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A Study of Variations in Origin of Cystic Artery and Relation of Cystic Artery to Biliary Ducts

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Abstract

Background and aims: The gallbladder and extra-hepatic biliary system are more often called for operative treatment as compared to any other intra-abdominal viscera, being second only to vermiform appendix. With the advent of laparoscopic cholecystectomy, sound knowledge of cystic artery and its variations has gained paramount importance. The very limited field of vision during laparoscopic surgeries can lead to intra- and post-operative complications, the most serious being haemorrhage and bile leakage. *Materials and Methods:* In the present study 40 adult cadavers were studied for site of origin of cystic artery and relations of cystic artery (origin) to Calot's triangle and to the biliary ducts. *Results:* In 23 cases, cystic artery originated from right hepatic artery, from proper hepatic artery in 8 cases, from superior mesenteric artery in 6 cases, from segmental branch of left hepatic artery in 2 cases and in 1 case from common hepatic artery. In 35 specimens cystic artery originated outside the Calot's triangle. In 28 specimens cystic artery was lying medial to cystic duct. In 27 specimens cystic artery was lateral to common hepatic duct and it passed anterior to common hepatic duct in 13 specimens. These variations are seen due to the alterations of the pattern of absorption of vessels during intrauterine life. *Conclusion:* The present study not only adds knowledge to the existing literature, but also, helps both the interventional radiologists and the surgeons in reducing the chances of injury to cystic artery and biliary ducts which usually lead to complications, morbidity and mortality.

Keywords: Cystic Artery; Calot's Triangle; Gallbladder; Cholecystectomy.

Introduction

The blood supply to the gallbladder, cystic duct, hepatic ducts and upper portion of the common bile duct is done by the cystic artery. The cystic artery normally arises from the right hepatic artery in the Calot's triangle. The cystohepatic triangle of Calot is an anatomical space bounded superiorly by the inferior surface of segment V of the liver, inferiorly by the cystic duct and medially by the common hepatic duct [1]. In 1891, Calot described this famous triangle as bounded by cystic duct, common hepatic duct / bile duct and cystic artery in its original description [2]. Later in 1981, Rocko and Di Gioia inferred that the triangle is bounded by cystic duct, common hepatic duct / bile duct and inferior surface of liver [3]. Hugh et al suggested that this triangle should be called the hepatobiliary triangle, with the small cystic artery branches supplying the cystic duct being called Calot's arteries [4]. The contents of this triangle are right hepatic artery, cystic artery, cystic lymph node of Lund and lymphatics.

Variations in the origin and course of the cystic artery are very common. The cystic artery most commonly arises from the right hepatic artery, but can also arise from left hepatic artery, proper hepatic artery, common hepatic artery, gastroduodenal artery, superior pancreaticoduodenal artery or superior mesenteric artery. The cystic artery may arise outside the Calot's triangle and then it passes anterior to the common hepatic duct [5].

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The course and length of the cystic artery in the Calot's triangle is variable, and it usually enters the gallbladder in the neck or body area. The cystic artery traverses through the centre of the triangle, but may at times be very close or even slightly inferior to the cystic duct. It further passes behind the common hepatic duct to reach the superior aspect of the neck of gallbladder, and then descends to the body [6]. On the body, the cystic artery divides into superficial branch that runs along the peritoneal surface (subserously) of the gallbladder, and a deep branch, which runs between the gallbladder and gallbladder fossa. These 2 branches anastomose and yield small branches that enter the gallbladder parenchyma [2]. In 25% of cases, the superficial and deep branches arise separately, deep branch usually from right hepatic and superficial from superior mesenteric artery [7].

Since the advent of laparoscopic cholecystectomy, a good knowledge of Calot's triangle is important as this triangle forms an imaginary reference area for all biliary surgeries. The variations in origin and course of the cystic artery can cause serious problems resulting from severe arterial bleeding during surgical procedures [6]. Cystic artery bleeding along with other intra-operative complications like injury to extra-hepatic bile duct leading to bile leakage are the most common cause for conversion of laparoscopic to open cholecystectomy. Poor identification of anatomical structures in the operation field along with the presence of anatomical variations contributes to the occurrence of major intra- and post-operative complications. Hence a thorough knowledge of Calot's triangle and its contents, both normal and its variations, is a must for surgeons operating in this area. The aim of this study was to evaluate the variations in the origin of cystic artery and the relation of cystic artery to the biliary ducts so as to help surgeons in avoiding injury to the cystic artery which usually leads to complications, morbidity and mortality.

Materials and Methods

The present study was carried out on 40 adult human preserved cadavers in the Department of Anatomy from January 2015 to February 2016. The abdomen was opened as per Cunningham's Manual, and after exploring the peritoneal cavity, the anterior layer of peritoneum was removed from the lesser curvature of the stomach. The cystic duct, right and left hepatic duct, common hepatic duct, common bile duct were traced, identified and dissected out. Boundaries of Calot's triangle were defined. Cystic artery, right hepatic artery, common hepatic artery and proper hepatic artery were identified [8]. The site of origin of the cystic artery and relation of its origin to the triangle were studied. The course of the cystic artery and the relation of the cystic artery to the common hepatic duct and bile duct were studied and noted. Variations found were recorded and photographed.

Results

In the present study of 40 specimens, the cystic artery originated from right hepatic artery in 23 specimens (57.5%), from proper hepatic artery in 8 specimens (20%), from superior mesenteric artery in 6 specimens (15%), from segmental branch of left hepatic artery in 2 specimens (5%) and from the common hepatic artery in 1 specimen (2.5%) (Table 1). Thus the site of origin of cystic artery varied. In 35 specimens (87.5%), the cystic artery originated outside the Calot's triangle, whereas in only 5 specimens (12.5%) it took origin within the triangle. Irrespective of the site of origin, in all the cases the cystic artery traversed through the triangle before reaching the gallbladder. Depending on the site of origin, the course and relation of the cystic artery to common hepatic or bile duct and to the cystic duct was different.

Out of the 23 specimens wherein the cystic artery originated from right hepatic artery (Figure 1), in 18 cases the site of origin was outside the Calot's triangle and in 5 specimens it was within the triangle. Where the site of origin was outside the triangle, in 15 specimens the cystic artery was crossing the common hepatic duct from the posterior aspect and in 3 specimens it crossed anteriorly. In the 5 specimens wherein the site of origin was within the triangle, the right hepatic artery crossed the common hepatic duct from posterior aspect in 3 specimens and from the anterior aspect in 2 specimens.

In 2 specimens the cystic artery originated from segmental branch of left hepatic artery outside the Calot's triangle and the segmental branch of left hepatic artery passed posterior to the common hepatic duct.

In 2 specimens the common hepatic artery trifurcated to give right hepatic, left hepatic and gastroduodenal arteries. In 1 case the cystic artery arose from right hepatic artery (Figure 1) and in the other case it was a branch of the segmental branch of left hepatic artery.

In 1 specimen, 2 cystic arteries were seen, 1 originating from the right hepatic artery and the other from segmental branch of left hepatic artery. They passed through the triangle parallel to each other up to the neck of the gallbladder (Figure 2).

In 8 specimens the cystic artery took origin from proper hepatic artery outside the triangle (Figure 3). In 6 cases the cystic artery was crossing the common hepatic duct from its posterior aspect and in 2 specimens from its anterior aspect.

In 1 specimen the cystic artery arose from the common hepatic artery outside the triangle and passed posterior to the common hepatic duct. In 6 specimens the cystic artery took origin from the superior mesenteric artery outside the triangle (Figure 4). In all these specimens the cystic artery was passing anterior to the bile duct (Table 2).

