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RESEARCH ARTICLE

MORPHOLOGICAL AND MORPHOMETRIC ANALYSIS OF JUGULAR FORAMEN IN DRY HUMAN SKULL IN UTTARAKHAND

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ABSTRACT

Introduction: The jugular foramen lies at the posterior end of the petro-occipital suture between the jugular process of the occipital bone and jugular fossa of the petrous part of the temporal bone which allows the passage of important nervous and vascular elements, such as the glossopharyngeal nerve, vagus nerve, accessory nerves and the internal jugular vein. Glomic tumors, schwannomas, metastatic lesions and infiltrating inflammatory processes are associated with this foramen, which can account for injuries of related structures. The increasing use of modern diagnostic procedures and new surgical approaches has created a need for much more detailed anatomical studies and explanations. Methods and materials: 44 jugular foramina of unknown age and gender were examined from the Department of Anatomy at SGRR Institute of Medical and Health Sciences, Dehradun, Uttarakhand. The morphological characteristic of all the foramina were studied, described and compared. **Result:** the mean anteroposterior, mediolateral diameter, area and depth of the jugular foramen was found to be greater on the right side than the left. **Conclusion:** The involvement of IX, X and XI cranial nerves at jugular foramen is known as Vernet's Syndrome, which might occur in this case due to narrowing of the jugular foramen. The need for familiarity with detailed anatomy of this region becomes greater importance for a neuro surgeon to approach this region.

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INTRODUCTION

The jugular foramen, a large irregular hiatus, lies at the posterior end of the petro-occipital suture between the jugular process of the occipital bone and jugular fossa of the petrous part of the temporal bone (Standring Susan, 2008). It allows the passage of important nervous and vascular elements, such as the glossopharyngeal nerve, vagus nerve, accessory nerves and the internal jugular vein (Avinash Kumar, 2015). The jugular foramen courses anteriorly, laterally, and inferiorly as it insinuates itself between the petrous temporal bone and the occipital bone. The jugular foramen is usually described as being divided into two parts by a fibrous or bony septum, called the jugular spine, into:

- The pars nervosa: anteromedial and smaller
- The pars vascularis: posterolateral and larger (Lo, 1996).

Patients with lesions of the jugular foramen most commonly present with combinations of cranial nerve palsies (cranial nerves VII, IX, XII), pulsatile tinnitus, and hearing loss.

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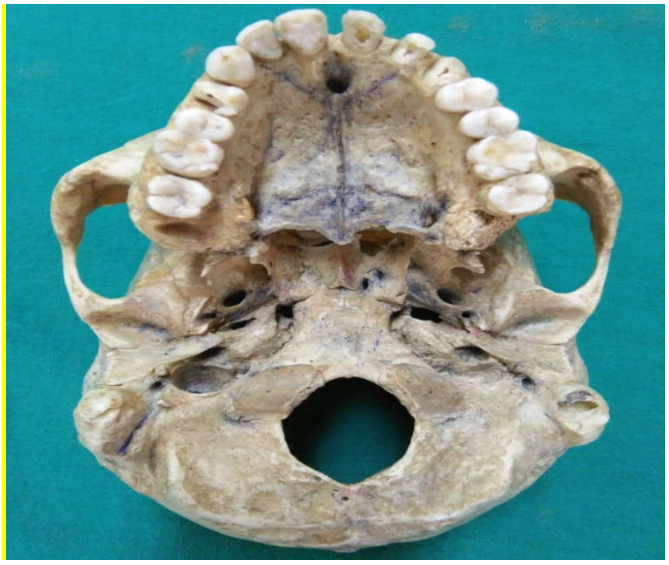
Patients may present with jugular foramen syndrome (Vernet syndrome), which is characterized by loss of taste in the posterior one-third of the tongue (cranial nerve IX); vocal cord paralysis and dysphasia (cranial nerve X); and weakness of the sternocleidomastoid and trapezius (cranial nerve XI). Larger tumors may also be indicated by nonspecific symptoms (eg, headache, increased intracranial pressure) or symptoms due to compression of adjacent structures such as the cerebellum and brain stem (eg, nystagmus, ataxia, dysequilibrium, long tract signs) (Hakuba, 1979). Intracranial and extracranial lesions may affect the jugular foramen in addition to intrinsic abnormalities. Pathological processes affecting JF include intracranial meningiomas, paragangliomas (glomus jugulare, from the jugular ganglion of the vagus nerve), schwannomas, metastatic lesions and infiltrative inflammatory processes from surrounding structures such as the middle ear (Chong, 1998). 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 (Shifan, 2013).

MATERIALS AND METHODS

44 jugular foramina of unknown age and gender were examined from the Department of Anatomy at SGRR Institute

of Medical and Health Sciences, Dehradun, Uttarakhand with the help of a digital vernier calliper. All skulls included in the studies were devoid of any gross malformation.



The parameters studied are:

- Maximum anteroposterior diameter of right and left jugular foramina
- Maximum mediolateral diameter of right and left jugular foramina.
- Area of right and left Jugular Foramina
- Depth of right and left Jugular Fossae
- Presence of domed right and left Jugular Fossae
- Number of septa in the right and left Jugular Foramina.

The mean, standard deviation (SD) and range of each dimension was calculated.

RESULTS

Comparision of dimensions of jugular foramen (n=22).

