

## VARIATIONS OF JUGULAR FORAMEN OF THE DRIED HUMAN SKULLS IN BIHAR

## Anatomy

**Dr. Hari Govind Prasad\***

Junior Resident, Department of Anatomy, DMCH, Darbhanga, Laheriasarai.  
\*Corresponding Author

**Dr. Kumar Shaleen** Junior Resident, Department of Anatomy, DMCH, Darbhanga, Laheriasarai.

**Dr. Seema Tabassum** Associate Prof. Department of Anatomy, DMCH, Darbhanga, Laheriasarai.

**Dr. S. K. Karn** Prof. & Head, Department of Anatomy, DMCH, Darbhanga, Laheriasarai.

## ABSTRACT

**Background:** The jugular foramen is the second largest foramen of the skull base. The jugular foramen is a large irregular hiatus, lies at the posterior end of the petro-occipital suture between the jugular process of the occipital bone and jugular spine of the petrous part of temporal bone. **Material And Methods:** Methods: Cross sectional study Total 102 dried human skulls were selected for the present study, Department of Anatomy, DMCH, Darbhanga, Laheriasarai, Bihar. **Conclusion:** The length and width of right jugular foramen were larger than the corresponding parameters of left side in majority of skulls which was statistically significant and this is attributed to larger sigmoid sinus on the right side.

## KEYWORDS

Human skull, Jugular Foramen, Morphometry, Bony Compartments, Length, Width.

## 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 the 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). A mastoid canaliculus runs through the lateral wall of the jugular fossa and transmits the auricular branch of the vagus nerve. The canaliculus for the tympanic nerve, branch of glossopharyngeal nerve lies on the ridge between the jugular fossa and the opening of the carotid canal. A small notch, related to the inferior glossopharyngeal ganglion, may be found medially, on the upper boundary of the jugular foramen (it is more easily identified internally), the orifice of the cochlear canaliculus may be found at the apex of the notch.<sup>4</sup> That the temporal and occipital bones forming the jugular foramen (JF) have irregular shapes, and also that embryologically the neurovascular structures traversing the foramen develop first and the bony structures develop later, is possibly responsible for this variability.<sup>5</sup> The left and right jugular foramina are asymmetrical. Usually the left is smaller than the right, which is presumed to have some relation with the dominance of the right cerebral venous drainage.<sup>2</sup> Two principal factors contribute to this asymmetry: 1) variability in bone formation around the primitive foramen lacerum posterius, and 2) unequal development of the transverse dural sinuses. The latter factor is usually more significant and is largely more responsible for the major differences in the size of the jugular foramina in a given skull. Thus when the transverse sinuses are equal in size, the jugular foramina are likely to be symmetrical; when one transverse sinus is much larger than the other, the JF on the side of the large sinus is larger.<sup>7</sup>

The jugular foramen is difficult to understand and to access surgically. It is difficult to conceptualize because it varies in size and shape in different crania, from side to side in the same cranium, and 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. Jugular foramen lesions are rare.<sup>10</sup> Lesions in the region of the jugular foramen may be indistinguishable from one another.

A competent diagnosis in such cases requires a detailed radiographic investigation. An in depth knowledge of the variation in size and shape of the jugular foramen would therefore be of value in the interpretation of radiographs involving this area.<sup>11</sup> It is important to recognize these anatomical relationships for exact interpretation of the high resolution computerized tomography (HRCT) images. The further anatomical studies are still needed and should be encouraged, to improve our understanding of the JF anatomy.<sup>13</sup> Despite numerous studies regarding the JF anatomy, it still requires further detailed studies.<sup>5</sup>

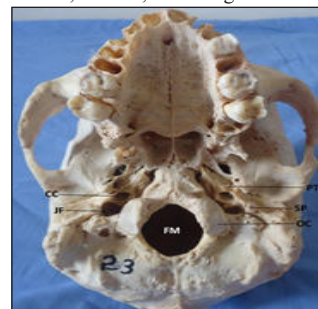
## REVIEW OF LITERATURE:

The jugular foramen lies medial to the external acoustic meatus, and almost level with its lower border.<sup>14</sup> The foramen may be partly or completely divided into three compartments by small spicules of bone.<sup>14</sup> The jugular foramen is situated so that its long axis is directed from posterolateral to anteromedial, giving it an anterolateral margin formed by the temporal bone and a posteromedial margin by the occipital bone. From the intracranial end, it is directed forward, medially, and downward.<sup>8</sup> The junction of the sigmoid and petrosal parts is the site of bony prominences on the opposing surfaces of the temporal and occipital bones, called the intrajugular processes, which are joined by a fibrous, or less commonly an osseous bridge, the intrajugular septum, separating the sigmoid and petrosal part of the foramen.<sup>8</sup> Although the margins of the jugular foramen are formed by the petrosal part of the temporal bone and the condylar part of the occipital bone, the other parts of these bones also have important relationships to the jugular foramen.<sup>8</sup>

The base of the skull showing exocranial opening of Jugular Foramen showing foramen magnum (FM), jugular foramen (JF), lower opening of carotid canal (CC), occipital condyle (OC), petrous part of temporal bone (PT), and styloid process.