In 70% cases the cystic artery was medial to the cystic duct. In 67.5% of cases the cystic artery was lying lateral to the common hepatic duct and it passed anterior to the common hepatic duct in 32.5% of the

Table 1: Variation in the site of origin of cystic artery

Site of origin of Cystic Artery	Number of Cases (out of 40 cadavers)	Percentage (%)
Right Hepatic Artery	**23**	**57.5**
Proper Hepatic Artery	**8**	**20**
Superior Mesenteric Artery	**6**	**15**
Segmental branch of Left Hepatic Artery	**2**	**5**
Common Hepatic Artery	**1**	**2.5**

Table 2: Relation of site of origin of cystic artery to Calot's triangle and relation of cystic artery to common hepatic duct/bile duct

Site of Origin of cystic artery	Relation of origin to Calot's triangle	Relation to Common Hepatic Duct/Bile Duct	No. of cases with percentage
Right Hepatic Artery **(23) 57.5%**	Outside the triangle: **18**	Cystic Artery to Common Hepatic Duct	Posterior: **15 (37.5%)** Anterior: **3 (7.5%)**
	Within the triangle: **5**	Right Hepatic Artery to Common Hepatic Duct	Posterior: **3 (7.5%)** Anterior: **2 (5%)**
Segmental branch of Left Hepatic Artery **(2) 5%**	Outside the triangle: **2**	Segmental branch of Left Hepatic Artery to Common Hepatic Duct	Posterior: **2 (5%)** Anterior: **0**
Proper Hepatic Artery **(8) 20%**	Outside the triangle: **8**	Cystic Artery to Common Hepatic Duct	Posterior: **6 (15%)** Anterior: **2 (5%)**
Common Hepatic Artery **(1) 2.5%**	Outside the triangle: **1**	Cystic Artery to Common Hepatic Duct	Posterior: **1 (2.5%)** Anterior: **0**
Superior Mesenteric Artery **(6) 15%**	Outside the triangle: **6**	Cystic Artery to Bile Duct	Posterior: **0** Anterior: **6 (15%)**

Table 3: Comparison of site of origin of cystic artery with previous studies (RHA- Right Hepatic Artery, PHA- Proper Hepatic Artery, LHA- Left Hepatic Artery, CHA- Common Hepatic Artery, GDA- Gastroduodenal Artery, CT- Coeliac Trunk, SMA- Superior Mesenteric Artery, SPDA- Superior Pancreaticoduodenal Artery, ABRHA- Aberrant Right Hepatic Artery)

Sr. No.	Author	Year of Study	No. of cases	Site of origin of cystic artery (% of cases)									
				RHA	PHA	LHA	CHA	GDA	CT	SMA	SPDA	ABRHA	Others
1	Anson[13]	-	676	61.3	3.4	5.9	-	2.5	0.9	0.9	0.9	10.2	14
2	Flint[14]	1923	200	98	-	1.5	-	0.5	-	-	-	-	-
3	Daseler[15]	1947	580	71.5	-	6.2	2.7	2.6	0.35	0.1	-	16.4	-
4	Michels[16]	1956	200	77.5	-	5	1.5	4	-	-	-	12	-
5	DeSilva[17]	2001	50	96	-	4	-	-	-	-	-	-	-
6	Futura[18]	2001	110	75.5	-	4.5	-	7.3	-	-	-	-	12.7
7	Flisinski[19]	2004	34	82.3	8.8	5.8	-	2.9	-	-	-	-	-
8	Khalil[20]	2008	60	90	2	3	2	2	-	-	1	-	-
9	Bakheit[5]	2009	106	78	-	2	17	3	-	-	-	-	-
10	Pushpalata[21]	2010	50	54	22	-	12	8	-	2	-	2	-
11	Present study	2016	40	57.5	20	-	2.5	-	-	15	-	-	5

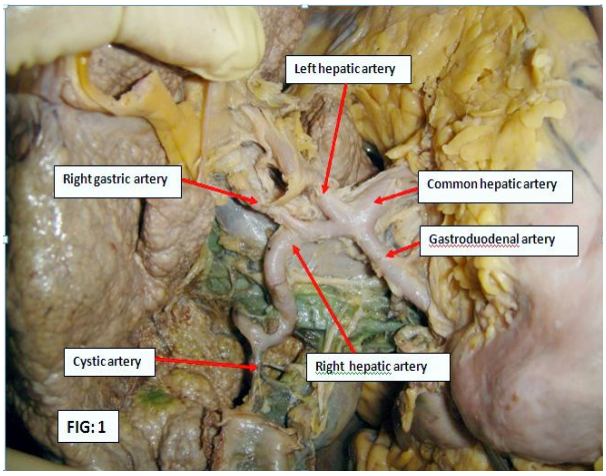

Fig. 1: Cystic artery arising from right hepatic artery; common hepatic artery trifurcating into right hepatic, left hepatic and gastroduodenal arteries

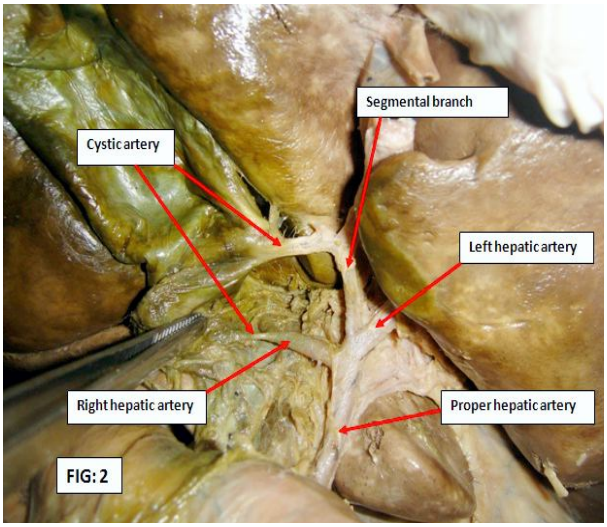

Fig. 2: Two Cystic arteries: one arising from right hepatic artery and one from segmental branch of left hepatic artery

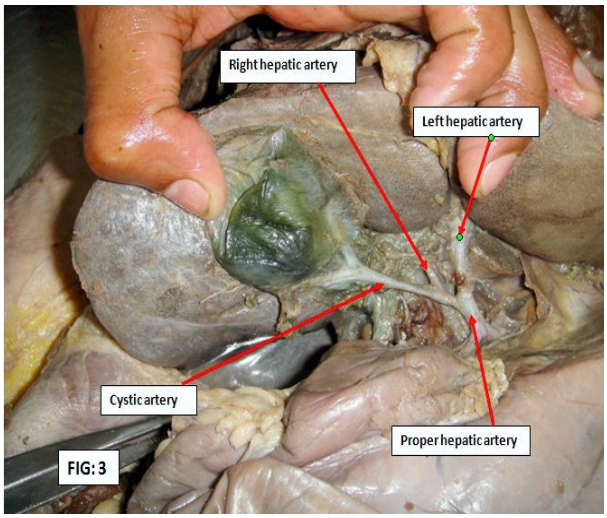

Fig. 3: Cystic artery direct branch from proper hepatic artery; right hepatic artery is branch of cystic artery

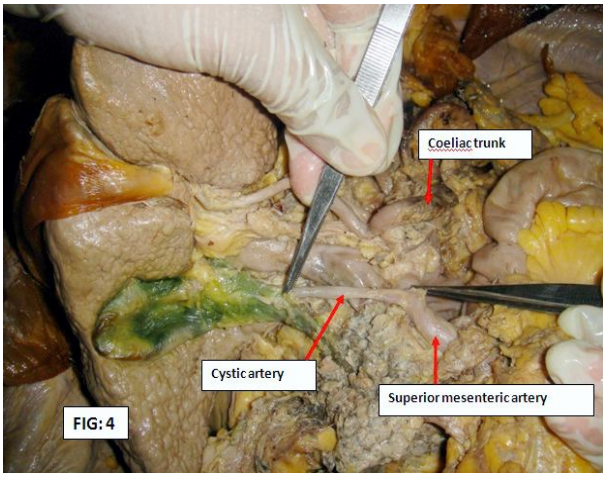

Fig. 4: Cystic artery arising from superior mesenteric artery

cases.