APD of right and left jugular foramen

	Right APD (in mm)	Left APD (in mm)
Mean	7.83	6.59
Standard Deviation	1.04	0.98

Mediolateral diameter of right and left jugular foramen

	Right MLD (in mm)	Left MLD (in mm)
Mean	13.56	11.01
Standard Deviation	1.59	1.77

Area of right and left jugular foramen

	Area of right JF(in mm)	Area of left JF (in mm)
Mean	106.09	72.91
Standard Deviation	18.64	17.89

Depth of right and left jugular fossa (in mm)

	Right FJD	Left FJD
Mean	11.82	8.79
Standard Deviation	4.43	3.71

Presence of Domed Jugular Fossa: Out of the 22 skulls examined, 14 skulls had dome in the roof on both the sides. 6 skulls had domed roof on single side (4 on the right and 2 on the left) and 2 skulls were observed with no domed roof.

Presence of septate jugular foramen on right and left sides: Bipartite jugular foramen (presence of a single septa) was observed in 11 skulls out of 22 skulls and tripartite jugular foramen (presence of two septa) was absent. 11 skulls had no septa.

DISCUSSION

In the present study, the anteroposterior diameter of the right jugular foramen ranged from 9.1 mm to 5.41 mm. The mean and standard deviation on the right APD were 7.83 mm and 1.04 mm respectively. The APD in the left JF ranged from 8.3 mm to 5.11 mm with mean and standard deviation as 6.59 mm and 0.98 mm respectively. The mediolateral diameter on the right JF ranged from 16.23 mm to 11.12 mm with mean and standard deviation as 13.56 mm and 1.59 mm respectively. The left MLD ranged from 13.93 mm to 7.56. The mean and standard deviation were 11.01 mm and 1.77 mm respectively. the area of the right jugular foramen ranged from 138.89 mm² to 70.39 mm². The mean and standard deviation were found as 106.09 mm² and 18.64 mm² respectively. Whereas the area of the left jugular foramen ranged from 115.62 mm² to 49.05 mm² with mean and standard deviation as 72.91 mm² and 17.89 mm². The depth of the right jugular foramen was between 19.18 mm to 5.21 mm. The mean and standard deviation were 11.82 mm and 4.43 mm respectively, whereas, the depth of the left jugular foramen was between 14.21 mm to 3.21 mm. The mean and standard deviation were 8.79 mm and 3.71 mm respectively. In the present study, 14 skulls had dome in the roof on both the sides. 4 skulls had domed roof on the right and 2 on the left whereas 2 skulls were observed with no domed roof. In this study, presence of a single septa (bipartite) was observed in 11 skulls out of 22 skulls and tripartite jugular foramen (presence of two septa) was absent.

Aydinlioglu A et al (2001)7 studied Eastern Anatolian skulls and reported that right APD (Rt APD) and left APD (Lt APD) were 12.2mm and 10.9mm respectively.

M. Anuradha and S. Chitra (2017) 8 reported that the mean anteroposterior diameter was 12.11 mm on the right side and 11.09 mm on the left side.

Shruthi B.N et al.,9 studied the anteroposterior diameter in adult dry skulls of South Indian origin and observed that it was 7.51±1.56 mm and 7.16±1.89 mm on the right and left respectively.

Namita A Sharma et al (2011)10 in their study of the foramina of skull base in 50 dry skulls said that the MLD of JF were 15.59±2.64 mm and 13.83± 4.94mm on the right and left sides respectively.

Anjali Singla et al (2012)11 studied 50 adult dry skulls and observed that the MLD of the JF were 15.67mm and 14.85mm on the right and left sides respectively.

Rahul Rai et al (2013)12 studied 100 dry skulls and observed that MLD of right JF was 12.90mm and the same of left JF was 13.01mm.

OE Idowu13 (2004) studied 40 JF of 20 Nigerian skulls and stated that mean JF area on the right was 437.49 mm2 and that on the left was 419.48 mm2.

Vijisha P et al 14(2013) in their study of 30 adult dry skulls reported that area of right JF was 210.87mm2 and that of the left JF was 141.93 mm2.

Chandni Gupta et al 15 (2014) studied 50 adult dry skulls and reported that mean area of JF were 187.34 mm2 and 153.2 mm2 on right and left sides respectively.

Ketu Chauhan et al 16(2011) in their study of 50 dry skulls reported that mean Rt FJD and Lt FJD were 13.08mm and 11.54mm respectively.

Anjali Singla et al 17 (2012) studied 50 adult dry skulls and reported that Rt FJD was 11.11mm and Lt FJD was 11.04mm.
Peiris HRD et al 18(2014) analysed 75 dry skulls and reported that the dome indicating the presence of a jugular bulb was present on right side in 34.9% and left side in 47.6% of skulls.

SA Athavale 19(2010) studied 116 dry skulls and reported that dome was present on right side in 78% and on left side in 69.4%.

R R Sturrock20 (1988) in his study of 156 adult dry skulls observed septate right JF in 4.5% and septate left JF in 14.1% specimens.

MM Patel et al 21(2007) in their study of 91 skulls stated that JF were septate in 73% on right side and 67.6% on left side.

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Vijisha P et al57 (2013) in their study of 30 adult dry skulls reported that Rt MLD was 17.33mm and Lt MLD was 15.30mm.

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