

# Structural Variations in the Jugular Foramen of the Human Skull of South Indian Origin

SUMATHI S.<sup>†</sup>, SHILPA K.<sup>‡</sup> & PRIYARANGANATH\*<sup>\*</sup>

*Department of Anatomy, Bangalore Medical College & Research Institute,  
Bangalore 560002, Karnataka*

**KEY WORDS:** Jugular foramen. Jugular fossa. Skull. South Indian origin.

**ABSTRACT:** The jugular foramen is present at the base of the skull. The foramen transmits many important structures through its anterior, middle and posterior part. One amongst them is the internal jugular vein passing through the posterior part. According to most of the textbooks of Anatomy, right jugular foramen is usually larger than the left. The size and shape of the jugular foramen is related to the presence or absence of prominent superior bulb and to the size of the internal jugular vein. The bony, neural and vascular anatomy of the jugular foramen is described in the context of surgery for tumours that involve this region. The concept of a bipartite jugular foramen with fixed neurovascular relationships is challenged by demonstrations of significant variability and anatomic relationships as they relate to surgical technique and avoidance of complications.

## INTRODUCTION

The jugular foramen is a large, irregular and elongated opening with its long axis directed forward and medially, placed at the posterior end of the petro-occipital suture. The foramen is bounded in front by the jugular fossa of petrous temporal and behind by the jugular notch of the occipital bone. The jugular fossa is related above with floor of the tympanic cavity. The jugular foramen is subdivided into anterior, middle and posterior parts. The anterior part transmits inferior petrosal sinus (1st tributary of internal jugular vein), intermediate part gives passage to glossopharyngeal, vagus and accessory nerves with meningeal branch of ascending pharyngeal artery and occasionally emissary veins, and the posterior part conveys internal jugular vein as continuation of sigmoid sinus. The commencement of internal jugular vein presents a dilatation, the superior bulb, which lodges in the jugular fossa of the petrous temporal.

The neural and vascular compartment are usually divided by a bony projection called the intrajugular process. The edge of the occipital bone forms a jugular notch and the petrous temporal is excavated to form a jugular fossa which accommodates the superior bulb of the jugular vein (Williams, *et al.*, '95).

## MATERIALS AND METHOD

50 adult, dry human skulls were examined in the Department of Anatomy, Bangalore Medical College & Research Institute, Bangalore. The skulls were of South Indian origin. All the skulls were normal and devoid of any malformation. Simple Vernier calipers were used to measure the antero-posterior diameter of the jugular foramen. In addition, the skulls were observed for the presence of dome and septation.

## RESULTS

The jugular foramen was larger on the right side in 31 skulls (62%) (fig. 1), larger on the left in 10 skulls (20%) (Fig. 2) and equal on both sides in 9 skulls (18%). Complete septation (Fig. 4) was

<sup>†</sup>Assistant Professor

<sup>‡</sup>Tutor

\*Professor & Head, corresponding author

observed in 6 skulls (12%) on the right and 4 skulls (8%) on the left. In regards to partial septation, it was observed in 14 skulls (28%) on the right (Fig1) and 26 skulls (52%) on the left.

The dome indicating the presence of jugular bulb was present bilaterally in 11 skulls (22%) (Fig.3&5) and absent bilaterally in 10 skulls (20%). In addition, the dome was present on the right in 20 skulls (40%) and on the left side only in 9 skulls (18%).

### DISCUSSION

Hatiboglu and Anil ('91) studied 300 Antonian skulls from 17th and 18th centuries. They observed that in 61.6%, the foramen was larger on the right side and in 26% it was larger on the left side. According to Sturrock ('98), the size of the jugular foramen was large on the right side in 68% of the skulls, and on the left side in 23.1% and of equal size in 8.3%. According to Patel and Singel (2007), the jugular foramen was usually larger on the right. In the present study, foramen was larger on right in 62% and on left in 20% (Table 1). According to Hatiboglu and Anil ('91), there was presence of dome bilaterally in 49%, on right side in 36%, on the left side in 6% and absent bilaterally in 10.3%. In the study by Sturrock ('98), dome was present in 30.1% on the right and in 6.4% on the left side and in 54% bilaterally. In this study, the dome was absent bilaterally in 9.6%. According to Patel and Singel (2007), a dome indicating the presence of a jugular bulb, was present on the right only in 38.5% of skulls and on left only in 14.3%, whereas it was present bilaterally in only 21% of skulls and it was absent bilaterally in 25.3% of skulls. In the present study, there was dome bilaterally in 22%, on right in 40% and on left in 18% and absent bilaterally in 20% (Table 2). Furthermore, according to Hatiboglu and Anil (1991), complete septation was observed on the left side in 4.3% of skulls and on the right in 5.6%; incomplete septation on the left side in 19.6% and on right side in 2.6% of skulls. In Sturrock's study ('98), it was noticed that there was complete septation of jugular foramen on both sides in 32% of 'the skulls and partial septation in 1.3% on right and 10.9% on left side. According to Patel and Singel (2007), partial septation was absent in 50% of the total skulls examined in both right and left jugular foramen,

whereas complete septation was observed in 23% on the right and 17.6% on the left. In the present study, complete septation was seen on the left side in 08% of skulls and on the right in 12% of the skulls. Partial septation was seen on the right in 28% and on the left in 52% of the skulls (Table 3 and 4). Sturrock ('98) described the presence of curved, inverted gutter in those cases where there was absence of domed roof at the site where bony channel had been in contact with internal jugular vein, which was not observed by Hatiboglu and Anil ('91). According to Patel and Singel (2007), a common variation was the absence of a domed roof, with the bony channel which had been in contact with the internal jugular vein resembling a curved inverted gutter.