Discussion

The cystic artery is normally a branch of right hepatic artery and along with gallbladder it also supplies blood to common hepatic duct, hepatic ducts and upper portion of common bile duct through numerous small branches [9].

Embryologically, the liver and gallbladder develop from the hepatic diverticulum of foregut in the 4th week of intra-uterine life. This diverticulum has a rich blood supply from abdominal aorta and its branches. Most of these branches degenerate during its development leaving only the mature vascular system [10]. The simple branching pattern of the gastroduodenal and hepatobiliary vasculature is majorly altered by the growth of the liver and pancreas and also by the assumption of a curved form in the stomach and duodenum [11]. As the degeneration pattern is highly variable, hence there are variations in the blood supply of the liver and gallbladder. This explains the variations in origin of cystic artery from: right hepatic (63.9%), hepatic trunk (26.9%), left hepatic (5.5%), gastroduodenal (2.6%), superior pancreaticoduodenal (0.3%), right gastric (0.1%), coeliac trunk (0.3%), and superior mesenteric artery (0.8%) as are reported by Patil et al [12].

The origin of cystic artery in our study was from: right hepatic (57.5%), proper hepatic (20%), superior mesenteric (15%), segmental branch of left hepatic (5%) and common hepatic (2.5%). Table 3 shows the comparison of site of origin of cystic artery with previous studies. Our findings on the site of origin of cystic artery are similar to those of Pushpalata and Shamsundar and this could be due to regional similarity as both these studies were done in the region of Karnataka.

Ding et al in 2007 presented a new laparoscopic classification of anatomic variations of the cystic artery, which can be divided into 3 groups: Calot's triangle type, which includes single cystic artery and double cystic arteries; outside Calot's triangle type, which includes 4 variants: cystic artery originating from gastroduodenal artery; cystic artery originating from the variant right hepatic artery; cystic artery directly arising from the liver parenchyma; and, cystic artery originating from the left hepatic artery; and, compound type, wherein the cystic artery is situated within and outside the Calot's triangle [22]. Balija et al have classified cystic artery variations into 2 groups. Group I comprises 5 variations of the cystic artery within the hepatobiliary triangle: normal position; frontal cystic artery; backside; multiple; and, short. Group II consists of variations of the cystic artery that approaches the gallbladder beyond the hepatobiliary triangle and includes low-lying, transhepatic and recurrent cystic artery [23]. Ignjatovic et al have divided cystic artery into 3 types in minimally invasive surgical procedures as: type 1 showing normal anatomy; type 2 showing more than one artery in Calot's triangle; and, type 3 showing no artery in Calot's triangle [24]. These classifications are of great help to the surgeons and radiologists in proper identification of the contents of the Calot's triangle.

In the present study, the cystic artery was a content of the Calot's triangle in 34 specimens (85%). The study done by Tejaswi et al [25] in 2013 showed this to be 65% whereas Aristotle [26] in 2014 reported it to be 92.5%. Rahman and Anwar [27] in 2012 found the incidence of the same to be 96.65%.

We found the cystic artery lying medial to the cystic duct in 28 cases (70%). Tejawsi et al [25] have reported the same as 65%. In 27 cases (67.5%) we noted the cystic artery lying lateral to the common hepatic duct and it was passing anterior to the common hepatic duct in 13 cases (32.5%). These are comparable to the findings of Tejaswi et al [25] at 67% and 30% respectively.

The gallbladder and its duct are more often called for operative treatment as compared to any other intra-abdominal viscera, being second only to vermiform appendix. Currently laparoscopic cholecystectomy is a gold standard treatment for cholelithiasis as it has many advantages over open cholecystectomy. All the more so, on laparoscopic visualization, the anatomical structures and their relations are seen differently as compared to the conventional surgeries. Hence misinterpretation of anatomy as well as the presence of anatomical variations can contribute to major intra- and post-operative complications [2].

The most frequent complications are: haemorrhage or bile leakage [28], lost gall stones [29], and iatrogenic bile duct injuries [30]. Haemorrhage and bile leakage usually occurs due to variations in structures present in the Calot's triangle and are the most common cause for conversion to open cholecystectomy. Lost gall stones often lead to stones in the port site or the abdominal abscesses. Iatrogenic bile duct injuries are the most serious and important causes of morbidity after cholecystectomy [31]. Hence every surgeon should be familiar with the anatomical conditions in the Calot's triangle in order to achieve proper recognition, ligation and cutting of the cystic duct and cystic artery with its branches during gallbladder removal surgeries.

Conclusion

Variations in origin and course of the cystic artery are very common. Thorough knowledge of these variations and also of the relations of the cystic artery with the biliary ducts is essential in performing cholecystectomy, both, open and laparoscopic. This not only helps the interventional radiologists but also the surgeons, and also goes a long way in preventing intra- and postoperative complications like haemorrhage and bile leakage.

Our study adds to the existing knowledge and helps the surgeons to minimize the chances of complications during cholecystectomy.

Conflicts of Interest

The authors do not have any conflicts of interest.

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Morphometric Analysis of Foramen Magnum in Dry Adult Human Skull

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Abstract

Background and Objective: Foramen magnum is a large opening in the occipital bone of human skull. Its morphometry is of outmost importance for neurosurgeons, radiologists, forensic experts, anatomists and anthropologists. Our study aims at measuring the morphometric measurements of foramen magnum in dry adult human skull and analyse the observation. *Materials and Methods:* One hundred dry adult human skulls of unknown age and sex were collected from the museum of the department of Anatomy of Navodaya Medical College, Raichur. The morphometric analysis of the foramen magnum was done using vernier calipers. *Results:* The mean antero-posterior diameter (APD) of the foramen magnum was found to be 34.1 mm. The mean transverse diameter (TD) of the foramen magnum was found to be 28.68 mm. The mean surface area of the foramen magnum was found to be 774.17 sq.mms. The mean foramen magnum index (FMI) was found to be 84.18. *Conclusion:* The knowledge of the dimensions of the foramen magnum helps the neurosurgeons, radiologists, forensic experts, anatomists and anthropologists during their analysis or surgery. This study is worthwhile because of this importance.

Keywords: Foramen Magnum; Skull; Human; Anatomy; Morphometry.

