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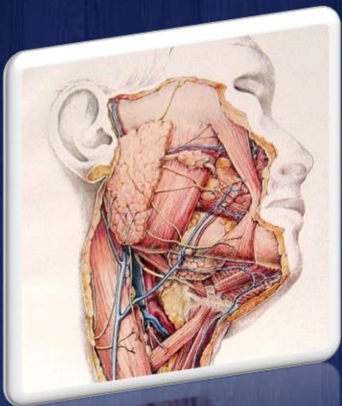

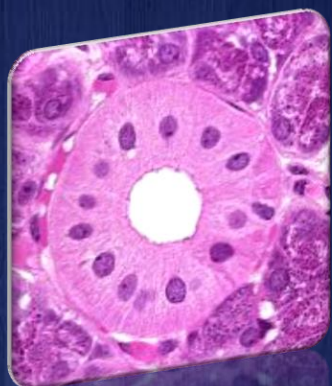

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Original Article

VOLUMETRIC STUDY OF HIPPOCAMPUS BY MAGNETIC RESONANCE IMAGING

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ABSTRACT

Introduction: Hippocampus is one of the major components of the brain, lies on ventral aspect of brain in temporal lobe of each cerebral hemisphere. It plays an important role in memory and therefore volumetric evaluation was done to establish normal values. The aim was to do a gender-wise comparison of right and left hippocampus volume in the age group of 21-40 years.

Materials and methods: Magnetic resonance imaging was done in 50 patients (20 females and 30 males) of age 21-40 years with complaint of epilepsy or headache. Magnetic resonance imaging was done in 50 patients (20 females and 30 males) of age 21-40 years with complaint of epilepsy or headache.

Results: Average of total volume of right side of hippocampus was 6.75 cm3 and of left side 6.21 cm3. In females, average volume of right hippocampus was 6.57 cm3 and left side 5.94 cm3. In males, average volume of right hippocampus was 6.88 cm3 while that of left was 6.37 cm3. Total average volume in females was 6.26 cm3 and in males was 6.62 cm3.

Conclusions: The total volume of right hippocampus was more than that of left side. The total average hippocampal volume of males was more than of females.

Keywords: Hippocampus, Volume, Brain, Magnetic resonance imaging

INTRODUCTION

Hippocampus, is mainly involved in memory and lies on ventral aspect of brain. It is a part of temporal lobe of each cerebral hemisphere. The hippocampus is named "Hippocampus" because it resembles a sea horse in coronal section. It lies above the subiculum and medial parahippocampal gyrus, forming a curved elevation approximately 5 cm long, along the floor of the inferior horn of the lateral ventricle [1]. The hippocampus plays important roles in the consolidation of information from short-term

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memory to long-term memory, and in spatial memory that enables navigation. The hippocampal formation includes the dentate gyrus, hippocampus proper, subicular complex (subiculum, pre subiculum, parasubiculum) and entorhinal cortex (area 28).

The main outflow bundle of the hippocampus, the fornix, wraps round the thalamus, from which it is separated by the choroidal fissure and the choroidal plexus. It has several named parts: fimbria, crus, body and column (pillar). The fibres of the alveus converge to form the fimbria along the medial portion of the floor of the inferior horn of the lateral ventricle. At a point beneath the splenium of the corpus callosum, the white matter of the fimbria separates from the hippocampus to become the crus of the ipsilateral fornix. The two crura pass upwards and forwards beneath the corpus callosum, mirroring its arch but with a tighter curve. They are joined via fibres that cross in the commissure of the fornix (hippocampal commissure). Beyond this point, the crura merge to become the body of fornix, which continues anteriorly within the roof of the third ventricle, below the lower border of the septum pellucidum and near the midline [1].

Hippocampal Volume (HV) is an important morphological parameter. Computed tomographic scan (CT scan) and Magnetic resonance imaging (MRI) are two modalities through which we can measure the volume of hippocampus. Many studies focus on a decrease in hippocampal volume associated with a wide variety of neurological and psychiatric conditions including depression [2], posttraumatic stress disorder (PTSD) [3,4], borderline personality disorder (BPD) schizophrenia [5,6], alcohol abuse [7], and Alzheimer's [8], Parkinson's and Huntington's diseases. It is yet unclear what mechanisms underlie the decrease in hippocampal volume associated with major depressive disorder (MDD). Although normative data for HV is available for the western population, no such data is available for North Indian population to the best of our knowledge. Therefore, the present study was planned to fill this lacuna.

MATERIALS AND METHODS

It was a prospective observational type of study which was done after approval from institutional ethical committee (Ref. code: 93rd ECM II B Thesis/P2). The study included 50 subjects of age range 21-40 years. Those subjects were included in the study who were not using any pacemaker or implants or prosthetic heart valves; and also those with no contraindications of MRI such as claustrophobia or pregnancy. Exclusion criteria were the subjects in whom unilateral or bilateral hippocampal regions were involved in any disease process and in whom abnormal magnetic resonance (MR) signal intensities were seen in unilateral or bilateral hippocampal regions.

Routine brain MRI protocol was followed (Table 1) including axial (T1WI and T2WI), coronal PDWI and sagittal T1WI for preparation of MR imaging (Fig. 1 a & b). The study images were transferred into DICOM format to a personal computer (PC). Manual and semi-automated tracing of the structures of interest was done with the help of an expert radiologist, which were allowed volume calculation by summation. Volume was described in cubic centimetres (cc) and images were taken in a DVD.

Data management was done by entering the data derived from each image into tables stored

Parameters	Value
Echo time TE	4.2 milliseconds
Repetition time TR	12.1 milliseconds
Matrix	256×192
Field of view (FOV)	24 cm
Flip angle (FA)	= 45°
Number of excitation (NEX)	2
Slice thickness	2 mm

Table 1: MRI protocol for preparation of MR imaging

in digital form. By using the tabulated data, correlation of age and sex with hippocampal volume was determined. Statistical analysis was performed using the standard Statistical Package for Social Sciences (SPSS).

RESULTS

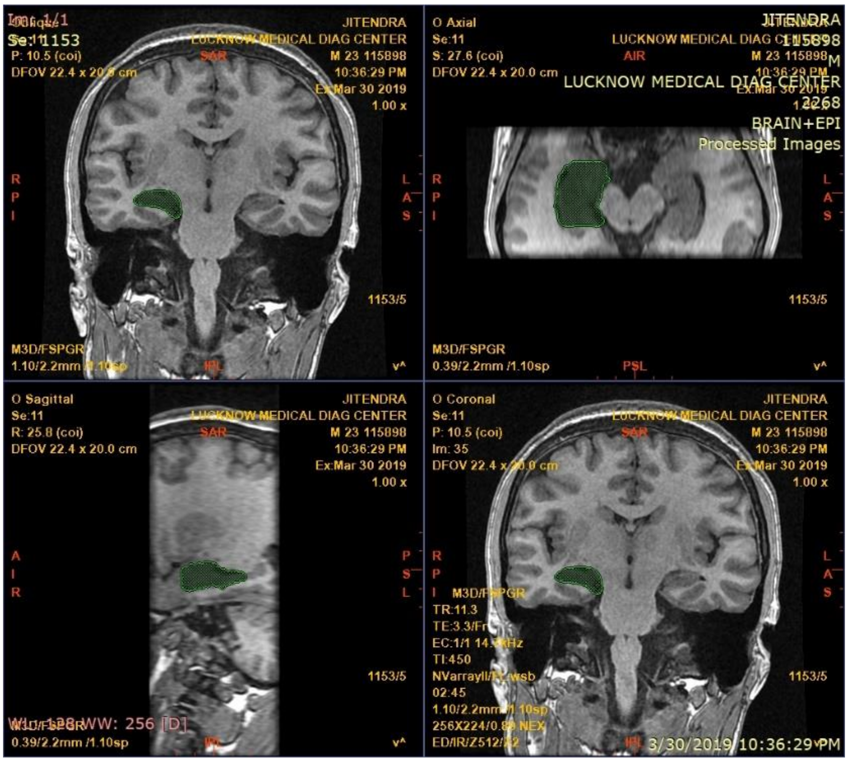
Average of total volume of right side of hippocampus was 6.75 cm3 and left side 6.21 cm3. In females, average volume of right hippocampus was 6.57 cm3 and left side 5.95 cm3. In males, average volume of right hippocampus was 6.88 cm3 while that of left was 6.38 cm3. Total average volume in females was 6.26 cm3 and in males was 6.63 cm3 (Table 2, Fig. 2).