### CONCLUSION

The jugular foramen has got many relations to the neurovascular bundle. The knowledge of its anatomic variations is important in surgical techniques involving the jugular foramen to avoid complications.

TABLE 1  
*Percentage of presence of bigger foramen*

Increased size of foramen/% in side	Right	Left	Equal
Hatiboglu & Anil, 1991	61.6	26	—
Sturrock, 1998	68	23.1	8.3
Patel & Singel, 2007	—	—	—
Present, 2013	62	20	—

TABLE 2  
*Percentage of presence of dome*

Presence of dome/ % in side	Right	Left	Bilateral	Bilateral absence
Hatiboglu & Anil, 1991	36	6	49	—
Sturrock, 1998	30.1	6.4	54	9.6
Patel & Singel, 2007	38.5	14.3	21	25.3
Present, 2013	40	18	22	20

TABLE 3  
*Percentage of presence of complete septation in foramen:*

Complete septation /% in side	Right	Left	Bilateral
Hatiboglu & Anil, 1991	5.6	4.3	—
Sturrock, 1998	—	—	32
Patel & Singel, 2007	23	17.6	—
Present, 2013	12	8	—

TABLE 4

<i>Percentage of presence of incomplete septation in foramen</i>			
Incomplete septation /% in side	Right	Left	Absent
Hatiboglu & Anil, 1991	2.6	19.6	—
Sturrock, 1998	1.3	10.9	—
Patel & Singel, 2007	—	—	50
Present, 2013	28	52	—

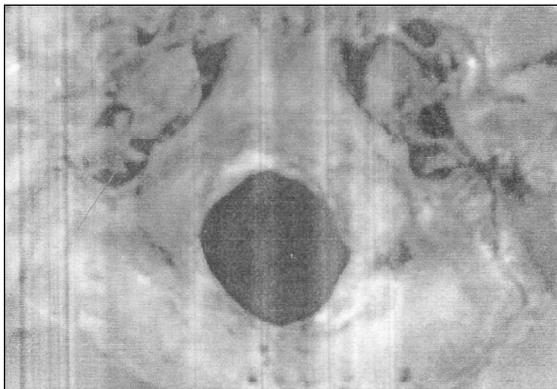


Figure 1: The presence of incomplete septation of the jugular foramen on the right side (arrow). It also shows right side jugular foramen larger than left side

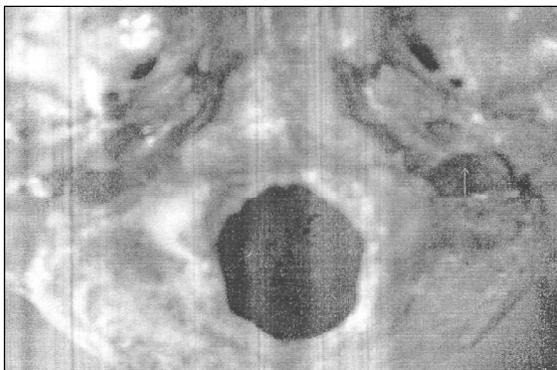


Figure 2: Skull base showing the left jugular foramen larger than the right side (arrow)

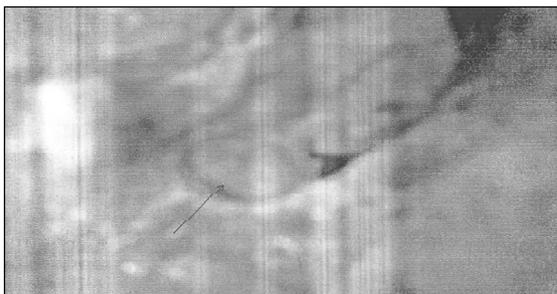


Figure 3: A domed bony roof to the jugular foramen is present on the right side (arrow)

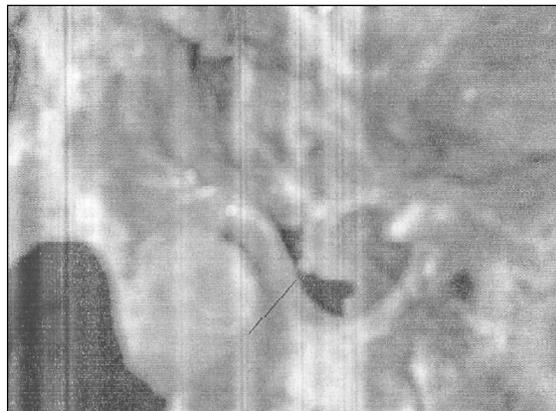


Figure 4: Skull base showing presence of complete septation of the jugular foramen (arrow)



Figure 5: Skull base showing a domed bony roof of the jugular foramen on the left side (arrow)

## REFERENCES

- Williams P. L., Bannister L. H., Berry M. M., Collins P., Dyson M., Dussek J. E. and Ferguson MWJ, 1995. In: *Gray's Anatomy*, 38th edition. Churchill Livingstone, London, pp. 329-331.
- Hatiboglu M. T. and Anil A. 1992. Structural variations in the jugular foramen of human skull. *Journal of Anatomy*, 189: 191-196.
- Sturrock R. R. 1998. Variations in the structure of the jugular foramen of the human skull. *Journal of Anatomy*, 160: 227-230.
- Patel M. M. and Singel T. C. 2007. Variations in the structure of the jugular foramen of the Human skull in Saurashtra Region. *J. Anat Soc. India*. 56(2): 34-37.