Introduction

The foramen Magnum (FM) (Latin: 'great hole') is a large opening in the occipital bone of the cranium. Foramen magnum lies in antero-median position. It is oval and wider behind, with its greatest diameter in antero-posterior direction. Its anterior border is formed by the basilar process of the occipital bone. Its lateral borders are formed by the left and right ex-occipitalis. Its posterior border is formed by the supra-occipital part of the occipital bone. Anteriorly, margins of foramen magnum are overlapped by the occipital condyles, that project downwards [1]. The foramen magnum, as a transition zone between spine and skull, plays an important role as a landmark because of its close relationship to key structures such as the brain and the spinal cord. Through this outlet, the medulla and spinal cord pass from the skull to the vertebral column. It contains lower end of medulla oblongata, meninges, vertebral arteries and spinal accessory nerve. The cranio-vertebral junction refers to the occipital bone that surrounds foramen magnum and atlas and axis vertebrae [2]. The abnormalities of the cranio-vertebral junction can be congenital, developmental, acquired, traumatic, tumours, inflammatory, occurring either alone or in combination. All these abnormalities are of importance to anatomists as well as clinicians as they produce clinical symptoms [3]. The measurements of the foramen magnum are helpful for neurosurgeons for performing lateral trans-condylar surgical approaches for reaching lesions in the middle and posterior part of cranial base [4]. The morphometry of the foramen magnum is important because diseases in this region like achondroplasia (as there is a high risk of spinal cord stenosis in the base of the skull due to the small size of the foramen magnum in patients with achondroplasia at all ages) [5] and Arnold-Chiari malformation (downward herniation of the cerebellar tonsils and a resultant foramen magnum which shows expansion of transverse diameter) [6,7] may compress the vital structures passing through it. Measurements of foramen magnum are also important in conditions like foramen magnum meningioma, plagiocephaly, basilar

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invagination, and others cranial deformities [8,9,10]. The diameters and area of the foramen magnum are found to be greater in males than in females. This fact helps forensic experts determine the sex in situations like explosions, aircraft accidents and war fare injuries [11,12]. Thus, it is obvious that morphometric knowledge of the foramen magnum is of outmost importance. Hence, our study is aimed at establishing a database for the measurements of the dimensions of foramen magnum.

Materials and Methods

Our study group included 100 dry adult human skulls with intact base chosen irrespective of age and sex from the museum of the department of Anatomy of Navodaya Medical College, Raichur of Karnataka state. Pathological, fractured, deformed and developmental disturbances of the skull were excluded from the study. Vernier calipers was used to measure the antero-posterior diameter (APD), transverse diameter (TD). The two authors recorded the above measurements independently and a mean of the two recordings was taken for final statistics. Measurements were recorded to the nearest millimetre. The antero-posterior diameter of the foramen magnum was measured from the anterior border (basion) through the centre of the foramen magnum until the end of the posterior border (opistion), towards the median plane while the transverse diameter was measured from the end of the right border with concavity stronger, through the centre of the foramen magnum to the opposite end of the lateral border of concavity, with transverse directions (Figures 1 and 2). This was followed by measurement of the surface area of the foramen magnum (FMA) which was calculated using formula derived by Radinsky [13].

Radinsky's Formula (FMA): $1/4 \times \pi \times APD \times TD$

Where, π (mathematical constant) = 22/7,

APD = Foramen magnum antero-posterior diameter and TD = Foramen magnum transverse diameter.

This was followed by measurement of the Foramen magnum index (FMI) which was calculated using following formula:

FMI = FM transverse diameter X 100 / FM antero-posterior diameter.

After each parameter was measured, calculated, and assessed, the mean value and standard deviation were computed using Microsoft Excel of Microsoft Office 2000.

Results and Observations

In our study, a total of 100 foramina were studied. The mean antero-posterior diameter (APD) of the foramen magnum was 34.1$\pm$3.36 mm. The maximum value for APD was 42 mm and the minimum value for APD was 26 mm. The mean transverse diameter (TD) of the foramen magnum was 28.68 $\pm$ 2.93 mm. The maximum value for TD was 34 mm and the minimum value for TD was 21 mm. The mean surface area of the foramen magnum (FMA) was 774.17 square mms. The maximum value for FMA was 1040.91 square mms and the minimum value for FMA was 428.61 square mms. The mean value for the foramen magnum index (FMI) was 84.18. The maximum value of the FMI was 91.18 and the minimum value of the FMI was 71.43 (Table 1).

Fig. 1: Measurement of the antero-posterior diameter of the foramen magnum using vernier callipers

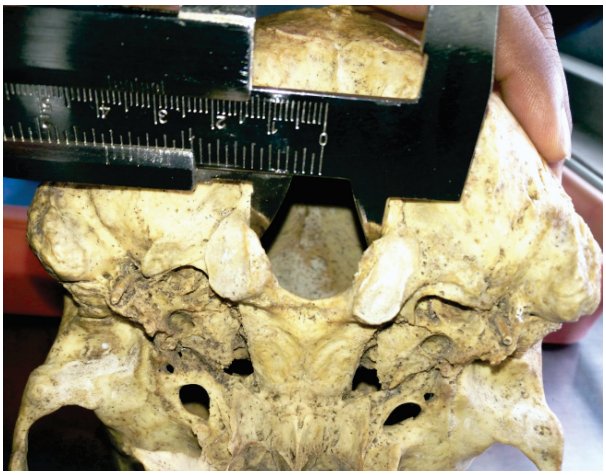

Fig. 2: Measurement of the transverse diameter of the foramen magnum using vernier callipers

Table 1: Morphometric measurements of the foramen magnum

Sl. No	Variable	APD (mm)	TD (mm)	FMA (sq. mm)	FMI
1	Mean	34.1	28.68	774.17	84.18
2	Maximum	42	34	1040.91	91.18
3	Minimum	26	21	428.61	71.43

[APD= Antero-posterior diameter, TD= Transverse diameter, FMA= Surface area of foramen magnum, FMI= Foramen magnum index]

Discussion

The FM is formed by sclerotomes of the first 4 somites that eventually fuse to form the occipital bone and the posterior element of the foramen magnum. The fourth sclerotome (proatlas) contains 3 portions: the hypocentrum, the centrum, and the neural arch, the latter divides into ventro-rostral and dorsal-caudal components. The ventro-rostral portion originates the occipital condyles and the anterior margin of the FM. As such, morphological anomalies and malformations in this process can result in different types and forms of foramen magnum [14]. Foramen magnum is morphologically variable osteological feature in the skull which has undergone evolutionary changes [15]. Embryologically, the length of the foramen magnum increases more rapidly during prenatal period when compared to its width[16]. A greater degree of cerebellar tonsillar herniation is associated with a wider antero-posterior diameter of foramen magnum [17]. Also, a longer antero-posterior dimension of foramen magnum permits greater contralateral surgical exposure for condylar resection in transcondylar approach [4].

Morphometric knowledge of the foramen magnum is important because pathological conditions like achondroplasia, occipital vertebra, basilar invagination, condylar hypoplasia, and atlas assimilation, Jeune's asphyxiating, thoracic dystrophy, Marchesani's syndrome, foramen magnum meningioma, Arnold-Chiari malformation, and plagiocephaly bring changes in the morphology of the foramen magnum [8-10, 18-20]. These diseases can cause compression of the structures that traverses the FM and produce symptoms like respiratory complications, lower cranial nerve dysfunctions; upper and lower extremity paresis, hypo or hypertonia, hyperreflexia or clonus, and general delay during motor development can appear [14]. Some studies suggest that foramen magnum measurements are higher in male subjects than in females [21-23]. However, study by Kamath et al. states that the measurements of foramen magnum may overlap and should not be used by itself for the determination of genre [9].