DISCUSSION

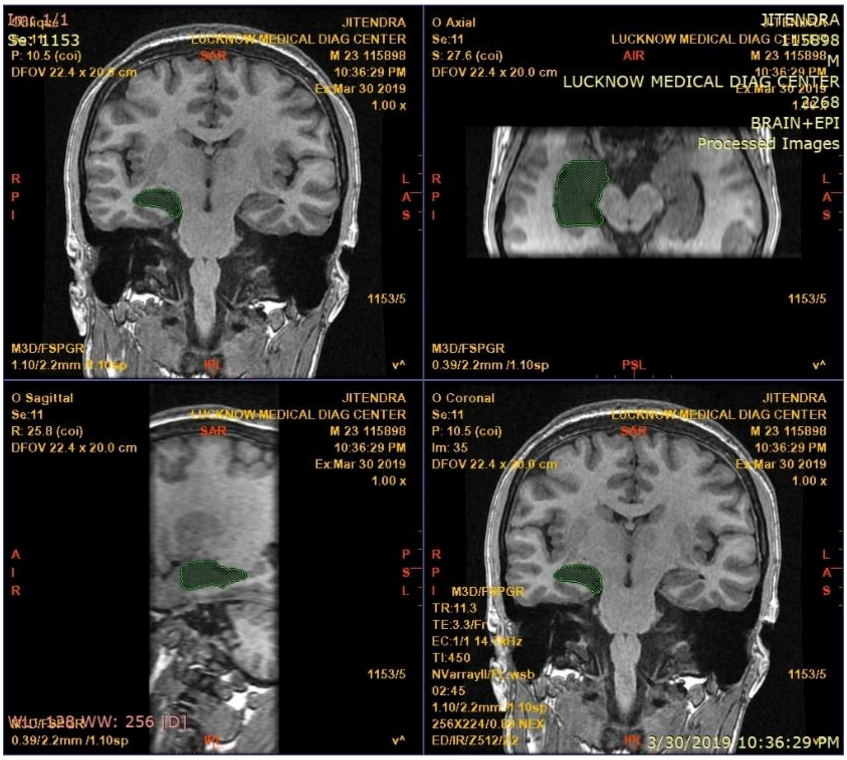
In present study, mean right hippocampus volume was more than left while total average hippocampus volume was more in males than females. This is similar to a MRI study done in Malay population by Jalaluddin et al. (2013), who also noted mean right hippocampus volume more than mean left hippocampus volume [10]. Honeycutt and Smith (1995) [11], Li et al. (2007) [12], Yastad et al. (2009) [13] and Embong et al. (2013) [14] also depicted right hippocampus volume to be greater than left. The results of our study is in accordance with the analysis done by Mohandas et al. (2014) [15] that total hippocampus volume was more in males than females, and that was statistically significant.

Side	Male (n= 30)	Female (n= 20)
Right Hippocampus	6.88±1.54	6.57±1.43
Left Hippocampus	6.38±1.75	5.95±1.13
Average total hippocampus	6.63±1.47	6.26±1.08

Table 2: Association of Hippocampal volume (cc) with Gender *(Values are Mean±SD)*



(a)



(b)

Fig. 1: MRI images showing measurement of hippocampus volume *(green color)* in age group 21-40 years (a) Right hippocampus (b) Left hippocampus

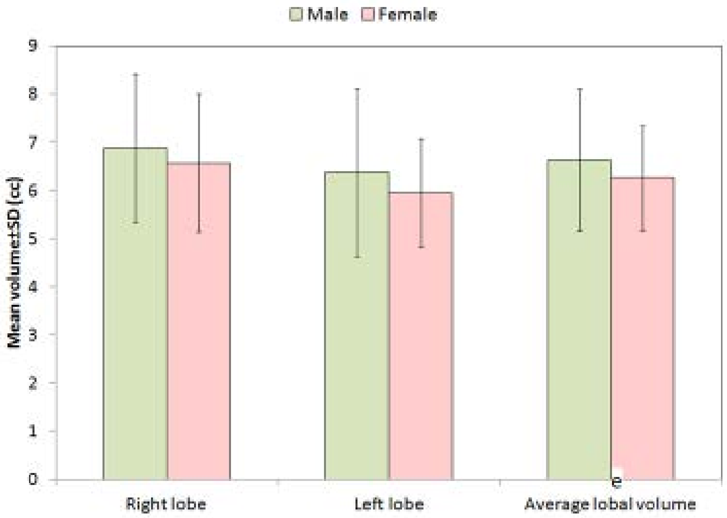


Fig. 2: Graphical representation showing comparison of mean hippocampus volume of right, left and total average volume between males and females *(age group 21-40 years)*

We concluded that mean volume of both right and left hippocampus was more in males i.e. 5.91±1.56 cc than in females i.e. 5.48±1.11 cc. Also average right side hippocampus in males was 6.22±1.80 cc as compared to females which was 5.70±1.30 cc and average left side hippocampus volume in males was 5.60±1.62 cc and in females was 5.25±1.24 cc, thus on both sides right and left individually, hippocampus volume was more in males than females. Mohandas et al. (2014) [15] studied MRI scans of 200 healthy volunteers using a 3 Tesla (3T) MRI scanner at tertiary level neurocenter in South India, and found the mean right hippocampus volume of 2.491 cc in males and 2.288 cc in females, with the difference being statistically highly significant ($P < 0.001$), and this was mirrored in the left hippocampal volume, with a mean of 2.447 cc in males and 2.298 cc in females ($P < 0.001$). Li et al. (2007) concluded that the volume range of hippocampus in healthy Chinese on MRI has no age and gender effects and also the right side hippocampus volume is larger than that of left side [12].

CONCLUSION

Right hippocampus volume was more than left while total average hippocampus volume was more in males than females. As hippocampus is involved in number of neurologic conditions, including temporal lobe epilepsy, postanoxic amnesia, and Alzheimer's disease, therefore it is essential to measure the volume of the hippocampus using high-resolution MRI.

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Original Article

STUDY OF NATURE OF SUPRAORBITAL FORAMEN IN DRY HUMAN NORTH INDIAN SKULLS

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ABSTRACT

Introduction: Supraorbital foramina are important passage for neurovascular bundles. Their nature should be known for Ocular and facial surgeries. The aim of study was to document topographical anatomical nature of Supraorbital foramen, which is necessary for procedures which are performed in supraorbital region.

Materials and methods: A total of 72 dry human skulls of unknown age and gender from North India, were studied. In each skull, nature of supraorbital foramen was observed on both sides.

Results: It was observed that the supraorbital foramen was complete in33,3% on left side and in 47.2% skulls on right side, with overall bilaterality of 19.44%. It was incomplete in 18.1% skulls on left and 4.2% skulls on right side. Supraorbital notch was present bilaterally in 36.12% skulls.

Conclusions: Precise knowledge about nature of Supraorbital foramen may have important implication on Orbital and periorbital procedures. It may provide guidance for anaesthetists and surgeons.

Keywords: Supraorbital foramen, Nature, North Indian Human skull.

INTRODUCTION

The accurate identification of Supra Orbital Foramen (SOF)/Supra Orbital Notch (SON), and Infra Orbital foramen (IOF) are important for both diagnostic and clinical procedures. Clinically, nerve bundles emerging from these foramina could probably be injured during surgical procedures, resulting in paraesthesia or anaesthesia. An understanding of the anatomical location of important maxillofacial foramina is of increased importance with the rising popularity of endoscopic procedures with limited visibility [1]. The facial foramina, which transmit nerves and blood vessels between the facial structures and the cranium, show positional and metric features at variance with standard descriptions in anatomy textbooks [2,3]. There are data that show variations with age, sex and ethnic groupings [4]. In adults, there are no absolute landmarks and, in some cases, the facial foramina may not be palpable [5].

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Ashwini LS et al [6] in their study of adult skulls revealed that the SON (69.87%) was found more frequently than the SOF (28.91%). Of all the cases, 56.62% had bilateral SON, while 14.45% had bilateral SOF. Notches were mostly observed on the right side and foramina were mostly seen on the left side. Londhe SR et al [7] found in their study that percentages of combinations on right and left side in adult and foetal skulls were as Incomplete Foramen (IF) in 29.7%, Complete Foramen (F) in 30.7%, Notch (N) in 39.6% on right side; and on left side it was Notch in 47.52%, Complete Foramen in 18.81%, Incomplete Foramen in 33.66% adult skulls.

In case of foetal skulls, the observations were as Incomplete Foramen in 18.64%, Absent (A) in 10.16%, Notch in 71.18% on right side; and Notch in 66.10%, Complete Foramen in 15.25%, absent in 18.64% on left side. Based on their study they showed various combinations in adult skulls as bilateral notch in 28.71%, bilateral complete foramina in 13.86%, bilateral incomplete foramina in 16.83%, left notch and right Incomplete Foramen in 7.92%, left notch right Complete Foramen in 2.97%, left Complete Foramen and right notch in 7.92%, left Complete Foramen and right Incomplete Foramen in 8.9%, left Incomplete Foramen and right notch in 10.89%, left Incomplete Foramen and right Complete Foramen in 1.98%. In case of foetal skulls, they showed the various combinations as bilateral notch in 50.84%, bilateral Incomplete Foramen in 3.38%, and bilaterally absent in 6.67%. Other combinations were as left notch and right Incomplete Foramen in 11.86%, left notch and right absent in 8.87%, left Incomplete Foramen and right notch in 11.86%, left Incomplete Foramen and right absent in 3.38%, left absent and right notch in 3.38% of foetal skulls.

Jha AK et al [8] determined after their study that of the supraorbital foramina 78.6 % were notches and remaining 21.4% were foramina. Trivedi DJ et al [9] observed different type of combinations of supra orbital foramen and notch as bilateral notch in 35.62%, right notch and left foramen in 7.72%, right notch and left incomplete foramen in 3.43%, right side notch and left side absent features in 0.85%, right foramen and left notch in 9.01%. Foramen were present bilaterally in 21.45%, whereas right foramen and left incomplete foramen in 5.15%, right foramen and left no features in 0.85%, left notch and right incomplete foramen in 5.15%, left foramen and right incomplete foramen in 3.43% were found. Their further observations were bilaterally incomplete foramen in 6.43%, left foramen with no features on right side in 0.42%, and bilateral absence of any features in 0.42% skulls.

