



Original Research Article

Morphometric Variation of Jugular Foramen in Dry Adult Skull of South Indian Population and Its Clinical Implications

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ABSTRACT

Introduction: Jugular foramen transmits neural and vascular structures through its three compartments divided by bony septum. It varies in dimensions, bridging pattern and dome in different racial group, sexes and even in both sides of same cranium. Several neoplastic lesions involving jugular foramen alter its normal anatomy.

Aims: This observational study has been done to study the variability of anatomy of jugular foramen which indicates the size of internal jugular vein and its superior bulb.

Materials and Methods: The present study was conducted on sixty dry adult human skull of South Indian population. The jugular foramen was observed by naked eye as well as by magnifying lens to access the variation in size and bridging pattern.

Results: The jugular foramen was larger in 88.3% skull on right side as compared to 3.3% skull on left side. In rest 8.3% skull, it was equal on both sides. The width and depth of jugular foramen was more on right side i.e. 9.06mm and 10.02mm respectively. Bilateral presence of dome have been found in 58.33% whereas bilateral absence in 8.3%. Bilateral complete septum was observed in 3.33% skull. Partial septum was seen in 48.3% skull on right side and 35% skull on left side.

Conclusion: The variations observed in jugular foramen are of immense value to neurosurgeons, radiologists and anthropologists.

Key words: Jugular foramen, internal jugular vein, superior bulb, dome, septum.

INTRODUCTION

Jugular foramen is a long irregularly shaped foramen at base of human skull lies between occipital bone and petrous part of temporal bone. It transmits neural and vascular structures through three compartments of jugular foramen which is divided by bony septum. Anteromedial compartment lodging inferior petrosal sinus, intermediate compartment transmits glossopharyngeal, vagus and cranial

accessory nerve, posterolateral compartment lodges sigmoid sinus which continues as internal jugular vein externally. [1] The presence of dome which is a bony roof in jugular foramen indicates the presence of superior jugular bulb. [2] It varies in dimensions, bridging pattern & dome in different racial group, sexes as well as in the both sides of same cranium. [3] Tumors like glomeric tumor, schwannoma, paraganglioma and other metastatic lesions involving

jugular foramen require a microsurgical approach to this region. [4] These neoplastic lesions also alter the normal anatomy of jugular foramen by invasion, erosion or expansion. [5] Hence this study has been conducted to know the anatomical details and its variation which could be of great help to surgeons.

MATERIALS AND METHODS

The study was conducted on 120 foramina of 60 dry adult skull obtained from department of anatomy of Velammal Medical College, Madurai and SVS Medical College, Mahabubnagar. Following parameters were studied: anteroposterior diameter, medial-lateral diameter, width of jugular fossa and depth of dome if present were measured by vernier calipers. The bridging patterns were observed macroscopically by naked eye as well as magnifying lens. Measurements had been taken by the use of vernier calipers. All these observations were recorded bilaterally and compared with other studies.

RESULTS

All the parameters recorded bilaterally have been shown in table-1 and table-2. The mean anteroposterior diameter of jugular foramen was 11.41 ± 2.16 mm and 8.21 ± 1.74 mm on right and left side respectively. While mediolateral diameter was found to be 17.65 ± 2.49 mm and 13.7 ± 2.39 mm on right and left side respectively (table-1). The jugular foramens were larger in (53)88.33% skull in right side and (2)3.33% skull in left side, whereas in 5(8.33%) skull size was equal. The dome of jugular foramen was present bilaterally in 58.33% skull, while 20% skull on right side and 13.33% skull in left side. It was absent in 8.33% skull. Bilateral complete septation was found to be in 3.33% skull. Unilateral complete septation was present in 8.33% skull in right side and 5% skull in left side. Partial septation have been observed in 48.33% and 35% of skull on right side and left side respectively (table-2).

Table 1: Relative Dimensions Of Jugular Foramen And Jugular Fossa

Parameters(mm)	Right jugular foramen		Left jugular foramen	
	Range	Mean \pm SD	Range	Mean \pm SD
AP diameter of JF	7-15	11.41 ± 2.16	6-11	8.21 ± 1.74
ML diameter of JF	12-21	17.65 ± 2.49	10-18	13.7 ± 2.39
Width of jugular fossa	6-13	9.06 ± 2.15	4-11	6.783 ± 1.87
Depth of jugular fossa	6-13	10.02 ± 2.22	4-12	8.75 ± 2.28

Table 2: Comparison Of Bridging Pattern & Dome Of Jugular Foramen

Sides	Septation		Dome
	Complete	Partial	
Bilateral	2(3.33%)	0	35(58.33%)
Right	5(8.33%)	29(48.33%)	12(20%)
Left	3(5%)	21 (35%)	8(13.33%)
Bilaterally absent	50(83.3%)	0	5(8.33%)