In our study, the mean antero-posterior diameter of the foramen magnum was 34.1 mm (range- 26 mm to 42 mm). This is similar to the reports of studies by Coin and Malkasian (34 mm), Schmeltzer et al (34 mm), Sayee et al (34.2 mm), Berge and Bergmann (33.8 mm), Kizilkant et al (34.8mm), Deshmukh and Devershi (34 mm), Avci et al (34.5 mm), Damiani et al (34.78 mm), Radhakrishna et al (34.04 mm), Kanchan et al (34.51mm), and Santhosh et al (34.37mm) [24]. Our finding matches most accurately with that of Coin and Malkasian (34 mm), Schmeltzer et al (34 mm), Deshmukh and Devershi (34 mm) and Radhakrishna et al (34.04 mm).

In our study, the mean transverse diameter of the foramen magnum was 28.68 mm (range- 21 mm to 34 mm). This is similar to the reports of studies by Coin and Malkasian (29 mm), Sayee et al (28.5 mm), Berge and Bergmann (28.3 mm), Damiani et al (28.69 mm), Radhakrishna et al (28.63 mm), Santhosh et al (28.98 mm), Patel and Mehta (28.29 mm), Ganapathy et al (28.7 mm) and Muralidhar et al (28.5 mm) [24]. Our finding matches most accurately with that of Damiani et al (28.69 mm).

In our study, the mean foramen magnum area was 774.17 square millimetres (range- 428.61 sq.mm to 1040.91 sq.mm). This is similar to the reports of studies by Acer et al (760 sq mm) and Milhorat et al (787.7 sq mm) [24]. Our finding matches near to that of the study by Milhorat et al.

In our study, the mean foramen magnum index was 84.18 (range- 71.43 to 91.18). This is similar to the reports of studies by Chaturvedi and Harneja (83.81) and Howale et al (84.85) 24. Our finding matches near to that of the study by Chaturvedi and Harneja.

Conclusion

The present study illustrates the morphometric data and the variations in the morphology of the FM with emphasis on their clinical implications. The morphometric knowledge of the foramen magnum is of importance to neurosurgeons, radiologists, forensic experts, anatomists and anthropologists. This study was undertaken because of the significance of this knowledge. However, our reports are limited by the

sample size. Hence, to obtain more robust conclusions, larger samples should be included.

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Ultrasonographic Measurement of Splenic Length in Relation with Height in Gujarati Population

Ramkumar K. Singhal*, Dhara Patel, S.M. Patel***, Anuj K Shrivastava******

Abstract

Introduction: The spleen is the largest organ in the reticuloendothelial system; it shows variations in size and weight at different periods of life in different individuals in different conditions. The spleen, normally lies entirely within the rib cage, has a maximum cephalocaudal diameter of 13 cm by ultrasonography or maximum length of 12 cm by radionuclide scan, and is usually not palpable. Only 10-15% of normal spleen is palpable. *Aim:* To study the splenic length by ultrasonography in relation to height of adult population. *Material and Methods:* A prospective study was conducted on 300 individuals, 150 males and 150 females, aged between 20-60 years. USG was done by using ESAOTE MY LAB 40 machine in Radiology Department Sir T Hospital Bhavnagar. Measurement of spleen was taken by using convex 2.5-6.6mhz probe. Individual was positioned on couch in supine and right lateral position for examination with deep inspiration. Spleen length was measured on longitudinal coronal image from dome to tip through hilum. The height of patient was recorded by Stadiometer with accuracy of 0.1 cm. *Results:* The study shows the splenic length increased with height in both male and female. The length of the spleen was less in females than males with each corresponding groups of height. *Conclusion:* This study provides the information that splenic length increases with the increase in the height, in both male and female.

Keywords: Spleen; Ultrasonography; Height; Length; Stadiometer.

Introduction

The spleen is the largest organ in the reticuloendothelial system; it shows variations in size and weight at different periods of life in different individuals in different conditions [1]. The spleen, normally lies entirely within the rib cage, has a maximum cephalocaudal diameter of 13 cm by ultrasonography or maximum length of 12 cm by radionuclide scan, and is usually not palpable. Only 10-15% of normal spleens are palpable.

The spleen size may give information regarding diagnosis of various gastrointestinal and haematological diseases so estimation of size of spleen is important in diagnosis, treatment and prognosis of variety of disorder [2] Ultrasound has been found to be accurate and reliable for measurement of spleen with lack of radiation, low cost, noninvasive investigation [3].

Materials and Methods

A prospective study was conducted on 300 individuals, 150 males and 150 females, aged between 20-60 years. USG was done by using ESAOTE MYLAB 40 MACHINE in Radiology department, Sir Takhtsinhji hospital Bhavnagar. Measurement of spleen was taken by using convex 2.5-6.6 MHz probe. Individual was positioned on couch in supine and right lateral position for examination with deep inspiration.

Spleen length was measured on longitudinal coronal image from dome to tip through hilum. The height of patient was recorded by Stadiometer with accuracy of 0.1 cm.

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Result

In this study, splenic length was measured in relation to height and following results were noted. It shows the splenic length is increased with height in both male and female.

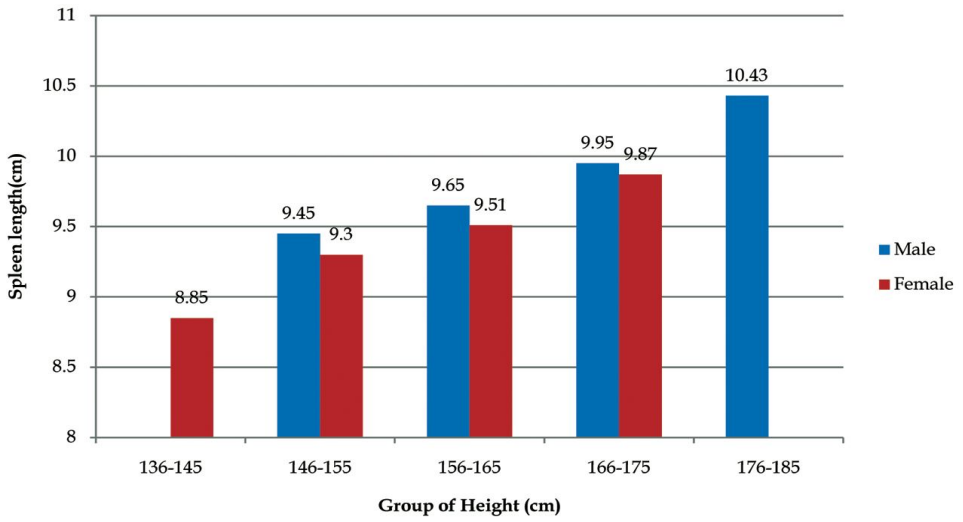
The length of the spleen was less in females than males with each corresponding groups of height.