Yukio DODO et al [10] found the incidence of complete SOF in Assam and Sikkim to be 44.6%, in East India 46.8, in South India 44.6% as and in Northwest India as 39.4%. Ongeti K et al [11] observed that the right and left supraorbital passages were present in 93.3% and 94.2% of the skulls respectively. The percentage of skulls with right and left supraorbital notches was 67% and 64.3%, respectively. Supraorbital notches ranged from mere dents on the superior surface of the orbit to near-circular notches. Funda AKSU et al [12] found in their study that Supraorbital foramen were found in 27.7% on right side and in 24.8% on left side; supraorbital notch were found in 66.3% on right side and in 67.3% on left side.

The rate of unilateral supraorbital notch and supraorbital foramen on the other side was found as 20%. There was no foramen or notch on 3% of skulls.

Apinhasmit W et al [13] observed that the SON (66.5%) was found more frequently than the SOF (33.5%). Of all cases, 50.0% had bilateral SON, 17.0% had bilateral SOF and 33.0% had a notch on one side and a foramen on the other. Among the available reports, the highest frequency (92.5%) of SON was observed by Cutright et al [1] in a study conducted on 40 black and 40 white cadaveric heads. Chung MS et al [4] found that supraorbital notches (69.9%) were more frequent than supraorbital foramina (28.9%). In their study, they showed that bilateral notches in 35.62% of skulls and bilateral foramina in 21.45 % of skulls and 16.73 % of skulls demonstrated a notch on one side and a contralateral foramen.

Similarly, an earlier study conducted by Berry and Berry also reported markedly low frequency of SOF (12.3%) in North Indian skulls [14] However, a study conducted on a North-West Indian population has revealed a much-balanced frequency of SOF and SON, which was 45.6% of SOF and 54.4% of SON [15]. An almost equal ratio of SOF (41%) and SON (49%) was observed by Kazkayasi M et al [16]. They also found 10% of cases with the groove. The frequency of SOF was reported to be more in North East Asians and North American populations from an arctic region than the other populations [17]. In another cross racial study, the frequency of SOF ranged from 8% to 51% depending upon the study population; it was lowest in a Burmese population and highest in Mexican populations [14]. Hollinshed WH [18] had described a total incidence of supraorbital foramina as 25% but has not given the side difference. Williams and Warwick [3] did not mention the absence of all the three (notch, foramen and incomplete foramen) features at supraorbital margin of human skull as also seen in our study.

The incidence of supra orbital foramina as reported by Duke Elder SS [19] was 25% of total adult skulls while Rao et al [20] reported 6.5% in South Indian studies. Bilodi Arun Kumar S and Sanikop MB [21] had shown incidence of supra orbital foramina of 39% on right side and 43.3% on left side, while study by Sinha DN [22] had shown the incidence to be 34.25% on right side and 28.5% on left side. Berry AC et al [14] had found equal incidences of supra orbital notches and foramina in Mexican crania. Sinha DN [22] observed incidence of supra orbital notch in 44.25% of skulls (14.25% on right side and 25.5% on left side). Rao et al [20] showed the presence of supra orbital notch in 38.5% adult skulls, while incidence of notch given by Bilodi Arun kumar S and Sanikop MB [21] was 47.38% on right side and 36.6% on left side.

Webster [23] observed that out of 108 skulls studied, 49.07% demonstrated bilateral supraorbital notching, 25.93% demonstrated bilateral supraorbital foramina, and 25% demonstrated a notch on one side and a contralateral foramen. Sinha D N et al [22] observed that out of 400 skulls studied, 44.25% demonstrated bilateral supraorbital notches, 18.25% demonstrated bilateral supraorbital foramina, and 38.50% demonstrated a notch on one side and contralateral foramen. Berry AC et al [14] observed that the incidence of complete supra orbital foramen in Indian Punjabis to be as 12.3%. Webster et al [23] observed that

49.07% of skulls demonstrated bilateral supraorbital notching, 25.93% demonstrated bilateral supraorbital foramina, whereas 25% demonstrated a notch on one side and a contralateral foramen. Sinha DN [22] observed that out of 400 skulls studied, 44.25% demonstrated bilateral supraorbital notches, 18.25% demonstrated bilateral supraorbital foramina, and 12.55% demonstrated a notch on one side and contralateral foramen. Chung M.S et al [4] found that supraorbital notches (69.9%) were more frequent than supraorbital foramina (28.9%).

Since modern surgical procedures, anaesthesia and acupressure techniques require a more precise understanding of surrounding anatomy, the aim of this study was to examine the different Anatomical variations of Supra Orbital foramen (SOF)/ Supra Orbital Notch (SON) related to side. This data would provide important information for local anaesthesia during Rhinoplasty and about Maxillo-facial area during Plastic surgery. An effort was made to provide reliable data for comparison of previous studies data and to provide the same for future studies.

MATERIALS AND METHODS

A total of Seventy-two dry human Indian adult skulls of unknown age and gender were utilized for this study. These dry skulls were obtained from the Museum of Department of Anatomy, Varun Arjun Medical College, Uttar Pradesh, India. Child skulls and skulls in which the openings were damaged, either unilaterally or bilaterally, which would hamper observations were excluded. In each skull, both sides of the SOF/SON were observed by single observer. The variables of age and gender were not considered. Presence of bilateralism (i.e., similar characteristics on both sides of same skull) was also studied.

Morphometric measurements were recorded regarding the nature of Supra Orbital foramen on left (LT) side as Complete Foramen, Incomplete Foramen, or Notch.

The information was tabulated and from these measurements means and standard deviations (mean ± SD) were calculated. Basic descriptive statistics were employed to analyse the data obtained using standard software (Excel 2007, Microsoft Corp.) and SPSS software (version 16, SPSS, USA 2007), on the basis of left and right sides.

RESULTS

In our study it was found that Supra Orbital Foramen showed different nature of presentation. It was complete foramen (CSOF) in 24 (33.3%) skulls on left side and in 34 (47.2%) on right side; and as incomplete foramen (INCSOF) in 13 (18.1%) on left side and in 3 (4.2%) on right side. Notch form (SON) was most prevalent form of SOF; in 35 (48.65%) skulls on both (left and right) side (Table 1(A)& 1(B)).

Overall, it was found that CSOF had frequency of 40.28%, INCSOF had frequency of 11.1%, whereas SON had maximum frequency (48.6%) as shown in Table 2. When bilateralism was compared, it was found that complete foramen was present bilaterally (B/LCSOF) in 19.44% skulls and notch was seen bilaterally (B/LSON) in 36.11% skulls. Maximum (44.44%) had bilaterally mixed presentation as shown in Table 3.

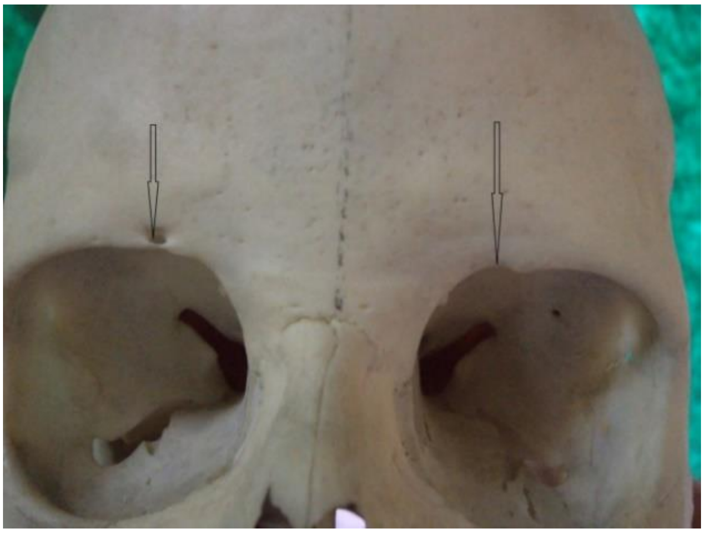

Fig. 1. Supra Orbital Foramen on Right side and Supra Orbital Notch (SON) on Left side

Table 1(A). Nature of Supra Orbital foramen on left (LT) side

	NATURE OF SOF (LT) ↓	FREQUENCY	PERCENT	VALID PERCENT	CUMULATIVE PERCENT
Valid	CSOF	24	33.3	33.3	33.3
	INCSOF	13	18.1	18.1	51.4
	SON	35	48.6	48.6	100.0
	Total	72	100.0	100.0	

Table 1(B). Nature of Supra Orbital foramen on right (RT) side

	NATURE OF SOF (RT)↓	FREQUENCY	PERCENT	VALID PERCENT	CUMULATIVE PERCENT
Valid	CSOF	34	47.2	47.2	47.2
	INCSOF	3	4.2	4.2	51.4
	SON	35	48.6	48.6	100.0
	Total	72	100.0	100.0	

Table 2. Overall nature of Supra Orbital foramen

PARAMETER↓	LEFT	RIGHT	TOTAL	PERCENT
CSOF	24	34	58	40.28
INCSOF	13	3	16	11.11
SON	35	35	70	48.61

Complete Foramen (CSOF) Incomplete Foramen (INCSOF), and Notch (SON)

Table 3. Bilateralism of nature of Supra Orbital foramen

B/L NATURE OF SOF PARAMETER ↓	FREQUENCY	PERCENT
B/L CSOF	14	19.44
B/L SON	26	36.11
MIXED	32	44.44
B/L INCSOF	00	

Bilateral Complete Foramen (B/L CSOF), Bilateral Incomplete Foramen (B/L INCSOF), and Bilateral Notch (B/L SON)