Table 3: Comparison of Present Study With Previous Studies

Study	Size of foramina			Presence of dome				Septation							
	R>L	R<L	R=L	B/L	R	L	A	Complete				Partial			
								B/L	R	L	A	B/L	R	L	A
Present study No.%	53 88.3	2 3.3	5 8.3	35 58.3	12 20	8 13.3	5 8.3	2 3.3	5 8.3	6 5	50 83.3	0	29 48.3	21 35	0
Avanish kumar (2014) No %	44 64.7	13 19.1	11 16.1	39 57.4	20 29.4	6 8.8	3 9.4	-	11 16.2	6 8.8	-	-	57 83.9	62 91.2	-
Vijisha P (2013)	23 76.6	3 10	2 6.6	21 70	8 26.6	1 3.3	-	-	3 10	2 6.6	-	-	22 73.3	24 80	-
Patel & Singel (2007)	55 60.4	14 15.4	22 24.2	19 21	35 38.5	13 14.3	23 25.3	-	21 23.1	16 17.6	-	-	45 49.5	54 59.3	-
Sturrock (1988)	107 68.6	36 23.1	13 8.3	84 53.9	47 30.1	10 16.4	15 9.6	-	5 3.2	5 3.2	-	-	2 1.3	17 10.9	-

DISCUSSION

The jugular foramen has complex anatomy which is difficult to understand as well as to access surgically. It is always characterized by smaller or greater asymmetry. [6] The size and shape of jugular foramen and its dome depend on size of internal jugular vein and superior bulb of internal jugular vein respectively. The difference in size of two internal jugular vein is already established embryologically and perhaps is due to difference in pattern of development of right and left brachiocephalic vein. [7]

Pereira et al found mean anteroposterior diameter to be 9.21mm, 8.65mm and mediolateral diameter to be 15.82mm and 15.86mm on right and left side respectively in Southern Brazilian population. [8] In another study by Anjali Singla et al anteroposterior diameter and mediolateral diameter was found to be 9.32mm, 7.34mm and 15.65mm, 14.85mm on right and left side respectively in North West region. [9] In a study of Nigerian skull, Idowu et al reported the mean width as 10.2mm, 9.52mm and the length as 14.11mm, 13.9mm on right and left side respectively. [10] Vijisha et al found the width and length of jugular foramen as 12.13mm, 9.27mm and 17.3mm, 15.3mm respectively in skull from Tamil Nadu. [11] Thus in all these above studies right jugular foramen was found to be larger than the left. But diameters in these skulls are varies from each other. Our findings are very much near to Vijisha et al because both studies have been done in South Indian skull (fig-1). According to Wysocki et al results variation can be due to racial and individual factors. [12]

In the present study width of jugular fossa was 9.06mm and 6.783mm on right and left side respectively, which is nearly half of the mediolateral diameter of jugular foramen. But Anjali Singla et al (2012)

observed the average width to be more than half of the mediolateral diameter. They found width of fossa was more in right side which is in accordance to our study. The width of jugular fossa may be related to the size of internal jugular foramen. [9] (fig -2).

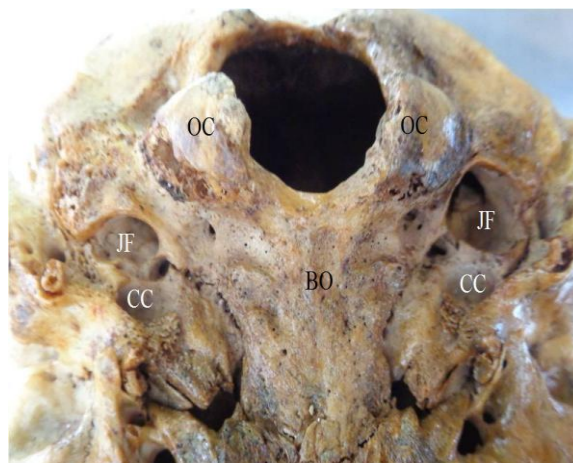


Figure-1: Basal view of skull showing right jugular is larger than left (JF- jugular foramen, CC- carotid canal, BO- basiocciput, OC- occipital condyle)

The obtained result regarding the bilateral domed bony roof was 58.3% which was comparable to those given by Avanih Kumar [13] who reported bilateral roof in 57.4% skull but lower than that of Sturrock (53.9%). [14] The presence of domed bony roof in right side is lower (29.4%) as compared to other studies but in left side is higher (13.3%) than their studies except of Sturrock [14] studies (table-3).

