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MORPHOMETRIC AND MORPHOLOGICAL STUDY OF JUGULAR FORAMEN IN DRIED HUMAN SKULL BONES

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Abstract

Background: One of the important hiatus located at the base of the skull is the jugular foramen. It is situated between the petrosal portion of the temporal bone and the occipital bone. Some important nervous and vascular structures, such as the glossopharyngeal, vagus, accessory nerves, and the internal jugular vein passes through it. Pathological lesions such as glomic tumors, schwannomas, metastatic lesions and infiltrating inflammatory processes are associated with this foramen, which can account for injuries of related structures. The advancement of modern diagnostic procedures and the introduction of new surgical approaches has created a necessity for detailed anatomical studies of the foramen.

Materials and methods: The present study was conducted on 100 dried human skull bones of unknown age and gender obtained from the Department of Anatomy, Vijayanagar Institute of Medical Sciences, Ballari, Haveri Institute of medical Sciences, Haveri, Karnataka, India. The length, width and area of jugular foramen were noted. Presence of septation(complete or partial) and dome was observed macroscopically. **Results:** The mean length of jugular foramen was 23.89±3.01mm and 20.92±3.96mm on the right and left sides respectively. While the width was found to be 7.69±1.62mm and 6.99±1.91mm on the right and left sides respectively. The mean area on the right was 574.28±90.82cmm and on the left was 481.22±111.41cmm. The complete septation of jugular foramen was present on right side in 5% and on left side in 4% and bilaterally in 3%. Partial or incomplete septation on right side in 45% and on left side in 48% and bilaterally in 42%. The dome of jugular foramen was present in 29% of skulls on right side, 24% of skulls on left side, in 14% of skulls bilaterally

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and it was absent in 11% of skulls. **Conclusion:** The variations observed in jugular foramen are of immense value to neurosurgeons, radiologists, cardiologists and anthropologists.
Key words: Jugular foramen, dome, septation, internal jugular vein, skull.

Introduction

Jugular foramen of human skull is a complex bony canal which is situated between the petrous part of the temporal bone and the occipital bone. It is a large foramen and irregular in shape[1]. The jugular foramen of skull is divided by a fibrous or bony septum into an anteromedial compartment and posterolateral compartment. The smaller pars nervosa is relatively more consistent in size compared with the larger and more variable pars vascularis[2]. A dome is a bony roof present in the jugular foramen. The presence of superior jugular bulb indicates the presence of dome[3]. Jugular foramen differs in dimensions, bridging pattern & dome in different racial groups, sexes as well as in both sides of the same cranium[4]. Pathological processes affecting the jugular foramen include intracranial meningiomas, paragangliomas, schwannomas, metastatic lesions and infiltrative inflammatory processes from surrounding structures such as the middle ear[5]. Surgical resection is the treatment of choice in the majority of these cases. Advances in microsurgical techniques have made possible the removal of advanced jugular foramen lesions, which were once assumed to be inoperable[6]. It is generally said that the jugular foramen on right side is larger than on the left side, 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 important nerves and venous channels that pass through it further compound its anatomy[4,7]. Hence a precise knowledge of the anatomy of the jugular foramen and its dimensions is of immense value for the treating surgeons.

Materials and Methods

A total of 200 jugular foramina were examined from 100 dried human skulls irrespective of age and gender. The skulls were obtained from the Department of Anatomy, Vijayanagar Institute of Medical Sciences, Ballari, Haveri Institute of medical sciences, Haveri, Karnataka, India. Following parameters were studied: length, width of jugular foramen and depth of dome if present were measured by vernier calipers. The bridging patterns were observed macroscopically. Presence of complete or partial bony septum and presence of dome formation were observed. All these observations were recorded bilaterally and results were tabulated.

Results

Table 1: Dimensions of the jugular foramen.

	Rt L(mm)	Lt L(mm)	Rt W(mm)	Lt W(mm)	Rt A(mm)	Lt A(mm)
Minimum	19.78	15.21	4.82	4.27	452.68	262.34
Maximum	29.02	26.78	10.95	9.86	721.32	599.04
Mean	23.89	20.92	7.69	6.99	574.28	481.22
SD	3.01	3.96	1.62	1.91	90.82	111.41

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The mean length of jugular foramen was 23.89±3.01mm and 20.92±3.96mm on the right and left sides respectively. While the width was found to be 7.69±1.62mm and 6.99±1.91mm on the right and left sides respectively. The mean area on the right was 574.28±90.82cmm and on the left was 481.22±111.41cmm (Table-1).