Table 4. Overall nature of Supra Orbital foramen

PARAMETER→ (NATURE OF SOF) STUDY ↓	COMPLETE FORAMEN (%)	INCOMPLETE FORAMEN (%)	NOTCH (%)
Our Study	40.28 (33.3-L; 47.2-R)	11.11 (18.1-l;4.2-R)	48.61(L ; R)
Ashwini LS et al …. 2012	28.91		69.87
Londhe SR et al …. 2011	30.7-R; 18.81-L	29.7-R; 33.66-L	39.6-R; 47.52-L
Jha AK et al ……...2011	21.4		78.6
Charconovic C et al.2011			47.50
Yukio D et al……... 2009	39.4 to 46.8		
Gupta T……………2008	45.6		54.4
Ongeti K et al...…… 2008			67-R; 64.3-L
Funda AKSU et al.. 2007	27.7-R; 24.8-L		66.3-R; 67.3-L
Apinhasmit W et al..2006	33.5		66.5
Cutright C et al.… .2003			92.5
Kazkayasi M et al…2003	41		49
Bilodi AKS et al.…2002.	39-R, 43.3-L		47.38-R, 36.6-L
Rao et al…………..1997	6.5		38.5
Chung MS et al.… 1995	28.9		69.9
Sinha DN et al ..…1978	34.25-R; 28.5-L		44.25
Berry AC et al ..…1967	12.3		
Duke Elder et al ...1961	25		

Table 5. Bilateralism of nature of Supra Orbital foramen

PARAMETER→ (NATURE OF SOF) STUDY ↓	B/L COMPLETE FORAMEN (%)	B/L NOTCH (%)	B/L INCOMPLETE FORAMEN (%)	MIXED %
Our Study	19.44	36.12	00	44.44
AshwiniLS et al …. 2012	14.45	56.62		
Londhe SR et al…. 2011	13.86	28.71	16.83	40.60
Trivedi DJ et al…..2010	21.45	35.62	6.43	36.50
Funda AKSU et al. 2007				20
ApinhasmitW et al 2006	17	50		33
Cutright C et al.… 2003		92.5		
Aziz SR et al …....2000		70		
Webster et al……..1986	25.93	49.07		25
Sinha DN et al….. 1978	18.25	44.25		38.50
Chung MS et al.… 1995	21.45	35.62		16.73

DISCUSSION

There is a wide range of reports available regarding the frequency of the supraorbital foramen and supraorbital notch. Generally, the notches are considered to be more frequent than the foramina [24]. In the present study, the SON was observed in 48.61% of cases and the SOF was observed in 40.28% of cases, whereas the incidence of incomplete foramen was 11.11% in adult skulls. Charcanovic BR et al [25] demonstrated that 47.50% of the supraorbital foramina were in fact notches, not foramen Another study conducted on Indian skulls also showed similar results where SON was more frequent compared to the SOF [23]. Similarly, an earlier study reported markedly low frequency of SOF (12.3%) in North Indian skulls [14]. However, a study conducted on a North-West Indian population has revealed a much-balanced frequency of SOF and SON, which was 45.6% of SOF and 54.4% of SON [15].

An almost equal ratio of SOF (41%) and SON (49%) was observed by Kazkayasi et al [16]. They also found 10% of cases with the groove. The frequency of SOF was reported to be more in North East Asians and North American populations from an arctic region than the other populations [17]. In another cross racial study, the frequency of SOF ranged from 8% to 51% depending upon the study population; it was lowest in a Burmese population and highest in Mexican populations [14]. Among the available reports, the highest frequency (92.5%) of SON was observed by Cutright C et al [1] in a study conducted on 40 black and 40 white cadaveric heads. Chung et al in a study conducted on 124 Korean skulls, reported 69.9% cases of SON and 28.9% cases of SOF. Hollinshed WH [18] had described a total incidence of supraorbital foramina as 25% but has not given the side difference. Williams and Warwick [3] did not mention the absence of all the three (notch, foramen and incomplete foramen) features at supraorbital margin of human skull, as it was also seen in our study. The incidence of supra orbital foramina as reported by Duke Elder SS [19] was 25% of total adult skulls while Rao et al [20] reported 6.5% in South Indian studies. Bilodi AKS & Sanikop MB [21] had shown incidence of supra orbital foramina of 39% on right side and 43.3% on left side, while study by Sinha DN et al [22] had shown the incidence to be 34.25% on right side and 28.5% on left side. Berry AC et al [14] had found equal incidences of supra orbital notches and foramina in Mexican crania. Sinha DN et al [22] observed incidence of supra orbital notch in 44.25% of skulls. It was 14.25% on right side and 25.5% on left side. Rao et al [20] showed the presence of supra orbital notch in 38.5% adult skulls, while incidence of notch by Bilodi AKS & Sanikop MB [21] was 47.38% on right side and 36.6% on left side. According to Cheng et al [17] the supraorbital neurovascular bundle is relatively fixed in position in the supraorbital foramen. Hence, the neurovascular bundle is in great danger during surgical dissection; since during retraction, it is more likely to be stretched. Surgeons must take additional precautions during the reflection of scalp flaps in populations with a higher incidence of supraorbital foramina. It is evident by these reports that while performing forehead, coronal, brow or temple lift surgeries; palpating SON alone is not sufficient in locating the supraorbital neurovascular bundle.

Therefore, surgeons should also be aware of the frequency of occurrence of SOF and their location well above the supraorbital margin [23].

Bilodi AKS, Sanikop MB [21] concluded that in the absence of supra orbital foramina and notches, supra orbital vessels and nerves are more prone for injury due to sharp supraorbital margin at orbital rim. Webster et al [23] observed in their study that 49.07% of skulls demonstrated bilateral supraorbital notching, 25.93% demonstrated bilateral supraorbital foramina, and whereas 25% demonstrated a notch on one side and a contralateral foramen. Sinha DN et al [22] observed that out of 400 skulls studied, 44.25% demonstrated bilateral supraorbital notches, 18.25% demonstrated bilateral supraorbital foramina, and 12.55% demonstrated a notch on one side and contralateral foramen. Chung M.S et al [4] found that supraorbital notches (69.9%) were more frequent than supraorbital foramina (28.9%). Present study showed, bilateral notches in 36.12% of skulls and bilateral foramina in 19.44% of skulls whereas 44.44 % of skulls demonstrated a notch on one side and a contra lateral foramen (i.e., mixed variety). Apinhasmit W et al [13] demonstrated 50.0% bilateral notching, 17.0% bilateral foramina and 33.0% a notch on one side and a contralateral foramen. It showed poor symmetrical relation between the sides. Webster RC et al [23] reported the distributions of 49.1% for bilateral SON, 25.9% for bilateral SOF and 25.0% for one notch and one foramen. In other study, bilateral SON was reported at 70% in white, black and Hispanic subjects [26] and 92.5% in white and black subjects [1]. Table No 4 &5 shows a comparative analysis of different studies.

CONCLUSION

Most of the data in the available literature was based on studies that were carried out in the foreign samples. Our study, on the other hand, represented the Indian population which differs in physical build from Western populations.

Comparison of results from previous studies makes the large variation of the anatomical characteristics of the infraorbital and supra orbital foramen evident, not only due to the diversity of the used parameters, but also due to the distinct investigated populations. With a possibility of these characteristics being dependent on population groups, this study makes the morphometric study of these foramen in the population of India relevant. The results showed a large dispersion and variability in the various distances pertaining to the location of the infraorbital foramen and supra orbital foramen/ notch because we analysed skulls from different geographical areas; individual's precision in measurements; and varying osteoblastic and osteoclastic activity in different individuals. The various mean distances along with standard deviation as elaborated in tables determine the exact position of infraorbital foramen, SOF/SON in Indian population and may be first hand vital information to the concerned clinicians to avoid complications during surgical procedures and nerve block. Besides, these results can play a role in the performance of surgical procedures in the periorbital area in order to prevent the involvement of neurovascular structures which cross these foramina.

All these findings are important for performing local nerve block and surgery in the forehead and the periorbital regions in order to avoid the neurovascular structures passing through these two foramina. As per the measurements in this study, the best site for local anaesthetic block for the infraorbital nerve would be about 8.15

mm inferior to the inferior orbital rim (at the point where one can palpate the zygomatic-maxillary suture), about 27.58 mm from the midline, and about 40.86 mm below the SON/F in the same vertical line. Extra care should be taken during surgical dissection in the superior orbital region especially in the middle aspect of the superior orbital rim. Some intra-ethnic and interethnic variations in the position of the SOF and IOF may exist, and thus these mean distances found may vary from population to population

Overall, it can also be stated that the position of the SOF/SON is not constant and it varies between different races and people of different regions. SON is observed more frequently compared to the SOF, though there is a slight difference in the frequency rate among the studies conducted in different regions and race groups. . It can be either a notch or a foramen. It may be an incomplete foramen. Complete absence of notch or foramen may deprive the supraorbital nerves and vessels, the protection given by these and make them more vulnerable to injuries at the sharp supraorbital margin. Because of the numerous variations of the exit points on the supraorbital rim, all surgical approaches to the supraorbital nerve on the supraorbital rim, especially the endoscopic ones, always have to be done under vision and with the necessary care of the nerves. The occurrence of accessory supraorbital foramina is very common and is more frequently seen lateral to the main SOF/SON. This should be kept in mind while performing these procedures.

