



Quantitative Analysis of Jugular Foramen in Human adult Dry Skulls

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ABSTRACT

The aim of the study was to examine the anatomy, morphological features and dimensions of Jugular Foramen in human adult dry South Indian skulls. 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 in front and behind by the occipital bone. It is the main route of venous outflow and passage for the lower three cranial nerves (9, 10, and 11) from the skull. 50 skulls were examined using the digital vernier caliper used to measure the antero-posterior, transverse, inter-jugular dimensions of both right and left jugular foramen. Mean length and mean breadth was 8.77mm and 11.85mm respectively. Inter jugular distance was about 43.23mm. This study will be helpful for the neurosurgeons in their surgery because it transmits important neuro-vascular structures.

Keywords: Jugular Foramen, Occipital Bone, Carotid Canal, Cranial Nerves.

INTRODUCTION

The jugular foramen (JF) lies between the occipital bone and the petrosal portion of the temporal bone in the posterior end of the petrosal-occipital structure, and it is long and irregularly shaped.¹ It is the chief route for the venous outflow from the skull. The glossopharyngeal, vagus and cranial part of spinal accessory nerve pass through this and exit the cranial cavity. The neural and vascular compartments are usually divided by a bone projection called the intrajugular process.²⁻⁵ Its anteriorly separated from the internal carotid artery opening by a crest and related laterally to the medial surface of the styloid process covering, and separated from the hypoglossal canal through a thin bone bar. In the anterior portion there is inferior petrosal sinus and the intermediate portion or neural compartment involves the vagus, accessory nerves and the glossopharyngeal, and its posterior portion or vascular compartment includes the internal jugular vein and the meningeal branches of the ascending pharyngeal and occipital arteries.¹ It is the chief route for the venous outflow from the skull. The glossopharyngeal, vagus and cranial part of spinal accessory nerve pass through this and exit the cranial cavity. The neural and vascular compartments are usually divided by a bone projection called the intrajugular process.²⁻⁵

The Jugular foramen on the right side is larger compared to the left. Its size, height and volume vary in different racial groups and sexes. The foramen's complexity in shape, its function, formation by two bones, and the numerous nerves and venous channels that pass through it further complex its anatomy.^{6,7}

Ligation of the internal jugular vein is sometimes performed during radical neck dissection with the risk of

venous infarction, which some adduce to be because of the ligation of the dominant internal jugular vein.⁸ Intracranial and extra cranial lesions may affect the jugular foramen in addition to intrinsic abnormalities. Intracranial meningioma, schwannomas, metastatic lesions and infiltrative inflammatory processes from surrounding structures such as the middle ear are the pathological processes affecting the jugular foramen.⁹ Microsurgical procedures, such as the lateral suboccipital access, have allowed for the removal of these lesions, which were formerly thought to be very difficult to undergo an operation.^{10,11} As neurosurgeons become bolder in approaching this region, so the need for familiarity with the detailed anatomy of this region becomes greater.

The study was embarked on to examine the anatomy of the Jugular Foramen with its dimensions of both right and left, inter-jugular distance and also to check the presence of complete or incomplete partition.

MATERIALS AND METHODS

The examination of 50 human adult unsexed dry South Indian skulls was done in the Department of Anatomy of Saveetha Dental College and Hospital, Chennai. All the skulls were normal and devoid of any signs of erosion. A digital vernier caliper was used to measure the dimensions of the following of both right and left Jugular Foramen.

- Antero- Posterior (mean length)
- Transverse (mean breadth)
- Area (length × breadth)
- Inter-Jugular distance (distance between right and left Jugular Foramen)
- Incidence of incomplete or complete partition



The data was recorded and mean values were calculated. The right and left side differences were analyzed accordingly.

RESULTS

Table 1: Dimensions of various aspects of JF

Left Jugular Foramen			Right Jugular Foramen			Inter-Jugular Distance (mm)
Mean Length (mm)	Mean Breadth (mm)	Mean Area (L*B) mm ²	Mean Length (mm)	Mean Breadth (mm)	Mean Area (L*B) mm ²	
8.858	11.355	100.582	8.689	12.36	107.396	43.233

The mean length on the right was 8.68mm and on the left was 8.85mm. The mean breadth of right and left JF are 12.36mm and 11.55mm respectively. The mean area calculated was 100.582mm² for left and 107.396mm² for the right JF. The inter-jugular distance which is the distance between the right and left JF was found to be 43.233mm.