Table 2: Septations and dome of the jugular foramen.

Sides	**Septations**		**Dome**
	Complete	**Partial**	
Bilateral	3(3%)	42(42%)	14(14%)
Right	5(5%)	45(45%)	29(29%)
Left	4(4%)	48(48%)	24(24%)
Bilaterally absent	0%	0%	11(11%)

Bilateral complete septation was found to be in 3% skulls. Unilateral complete septation was present in 5% skulls on the right side and 4% skulls on the left side. Partial septation have been observed in 45% and 48% of skulls on the right and left sides respectively and 42% bilaterally. The dome of jugular foramen was present in 29% of skulls on the right side and 24% of skulls on the left side and in 14% of skulls bilaterally. It was absent in 11% of skulls (Table-2).

Figure 1: Showing 100 dry human skull bones

Figure 2: Measurement of length of jugular foramen with the help of vernier calipers

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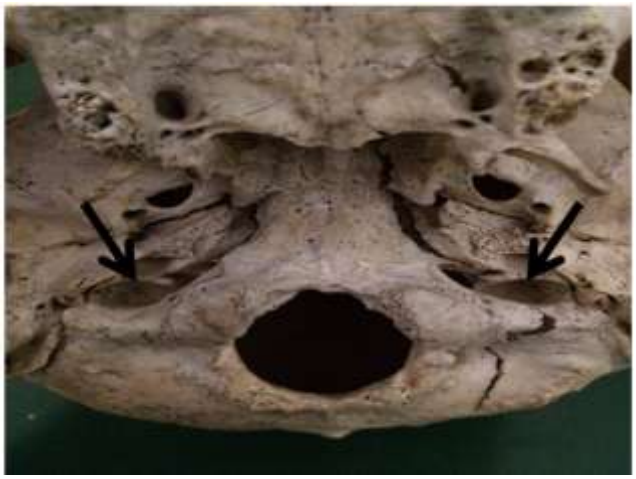

Figure 3: Showing the presence of bilateral dome of the jugular foramen

Figure 4: Red arrow shows complete partition on left side and black arrow shows incomplete partition on right side

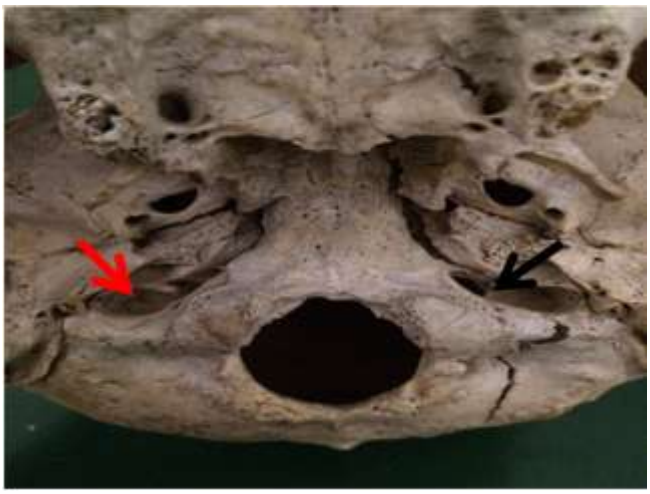

Figure 5: Red arrow shows dome and black arrow shows partition of the jugular foramen

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Discussion

The jugular foramen is difficult to access surgically and also to understand. The deep location of jugular foramen and the important structures surrounding it created difficulties in exposing this foramen. The size and shape of the jugular foramen is related to the size of the internal jugular vein and the presence or absence of a prominent superior bulb. 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.

In the present study, the average value of length of right foramen was 23.89±3.01mm and on the left side was 20.92±3.96mm. Average value of width of right foramen was 7.69±1.62mm and on the left side was 6.99±1.91mm. The mean area on the right foramen was 574.28±90.82cmm and on the left side was 481.22±111.41cmm.