The skew values found in present study alert the surgeons to avoid anaesthetic failures and other procedures involving infraorbital and supra orbital foramen. Therefore, the risks associated with facial surgery may be reduced for the Indian population if the anatomic morphometry is taken into consideration. The data are of direct relevance to clinical practice and teaching.

Our sincere effort by present study was to add information to the literature concerning the morphology of the SON/SON, and IOF especially in an Indian population. Also, we tried to provide some information about Infra orbital groove and canal, but to clarify the morphological characteristics of them, it will be necessary to carry out a correlation study concerning the size of skull, total length of the infraorbital canal, and data obtained by this study.

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Original Article

STUDY OF THE BI-ORBITAL DISTANCE AND INTER-ORBITAL DISTANCE OF HUMAN DRY SKULLS IN NORTH INDIAN POPULATION

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ABSTRACT

Introduction: Bi-orbital distance and inter-orbital distance are two of the most important anthropometric parameters. Distance varies with race, regions within the same race & period in evaluation. Anthropometric study of orbit is of immense importance on account of its various implications in medical science, ranging from ophthalmic surgery, facial surgery and for forensic record. It is also helpful in plastic surgery (reconstructive surgery) and is used to treat congenital or post traumatic facial disfigurements successfully. The aim of the study was to investigate the orbital anthropometric variations in the normal population.

Materials and methods: The study was conducted on hundred human dry skulls in the department of anatomy, S.N medical college Agra. Bi-orbital distances and inter-orbital distances were measured directly by using digital vernier calipers.

Results: In the current study, the mean bi-orbital distance was 93.29±4.37 mm and the inter-orbital distance was 19.79±2.39 mm.

Conclusions: The findings of our study provide a database to determine normal inter orbital distance and bi-orbital distance. The BOD and IOD can be utilized by ophthalmologists, in reconstructive cosmetic surgeries of face and by forensic experts.

Keywords: Inter-orbital distance, Bi-orbital distance, Dry skull, Digital vernier caliper.

INTRODUCTION

Morphometry is a fast & efficient method for the evaluation of morphological characteristics such as ethnicity, gender, age, genetic factors, dietary habits & regional variation which can alter the shape & size of bone structure. These aspects are significantly important in determining the anthropometric changes between different populations and genders [1].

Study of the bony orbit is of immense importance on account of its various

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implications in anthropological & medical science ranging from ophthalmic surgery and plastic surgery (reconstructive surgery) of face in preserving the neurovascular bundle related to orbit. [2]

Though much work has been done in craniometry of Indian skulls but there is not much data available on details of the various absolute measurements of the orbit.

The orbital morphometric study was done on 100 adult human dry skulls in north Indian population in order to determine interorbital and bi-orbital distances and this study was compared with previous studies done by other authors.

MATERIAL AND METHODS

This anthropometric study employed the use of digital vernier caliper for direct measurement on dry skulls as it presented a different & more natural prospective in assessing the orbital cavities[3].

The study was conducted on 100 human dry skulls in the department of anatomy, S.N. medical college, Agra. Interorbital distances and bi-orbital distances were measured directly on 100 skulls using Digital Vernier Caliper.

Exclusion Criteria - Adult skulls with deformity, incomplete orbital margins and broken skulls were excluded.

In each dry skull, the following measurements were taken on the orbit.

1. Interorbital distance (IOD) - Distance between the two anterior lacrimal crests. [4] (Fig. 1)

2. Biorbital distance (BOD) - Distance between most lateral points on right and left orbits in each skull. [4] (Fig. 2)

Above measurements were compared with studies of different authors. As anthropometric measurements are different in different population and geographical areas, this study provides data for north Indian adult population.

	SAMPLE SIZE	MINIMUM (mm)	MAXIMUM (mm)	MEAN ±SD
INTERORBITAL DISTANCE (IOD)	100	14.88	28.96	19.79±2.39

Table 1 : Inter Orbital Distance (IOD)

Figure 1: Measurement of Interorbital distance *(distance between two anterior lacrimal crests)*

Figure 2: Measurement of Bi-orbital distance
(distance between right and left most lateral points on the orbit)

	SAMPLE SIZE	MINIMUM (mm)	MAXIMUM (mm)	MEAN ±SD
BIORBITAL DISTANCE (BOD)	100	80.71	103.43	93.24±4.37

Table 2 : Bi Orbital Distance (BOD)

RESULTS

The maximum value of IOD in 100 human dry skulls was 28.96 mm & minimum value of IOD was 14.88 mm. The mean value was 19.79 ± 2.39 mm.

The maximum value of BOD in 100 orbits in human dry skulls was 103.43 mm and the minimum value of BOD was 80.71 mm. The mean value was 93.24 ± 4.37 mm.

DISCUSSION

The Inter-orbital distance and bi–orbital distance are significant factors that need to maintenance of facial symmetry considered during nasal bridge reconstruction, facial cosmetic surgeries and in the design of spectacle bridges. These measures have been known to vary with race, region and within the same race, during periods in evolution.[5]

In the present study of skulls from north Indian population the IOD was observed as 19.79 ±2 mm. Scmittabhul [6] observed IOD as 19.81 mm in the French population. Yasan [7] observed IOD as 25.71 mm in Turks, which was a higher IOD than north Indian population. Jeremiah Munguti et al. [5] observed IOD as 18.91 mm in Kenyan population which was a lower IOD than the north Indian population. Gossavi [4] observed IOD as 19.49 ±3.35 mm in central Indian population. The reason of different values of IOD in all studies could be due to racial difference.

In the present study of skulls from north India, the BOD was observed as 93.24 ±4.37 mm. Scmittbhul [5] observed it as 98.97 mm in French population. In French population BOD was higher than north Indian population. Jeremiah Munguti et al. [5] observed BOD as 99.40 mm in Kenyan population. Gossavi [4] observed BOD as 95.65 ± 3.48 mm in central India.

The values of BOD were higher in the previous studies than the present study. These differences could be due to racial differences as they were studied in different population. This set of measurements can also be used in the design of protective equipment for the eye.[8]

The inter-orbital distance and bi –orbital distance are significant factors that need for the maintenance of facial symmetry considered during nasal bridge reconstruction, facial cosmetic surgeries and in the design of spectacle bridges. These measurements have been known to vary with race. [7]

The knowledge of the dimensions of the orbital cavity in relation to the skull craniometry is also important in various aspects such as in interpretation of fossil records, skull classification in forensic medicine and in exploring the trends in evolutionary & ethnic differences [3]. Detailed knowledge of orbital anatomy and its variations will help the surgeons to avoid surgical complications.

CONCLUSION

Data collected in the present investigation could serve as a data base for the quantitative description of human orbital morphology during normal growth and development considering race and ethnic related variations. These findings allow for the quantification of the orbital features of north Indian population and provide parameters for preoperative planning and prediction of postoperative outcome. Orbital morphometry is important to provide useful baseline data for ophthalmological, maxillary surgeries and reconstructive cosmetic surgeries of face. Detailed knowledge of anatomy and its variations will help the surgeon to avoid surgical complications.

AUTHORS	YEAR	POPULATION	INTERORBITAL DISTANCES (IOD) (mm)
SCMITTBHUL(5)	1998	FRENCH	19.81
YASAN H(6)	2006	TURKS	25.71
JEREMIAH MUNGUTI etal(7)	2012	KENYAN	18.91
GOSSAVI SN(4)	2014	CENTRAL INDIA	19.49±3.35
PRESENT STUDY	2017	NORTH INDIA	19.79 ±2

Table 3 : Comparison of Interorbital distances

AUTHORS	YEAR	POPULATION	Biorbital Distance (BOD)
SCMITTBHUL[6]	1998	FRENCH	98.97
JEREMIAH MUNGUTI Etal [5]	2012	KENYAN	99.40
GOSSAVI SN[4]	2014	CENTRAL INDIA	95.65 ± 3.48
PRESENT STUDY	2017	NORTH INDIA	93.24 ±4.37

Table 4 : Comparison of Bi-orbital distance

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Original Article

A MDCT STUDY ON THE ANALYSIS OF COELIAC TRUNK AND ITS BRANCHING PATTERN IN THE NORTH INDIAN POPULATION

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ABSTRACT

Introduction: The coeliac trunk, which emerges from the AA at the level of T12-L1 vertebra immediately before the aortic hiatus, is the first anterior branch. The left stomach artery is the first branch, and the coeliac trunk divides into the common hepatic and splenic arteries. It divides into three branches: the left gastric artery, common hepatic artery, and splenic artery.

Materials and methods: Hundred patients (aged 18 to 70) referred to the Department of Radiodiagnosis at Subharti Medical College & Hospital, Meerut, and neighbouring Imaging Centers in the NCR underwent the cross-sectional study (MDCT). From August 2019 to October 2022, MDCT scan images of the abdomen region were examined for the normal anatomy of the coeliac trunk and its branches to determine their changes and type.

Results: According to Uflacker's classification, type-1 coeliac trunk branching pattern is the most frequently observed variant in the current study, whereas type-2 is the least frequently observed variety. In 2% of the population, there are variations in the type-1 coeliac trunk, such as the gastroduodenal artery and accessory hepatic artery that immediately emerge from the coeliac trunk. Common hepatic artery emerging from superior mesenteric artery in 2% of the population of type-5 variant. Left gastric artery takes a distinct origin from the abdominal aorta in 1% of type-6 coeliac trunks.

Conclusions: The most prevalent coeliac trunk branching pattern linked with other variations is type - 1 variety. Each variation is distinct, and the carelessness of a combination of such variances may pose a serious risk and result in fatal complications. Understanding the coeliac trunk branching pattern precisely is crucial.

