)	169 (65.25%)	74 (28.57%)	73 (28.18%)
Supratrochlear	259	14 (5.4%)	12 (4.6%)	18 (6.94%)	18 (6.94%)	13 (5.04%)	12 (4.63%)
FEMALES Supraorbital	53	16 (30.18%)	15 (28.3%)	27 (50.94%)	25 (47.16%)	27 (50.94%)	24 (45.28%)
Supratrochlear	53	2 (3.77%)	0	6 (11.32%)	2 (3.77%)	4 (7.54%)	3 (5.66%)

1- Total notches were higher in males as compared to females ($p<0.05$)
2- Total foramina were higher in females as compared to males ($p<0.01$)

and notches were measured. The distance between the supraorbital and supratrochlear notches or foramina was recorded by measuring the distance between the closest edge of one to the other. These measurements were made by using electronic sliding calipers capable of measuring to the nearest 0.01 mm. Overall the complete data of all frequencies and measurements were tabulated and separated with respect to gender and side.

RESULTS

Three hundred and twelve skulls of known sex and age were examined for the presence of supraorbital and supratrochlear notch/foramen. Out of these skulls, 259 belonged to males and 53 belonged to females. In males as well as in females the age ranged from 18 to 90 years.

In males, 54.82 %(142) skulls had bilateral supraorbital notches and 18.91% (49) had bilateral supraorbital foramina which was significantly less ($P < 0.001$). 9.6%(25) had foramen on right side and a notch on left side 6%(13) had both foramen and notch on right side, 4.6%(12) had both foramen and notch on left side. Thus18.91% skulls had a foramen on one side and a notch on the other side.5.4%(14) had bilateral notch and supraorbital foramen, 1.5%(4) had double notch on right side and double notch on left side each (Table-1).

On analysis of total foramina and notches, the notches were found to be significantly more ($P<0.0001$) than foramina on both right and left sides. Sidewise there was no significant difference in the distribution of supraorbital foramina and notches on both the sides. In females 30.18 % (16) skulls had bilateral supraorbital notches, 32% (17) had bilateral supraorbital foramina. There was no significant difference between the distribution of notches and foramina. 11.32% (6) had right sided foramen and left sided notch, 13.2% (7) had left sided foramen and right sided notch, 7.54% (4) had supratrochlear foramen and supraorbital notch on right side, 5.6% (3) had supratrochlear foramen and supraorbital notch on left side and 3.7% (2) had bilateral supraorbital notch and supratrochlear foramen. Thus, 37% had a foramen on one side and a notch on the other side.

On sidewise analysis there was no significant difference in the distribution of notches and foramina between right and left sides in both the sexes.

On sexwise analysis, bilateral notches as well as total notches were significantly higher in males as compared to those in females ($P<0.05$) whereas bilateral foramina as well as total foramina were significantly higher in females ($P<0.01$) as compared to those in males. On comparison of the supratrochlear foramina and notches

Table 2: Anthropometric measurements related to Supraorbital Foramen or Notch

	No of Orbits		**Average distance (mm)**		**Range(mm)**	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**
SON/F-NM	485	103	24.20	23.31	13.89- 8.03	11.91-7.52
SON/F-TCFB	485	103	23.46	22.09	13.94-9.06	9.19-36.82
SOF-SOR	147	51	3.75	2.91	0.92-11.32	0.8-10.89

SON/F-supraorbital notch or foramen; **NM**-nasal midline; **TCFB**-temporal crest of frontal bone**; SOR**-supraorbital rim

Table 3: Dimensions of the Supraorbital Notches and Foramina

Sex	No	Average length of notch(mm)	Range(mm)	Average diameter of foramen(mm)	Range(mm)
Male	485	5.43	2.06 -7.91	2.45	0.89-3.8
Female	103	3.09	1.51- 6.9	1.8	0.88-2.9

no significant differences were observed between the two sexes as well as between supratrochlear notches and foramina in a given sex.

Overall, the complete data of all frequencies and measurements were tabulated and separated with respect to side and gender. The mean age of male skulls was 50.89 years with standard deviation of 18.53 and the range of 18-90 years. The mean age of female specimen was 57.65 years with standard deviation of 21.52 and the range of 18-90 years. Compared to the males, the age of females was significantly more ($P<0.05$).

