**Original Research Paper** 



# Anatomy

# MORPHOLOGICAL STUDY OF JUGULAR FORAMEN IN HUMAN ADULT NEUROCRANIUM

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ABSTRACT (AIM: To evaluate bilateral morphological features of the Jugular Foramen in human adult skulls.

Material and methods: Study was conducted in 50 crania(unknown sex) of Indian origin. Morphological features of the Jugular foramen studied in detail like likeDome (presence/ absence), Septa(presence/ absence) & Type of septa (complete/incomplete) were noted and are the values are compared with the earlier literature.

**OBSERVATIONS & RESULTS:** Morphology of the jugular foramen is observed for Dome (presence/ absence), Septa(presence/ absence) & Type of septa (complete/ incomplete). Mean Dimensions for the right side (APD, MLD& AREA) were  $11.8 \pm 2.03$ mm,  $15.7 \pm 2.42$ mm,  $141.45 \pm 41.18$ mm and the left side were  $11.3 \pm 1.85$ mm,  $13.72 \pm 2.31$ mm,  $120.41 \pm 36.24$ mm respectively **CONCLUSION:** In depth knowledge on morphological features of the jugular foramen could assist the neurosurgeons and the radiologists.

**KEYWORDS** : Crania, Jugular foramen, Morphology

## INTRODUCTION:

Jugular foramen (JF) is formed in front by the petrous part of temporal bone and behind by the occipital bone which is partially or totally divided into three compartments by small bony spicules.

JF transmits inferior petrosal sinus, IX,X & XI cranial nerves, the sigmoid sinus and meningeal branches of ascending pharyngeal and occipital arteries.

Obstruction of JF will cause Vernet's syndrome{paresis of IX,X,XI nerves together} leading to dysphagia, breathing difficulty, hoarseness, and pneumonia due to aspiration are potential dangerous problems<sup>1</sup>. If neural preservation is to be done a good understanding in measurements of JF and the relationship between the compartments are essential<sup>2</sup>.

## MATERIAL AND METHODS:

Present study is carried out in 50 crania of unknown sex that has been obtained from Anatomy department, Vishnu dental college ,Andhrapradesh, India . Skull with any fractures or pathology are not included in the study. Morphological features of the Jugular foramen like Dome (presence/ absence),Septa(presence/ absence) & Type of septa (complete/ incomplete) were noted and are the values are compared with the earlier literature.

### **RESULTS:**

Morphology of jugular foramen is observed for presence or absence of dome, septal presence or absence and for dominance of jugular foramen. Bilateral occurrence of bony roof of jugular fossa was observed among 21% of skulls, bilateral absences were noticed in 38% skulls. Unilateral incidence was observed in 28% and 13% on successive Right and Left sides.

Complete septum on the right side was observed among 17.5% and on left side among 18% skulls. Incomplete septa were noticed among the right side in 15.5% and on left in 12.5% of the specimens.

Right one is bigger than the left foramen in 70% of samples. Left one is larger than the Right among 25% of the cases. 5% of the samples executed equivalence on both the sides. representing the superior jugular bulb<sup>3</sup>Jugular foramen differs in its size, shape, laterality dominance aside from its association with sex and racial disparities. Many authors have reported about laterality dominance<sup>4, 5, 6</sup>. Winsock, Chmielik and Gacek, 1999; Berge and Bergman, 2001; Idowu, 2004.

The foramen's irregular size & shape among different crania, difference in the same cranium from side to side, complexity information by two bones, and multiple nerves, arteries and venous channels passing through the foramen further defines the difficulty in understanding its anatomy<sup>7</sup>.

Vesalius (1543) has reported compartmentations of jugular foramen in his presentations on base of skull. Handful of studies involving osteological, radiological and micro dissections was executed to resolve the uncertainity in compartmentation and dissimilarity in the jugular foramen anatomy, which led to contradictory findings.

Anomalies associated with jugular bulb and jugular fossa may directly affect the structures like internal jugular vein The level of the bony roof /dome of the jugular fossa corresponds to the higher boundary of jugular bulb.

The higher prevalence of dome of jugular fossa and the outstanding superior jugular bulb on the right side may be often associated with drainage of superior sagittal sinus Via Rt transverse sinus and Rt sigmoid sinus and Rt Internal Jugular vein.