Keywords: Coeliac trunk (CT), Abdominal aorta (AA), Multidetector computerised tomography (MDCT), Common hepatic artery (CHA), Uflackers Classification.

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INTRODUCTION

The coeliac trunk (CT), which arises from the AA right below the aortic hiatus at the level of T12-L1 vertebra, is the first anterior branch of the abdominal aorta. This is between 1.5 and 2 centimetres long.[1] The left gastric artery, common hepatic artery, and splenic artery are the three branches that emerge from the coeliac trunk (CT).[2] The conventional branching pattern, in which the left stomach artery is the first branch and the coeliac trunk divides into the common hepatic and splenic arteries, is present in about 70% of people.[3] One-third of adults have true trifurcations, where all three branches emerge from the coeliac trunk at its terminal level.Haller[4] first recognised this coeliac trunk trifurcation, which has long been believed to constitute the normal vascular structure (Van Damme and Bonte, 1990, Oran et al., 2001).[2] The left gastric artery (LGA), which typically emerges as a tributary elsewhere in the trunk, is said to be the division of the coeliac trunk according to Haller 1756, whereas the other divisions of the coeliac trunk only occasionally occur in human populations.[4]

In 1917, Lipshutz was the first to name and classify four categories of variants.Type I- normal trifurcation, Type II- hepatosplenic trunk, Type III hepatogastric trunk, Type IV gastrosplenic trunk.[5] Due to the inclusion of the superior mesenteric artery in six separate types of variants with 28 forms, Adachi updated the classification in 1928.[6]

Given below is Michels' (1966) classification of celiac trunk variations based on the coeliac trunk's branching pattern: I. The classic coeliac trunk; II. The hepatosplenic; III. The hepatogastric; IV. The hepato-splenicmesentery; V. The gastrosplenic; VI. The coeliac-mesenteric; VII. The coeliac-colic; and VIII. The absence of the celiac trunk.[7]

Uflacker's classification of celiac trunk variations:

Trifurcation, Type I The CHA, SA, and LGA all originate from the celiac trunk in a traditional manner. Unusual pattern: The LGA exhibits a changeable point of origin, while the CHA and SA share a common point of origin.

Hepato-splenic trunk, type II The LGA develops independently from the aorta and shares a trunk with the CHA and SA.

Hepatogastric trunk, type III The SA separates from the aorta or SMA, while CHA and LGA share a trunk.

Hepatosplenic-Mesenteric trunk type IV The LGA develops independently from the aorta, while the CHA, SA, and SMA share a single trunk.

The CHA develops independently from the aorta or SMA and has a common trunk with the LGA and SA, type V.

Celiacomesenteric trunk SMA and celiac disease share the same trunk, type VI.

The middle colic artery and the celiac have the same trunk in a type VII celiaco-colic trunk.

No celiac trunk, type VIII CHA, SA, and LGA arise from the aorta directly.[8]

The celiac trunk has been categorised by many authors depending on its branching structure. The current study's objective was to examine the celiac trunk's (the first ventral branch of the abdominal aorta) structural variations and those of its branches in the north Indian population.

MATERIALS AND METHODS

The present cross- sectional study was conceptualized in the Department of Anatomy, Subharti Medical College, Meerut in collaboration with the Department of Radiodiagnosis, Subharti Medical College & Hospital, Meerut and from nearby imaging centres in the NCR.

The study was performed on the 100 patients (including both the males & females between 18-70 years of age) referred to the Department of Radiodiagnosis, Subharti Medical College & Hospital, Meerut and nearby Imaging Centres in the NCR for Multidetector Computerised Tomographic Angiography (MDCTA) for evaluation of various suspected abdominal pathologies. CTA scan images were reviewed for normal anatomy of coeliac trunk and its branches to assess their variations and its type according to Uflacker's classification from August 2019 to October 2022.

A randomized sampling technique was used in the study. A proper ethical clearance was obtained from Ethical committee of the Subharti Medical College and Hospital Meerut.

Inclusion criteria

• Good quality of reformatted contrast-enhanced MDCTA images of the Abdominal Aorta and its branches.

• Absence of morphological features of the Abdominal Aorta and its branches.

Exclusion criteria

• Allergy to contrast

• Contraindication to radiation exposure (ex: pregnancy)

• Contrast-enhanced MDCT images with artifacts, suboptimal postcontrast arterial opacification.

• Contrast-enhanced MDCT images of patients with abnormalities that could interfere with optimum evaluation of the Abdominal Aorta and its branches.

RESULTS

Present study was done on the 100 patients including both males and females. The mean age of the patients was 43 years. The most commonly found type of coeliac trunk according to Uflacker's classification in the present study was type-1 and least commonly variety was type-2. Type-3,4, 7, 8 variety of coeliac trunk pattern were not found in the present type.

In one case of type-1 variety of coeliac trunk gastroduodenal artery was seen arising from the coeliac trunk.

In one case of type-1 variety of coeliac trunk accessory hepatic artery was seen arising directly from the coeliac trunk.

In two cases of type-5 variety of coeliac trunk, Common hepatic artery was seen arising from the superior mesenteric artery.

In one case of type-6 variety of coeliac trunk, left gastric artery was seen taking separate origin from the Abdominal aorta, in place of classical pattern from the coeliac trunk.

Coeliac trunk branching pattern	Type-1	Type-2	Type-5	Type-6
No of cases & % of type of CT found	89cases (89%)	2cases (2%)	6cases (6%)	3 cases (3%)

Table 1: Frequency of type of coeliac trunk in the present study according to Uflacker's Classification

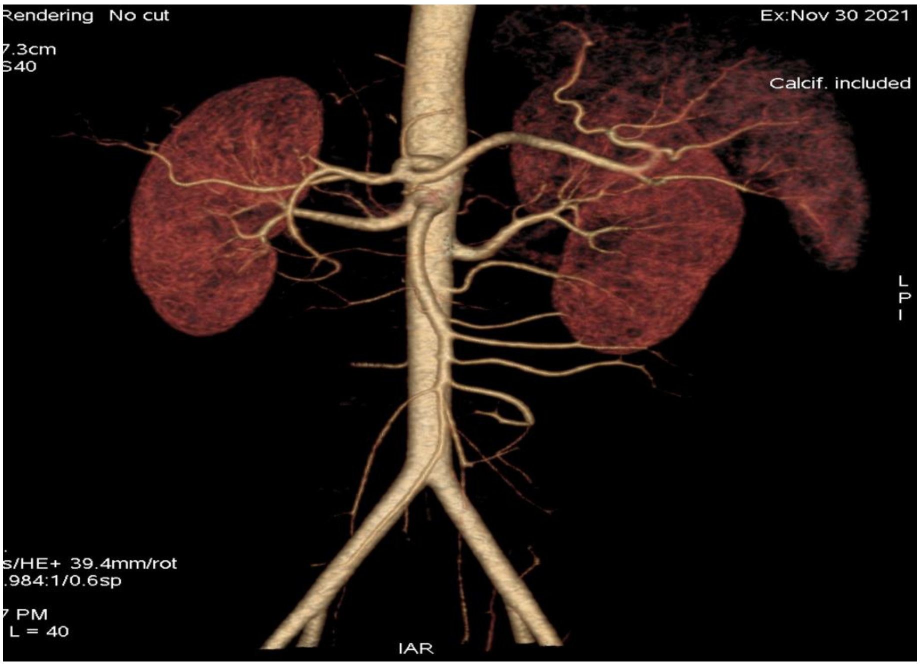

Figure 1: Type-1 variety of coeliac trunk branching pattern.

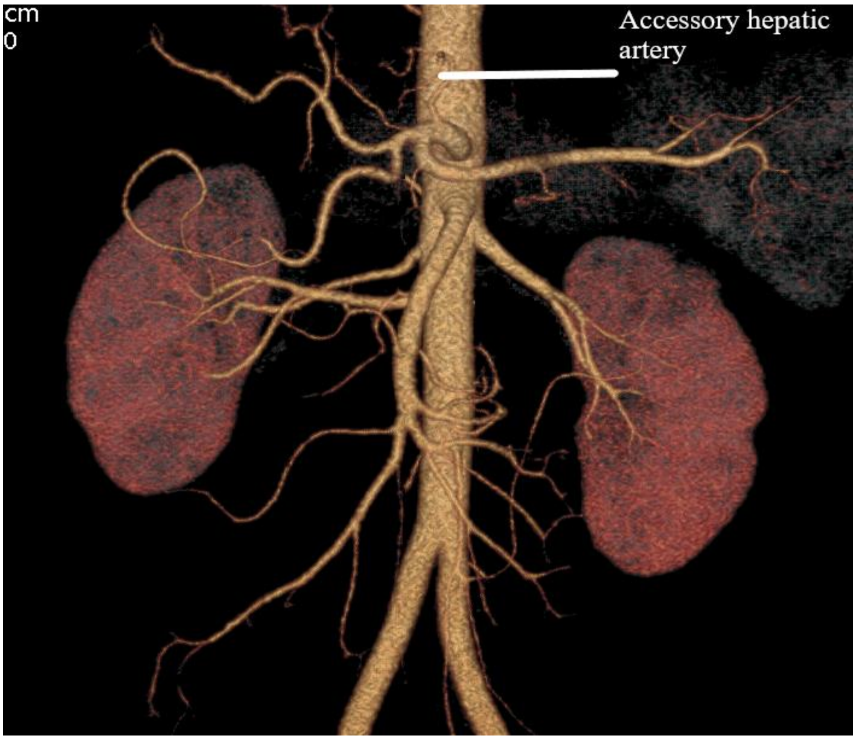

Figure 2: Type-1 variety of coeliac trunk branching pattern and accessory left hepatic artery.

