

MORPHOMETRIC AND MORPHOLOGIC STUDY OF JUGULAR FORAMEN IN WESTERN MAHARASHTRA REGION OF INDIA

Vishal Ramesh Jasuja ^{*1}, Prasad G. Kulkarni ², Shabana M. Borate ³, Pankaj R. Wadekar ⁴, Silky R. Punyani ⁵.

^{*1} Assistant professor, Department of Anatomy, People's College of Medical Sciences & Research Centre, People's University, Bhanpur, Bhopal, India.

^{2,3} Associate professor, Department of Anatomy, Grant Govt. Medical College & Sir J. J. Group of Hospitals, J. J. Marg, Nagpada, Mumbai, India.

⁴ Assistant professor, Department of Anatomy, Government Medical College, Akola, India.

⁵ Senior lecturer, Department of Oral Medicine and Radiology, People's Dental Academy, People's University, Bhanpur, Bhopal, India.

ABSTRACT

Background: The jugular foramen is an intricate anatomic area in the skull base owing to the fact that there are considerable differences in its dimensions bilaterally as well as in different cranial bases. Furthermore, it remains to be a difficult area to access for the neurosurgeon. Hence, knowledge of the precise anatomy and dimensions of the jugular foramen is imperative.

Materials and Methods: 100 (male-59; female-41) dry adult human skulls were obtained from the Dept. of Anatomy and Forensic Medicine & Toxicology of Grant Medical College in Mumbai, India. A millimetric sliding vernier caliper was used to measure the distances. The statistical analysis was done using the statistical package Graph Pad Prism 5 software.

Results: The sagittal diameter of the jugular foramen (SDJF) & the transverse diameter of the jugular foramen (TDJF) on the right side was significantly greater than that of the left side (p value: SDJF- 0.0001, TDJF- 0.045) for all samples studied. For all the samples studied there was a significant correlation between the right and left sides. (r values- SDJF-0.284, TDJF-0.474). In the male skulls SDJF was significantly greater on right side ($p < 0.0001$) whereas TDJF was non significantly greater on the right side ($p = 0.33$). For the female skulls both the parameters were significantly greater on the right side (p value: SDJF- $p < 0.0001$, TDJF- $p = 0.03$). In the gender comparative analysis, SDJF in the male skulls was greater than the female skulls on both the sides but the difference was non significant (p value: right side-0.56, left side-0.12). TDJF in male skulls was also greater than the female skulls and the difference came out to be significant on both sides (p value: right side-0.03, left side-0.0003). The occurrence of dome (49-bilateral, unilateral-35, 16-absent) and septation (58-absent, 10-complete, 32-partial) in the jugular foramen was also ascertained.

Conclusions: The study gives a useful perspective about the morphology of the jugular foramen in a subset of population in the western Maharashtra region of India. Studies with larger sample size are required to corroborate these findings and its relevance in a clinical setting.

KEY WORDS: Skull Base, Morphometry, Jugular Foramen, Dome, Septation.

Address for Correspondence: Dr Vishal Ramesh Jasuja, C-14 Senior MIG, PCMS Campus, People's University, Bhanpur, Bhopal, India. Mobile: 09685355774 **E-Mail:** vishaljasuja1@gmail.com

Access this Article online

Quick Response code



DOI: 10.16965/ijar.2016.150

Web site: International Journal of Anatomy and Research
ISSN 2321-4287
www.ijmhr.org/ijar.htm

Received: 15 Feb 2016 Accepted: 10 Mar 2016
Peer Review: 15 Feb 2016 Published (O): 31 Mar 2016
Revised: None Published (P): 31 Mar 2016

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. A number of important structures pass through this foramen: Inferior petrosal sinus (anterior); glossopharyngeal, vagus and accessory cranial nerves (middle); internal jugular vein (posterior) [1]. In addition to its intrinsic abnormalities, intracranial and extracranial pathologies like meningiomas, paragangliomas, schwannomas, metastatic lesions and infiltrative inflammatory processes from surrounding structures such as the middle ear, may affect this region [2]. Surgical resection is the mainstay of treatment in such cases. Most microsurgical techniques involve drilling the bone around the jugular foramen [3]. Moreover in developmental abnormalities like achondroplasia, there occurs a significant narrowing of the skull base [4]. There can be variations in its size on either sides and amongst different races. Hence a detailed knowledge of the anatomy of the jugular foramen and its dimensions is essential and valuable for the treating surgeon.

