To study the side dominance, depth, width, and septation of Jugular Foramen of dry skulls

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Abstract:

Background: The goal of this study is to learn more about the variations in and around the jugular foramen in adults. As a result, the current study’s hypothesis states that there is no variation in or around the jugular foramen in adult human skulls. We set out to determine the side dominance, depth, width, and septation of dry skull jugular foramen, as well as the variations in jugular foramina that differed from previous observations due to geographical differences between the study sites. Materials & Methods: Damaged skulls with unidentifiable features of jugular foramen were not included in this study's exclusion criteria. 60 adult dry human skulls of unknown sex Caliper, flexible wire and 25G Spinal needle with rubber stopper. Results: The present study had shown the 53% dominance on the right side of Jugular Foramen and 40% dominance on the left side of Jugular Foramen, whereas 7% of skulls have shown no dominance on either side of Jugular Foramen. The width of right & left Jugular Foramen shown a mean measurement of 7.48 mm & 8.32 mm respectively. The depth of the right & left Jugular Foramen were mean measurement of 2.98 mm & 11.02 mm respectively. The present study observed septum and this accounts to 88% absence of septum on Jugular Foramen and bilateral presence of septum on Jugular Foramen at 12%. On both sides, a positive correlation was found between the width and depth of the Jugular Fossa. Conclusion: According to this research, the Jugular Foramen is as described on the Indian subcontinent. It was discovered that the findings did not match up with those of other studies suggesting that the Jugular Foramen has ethnic, demographical, and spatial variations.

Introduction:

Extensive research on human age morphology, particularly the problem of acceleration, was conducted in the early 1950s. When conducting morphological research, it is possible to acquire information regarding the body composition, also known as the tissue components that make up the body of a living human being, thanks to the utilization of physical and chemical analysis. In addition to this, research is being conducted to investigate the genetics of morphological characteristics, the influence of environmental factors on human morphology, and the relationship between morphological features and biochemical, physiological, and endocrinological characteristics. As an example, anthropological standardization and biotechnology frequently use morphological data to design consumer goods and workplaces that are convenient for both the user and for maximum efficiency.

According to [1,2], the jugular foramen is an opening that is formed anteriorly by the petrous part of the temporal bone and posteriorly by the occipital bone. Its primary function is to serve as a passageway for essential structures to exit [1-3]. The sigmoid sinus and jugular bulb, the inferior petrosal sinus, meningeal branches of the ascending pharyngeal and occipital arteries, the glossopharyngeal, vagus, and accessory nerves with their ganglia, and the tympanic branch of the glossopharyngeal nerve traverse the jugular foramen [1-3]. As a result, any tumor that forms a ring around the bony structure of the jugular foramen would compress the passing structures. The passing structures may be altered if the base of the skull fractures. Alternately, any infection that is present in the vicinity, on the structures, or within the structure itself has the potential to cause the infection to spread.

The goal of this study is to learn more about the variations in and around the jugular foramen in adults. As a result, the current study’s hypothesis states that there is no variation in or around the jugular foramen in adult human skulls. We set out to determine the side dominance, depth, width, and septation of dry skull jugular foramen, as well as the variations in jugular foramina that differed from previous observations due to geographical differences between the study sites.

Materials & Methods:

The Ethics committee of the university gave its permission to the current investigation, so it could begin. The Anatomy department of Index Medical College & Hospital, Indore, India, provided sixty normal skulls for the study. The length, width, and area of the jugular foraminae were measured and documented. Vernier calipers were used to measure sagittal and transverse diameters. Each dimension was measured three times, and the average figure was taken into account. Both sides would be compared and contrasted. The jugular fossa and septation are also present. Adult human dry skulls of unknown sex with clearly defined skull sutures met the inclusion criteria. Damaged skulls with unidentifiable features of jugular foramen were not included in this study's exclusion criteria. 60 adult dry human skulls of unknown sex Caliper, flexible wire and 25G Spinal needle with rubber stopper.
Asymmetry in the location of the right and left jugular foramina in the same skull reveals the presence of this condition. Jugular Foramen area on the right side is greater than that on the left side. dominance on the left side of the jugular foramen compared to the right Area of the right Jugular Foramen and left Jugular Foramen are the same. When measuring Jugular Fossa Width, it is important to know the distance between the lateral and medial most points of the Jugular Fossa. In order to measure the depth of the Jugular Fossa, a 2SG spinal needle and a rubber stopper are used. A digital Vernier caliper is used to get the measurement. It is accurate to within 0.001 inch. The following morphological characteristics were observed with a simple visual inspection. The Jugular Foramen contains a septum: Bony septum (septum) dividing the Jugular Foramen into three compartments has been analyzed. The foramen jugulare is divided into the following categories: a single septum in the bipartite jugular foramen The presence of two septa indicates a three-partite jugular foramen. The septum in the Jugular Foramen: As to whether or not the bony bridges are fully completed, this is referred to. Between the petrous temporal bone's upper border and the occipital bone's jugular process, there is an entire septum dividing the foramen. The foramen is only partially divided by the incomplete septum, which is shorter and narrower than the full septum.

