

## STUDY ON MORPHOLOGICAL VARIATIONS IN STRUCTURE OF THE JUGULAR FORAMEN

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### ABSTRACT

**Background:** The jugular foramen is difficult to understand and to access surgically; the difficulties in exposing this foramen are created by its deep location and the surrounding structures, such as the carotid artery anteriorly, the facial nerve laterally, the hypoglossal nerve medially and the vertebral artery inferiorly, all of which block access to the foramen and require careful management. It is difficult to conceptualize because it varies in size and shape in different crania, between the two sides the same cranium, from its intracranial to extracranial end in the same foramen and because of its complex irregular shape, its curved course, its formation by two bones and the numerous nerves and venous channels that pass through it. The present study is concentrated to study morphological features of jugular foramen.

**Material and Methods:** The present study was undertaken in 250(500 sides) adult south Indian skulls from different regions of south India, from different medical colleges. We have observed the size of foramen and presence of jugular fossa.

**Result:** Out of 250 skulls in 20.8% of cases the right foramina were larger than the left, in 24.8% of cases the left foramina were larger than the right and in 8% cases were equal on both sides. The jugular fossa present bilaterally in 60%, on the right only in 21.6% cases, on the left only in 7.6% cases and was absent in 10.8% cases.

**Conclusion:** The present study concludes that there is no significance different between size of foramen in right and left side. The jugular fossa or bulb present bilaterally in majority of cases.

**KEY WORDS:** Jugular foramen, Jugular fossa, Compartments, Separation.

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### INTRODUCTION

Jugular foramen is a large aperture in the base of the skull. It is located behind the carotid canal and is formed by the petrous part of the temporal bone and behind by the occipital bone. The jugular foramen is the main route of venous outflow from the skull and is characterized by

laterality based on the predominance of one of the sides. Sigmoid sinus continues as internal jugular vein in posterior part of jugular foramen. Ligation of the internal jugular is sometimes performed during radical neck dissection with the risk of venous infarction, which some adduce to be due to ligation of the dominant

internal jugular vein[1]. In general Jugular foramen is larger on the right side compared to the left, its size as well as its height and volume vary in different racial groups and sexes. The foramen's complex shape, its formation by two bones, and the numerous nerves and venous channels that pass through it further compound its anatomy [2]. The jugular foramen can be regarded as a hiatus between the temporal bone and the occipital bone. The jugular foramen is commonly divided into three compartments-two venous and a neural or intrajugular compartment. The structures that traverse the jugular foramen are the sigmoid sinus and jugular fossa, the inferior petrosal sinus, meningeal branches of the ascending pharyngeal and occipital arteries, the glossopharyngeal, vagus and accessory nerves with their ganglia [3,4]. The present work was carried out to study normal range of variations in relation to size, shape and compartments of jugular foramina.

**MATERIALS AND METHODS**

One hundred and twenty five normal adult skulls were procured from of the Defferent medical colleges in south India. The length, width and area of the jugular foramina were measured. Sagittal and transverse diameters were taken using vernier callipers. Each dimension was measured thrice and the mean figure recorded. Differences in the sides were analysed. The presence of jugular fossa and septation were also observed.

**RESULTS**

The size of the jugular foramen varied on the two sides. In the present study of 250 skulls right jugular foramen greater than left were 178 (71.2%), right jugular foramen lesser than left were 52(20.8%), right jugular foramen equal to left were 20 (8%). The jugular bulb dome was present bilaterally in 150(60%), on the right side only in 54 (21.6%), on the left side only in 19(7.6%), and absent in 27 (10.8%) (Table 1). Complete or partial separation or non separation of compartments of jugular foramina were observed as follows: Complete separation was present in 58(23.2%) on the right side and 48(19.2%) on the left side. Partial separation was present in 110(44%) on the right side and in 142(56.8%) on the left side. Non separation

was present in 82(32.8%) on the right side and in 60(24%) on the left side (Table 2).

**Table 1:** Relative size of jugular foramina and the jugular bulb dome.

	Relative Size of Foramen			Dome			
	R<L	R>L	R=L	BL	RO	LO	AB
<b>Number</b>	178	52	20	150	54	19	27
<b>Percentage</b>	71.20%	20.80%	8%	60%	21.60%	7.60%	10.80%

R = Right L= left BL= Bilateral R.O = Right only L.O = Left only AB =Absent.