AIMS AND OBJECTIVES: With this backdrop our study was conceptualized and designed to perform a morphometric analysis of the jugular foramen by determining:

- A) Sagittal diameter of the jugular foramen-**SDJF** on both sides.
- B) Transverse diameter of the jugular foramen-**TDJF** on both sides
- C) Difference in these dimensions on the right and left side.
- D) Correlation between the right and left side.
- E) Gender comparative analysis for these dimensions

In addition to this morphological features of dome and septation in the jugular foramen were also assessed.

MATERIALS AND METHODS

100 dry adult human skulls (59 males and 41 females) were obtained from teaching skeletal collections & medico-legal samples of the bones

at the departments of Anatomy and Forensic Medicine, Grant Medical College, Mumbai. The determination of skull sex was performed by considering the classic anatomic characteristics as described by Mukherjee J. B [5].

A morphometric analysis of the jugular foramen was done by measuring the following distances : (Figure 1)

Fig. 1: Morphometric parameters of the jugular foramen; SDJF & TDJF.

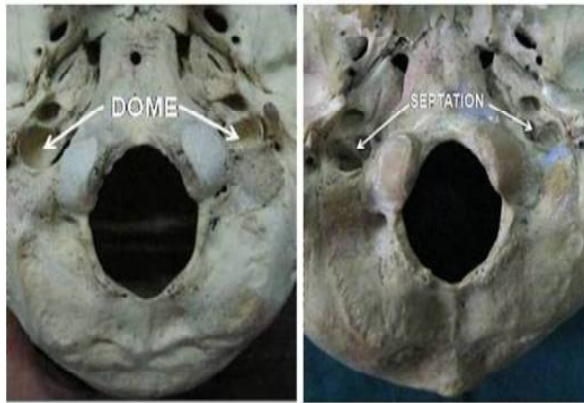


SDJF: It was measured between the anteriormost and the posteriormost points of the jugular foramen.

TDJF: It was measured between between the medialmost and the lateralmost points of the jugular foramen.

The above parameters were measured with a sliding vernier caliper in mm. scale. Photographs of the skull base were captured with a digital camera. Additionally, a few morphological features were observed i.e the presence or absence of the Dome i.e presence or absence of a domed bony roof. Septation i.e bony bridge dividing the foramen into compartments either complete or incomplete was also assessed (FIGURE 2). The statistical analysis was done using the statistical package GraphPad Prism 5 software. The p value of < 0.05 was considered as significant for all the tests applied. The mean values of the different parameters were compared by using unpaired t-test. To determine the relationships between the studied parameters, Pearson correlation coefficients were calculated.

Fig. 2: Morphologic features of the jugular foramen; Dome & Septation.



RESULTS AND DISCUSSION

Table 1 summarizes the mean \pm standard deviation of the values (in mm) obtained for the sagittal and transverse diameter of the jugular foramen for, all samples studied (n=100), male skulls (n=59) and female skulls (n=41).

Table 1: Mean \pm standard deviation values of SDJF & TDJF.

Sl. no	Parameter	Mean \pm SD(mm)		
		Total samples (n=100)	Male skulls (n=59)	Female skulls (n=41)
1	SDJF-right	11.80 \pm 1.82	11.189 \pm 1.76	11.67 \pm 1.92
2	SDJF-left	10.04 \pm 1.90	10.29 \pm 1.89	9.69 \pm 1.88
3	TDJF-right	17.28 \pm 2.11	17.66 \pm 2.20	16.75 \pm 1.88
4	TDJF-left	16.7 \pm 2.01	17.29 \pm 1.85	15.84 \pm 1.94

SDJF and TDJF in all samples: In all the 100 samples collectively, the SDJF was significantly greater on the right side as compared to the left (p value= 0.0001). The same held true for TDJF being significantly greater on the right side (p value= 0.045). For all the samples studied there was a positive correlation between the values obtained for the right and left sides. The Pearson's correlation coefficient i.e r value for SDJF was 0.284 and for TDJF it was 0.474.