Shruthi B.N. *et al.* in their study revealed that the mean length of the foramen on the right and left sides were 24.48±3.17mm and 21.24±4.51mm; the width measured 7.51±1.56mm and 7.16±1.89mm on the right and left sides respectively; the mean area on the right was 569.41±91.58cmm and on the left 470.40±115.45mm[8]. In a study done by Hussain Saheb S *et al.*, the mean length of the foramen on the right and left sides were 23.62mm and 22.86mm; the width measured were 7.83mm and 6.83mm on the right and left sides respectively; the mean area on the right was 584.36cmm and on the left 493.30cmm[1]. Our results are in agreement with Shruthi B.N. *et al.* and Hussain Saheb S *et al.*

Anjali Singla *et al.* in their study revealed that the anteroposterior diameter and mediolateral diameter was found to be 9.32mm, 7.34mm and 15.65mm, 14.85mm on right and left sides respectively in North West region[9]. Pereira *et al.* in their study found that the mean anteroposterior diameter to be 9.21mm, 8.65mm and mediolateral diameter to be 15.82mm and 15.86mm on the right and left sides respectively in Southern Brazilian population[10].

A study conducted by Vijisha *et al.* on skulls from tamil nadu region, they found that the width of jugular foramen was 12.13mm, 9.27mm and the length was 17.3mm, 15.3mm on the right and left sides respectively[11]. In a study of Nigerian skull, Idowu *et al.* reported that the mean width was 10.2mm, 9.52mm and the length was 14.11mm, 13.9mm on the right and left sides respectively[12].

Our present study observed that the complete septation of jugular foramen was present on right side in 5% and on left side in 4% and bilaterally in 3%. Partial or incomplete septation on right side in 45% and on left side in 48% and bilaterally in 42%.

Patel and Singel studied 91 Indian skulls and observed complete septation on the right side in 23.1%, on the left side in 17.6% and partial septation on the right side in 49.5%, on the left side in 59.3%[3]. Sturrock's observed that complete septation of jugular foramen was present on right side in 3.2% and left side in 3.2%. Partial or incomplete septation on right side in 1.3% and on left side in 10.9%[13]. Hatiboglu and Anil observed that complete septation of jugular foramen was present on right side in 5.6% and left side in 4.3%. Partial or incomplete septation on right side in 2.6% and on left side in 19.6%[14].

In the present study, the dome of jugular foramen was present in 29% skulls on right side and 24% skulls on left side and bilaterally in 14% skulls. It was absent in 11% of skulls. In a study conducted by Khanday S *et al.* observed that in 20% of skulls the dome was present bilaterally, in 40% of skulls on the right side and in 29% of skulls on the left side. The dome

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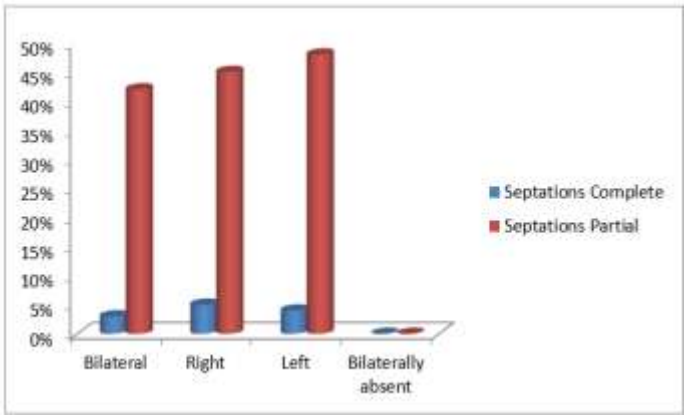
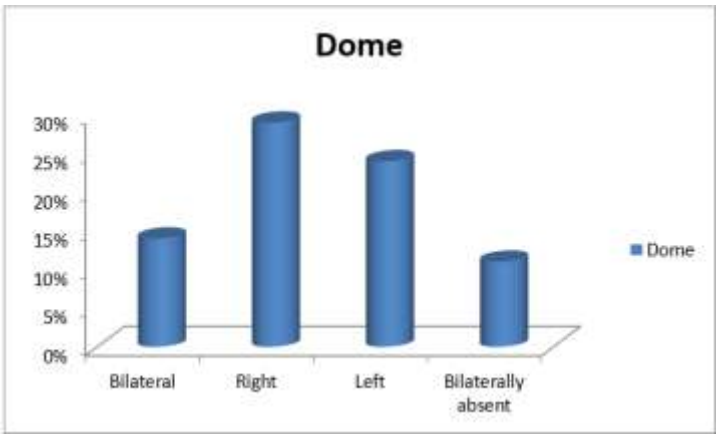
was absent in 11%[15]. In a study conducted by Avinash K *et al.*, in 57.4% of skulls the dome was present bilaterally, in 29.4% of skulls on the right side and 8.8% of skulls on the left side. The dome was absent in 9.4%[16].