**Table 2:**Complete or partial separation or nonseparation of compartments of jugular foramina.

	Separation of Compartments					
	Complete	Partial	Non-Separation			
<b>Number</b>	58	48	110	142	82	60
<b>Percentage</b>	23.20%	19.20%	44%	56.80%	32.80%	24%

**DISCUSSION**

The size of the internal jugular vein directly influence on the size of jugular foramen and the presence or absence of a prominent superior bulb the right foramen is usually larger than the left. The variation in the anatomy of the intra cranial venous sinuses which accounts for variation in size and shape of jugular foramina but usually superior sagittal sinus as draining into the right transverse sinus. The difference in size of the two internal jugular veins is already visible in the human embryo at the 23mm stage and probably results from differences in the pattern of development of the right and left brachiocephalic veins[4].

In the present study of 250 skulls right jugular foramen greater than left were 178(71.2%), right jugular foramen lesser than left were 52(20.8%), right jugular foramen equal to left were 20(8%). The jugular bulb dome was present bilaterally in 150(60%), on the right side only in 54(21.6%), on the left side only in 19(7.6%), and absent in 27(10.8%) (Table 1). Our results are in agreement with Sturrock's investigation of 156 skulls the right foramen was larger in 68.6%, the left larger in 23.1% and equal on both side in 8.3%. The jugular fossa was present in 30.1% cases on the right side, 6.4% cases on the left side, 53.9% cases bilaterally and absent bilaterally in 9.6% of cases [5]. Our results were correlated with study of Hatiboglu and Anil [6]

300 Anatolian skulls from the 17<sup>th</sup> and 18<sup>th</sup> centuries and observed that in 61.6% the foramen was larger on the right side and in 26% it was larger on the left side and in the remainder of equal size. Presence of jugular fossa was observed bilaterally in 49%, on the right only in 36%, on the left only in 4.7% and absent bilaterally in 10.3% of skulls[6]. In same subcontinent of present study the earlier studies also giving similar results as present study, Patel and Singel [7] studied 91 Indian skulls (Saurashtra region) and observed in 60.4% cases larger right foramen, in 15.4% larger left foramen and in 24.2% equal on both sides. The jugular fossa was observed in 38.5% cases on the right side, 14.3% cases on the left side, 21% cases bilaterally and absent in 25.3% of skulls. Hussain Saheb et al[4] study was given similar results from same region, in their study of 125 skulls R>L were 81(64.8%), R<L were 31(24.8%), R=L were 13(10.4%). The jugular bulb dome was present bilaterally in 62(49.6%), on the right side only in 34(27.2%), on the left side only in 11(8.8%), and absent in 18(14.4%).

In present study complete or partial separation or non separation of compartments of jugular foramina were observed as follows: Complete separation was present in 58(23.2%) on the right side and 48(19.2%) on the left side. Partial separation was present in 110(44%) on the right side and in 142(56.8%) on the left side. Non separation was present in 82(32.8%) on the right side and in 60(24%) on the left side (Table 2). Our results in agreement with the previous studies, Hussain sahib et al[4] study of 125 skull jugular foramina were larger on the right side in 64.8%, larger on left side in 24.8% and equal in size in 10.4%. The jugular fossa was present bilaterally in 49.6% cases, on the right only in 27.2% cases, on the left only in 8.8% cases and absent on both sides in 14.4%. In study of Sturrock R.R[5] observed that complete separation on right side in 3.2%, left side in 3.2% and partial separation on the right side in 1.3%, on left side in 10.9%. In study of Hatiboglu and Anil[6] observed complete separation on the right side in 5.6%, on the left side in 4.3% and partial separation on the right side in 2.6%, on the left side in 19.6%. In study of Patel and Singel[7] observed complete separation on the

right side in 23.1%, on the left side in 17.6% and partial separation on the right side in 49.5%, on the left side in 59.3%.

## CONCLUSION

The present study observations of the variations of jugular foramina were very near to Patel & Singel compared to Sturrock R.R and Hatiboglu & Anil studies because of the different geographical areas. The present study had similar results with those of Patel & Singel because the skulls taken for study in both cases were from the same subcontinent but different regions.

**Clinical significance:** The compartmentalization of the jugular foramen is an oversimplification and has no surgical significance. In-stead, it is more useful to describe the petrosal, sigmoid, and intrajugular portions of the jugular foramen. The pet-rosal portion contains the inferior petrosal sinus. The sigmoid portion receives the sigmoid sinus. The intrajugular portion contains cranial nerves IX, X, and XI.

**Conflicts of Interests: None**

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