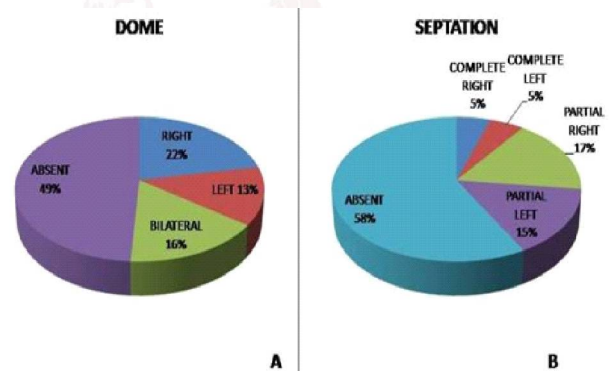
SDJF and TDJF separately in the male & female skulls: In the 59 male skulls, SDJF was significantly greater on right side as compared to the left (p<0.0001). The TDJF was also greater on the right side but the difference from the left side was statistically non significant (p=0.33). For the 41 female skulls studied both these parameters were significantly greater on the right side (p values: SDJF- 0.0001, TDJF-0.03).

Gender Comparative Analysis: On comparing the findings between the male and female skulls

it was found that both the parameters were higher in the male skulls for both the sides. Though SDJF was higher in male skulls on both the sides, the difference was statistically non significant (p values: right side-0.56, left side-0.12). As opposed to this, TDJF in the male skulls was significantly greater on both sides as compared to the female skulls (p value: right side-0.03, left side-0.0003).

Dome and septation: The presence of a dome is attributed to a prominent superior bulb of the internal jugular vein. It may be partly or completely divided into three compartments by small spicules of bone giving rise to septations [6]. Figure 3 is a graphical representation of the presence or absence of dome (A) and septation (B) expressed as a percentage of the total sample size.

Fig. 3: Percentage of samples showing presence/ absence of Dome & Septation.



Woodhall postulated that the shape and size of the jugular foramen was related to the size of the internal jugular vein and the presence or absence of a prominent superior bulb. It might be expected that the right foramen would usually be larger than the left [7]. Our study was performed to carry out a morphometric and morphologic assessment of the jugular foramen in the adult skull bases of a subset of population. This was the first study of its kind carried out in the regional population of the western Maharashtra, India. The findings of the present study were in accordance with those by Woodhall[7]; Ekinici N, Unur E [8]; Aynur Emine Cicekcibasi et al [9] as far as dimensions of the jugular foramen were concerned, being more on the right side. Thus affirming the view that the superior sagittal sinus drained into the right transverse sinus, which poured into the right internal jugular vein. So the size of the internal

jugular vein, being more on the right side would be reflected by increased diameters of the jugular foramen on the right side as a complementary mechanism. Lang[10] stated that in most cases the width of the right jugular foramen was greater than that of the left, but there was no difference in respect of the length. But in the present study these two parameters were significantly greater on the right side. Also the TDJF was significantly greater in the male skulls, which was insignificant in the study of Aynur Emine Cicekcibasi et al[9]. The significant bilateral differences (Rt>Lt) in the length and the width of the jugular foramen in the present study also contradicted with those of the study of O. E. Idowu [11] in which those were insignificant. These differences could be attributable to different racial and geographical characteristics of the populations studied.

In relation to the presence or absence of the dome our results were similar to those by R. R. Sturrok [12] and M. Tahir Hatiboglu, Afitap Anil [13] where dome was bilateral in the majority of skulls. However in the study by Patel M.M, Singel TC [14] it was present on the right side in 38.5% of the skulls. As far as the occurrence of the septation is concerned, the results were similar to those by R. R. Sturrok [12] and M. Tahir Hatiboglu, Afitap Anil [13] where complete septation of the jugular foramen was rare. Partial septation of foramina as per study of R. R. Sturrok [12] was in accordance with the present study. In study of M. Tahir Hatiboglu, Afitap Anil [13] there seemed to be a mismatch, with only 2.6% of their studied skulls showing a partial septation on the right side. However in the study by Patel M.M, Singel TC [14] a considerable number of the skulls exhibited a septation: complete and partial on the right and left sides.