Table 1: Splenic length in relation to height Male

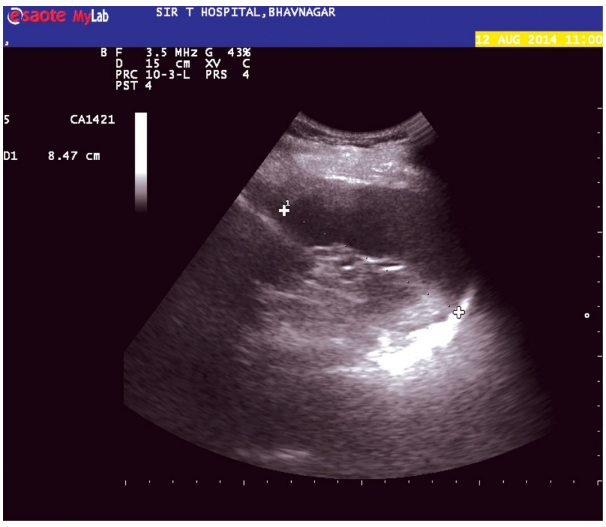
Height Group	Mean ±SD	Range	
146-155	9.4581 ± 0.9431	8.31-10.33	F = 7.71
156-165	9.6581 ± 1.1381	7.59-11.9	
166-175	9.9556 ± 1.0537	7.39-11.9	P = 0.0001
176-185	10.43424 ± 0.8266	8.39-11.78	

Table 2: Splenic length in relation to height: Female

Height Group	Mean ±SD	Range	
136-145	8.8541 ± 0.7518	7.15-10.33	F = 0.20
146-155	9.3077 ± 1.1304	6.83-11.93	
156-165	9.5192 ± 1.0691	6.89-11.74	P = 0.8972
166-175	9.8724 ± 1.1297	7.59-11.44	



Graph 1: Splenic length in relation to Height in both sexes



USG IMAGE showing measurement of splenic Length

Discussion

It is observed that the splenic length is increased with height in both sexes.In one study the splenic size was evaluated in patients with sarcoidosis and thrombocytosis, the splenomegaly was present in 57% of the patients (using sonographic criteria to evaluate the size), but only clinically palpable in 8% of the cases [4].

Rosenberg *et.al*. studied that the upper normal limit of the splenic length was observed to be 12 cm for girls of 15 years or more and 13 cm for boys of 15 years or older. These findings were slightly different from the findings of the present study [5].

Konus et.al and Singh A *et.al*. Proposed that the splenic length was correlate best with body height.

This was similar to the finding of our study [6]. Spielmann *et.al*, have studied that the spleen length was greater in male athlete than female. In our study the length is greater in male than female but the mean value of length is lesser than the Spielmann's study [7] .

Conclusion

By this study we concluded that the length of spleen increases with height in both male and female. It also revealed that the ultrasonography is the current procedure of choice for routine assessment of spleen size (normal = a maximum cephalocaudal diameter of 13 cm) because it has high sensitivity and specificity and is safe, non-invasive, quick, mobile, and less costly.

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The Golden Proportion and Its Application to the Human Face: A Cross-Sectional Study

Deepa G.*, Shrikrishna B.H.**

Abstract

Background and Objective: The golden proportion or *phi* is 1.618. The Golden Ratio is believed to be a blueprint for facial features that conform to beauty. Our study aims at finding the ratio between the length of the face and the width of the face and correlate it with the golden ratio. *Materials and Methods:* One hundred students studying first phase of MBBS at Navodaya Medical College, Raichur were included in this study, belonging to the age group of 17 to 19 years. The length and width of the face were calculated from their black and white profile photographs using vernier calipers. *Results:* In the male group, the mean vertical length of the face was 16.44 cms (±1.31), the mean width of the face was 11.40 cms (±1.09) and the mean ratio of length to width of face was 1.45 (±0.17). In the female group, the mean vertical length of the face was 15.67 cms (±2.16), the mean width of the face was 10.58 cms (±0.71) and the mean ratio of length to width of face was 1.50 (±0.26). None of the 100 participants had the length to breadth ratio equal to golden ratio (1.61). *Conclusion:* The human face follows the golden ratio. The nearer the face size is to the golden ratio, the more attractive is the face of that person. In our study, we found that the size of the face was more close to the golden ratio in the female group than the male group. The golden ratio has been considered useful for maxilla-facial and facial plastic surgeries.

Keywords: Face; Beauty; Human; Photographs; Golden Ratio.

Introduction

Though not an understandable or quantifiable entity, everyone admires beauty and its unique balance in nature. This balance and perception of beauty has been attributed to the 'golden' number or the ratio that gives certain things their exquisiteness [1]. The "divine proportion" is one of the several terms used to describe the division of a line such that the ratio of the smaller section to the larger section is the same as that of the larger section to the whole [2]. Other names given to this ratio include the "golden proportion," and the "golden section" [3]. This ratio can be expressed mathematically as 1.618:1 or 1:0.618. There have been many claims that the divine proportion was used in Greek art and architecture by the sculptor Phidias. This has led to its nickname as the "Phi" ratio [4]. The term "divine proportion" was first used by the Italian Renaissance mathematician Fra Luca Pacioli [5,6]. Marquardt, who developed a beauty mask based on the divine proportion, showed that regardless of race or age, a face is deemed beautiful if it conforms to this beauty mask [7]. The human face must also conform to the divine proportion in order to be biologically efficient and viable. Development towards ideal proportion maximizes efficiency and health. Patients who are dolicho-facial tend to have upper airway obstructions and temporo-mandibular joint disorders [8,9,10] and patients who are extremely brachy-facial tend to have severe myofacial pain and temporo-mandibular joint disorder [11,12,13]. Thus it can be inferred that faces that do not conform to the divine proportion not only have esthetic problems but have physiologic problems as well. The introduction of a standard called the Divine Proportion for the evaluation of a profile can lead orthodontic, orthopedic and surgical treatment to obtain maximum facial beauty [14]. The human face abounds with examples of the Golden Section. The head forms a Golden Rectangle with the eyes at its midpoint. The mouth and nose are each placed at

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golden sections of the distance between the eyes and the bottom of the chin. *Phi* defines the dimensions of the human profile. Even when viewed from the side, the human head illustrates the Golden Proportion [15]. The human face has rhythm both transversely and vertically in width and height [16]. Our study aims at finding the ratio between the vertical length of the face and the width of the face and correlate it with the golden ratio as a cross sectional study in first phase MBBS students at our Medical College.

Materials and Methods

Our study is a cross sectional study done at Department of Anatomy, Navodaya Medical College, Raichur during October 2015 to March 2016. The study involved 50 male and 50 female students of first phase of MBBS. They were in the age group of 17 to 19 years. Subjects with gross facial deformity/ asymmetry, history of orthodontic treatment, or extraction of teeth, except for third molars or cosmetic surgeries on the face were excluded. The aim of this study was explained and informed consent was obtained from each participant. The subjects' standardized profile photographs were taken. During this procedure, the subjects were requested to adopt normal facial expression, without any asymmetry, sagittal and vertical deviations, and to maintain normal lip position (without excessive or decreased lip protrusion). The operator ensured that the subjects removed their glasses and that the subject's forehead and neck were clearly visible while the photograph was taken. The subjects' heads were oriented in the natural head position, and a standardized front profile photograph of each subject was taken using a digital camera. The distance between the photographic equipment and the subjects was 150 cm. All the photographs were taken by the same operator. In order to take the photographs in natural head position, subjects were asked to stand up and look straight into their eyes' image in the mirror located on the wall in front of them at the same level as their pupils. In this position, the lips had to be relaxed, adopting the position they normally show during the day. All 100 photographs were then converted to black and white (silhouette), using the Microsoft Office Picture Manager 2000 software program and then cropped to include only the facial outline. Following this, 4 anatomic landmarks were identified on each silhouette as follows, namely Trichion (Tr) (The superior border of the anatomical forehead, the hairline), Soft tissue menton (Me) (The most inferior point on the soft tissue chin.) and the centres of right and left ear lobules. A Vernier callipers was used to measure the dimensions of the face. The length of the face was the vertical distance in the midline of the face between the Trichion and menton. The width of the face was the horizontal distance between the centre of right and left ear lobules (Figures 1 and 2). The size of the face was the ratio between length of the face and width of the face. The mean and standard deviation of the length of the face, width of the face and the ratio was calculated using Microsoft Excel of Microsoft Office 2000 software. The Golden proportion or *phi* was 1.6. The shape of the face was normal when its size was equal to 1.6; the shape of the face was long when its size was larger than 1.6, and was short when its size was smaller than 1.6. All the measurement procedures were undertaken by the same operator and all of these processes were repeated two times to reduce errors. The statistical test applied was unpaired "t" test.