## MATERIALS AND METHODS

The Cross sectional study Total 102 dried human skulls were selected for the present study, Department of Anatomy, Darbhanga medical college and Hospital, Darbhanga, Laheriasarai, Bihar. From the Museum, Department of Anatomy, from the osteology tutorials, Department of forensic, DMCH, Darbhanga.



## Inclusion Criteria:

Normal looking, non damaged non pathological adult dried human skulls.

## Exclusion Criteria:

- a) Malformed and damaged skulls
- Unossified skulls.
- Foetal skulls.

**RESULTS****STUDENT'S „t“ TEST AND PEARSON CORRELATIONS OF THE CONTINUOUS VARIABLES**

| Variables | t value | p-value | r     | p-value | Significance |
|-----------|---------|---------|-------|---------|--------------|
| RL-LL     | 6.980   | 0.0000  | 0.377 | 0.0000* | HS           |
| RW-LW     | 9.842   | 0.0000  | 0.109 | 0.274   | NS           |
| RL-RW     | 26.500  | 0.0000  | 0.161 | 0.107   | NS           |
| LL-LW     | 29.135  | 0.0000  | 0.412 | 0.0000* | HS           |
| RL-LW     | 33.623  | 0.0000  | 0.097 | 0.334   | NS           |
| LL-RW     | 16.693  | 0.0000  | 0.143 | 0.150   | NS           |

RL-right length, LL-left length, RW-right width, LW-left width, r-Pearson correlation coefficient; (\*p<0.05 Significant, p<0.001 Highly Significant)HS-highly significant, NS-not significant. The lengths and widths of right and left sides were subjected to Student's „t“ test and „p“ value was <0.001 so it was highly significant statistically.

**RELATIVE DIAMETERS OF JUGULAR FORAMINA**

|            | Relative diameters of jugular foramen |        |       |        |        |       |
|------------|---------------------------------------|--------|-------|--------|--------|-------|
|            | RL>LL                                 | LL>RL  | RL=LL | RW>LW  | LW>RW  | RW=LW |
| Number     | 74                                    | 25     | 3     | 88     | 12     | 2     |
| Percentage | 72.55%                                | 24.51% | 2.94% | 86.27% | 11.77% | 1.96% |

RL-right length, LL-left length, RW-right width, LW-left width

**Predominance Of Dimensions:**

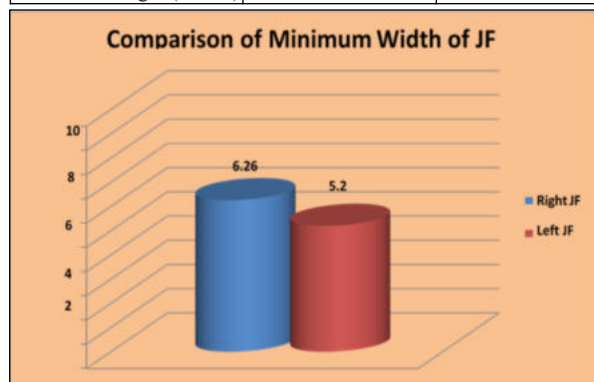
In 72.55% of skulls the length of right JF was larger than the left and in 24.51% the left was larger than the right, whereas in 2.94% skulls the length of right and left jugular foramen were equal. The width of right JF was larger than the left in 86.27% and left was larger than right in 11.77% skulls whereas in 1.96% skulls the width of right and left JF were equal.

**COMPARISON OF MAXIMUM LENGTH OF RIGHT AND LEFT JUGULAR FORAMEN**

|                        | Right JF | Left JF |
|------------------------|----------|---------|
| Maximum Length (in mm) | 19.72    | 20.62   |

**COMPARISON OF MINIMUM LENGTH OF RIGHT AND LEFT JUGULAR FORAMEN**

|                        | Right JF | Left JF |
|------------------------|----------|---------|
| Minimum Length (in mm) | 11.42    | 8.34    |



showing comparison of Minimum Width of Right and Left Jugular Foramen.