Figure 1: Measuring the width of the JF



Figure 2: Measuring the inter-jugular distance



Figure 3: Measuring the length of the JF

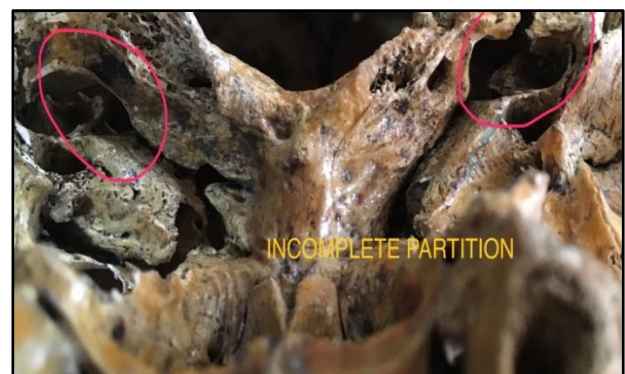


Figure 4: Incomplete Partition

DISCUSSION

From the results obtained, we have the area of the right JF to be 107.396 mm² and that of left JF is 100.582 mm². So we come to know that the Right Jugular Foramen is larger than the Left Jugular Foramen. This size and shape of the jugular foramen is related to the size of the interjugular vein and presence or absence of superior bulb. According to Sturrock, this prominent difference in the size of interjugular veins is visible in the human embryo at

the 23mm stage of development of the right and left brachiocephalic veins.

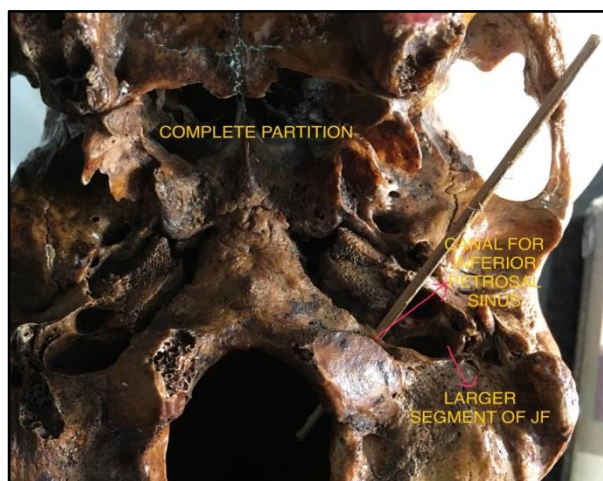


Figure 5: Complete Partition

Patel and Singhel¹² observed that area of the right Jugular Foramen is greater than the left JF in 60.4%. Right JF is lesser than left JF in 15.4%. Right JF is equal to Left JF in 24.2%. Hatiboglu and Anil^[18] in Turkish subjects' skulls, and Sturrock (1988), in a sampling of Roman-British skulls, have also found a larger area on the right side, although with a genus-independent analysis. This is similar to our result where more than 60% had right JF larger.

A separate foramen for the inferior petrosal sinus was seen in 5% skulls on right side and 7% skulls on the left side. The foramen is clearly demarcated from the rest of the Jugular Foramen. This is similar to Rhoton et al^{13,14} and DiChiro's¹⁵ study who observed a separate bony canal anterior to pars nervosa in 6% of the skulls. Whereas, it contradicts Patridge's¹⁶ results where he got a frequency of 25%. This shows that complete partition is very rarely found and incomplete partition is the most prevalent.

The figures reported by Idowu¹⁷ the mean length of 13.9mm on the right side, and 14.11mm on the left side and the mean width of 10.2mm on the right side, and 9.57mm on the left side in Nigerian skulls. The results and variation can be explained according to the racial and individual factors of the skull. While in this study, mean length on the right was 8.68mm and on the left was 8.85mm. The mean breadth of right and left JF are 12.36mm and 11.55mm respectively.

The inter-jugular distance which is the distance between the medial part of the right and left Jugular Foramen was found to be 43.233mm.

CONCLUSION

Variations in the size, shapes and compartments of jugular foramen might be a part of the ongoing evolutionary process. Knowledge of morphology, compartments and arrangement of structures within the foramen helps in deducing position of various structures

from the available data of jugular foramen depicted by this study. The knowledge may also be utilized by the clinicians to understand clinical presentations and progression of the lesions of the jugular foramen lesions and planning for the possible approaches for the operations. These findings will also be of help to understand the involvement /sparing of neurovascular structures in the Jugular foramen lesions and the interpretation of images of the Jugular foramen.

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