Graph 1: Comparison of Septations of the Jugular Foramen



Graph 2: Comparison of the dome of the jugular foramen

Conclusion

The jugular foramen contains significant vessel and neural structures and it exhibits complex anatomical relationships. Variations in the size, shape and compartments of jugular foramen might be a part of the ongoing evolutionary process. Precise knowledge of morphology, morphometry, compartments and arrangement of structures within the foramen helps in deducing position of various structures from the available data depicted by this study. The observed variation of jugular foramen can be due to racial, constitutional or genetic factors. The present study would provide valuable information to neurosurgeons, radiologists, cardiologists and anthropologists.

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References

1. Hussain Saheb S., Mavishetter G.F., Thomas S.T., Prasanna L.C. and Muralidhar P. 2010. Morphological variations in the structure of the jugular foramen of the human skulls of south India. Biomedical Research, 2010;21(4) : 349-350.
2. Di Chiro G, Fisher RL, Nelson KB. The jugular foramen. J Neurosurgery 1964; 21:447–452.
3. Patel MM, Singel TC. Variations in the structure of the jugular foramen of the human skull in Saurasthra region. J Anat Soc India. 2007; 56(2):34-37.
4. Navsa N, Kramer BA. Quantitative assessment of jugular foramen. Anat Anz. 1998; 49: 534- 537.
5. Kanemoto Y, Ochiai C, Yoshimoto Y, Nagai M. Primarily extracranial jugular foramen
6. Neurinoma manifesting with marked hemiatrophy of the tongue: case report. Surgical Neurology 1998; 49: 534–537.
7. Tekdemir I, Tuccar E, Aslan A, *et al.* The jugular foramena comparative radioanatomic study. Surgical Neurology 1998; 50: 557–562.
8. Hovelacque A. Osteologie. Paris. 1967;155-56.
9. Shruthi B.N, Pavan P. H, Hussain Saheb S, Henjarappa K S. Morphometric study of jugular foramen. Int J Intg Med Sci 2015, 2(10):164-66.
10. Anjali Singla, Daisy Sahni, Anjali Aggarwal *et al.* Morphometric study of the Jugular foramen in Northwest Indian Population. J of Postgraduate Medicine, Education and Research. 2012; 46(4):165-71.
11. Pereira GAM, Lopes PTC, Santos AMPV, Kerbs WD. Morphometric aspects of jugular foramen in dry skull of adult individuals in Southern Brazil. J Morpfol Sci. 2010; 27(1):3-5.
12. Vijisha P. Arun kumar bilodi, Lokeshmaran. Morphometric Study of Jugular foramen in Tamil nadu region. National J of Clinical Anatomy. 2013;2 (2):71-74.
13. Idowu OE. The jugular foramen - A morphometric study. Folia Morphol. 2004; 63: 419–22.
14. Sturrock R.R, Variations in the structure of the jugular foramen of the human skull. Journal of Anatomy. 1998;160:227-230.
15. Hatiboglu MT, Anil A. Structural variations in the jugular foramen of the human skull. J Anat 1991;180:191–196.
16. Khanday S, Subramanian RM, Rajendran M, Hassan AU, Khan SH. Morphological and morphometric study of jugular Foramen in South Indian population. Int J Anat Res. 2013;1:122-6.
17. Avanish Kumar, Ritu, Md. Jawed Akhtar, Avanindra Kumar. Variation in Jugular foramen of human skull. Asian Journal Medical science.2014; 6(2):95-98.