**DISCUSSION**

A study on structural variations of jugular foramen of 102 dry human skulls of Region has been conducted in DMCH darbhanga Bihar. The morphologic analysis of jugular foramen was carried out by comparing the presence of bony septations whether complete, incomplete or absent. Number of compartments and formation of dome and gutter is also noted and analyzed statistically. The morphometric analysis was carried out by taking measurements of length and width of jugular foramen using digital Vernier Calipers. Range, mean and standard deviations are calculated. Dodo Y in 1986 studied JF in 222 skulls and he reported complete bony septations in 5.85% on right side and 6.31% on left side. Sturrock R.R (1988) studied 156 skulls; he found complete septations on right side in 3.2% and on left side in 3.2% of skulls. In 1992 Hatiboglu M.T et al studied 300 Anatolian skulls and reported complete septations in 5.6% on right side and in 4.3% on left side. Patel.

M.M et al in 2007 studied 91 skulls and found complete septations in 23.1% of skulls on right side and in 17.6% on left side. Hussainsaheb S et al reported complete bony septations in 20.8% on right side and in 16.8% on left side of their 125 skulls study in, India. Athawale S.A reported complete bony septations in 24.3% on right side and in 24% on left side in her study of 116 skulls in South India. Incomplete (partial) bony septations of jugular foramen were found in 1.3% on right and in 10.9% on left side in a study of 222 skulls by Sturrock R.R et al in 1988. In their study of 300 Anatolian skulls in 1992, Hatiboglu M.T et al reported incomplete bony septations in 19% on right side and in 5.65 on left side. Patel M.M et al in 2007 studied 91 skulls in Saurashtra region, Gujarat, India and noted incomplete septations in 49.5% on right side and in 59.3% on left side. Athawale S.A studied 116 South Indian skulls in 2010 and observed partial septations in 17.2% on right side and in 12.9% on left side. In 2010, a study on 125 South Indian skulls carried out by Hussainsaheb S et al observed incomplete septations in 45.6% on right side and in 58.4% on left side. Vijisha P et al reported incomplete bony septations in 73.3% on right side and in 80% on left side in their study of 30 skulls in 2013. In the present study of 102 skulls, incomplete bony septations were found in 62.75% on right side and in 67.65% on left side far higher compared to other studies. In the present study of 102 skulls there was presence of dome in 99 (97.06%) skulls on right side only and in 87 (85.09%) skulls on left side only, but dome was absent in 3 (2.94%) skulls on right side only and it was absent on left side only in 15 (14.71%) skulls. It was bilaterally present in 85 (83.33%) skulls. Present study has higher percentage of presence of dome unilaterally as well as bilaterally compared to any other previous studies. In present study of 102 skulls the mean length of right JF (16.02 mm) was larger than the left JF (14.41 mm). The mean width of right JF (10.19 mm) is larger than that of left (8.08 mm). In the above studies it is clear that the mean length and width of right side are larger than left with few exceptions. The mean length of right JF (16.02 mm) in present study closely resembles that reported by Pereira G et al (15.82 mm), Di Chiro et al (16.6 mm), Osunwoke E.A et al (15.76 mm) and Singla S et al (15.67 mm) whereas it differs by a large margin with that of Hussainsaheb et al (23.62 mm). The mean length of left side of present study (14.41 mm) is closer to that reported by Idowu O.E et al and Singla A et al. The mean width of right side in present study (10.19 mm) is nearer to that reported by Idowu O.E et al and the mean width of left JF in present study (8.08 mm) is closer to that reported by Chauhan K et al. There were few exceptions in the individual skulls where 24 (20%) of the skulls had jugular foramen with large left width and small right width, another 12 skulls (10%) had jugular foramen with large left length and small right length. 3 Vijisha P et al predominance of one of the two foramina in 26 cases (86.6%). Predominance on the right was 23 (76.6%) and 3 (10%) on left respectively. In two skulls (6.6%) the sizes were equal on both sides.

**CONCLUSION**

The length and width of right jugular foramen were larger than the left length respectively in majority of skulls which is statistically significant. The incidence of complete bony septations (bony bridging) was not that common the skulls of present structure. Complete bony septations were present in 7.84% of skulls on right side and in 0.98% only on left side, which is less compared to many studies. The present study observed the variations of exocranial opening of jugular foramen which are different from the observations made by previous studies may be because of the skulls from different geographical areas.

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