Statistical Analysis:
Both hemispheres were analyzed at the skull base. Each metric's mean, SD, and range were calculated. The paired t-test was used to analyze the right-left differences. This study considered P values below 0.05 significant. Two continuous variables were compared using the correlation coefficient.

Results:
The present study had shown the 53% dominance on the right side of Jugular Foramen and 40% dominance on the left side of Jugular Foramen, whereas 7% of skulls have shown no dominance on either side of Jugular Foramen in figure 1. Observations of 60 dry skulls with a width of the right & left jugular foramen are shown in Table 1. The minimum diameter was 4.94 mm, and the maximum diameter was 12.84 mm. A standard deviation of 2.04 was found for a range of 8.86 mm, with a mean measurement of 7.48 mm. On the left side, the minimum diameter was 4.82 mm, and the maximum diameter was 11.34 mm. A standard deviation of 1.98 was found for a range of 8.02 mm, with a mean measurement of 8.32 mm.

Table 2 displays observations from 60 dry skulls with a depth of the right & left Jugular Foramen. The minimum and maximum diameters were 4.98 mm and 22.02 mm, respectively. For a range of 17.13 mm, a standard deviation of 2.98 was found, with a mean measurement of 2.98 mm. On the left side, the minimum and maximum diameters were 5.64 mm and 16.94 mm, respectively. For a range of 13.02 mm, a standard deviation of 2.06 was found, with a mean measurement of 11.02 mm.

Figure no 2 shows the presence of septum in the study. The present study observed septum in total of 43 dry skulls out of 60 dry skulls. This accounts to 63% on the right side and 37% on the left side. The present study observed bilateral septum in only two dry skulls and absence of septum in 15 dry skulls out of 60 dry skulls. This accounts to 88% absence of septum on Jugular Foramen and bilateral presence of septum on Jugular Foramen at 12%. On both sides, a positive correlation was found between the width and depth of the Jugular Fossa.

Discussion:
Because of developments in microsurgical techniques such as the lateral suboccipital approach, there has been a significant explosion in the demand for in-depth knowledge of the normal anatomy and variations of the jugular foramen over the course of the past few decades. This demand has led to an increase in the number of people who need to possess this knowledge.

In an analysis of 125 adult dry skulls, Saheb et al. (2010) [4] found that the right Jugular Foramen was larger than the left 64.8 percent of the time and that it was the same size as the left 10.4 percent of the time. The left side of the remaining skulls had a larger Jugular Foramen. Sethi et al. (2011) [5] examined 56 adult dry skulls for morphological variations of a Jugular Foramen and found that the right Jugular Foramen was larger in 53.5 percent of the skulls and the left Jugular Foramen was larger in 7.1 percent of the skulls. The Jugular Foramen was the same size on both sides in the remaining 39.4 percent of skulls. Osunwoke et al., 2012 [6], studied 120 dry skulls and stated that right Jugular Foramen was larger than the left Jugular Foramen. Kumar et al., 2014 [7] found that Jugular Foramen was larger on the right side in 64.7 percent of cases, 19.1 percent of the time on the left side, and 16.1 percent of the time on both sides in their study of 68 skulls. In their analysis of one hundred dry skulls, Patel et al., 2014 [8], found that the size of the jugular foramen varied on both sides of the skull. For the right Jugular Foramen, 75 percent were larger than the left; 23 percent were smaller, while 2 percent were identical. The present study had shown the 53 percent dominance on the right side of Jugular Foramen and 40 percent dominance on the left side of Jugular Foramen, whereas 7 percent of skulls have shown no dominance on either side of Jugular Foramen.

A study by Singla et al. (2012) [9] examined 50 dry skulls of unknown gender. The right side of the jugular fossa had a greater depth than the left. The depth of the fossa was surveyed. A total of 72% of the right side and 82% of the left side were afflicted, according to their findings There was an average depth of 11.11 mm on the right and an average depth of 11.04 mm on the left. Between 5 and 15 mm in depth, the majority of the foramina were found. However, a deep tunnel-like fossa with a depth of 24.23 mm was found on the left side, which was the extreme of normal variation. Using morphometric analysis of 85 Nigerian dry skulls of unknown gender, Ukoha et al. (2018) [10] investigated the jugular foramen. Often, septation was found (60.6 percent of the time) (39.4 percent). Nearly half (41.2 percent) of the jugular foramen had incomplete septations, while only 19.4 percent had complete septations, and this was distributed equally on either side. Baisakh et al., 2021 [11], conducted a morphological and
morphometric study of the Jugular Foramen in Eastern Indian human dry skulls. Jugular fossa depth ranges from 9.3mm to 15.5mm on the right and 8.7mm to 13.8mm on the left. Eighty-four percent of skulls have a greater Jugular Fossa length and depth on the right side, compared to sixteen percent of skulls on the left. The minimum and maximum diameters of the right Jugular Fossa were 4.98 mm and 22.02 mm, respectively, while the depth of the left Jugular Fossa was also shown. The smallest and largest diameters were measured at 5.64 mm and 16.94 mm, appropriately.