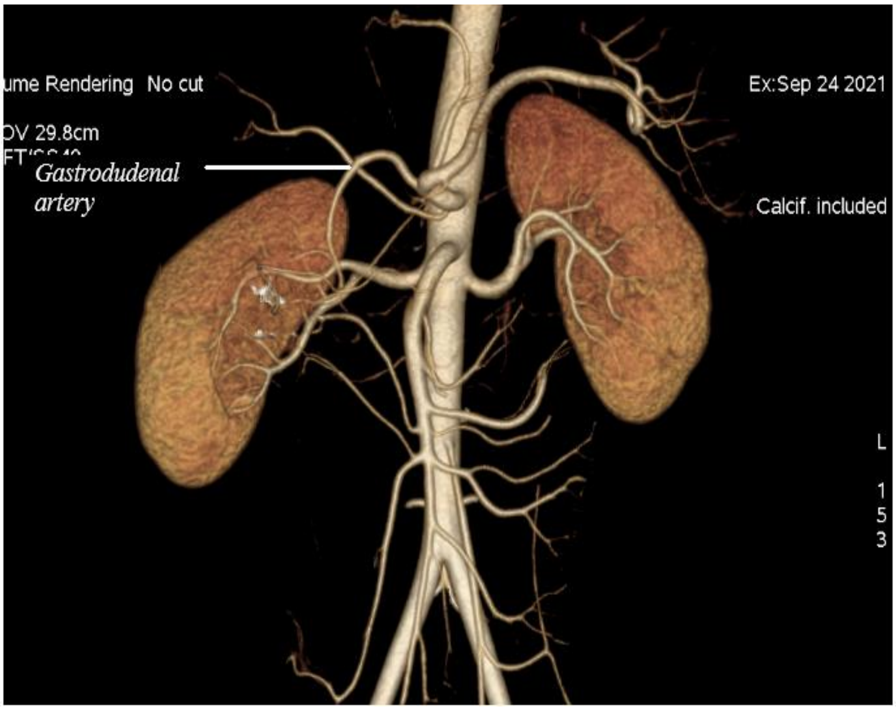

Figure 3: Type-1 variety of coeliac trunk branching pattern where gastroduodenal artery arising from coeliac artery.

Figure 4: Type-2 type of coeliac trunk branching pattern where Common trunk hepatic artery and splenic artery and separate origin of Left gastric artery from aorta.

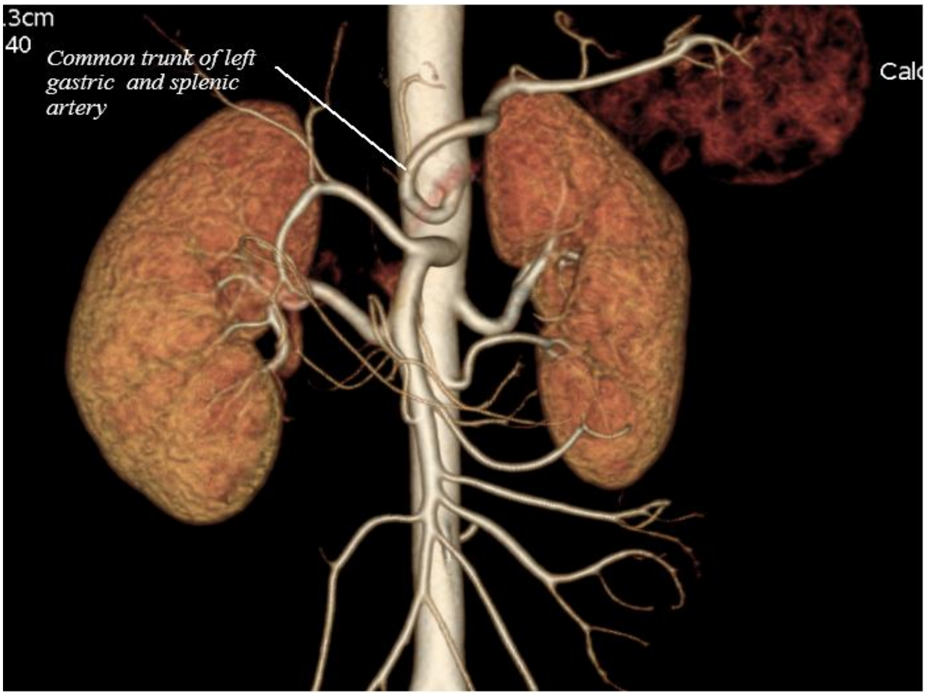

Figure 5: Type-5 type of coeliac trunk branching patter where Common spelnic artery and Lt gastric artery and CHA arising from SMA.

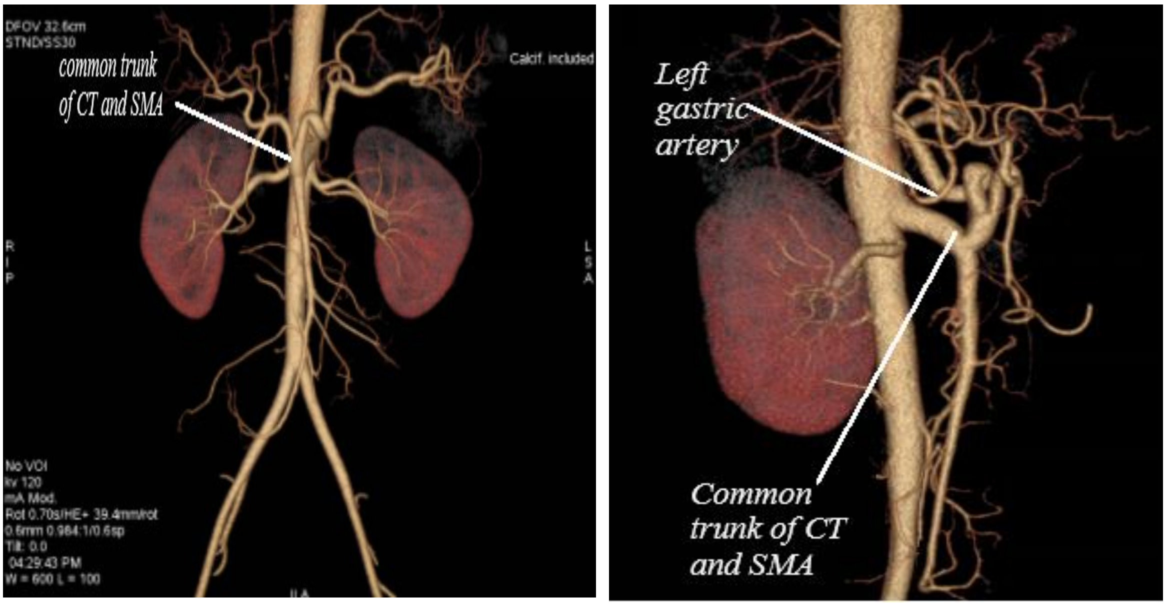

Figure 6: (a, b) Type-6 common trunk of celiac trunk and SMA and showing left gastric artery taking direct origin from the Aorta

DISCUSSION

The diameter, length, and location-related anatomical differences in the coeliac trunk are assumed to have an embryological origin. The yolk sac, the primitive intestine, and its derivatives are supplied by the paired ventral splanchnic branches that emerge from each dorsal aorta. The ventral branches join together to create a series of unpaired segmental arteries that run in the dorsal mesentery of the gut and are joined by a ventral longitudinal anastomosing channel with the fusion of the dorsal aortae during the fourth week of intrauterine life (IUL). Numerous ventral splanchnic branches are withdrawn as a result of the creation of the longitudinal anastomotic channel, leaving just the coeliac artery for the foregut, the superior mesenteric artery for the midgut, and the inferior mesenteric artery for the hindgut. According to Tandler (1904), the 10th and 13th roots continue to be connected by the ventral anastomoses while the 11th and 12th ventral segmental roots vanish. The longitudinal anastomosis is typically the point of origin for the common hepatic, left gastric, and splenic arteries. Typically, these branches are cut off from the 13th root (the future superior mesenteric artery). One of the coeliac trunk's branches is moved to the superior mesenteric artery if this separation occurs at a higher level. The formation of a coeliaco-mesenteric trunk occurs if the 10th or 13th root vanishes.[9]

The data gathered from past studies has been combined in one article so that it may be compared to the results of the current investigation. Coeliac trunk trifurcation was discovered in 89 percent of cases, and bifurcation in 8%, according to Ugurel MS et al. (2010). One percent of patients had no coeliac trunk, one percent had a hepatosplenomesenteric trunk, and one percent had a splenomesenteric trunk.[10] Similar to the previous study, Type I celiac trunk trifurcation was discovered in 89 percent of patients.

The superior mesenteric artery and two traditional branches of the celiac trunk share a shared origin with the hepato-splenomesenteric trunk, according to Varma KS (2010). The left gastric artery, the third conventional branch of the celiac trunk, arises directly from the abdominal aorta.[11] A case where the left gastric artery had a clear direct origin from the abdominal aorta was also described by us.