CONCLUSION

A precise knowledge of the jugular foramen morphometrics is essential to the neurosurgeon, often posed with the colossal challenge of approaching this area to treat various pathologies afflicting this area. Our study definitively concluded that the right side jugular foramen is larger and measurements are greater in the male skulls. Based on our findings, the morphologi-

cal features of dome and septation can be randomly expected without any reliable indicators of the same. Further studies correlating the jugular foramen morphometrics on the dry skull specimens and radiographs of the same could provide an insight on the difference of the actual and radiographic measurements and thus validate the utility of such a study in a clinical scenario.

ABBREVIATIONS

SDJF: Sagittal diameter of the jugular foramen.

TDJF: Transverse diameter of the jugular foramen.

Conflicts of Interests: None

REFERENCES

- [1]. Standring Susan, Berkovitz Barry KB. Head and Neck. In: Gray's Anatomy The Anatomical basis of clinical practice. 40th edition. Elsevier Churchill Livingstone; 2008;409-417.
- [2]. Kanemoto Y, Ochiai C, Yoshimoto Y, Nagai M. Primarily extracranial jugular foramen neurinoma manifesting with marked hemiatrophy of the tongue: case report. *Surg Neurol* 1998 May; 49(Suppl 5):534-537.
- [3]. Tekdemir I, Tuccar E, Aslan A, Elhan A, Deda H, Ciftci E, Akyar S. The jugular foramen: a comparative radioanatomic study. *Surgical Neurology* 1998;50:557-562.
- [4]. Francis J. DiMario Jr, Gale R. Ramsby, Joseph A. Burlinson and Ian R. Greensheilds. Brain morphometric analysis in achondroplasia. *Neurology* 1995;45:519-524.
- [5]. Mukherjee JB. Personal identification: sex difference in bones. In: Forensic medicine and toxicology. 3rd edition. Academic publishers; 2007:116-118.
- [6]. Romanes G.J. Bones, the skull. In: Cunningham's textbook of Anatomy. 11th edition. Oxford university press; 1972:112.
- [7]. Woodhall B. Anatomy of the cranial blood sinuses with particular reference to the lateral. *Laryngoscope* 1939;49:966-1010.
- [8]. Ekinci N, Unur E. Macroscopic and morphometric investigation of the jugular foramen of the human skull. *Kaibogaku Zasshi* 1997;72:525-529.
- [9]. Aynur Emine Cicekcibasi, Khalil Awadh Murshed, Taner Zuylan, Muzaffer Seker, Isik Tuncer. A morphometric evaluation of some important bony landmarks on the skull base related to sexes. *Turk journal of medical sciences* 2004;34:37-42.
- [10]. Lang J. Skull Base and Related Structures D Atlas of Clinical Anatomy. (Translation into English by Juliane Kemmer). Schattauer Verlagsgesellschaft mbH. Stuttgart, 1995.
- [11]. Idowu OE. The jugular foramen – a morphometric study. *Folia Morphol.* 2004;63 (Suppl 4):419-422.

- [12]. Sturrock RR. Variations in the structure of the jugular foramen of the human skull. *Journal of Anatomy* 1988;160:227-230.
- [13]. Hatiboglu MT, Anil A. Structural variations in the jugular foramen of the human skull. *Journal of Anatomy* 1992; 180:191-196.
- [14]. Patel MM, Singel TC. Variations in the structure of the jugular foramen of the human skull in Saurashtra region. *Journal of Anatomical Society of India* 2007;56(Suppl 2):34-37.

How to cite this article:

Vishal Ramesh Jasuja, Prasad G. Kulkarni, Shabana M. Borate, Pankaj R. Wadekar, Silky R. Punyani . MORPHOMETRIC AND MORPHOLOGIC STUDY OF JUGULAR FORAMEN IN WESTERN MAHARASHTRA REGION OF INDIA. *Int J Anat Res* 2016;4(1):2085-2089. **DOI:** 10.16965/ijar.2016.150