Results and Observations

Our study included 100 subjects with 50 male and 50 female students of first phase MBBS. The age of the subjects ranged from 17-19 years. Of the 50 male participants, none had the ratio equal to golden ratio. Eight (16%) males were having long face (ratio>1.6) and 42 (84%) males were having short face (ratio<1.6). In the male group, the mean vertical length of the face was 16.44 cms(±1.31), the mean width of the face was 11.40 cms (±1.09) and the mean ratio of length to width of face was 1.45 (±0.17). Of the female participants too, none had the ratio equal to golden ratio (1.61). Eighteen (36%) females were having long face (ratio>1.6) and 32 (64%) females were having short face (ratio<1.6). In the female group, the mean vertical length of the face was 15.67 cms (±2.16), the mean width of the face was 10.58 cms (±0.71) and the mean ratio of length to width of face was 1.50 (±0.26) (Table 1). When the unpaired "t" test was applied, t value was found to be 1.1381, degree of freedom was 98, standard error was 0.044 and p value was 0.2578 which is not significant as its value is more than 0.05. Thus, in our study, even though the length to breadth ratio of the face in females is more nearer to the golden proportion than in males, it is not statistically significant.

Table 1: Measurements of mean length, width and ratio of the face in male and female groups.

	Mean Length (±SD)	Mean Width (±SD)	Mean Ratio (±SD)
MALE (n=50)	16.44 (±1.31)	11.40 (±1.09)	1.45 (±0.17)
FEMALE (n=50)	15.67 (±2.16)	10.58 (±0.71)	1.50 (±0.26)

Fig. 1: Front profile silhouette of a male participant [1= trichion 2= menton 3=centre of the right ear lobule 4=centre of the left ear lobule]

Fig. 2: Front profile silhouette of a female participant [1= trichion 2= menton 3=centre of the right ear lobule 4=centre of the left ear lobule]

Discussion

Although Euclid is the oldest known writer to describe the construction of this golden proportion, the proportion was probably already known by the ancient Egyptians, since this ratio can be recognized in the large Egyptian pyramids from the 3rd millennium BC. A more accurate mathematical approach came from Fibonacci in the 12th century, in which the golden proportion was defined as phi, and was found to be equal to 1.618. The golden proportion is often associated with esthetics and harmony in many fields such as architecture, sculpture, music, poetry, the morphology of flowers, sea shells, mammals, and the human face [17].

Phidias, a Greek sculptor and mathematician, first discovered phi, commonly known today as the Golden Ratio. Phidias studied the phenomenon of phi in various Greek sculptures, but Leonardo Da Vinci coined the term "Golden Ratio" by using it in some of his most famous works: "The Last Supper" and "Mona Lisa." In the portrait of Mona Lisa, the wife of an affluent Florence businessman, Da Vinci included numerous examples of the Golden Ratio, as he believed that the Golden Ratio represented an aesthetic bond between humanity and nature [18].

Since research of multiple cultures indicates that there is common consensus on the rating of facial beauty, golden ratio seems to be an indication of recurrent underlying factors [19]. Could it be that human beauty is not appraised by fanciful whims, but rather, determined by a scientific basis? The answer lies, once again, in the Golden Mean. What is Ö? Not only is it the most attractive number in the world, but it is the essence of beauty itself. Beauty is 1.618033 989…trailing off into infinity [20].

The age group of subjects in this study was 17 to 19 years because, between the ages of 14 to 24, the mature face is usually quite attractive in a nurturing way for parents and in a sexually attractive way for a mate. From about 24 years of age, the post pubescent adult face begins to slowly and progressively become less attractive [14]. The present study used silhouettes for evaluating the divine proportion in profiles because this eliminated all extrinsic and intrinsic distracting variables (such as hair style, make-up, skin complexion) that could influence an evaluator's judgement [14]. Barrer and Ghafari assessed profile silhouettes before and after orthodontic treatment. Their results also supported the use of the silhouette in the evaluation of profiles [21].

In our study, none of our 100 participants had the length to breadth ratio equal to golden ratio (1.61). However, the ratio was more nearer to the golden ratio in females (1.50) compared to the males (1.45). As the ratio of the length of the face to the width of the face gets closer to the golden ratio, both male and female images are viewed as more attractive [22]. Also, the human male face is considered to be generally less attractive than the human female face in the post pubescent period [7]. In our study, even though the length to breadth ratio of the face in females is more nearer to the golden proportion than in males, it is not statistically significant. A larger study is required in this regard to get better conclusions.

Besides the beauty aspects of it, the golden ratio has health implications. Golden Proportion has been considered useful for maxillofacial surgery [23]. Individuals with an abnormal size of the face may be at risk of developing maxillofacial, jaw, respiratory, occlusal, and sleep disorders due to disproportionate face size and tooth size. This simple technique of applying the golden proportion to the face and identifying individuals with any values larger or smaller than it in mass surveys in order to determine the individuals and the percentage in a given population at risk of respiratory and jaw disorders facilitates early preventive and corrective interventions so that the population can lead a healthy and normal life [15].

However, there are some studies which tell that golden ratio is uncommon in humans. The study done by Ricketts supports that the Golden Ratio is not common in humans and is therefore only an artistic and architectural concept [24]. A study conducted by Mos et al. had similar conclusions as they found that even professional models did not resemble the Golden Ratio [25].

Though the present study attempted to investigate the relationship of measured proportions in facial profiles to the divine proportion, considering the numerous factors which are influential in determination of beauty of a profile, it may be concluded that if the divine proportion is to be used as an aid to treatment planning, it should perhaps be used along with other factors [14]. We have taken only the length to width ratio of the face in our study. The overall attractiveness of the face is decided by several other ratios in the face in combination. A further study taking into account several ratios of the face using a bigger sample size is advised.

Conclusion

In our study, none of our 100 participants had the length to breadth ratio equal to golden ratio. However, when females are compared to males, it is obvious that they are more aesthetically pleasing as they have an overall average ratio that is closer to the Golden Ratio than males do. With recognition of this golden proportion principle, these relationships can be employed by the clinician on the practical basis and objective relationships can be assessed and planned.

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Variations in the Mode of Termination of Facial Artery

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Abstract

Introduction: Accurate knowledge of the normal and variant arterial anatomy of the facial artery is important for vascular radiology and will provide an anatomical basis to assist surgeons in performing maxillo-facial surgeries successfully. *Materials and Methods:* Formalin-fixed faces of unknown sex adult cadavers were dissected following the Cunningham's manual of practical anatomy, volume 3. The age of the cadavers was not noted. *Results:* The variations in the facial artery were grouped under three categories following the classification of Bayramet.al, 2010. Type I category – Facial artery terminated as angular artery ; Type II category – facial artery terminated as superior labial ; Type III – Facial artery terminated as inferior labial .In present study (type-II) is seen. Premasseteric branch was observed. *Discussion:* Niranjan NS (1988) observed the variations of facial artery in 50 hemi-faces. According to him, facial artery terminated as angular artery in 68 % of hemi-faces, lateral nasal artery in 26% of hemi-faces, Superior labial artery in 4% of hemi-faces and 2% terminated at the alar base 12. In present study facial artery terminates as superior labial artery. A study conducted by Magden et.al (2009) , on the premasseteric branch, suggested that in 3% cases the diameter of premasseteric branch was larger than the facial artery. *Conclusion:* This study shows that the variation in the branching pattern of facial artery variations, which help in avoiding the mishaps during certain surgical procedures.