Anjali Singla et al noted the average depth of jugular fossa nearly equal on both sides i.e. right side - 11.11mm, left side- 11.04mm. [9] This observation is not in accordance to the present study, since the depth of jugular fossa showed quiet difference in both sides i.e. right side- 10.02mm, left side-8.75mm. Jugular fossa depth is directly related to level of superior jugular bulb. Deep fossa indicates high jugular bulb which has vital surgical importance for neurosurgeon. High jugular bulb can cause conductive hearing loss by interfering ossicular chain. It can also

complicate cochlear implantation due to its encroachment in middle ear cavity. [15] It disturbs vestibular schwannoma surgery due to its proximity to internal acoustic meatus. [16]

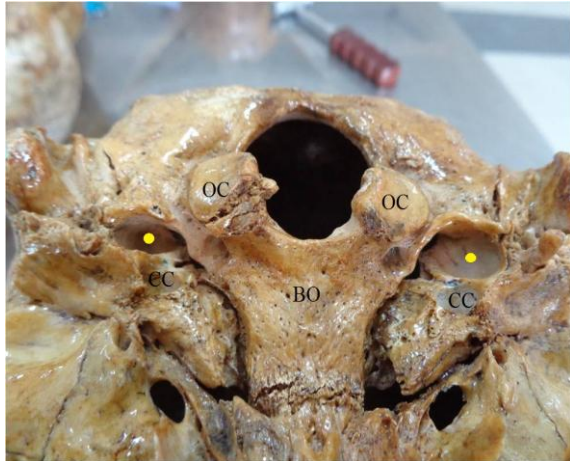


Figure -2: Basal view of skull showing bilateral dome

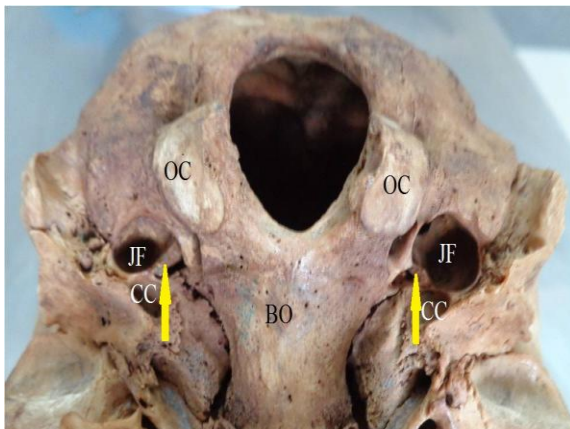


Figure-3: Basal view of skull showing bilateral complete septum



Figure - 4: Cranial view of skull showing unilateral complete septum

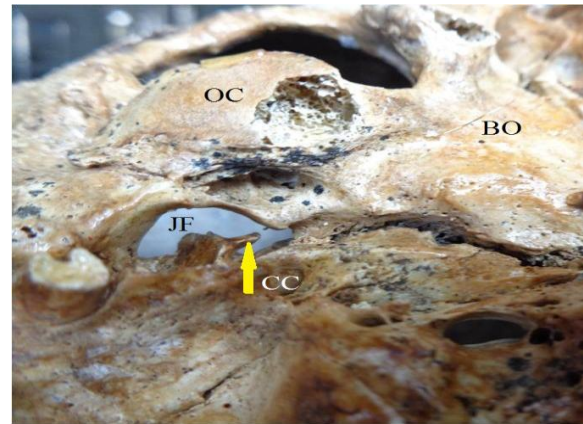


Figure -5: Basal view of skull showing unilateral partial septum

In present study majority (83.3%) of skull had partial septum as well as the frequency of bridging pattern was more on right side (56.7%) (Fig-5). We also found bilateral complete septum in 3.3% skull (fig-3). In a study of 300 Anatolian skulls, Hatiboglu et al observed complete septation in 5.6% and 4.3% skull and partial septation in 2.6% and 19.6% skull on right and left side respectively. [17] Patel and Singel reported complete septum on right side-23.1%% and left side-17.6%; partial septum on septum on right side-49.5% and left side-59.3% in a study of Shaurashtra region. [2] The wide difference in these observation suggesting racial factors involved in bridging pattern. Bridging of the jugular foramen could be the reason for the compression on the structure passing through it causing jugular foramen syndrome. [18]

CONCLUSION

This variability in morphometry of jugular foramen and its possible implications call for further studies. The observed variation of jugular foramen can be due to constitutional, racial or genetic factors. The present study of jugular foramen would be of great help to neurosurgeons, radiologists and anthropologist.

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