Using morphometric analysis of 85 Nigerian dry skulls of unknown gender, Ukoha et al. (2018) [10] investigated the jugular foramen. The right side of the Jugular Fossa has a width of 12.06 mm 3.6 mm, while the left side has a width of 11.80 mm 3.3 mm, with a mean width of 12.0 mm. Comparative studies of the anatomy of the Jugular Foramen in dried adult human skulls from the Sri Lankan population were conducted by Hasan et al., 2019 [12]. The morphometry of the jugular foramen and fossa of 27 skulls, regardless of gender, was described in a descriptive study. It is possible that the remaining differences are due to constitutional, racial, gender-related, or genetic factors based on previous research. Several studies have provided evidence to back up the validity of this claim. Baisakh et al., 2021 [11], conducted a morphological and morphometric study of the Jugular Foramen in Eastern Indian human dry skulls. Fossa width varies from 7.66mm to 11.5mm on the left side and from 8.4mm to 14.7mm on the right side, with a mean of 10.74mm and 8.81mm on each side. Eighty-four percent of skulls have longer and wider jugular foramen on the right side, while sixteen percent of skulls have longer and wider foramen on the left side. The right jugular foramen had a mean width of 7.48 millimeters, with a minimum diameter of 4.94 millimeters and a maximum diameter of 12.84 millimeters, all with a standard deviation of 2.04 millimeters. For a measurement range of 8.02 mm, a standard deviation of 1.98 mm was found for the width of the left Jugular Foramen with a mean measurement of 8.32 mm.

The morphometrics and anatomical variations of the Jugular Foramen by Das et al., 2016 [13], study observed complete left bipartite compartmentalization in 8 cases (5 in males and 3 in females; total 7 percent ), incomplete right and left bipartite compartmentalization in 4 (3 in males and 1 in females; total 3.5 percent ) and 13 (7 in males and 6 in females; total 11.4 percent ) cases, respectively. We also noticed 3 cases (2 in males and 1 in females; total 2.6 percent ) of bilateral incomplete bipartite compartmentalization. All 50 Jugular Foramen from 50 adult dry skulls were examined by Anuradha et al., 2017 [14], in their study at Stanley Medical College in Chennai, India. The septation in the Jugular Foramen on the right and left side was 35 percent and 31 percent respectively. Complete septation was present in 17 percent on the right side and 17 percent on the left. Seventy percent and 12 percent of patients on the right and left had partial septation, respectively. Using morphometric analysis of 85 Nigerian dry skulls of unknown gender, Ukoha et al. (2018) [10] investigated the jugular foramen. As you can see from these measurements, the Jugular Fossa depths on the right and left sides of the face are 12.38 and 10.95 millimeters, respectively, statistically significant differences were found in the Jugular Fossa depth. The Jugular Fossa had an average depth of 11.7 millimeters when measured from both sides. Dry skulls from Egypt were studied by Manawy et al. (2019) [15] for the Jugular Foramen's anatomical variation. The jugular foramen frequently contain septa (97 percent of the time), which serve to partition the foramen into distinct sections. Their state can range from full to half-finished. Also, they can be either bilateral or unilateral in their nature. Complete bilaterally in 25% of cases, and unilaterally in 40% of cases (26 percent right, and 14 percent left). 32 percent of the time. Fewer than 3% of the participants in this study had no septation. Both sexes showed complete septation of the Jugular Foramen in the study of 148 individuals. This occurred equally in both sexes. Baisakh et al., 2021 [11], conducted a morphological and morphometric study of the Jugular Foramen in Eastern Indian human dry skulls. Bony septum was found in 76% of cases on the right and 60% on the left. Their study did not find a complete septum that divided the foramen into compartments, and only one foramen had a separate opening for the inferior petrosal sinus. More than half of the dry skulls studied in this study had their septae examined. A total of 63% of the population is on the right and 37% is on the left. Only two dry skulls had a bilateral septum, and 15 of 60 dry skulls were found to be septum-free. Jugular Foramen septum is absent in 88 percent of cases, while bilateral septum presence is found in 12 percent of cases.

Conclusion:

According to this research, the Jugular Foramen is as described on the Indian subcontinent. It was discovered that the findings did not match up with those of other studies suggesting that the Jugular Foramen has ethnic, demographic, and spatial variations.

References:


Figure 1: Side dominance of Jugular Foramen

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Table 2: Depth of Right & Left Jugular Foramen

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Figure 2: Presence of Septate Jugular Foramen on Right & Left sides