On anthropometric measurements average distance of the medial margin of a supraorbital notches/ foramina (SON/SOF) from the nasal midline was 24.20mm in males and 21.31mm in females with the range of 13.89 to 38.03mm in males and 11.91 to 37.52 mm in females (Table-2). The average distance of the lateral margin of SON/F from the temporal crest of frontal bone was 23.46mm in males (Range13.94-29.06mm) and 22.09 mm (Range 9.19-36.82mm) in females.

The average distance of supraorbital foramen from the supraorbital rim was 3.75 mm (Range-0.92 to 11.32 mm) in male's and 2.91 mm (Range 0.8 to 10.89 mm) in females. In males the average horizontal length of a notch was 5.43mm (Range 2.06 to 7.91mm) whereas in females it was 3.09 mm (Range1.51 to 6.09 mm) (Table-3). The supraorbital foramina diameter measured 2.45 mm (Range .89 to 3.8 mm) in males and 1.8 mm (Range 0.88 to 2.9 mm) in females. The average distance between a SON/F and a STN/F was 5.4mm (0.8 to 13) in males and 5.1 mm (0.9 to 11) in females (Table-4).

Table 4: Distance between Supraorbital notch/ Foramen and Supratrochlear Notch/Foramen

Sex	Average distance between SON/F and STN/F(mm)	Range(mm)
Male	5.4	0.8-13
Female	5.1	0.9-11

SON/F-Supraorbital notch/Foramen; STN/F-Supratrochlear notch/ Foramen

DISCUSSION

Clinical procedure on forehead whether diagnostic, corrective or cosmetic demand accurate identification of supraorbital notch/foramina to avoid injury to the neurovascular bundles emerging from these foramina/ notch. Any mistake in surgical intervention in this result would lead to the formation of hematoma, paresthesia or anesthesia. Therefore the understanding of the exact position of SON/F is of increased importance.

In the present study, the SON/F in males, 49.4 % (128) demonstrated bilateral notching, 18.91% bilateral foramina out of which 5.4 % (14) showed bilateral supratrochlear notches also and 31.66 % (82) SON/F on one side with different combination on the contralateral side. This was consistent with a previous study of skull from India, Thailand where 49.1% and 50.0% bilateral SON and 25.9% and 17.0% bilateral SOF and 25.0% and 33.0% one SON/F with combination were reported.[1-5]

In other studies, SON was reported at 70% in white, black and Hispanic subjects (14) and 92.5% in white and black subjects.[6-11] In the present study, the data of the distances from SON/F to the midline and to the temporal crest of the frontal bone were nearly similar to those in Thai population[2-5] but were different from those studied in whites and blacks[6-12].The neurovascular bundle might exit through the surpaorbital foramina, when present. In males its average location is 3.75 mm and in female it is 2.9 mm above the supraorbital rim. This corroborates well with those in Thai subjects. These data may be helpful for the surgeons in localizing this opening in order to avoid injury to the neurovascular bundles during routine coronal dissection.[12] Since it is difficult to exactly identify the midline of the skull, the use of the distance of 23.46 mm in males and 22.09 mm in females from the temporal crest of the frontal bone may be a reliable landmark for performing a coronal approach in Japanese Subjects.[1]

The present study showed significant gender difference in the distance of SON/F from nasal midline and from temporal crest of the midline and from temporal crest of the midline supporting the gender differences reported in different population

This was true with the average horizontal length of SON as well as average horizontal diameter of SOF in males

as comp to those in females, again supporting the gender differences .The average distance between SON/F and STN/F was non significantly more in males as compared to those in females.

Therefore it is stated that the situation of SON/F was contrary to the belief that it is situated at the junction of rounded medical one-third and the sharper lateral two-third of the superior orbital rim. The statement of Hollinshead that the notch is frequently converted into a foramen by ossification of the ligament that crosses it does not stand true[13] (Table-1). This shows that in population the supraorbital notch is not sufficient in locating the supraorbital neurovascular bundle in all cases as it might exit from supraorbital foramina well above the supraorbital rim and that also a combination of notches and foramina is possible in one skull. Hence, the measurements recorded in this study might be helpful to the surgeon in locating these opening and avoid injuring the neurovascular bundles.

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