The celiac trunk was trifurcated in 76 (61.7 percent) cases, bifurcated in 22 (17.9 percent), and gave collaterals in 25 cases, according to Mburu KS (2010). (20.3 percent).[12]

Daniela Malnar (2010) found that the left gastric artery emerges as a first branch and has its origin in the aorta all along the celiac trunk up to a bifurcation, whereas the splenic and common hepatic arteries divide into them in 72% of all cases. Four of the 90 cadavers had anatomical differences.In contrast to given study we found one case in which left gastric artery taking direct origin from the abdominal aorta out of 100 cases and trifurcation is the most common type of coeliac trunk.[13]

In 69 out of 70 patients, Sehgal S et al. (2013) found distinct origins for the Celiac Trunk (CT), Superior Mesenteric (SMA), and Inferior Mesenteric arteries (IMA) from the front side of the abdominal aorta. The celiac artery and superior mesenteric artery had a single origin from the anterior aspect of the aorta in a 40-year-old female individual (CMT).[14] However, in the current investigation, we did not discover any such variance.

Rare anatomical changes were discovered in 2014 by Skorzewska A et al. during the investigation of hepatic artery vascularization in multidetector computed tomography angiography. The right hepatic lobe is supplied by the common hepatic artery (CHA), which emerges from the coeliac trunk (CTr) in the earliest documented variation. An aberrant left hepatic artery that has a common trunk with the left gastric artery and the splenic artery supplies blood to the left lobe of the liver.[15] We also discovered one case of an accessory left hepatic artery and one case of CHA originating directly from CT in the current MDCT investigation on the celiac trunk.

According to Ahmed M. et al. (2016), 90.5% of the patients displayed a normal trifurcation pattern of the celiac trunk (Uflacker type I), with the gastro-splenic trunk (Uflacker type V) having the highest incidence rate at 4.3%. 7.7 percent of patients had the bifurcation pattern.[16] Similarly, in the current investigation, we discovered that the type-1 pattern of coeliac trunk is the most prevalent.

CONCLUSION

The type -1 variety of coeliac trunk is the commonest type of coeliac trunk branching pattern in the present study. Each variation is unique; the negligence of a combination of such variations may cause considerable risk, leading to lethal complications.

For the following methods, precise understanding of the celiac trunk branching pattern is essential: There is a need for an accurate description of the coeliac trunk and its branches for procedures like transarterial chemoembolization (TACE), abdominal angioplasties, abdominal angiographies, and upper abdominal laparoscopic surgeries like Whipple's procedure and aortic replacement with reimplantation of coeliac trunk in order to prevent ligation or division of the wrong vessel, which could result in necrosis or bleeding.

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Case Report

RARE UNILATERAL THIRD HEAD OF BICEPS BRACHII – A CASE REPORT

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ABSTRACT

Introduction: Biceps Brachii has been described as one of the muscle showing frequent anatomical variation . Third Head of Biceps Brachii arising from Humerus is one of the commonly seen anatomical variation. Understanding the existence of unilateral or bilateral supernumerary heads may influence preoperative diagnosis and surgery of Upper limbs. In this current case report , Inferolateral third head of Biceps Brachij was found in an 85 year old cadaver. The knowledge of such variation will be advantageous to surgeons, radiologists, etc.

Keywords: MN-Median Nerve, MCN- Musculocutaneous Nerve , LR – Lateral Root

INTRODUCTION

The biceps brachii is a dominant muscle of the anterior compartment of the arm and is characteristically illustrated as a large, fusiform muscle with two heads.[1] The short head originates from the tip of the coracoid process, and the intracapsular tendon of long head arises from the supraglenoid tubercle of the scapula. The two tendons lead into closely applied elongated bellies to terminate in a flattened tendon about 7 cm from elbow joint and get inserted into the rough posterior area of the radial tuberosity .The tendon gives a broad medial expansion, the bicipital aponeurosis, which merges with the antebrachial fascia.[2]

The musculocutaneous nerve (MCN) is the continuation of lateral cord of brachial plexus. It gives motor branch to coracobrachialis about 2cm below the tip of coracoid process. The MCN then pierces coracobrachialis after which it gives motor branches to biceps brachii and brachialis. It pass downward and laterally between brachialis and biceps brachii, gives a branch to humerus and continues as lateral cutaneous nerve of the forearm. [3]

Meticulous knowledge of the variant morphology of the biceps brachii (BB) muscle is vital, as they may confuse surgeons during upper limb operations or they may cause compression of adjacent neurovascular structures.[4]

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OBSERVATIONS

During a routine cadaveric dissection of Brachial Plexus for Under graduate teaching in Department Of Anatomy, Saraswathi Institute Of Medical Sciences Hapur, an accessory head of Biceps Brachii was noticed in left arm of an 85 year old formalin embalmed adult male cadaver. The variation was photographed and recorded .The other side of the arm was found to be normal .The arm was dissected carefully to display full length of biceps from proximal to distal attachment. All other related structures were exposed. The anomalous muscle or the third head of Biceps Brachii was seen to be originating from the anterolateral surface of the humerus below the level of insertion of deltoid. The muscles fibers merged with the fibers of short head of biceps brachii .The common tendon then crossed the elbow joint to get attached on the posterior side of radial tuberosity. Like the other two heads of Biceps brachii it was also seen to be innervated by the Musculocutaneous nerve. (Fig. 1)

DISCUSSION

The Biceps Brachii muscle shows variations in the number of heads, with an estimated 9-22% of all people having a supernumerary head [5]. The most common variation is third head but four, five or even seven heads have been reported.[6].The supernumerary head may have a clinical importance, as they may confuse a surgeon who performs a surgery on the arms or they may cause a compression on neurovascular structure in the upper limbs[7]. Supernumerary heads of biceps brachii were classified by RodriguezNiedenfuhr, et al. on the basis of origin and location as - superior, inferomedial and inferolateral types. According to them inferomedial type is the most prevalent, arises from the anteromedial surface of humeral shaft between distal attachment of coracobrachialis and proximal attachment of brachialis. The current cadaveric finding resembles “Inferolateral” type, which is uncommon variety according to RodriguezNiedenfuhr, et al. [8]. The emergence

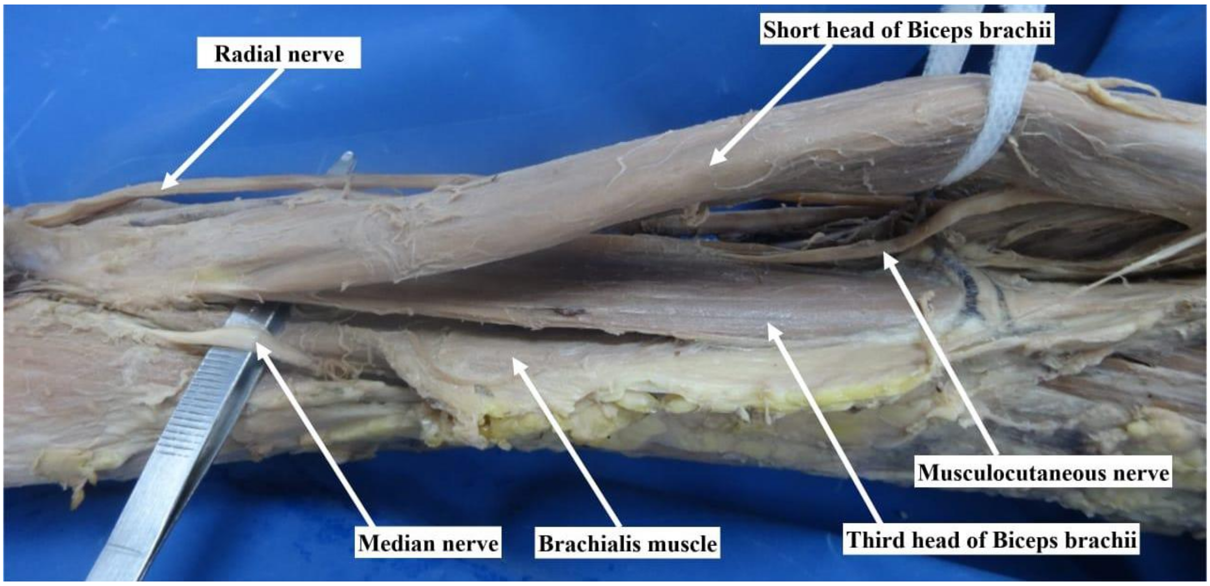

Figure 1: Dissected left arm showing the third head of Biceps brachii.

of the supernumerary head of any muscle, may be the result of longitudinal splitting of primordial muscle mass destined to form a parent muscle, as explained by McMurrich.[9]

CONCLUSION

The Biceps brachii muscle presents a wide range of variations. This anomaly varies among populations such as Chinese,8% ;European white,10 %;African Black, 12% %,Japanese ,18%;South African Blacks 21%;South African whites,8% and 38% in Colombians [10].The anomalies can manifest as a cluster of accessory fascicles arising from the coracoid process, pectoralis minor tendon, proximal head of humerus or articular capsule of humerus .[11]The most common variation is the muscle arising from the shaft of the humerus itself also known as humeral head or the third head of Biceps brachii muscle[12].The presence of supernumerary muscle might increase its kinematics. The biceps is known for its powerful elbow flexion (secondary to brachialis) when the forearm is supinated. It also acts when rapid supination is required . Anatomists consider that additional biceps head as observed in this case may increase the power of flexion and the supination component of the elbow .However no attempt to amalgamate the relationship between the additional muscle head and its strength has been made [13].

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