An injury during middle ear operations ensues because of the absence of dome with consequential exposure of the jugular bulb particularly due to more slender vessel wall in this region<sup>8</sup>

### Incidence Of Dome / bony Roof Of Jugular Fossa

In the present study Bilateral occurrence of bony roof of jugular fossa was observed among 21% of skulls, bilateral absences were noticed in 38% skulls. Unilateral incidence was observed in 28% and 13% on successive Right and Left sides as indicated in Table no In a study conducted by Namita A Sharma et al (2011)<sup>9</sup> on 50 human dry skulls stated that incidence of unilateral dome in 28% and in 8% on right & left sides respectively and bilateral bony roof among 58%.,Bilaeteral absence in 6%.In an analysis done by Vijisha P et al<sup>10</sup> (2013) on 30 skulls noticed that bilateral bony roof

# DISCUSSION

Jugular foramen presents a bony roof called Dome P et al<sup>™</sup> 128 ☆ GJRA - GLOBAL JOURNAL FOR RESEARCH ANALYSIS dome was seen in 70% and unilateral was observed on right side among 26.6% and on left side among 3.33 % .Another study performed by Roma Patel et al<sup>11</sup> in the year 2014 on 100 dry skulls expressed that bilateral dome of the jugular bulb was observed in 23% and absent in 36%.On right side among 30% skulls and on the left side among 11%.skulls it was evident as unilateral. Thus the current study of bony roof of jugular fossa is in correlation with the earlier studies as depicted in figure 1.



# Incidence Of Septa In Jugular Foramen

Factors such as unpredictability of bone development in the region of primal posterior foramen lacerum can lead to variability in the anatomical character and the prevalence of septation. There could anatomical disparity among the cranial nerves based on the nature of septation and its types. In a study performed by Roma Patel et al (2014)<sup>11</sup> on 100 adult dried skulls expressed that presence of septa on Rt and Lt sides were 45% and 39% respectively. As reported by Vikas. C.Desai et al (2017)<sup>12</sup> out of 263 skulls incidence of Complete septation on the right side was 47(17.87%) & on the left side was 56(21.29%). Incomplete partition on the right side was noticed in 92(34.98%) and on the left side in 101(38.40%) of cases. No partition has been observed in 124(47.14%) & 106(40.30%) of Rt and Lt sides separately. Shifan Khanday et al<sup>13</sup> (2013) studied 324 skulls (648 JF) and analyzed Jugular foramen is septate among 36.3% and 24.1% on Rt and Lt sides respectively.

In the current study it was observed that complete septum on the right side among 17.5% and on left side among 18% skulls. Incomplete septa was noticed among the right side in 15.5% and on left in 12.5% of the specimens. The values were in coincidence with the previous researchers as shown in figure 2



#### Figure 2

### Jugular Foramen Dominanace

It was noted from the present study of jugular foramen Rt one is bigger than the left foramen in 70% of samples. Lt one is larger than the Rt among 25% of the cases. 5% of the samples executed equivalence on both the sides as shown in Figure 3. The present values are almost in accordance to that of the previous details, mention by various authors as depicted in Figure 4 except with that of Ruchira sethi and Vikas.C.Desai et  $al^{12}$  in the studies of which both the authors found more uniformity in the Jugular foramen.



## Figure 3

## JUGULAR FORAMEN DOMINANCE



Figure 4

In an investigation done by Ruchira Sethi et al (2011)<sup>14</sup> over 56 dry adult skulls, announced that the Rt jugular foramen is bigger in 53.5% and Lt jugular foramen is bigger in 7.1% skulls. In 39.4% of the skulls the jugular foramen was equivalent in size on the two sides. Another study performed by Roma Patel et al (2014)<sup>11</sup> on 100 adult dried skulls expressed that size of the jugular foramen changed on the different sides. The Rt foramen is bigger than the Lt observed in 75%, Rt littler than the Lt were 23% and both were of equivalent size in 2%. Prefulla P.R (2016)<sup>15</sup> analyzed 100 adult dry skulls and reported that the area of Rt Jugular Foramen in 69% of skull was greater than the Lt. JF is larger on the left side in 25% and equal bilaterally among 6% skulls. As reported by Vikas.C.Desai et al (2017)<sup>12</sup> out of 263 skulls in 61.21% of cases the Rt foramina were larger than the Lt, in 13.68% of cases the Lt foramina were larger than the Rt and in 25.09% cases were equivalent on the two sides 70% of the Jugular foramen dominance on the right side from the current study is in coincidence with jugular venous supremacy happening in 70% to 80% of cases on right side. Surgical procedures such as major neck dissection, obliteration of internal jugular vein, particularly of the dominant side, may result in cerebral hemorrhage, clot development and Dural arteriovenous deformity. This awareness will be helpful during IJV cannulation by interventionists.

### **CONCLUSION:**

Present study is focused on a profound detailing of the jugular foramen & it reinforces the reported variations and also succour Neurosurgeons in dealing with space occupying leisions of jugular foramen& also they can proceed towards the cranial base with minimal morbidity & mortality, Radiologists in their approach to proper diagnosis .The divergence in the anatomy and the morphometry of the jugular foramen & its indications necessitates further studies.

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