Keywords: Facial Artery; Plastic Surgery; Variation.

Introduction

Blood vascular system in the body is very important as the blood flows from heart to various regions of the body through arteries, which are thick walled tubes as the air tubes.

Variations in origin and branching pattern are common in arteries. Facial artery is an important vessel which distributes blood to entire face. It has much clinical significance. Aneurysm of the artery is a very often reported clinical entity. Branches of facial artery are of importance in raising vascular skin flaps for reconstructive surgeries.

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Branches of facial artery are of importance in raising vascular skin flaps for reconstructive surgeries. This knowledge of branches of facial artery are important in different surgical and clinical procedures.

The part of facial artery distal to its terminal branch is called the angular artery.

Review of Literature

Midy D et al. (1986) done work on 40 facial arteries and their collaterals. They observed 4 types of arteries based on mode of termination which are labial, angular, nasal and abortive.

In 1988,Niranjan NS ,carried out dissection of 50 facial arteries in 25 adult cadavers where the facial artery was symmetrical in 17 of 25(68%).

The facial artery terminated as angular artery in 34(68%),lateral nasal vessel in 2(4%);as alar in 1(2%) and longer course was identified in 5(10%) facial arteries.

Soikkonen K et al. (1991) classified facial artery into 4 types based on dominance:

Type A -22%

Type B-49%

Type C-20%

Type D-9% hypoplastic artery

In 2002, Nakajima et al. examined 25 facial arteries and classified major branches of it into three types based on anatomy of lateral nasal artery. In 22 cases (88%) it bifurcated into lateral nasal and superior labial artery. In 2 cases (8%) it became an angular artery after branching into lateral nasal and superior labial artery. In 1 case (4%) it became angular artery after branching off into superior labial artery and lateral nasal artery.

Koh KS et al. (2003) investigated 47 Korean cadavers and described that the final branch of facial artery as lateral nasal branch in 44.0%, angular branch in 36.3% cases. It ended symmetrically in 54.5% cases .They also reported that superior and inferior labial arteries on right side were more dominant than those on left side.

Marios loukas et al. (2005) examined facial artery in 142 cadavers(284 hemifaces) and categorized its distribution into five types with emphasis on superior labial artery:

Type A (47.5%)-it bifurcates into superior labial and lateral nasal [it gives off inferior and superior alar and ends as angular]

Type B (38.7%)-similar to type A, except lateral nasal artery terminates as superior alar (angular artery is absent).

Type C (8.4%)-facial artery terminates as superior labial artery.

Type D (3.85)-angular artery arises directly from facial arterial trunk rather than terminating as lateral nasal, with facial artery ending as superior alar.

Type E (1.4%)-it terminates a rudimentary twig without providing significant branches.

Sule Biyik Bayram et al. (2010) investigated 25 facial arteries in fetuses and described that in type 1, it terminated as angular, in type 2 as superior labial and in type 3, it terminated as inferior labial artery.

Materials and Methods

This project work consists of the study of facial artery in adult human specimens obtained from cadavers placed in the department of anatomy for student dissection. The total numbers of specimens studied are 25 (out of which 21 are males and 4 are females).

The facial artery is exposed by the following dissection method. Facial artery in carotid triangle is opened by giving following incisions.

Incisions

On Neck:

1. A midline incision from chin to hyoid bone.
2. A transverse incision from chin to mastoid process on both sides.

Incisions:

On Face:

1. A median mid line incision from root of nose to chin encircling the lips on both sides.
2. A transverse incision from root of nose to upper border of zygomatic arch encircling the eye lids on both sides.

Steps:

1. Skin is reflected infero-laterally on neck till the anterior border of sternocleidomastoid.
2. Clean fascia to define posterior belly of digastic and superior belly of omohyoid. Then observe facial artery and its branches in carotid triangle.
3. Skin is reflected laterally on face. Remove fascia to define couse and branches of facial artery.
4. Origin, course, termination and branching pattern of facial artery are to be studied.

Variations noticed are noted and photographed.

Termination

The part of facial artery distal to its terminal branch is called the angular artery (Figure 1). It is observed in 19 specimens (34 hemi faces). In specimen no.8 on left side facial artery terminated as angular artery by a separate twig that arose from main trunk (Figure 2).

Facial artery terminated as superior labial artery in specimen no. 7 on right side and in specimen no.3, 4 on left side .In specimen no.1 facial artery terminated as superior labial artery on both sides (Figure 3).

In specimen no.3 on right side and in specimen no.6, 7, 19 on left side it terminated as lateral nasal branch In specimen no.5, 20 and 21 it terminated as lateral nasal branch on both sides (Figure 4).

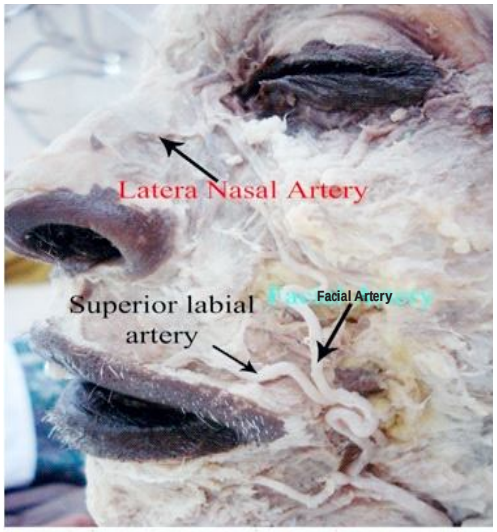

Fig. 1:

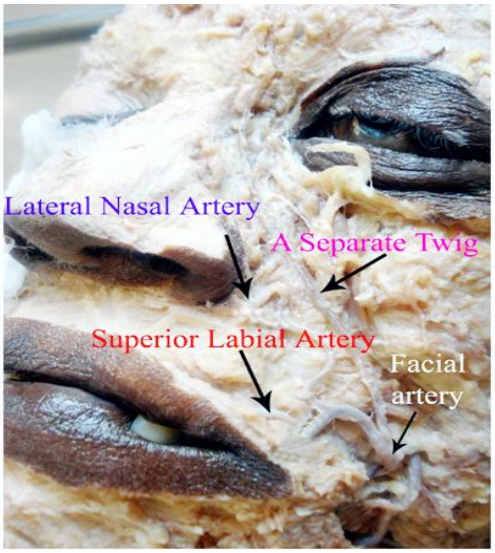

Fig. 2:

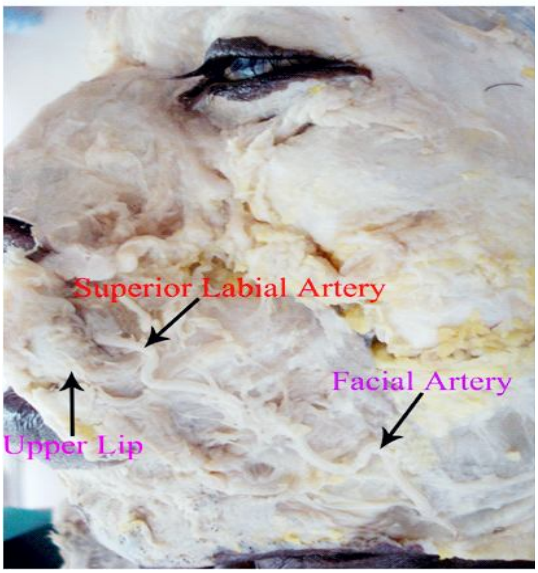

Fig. 3:

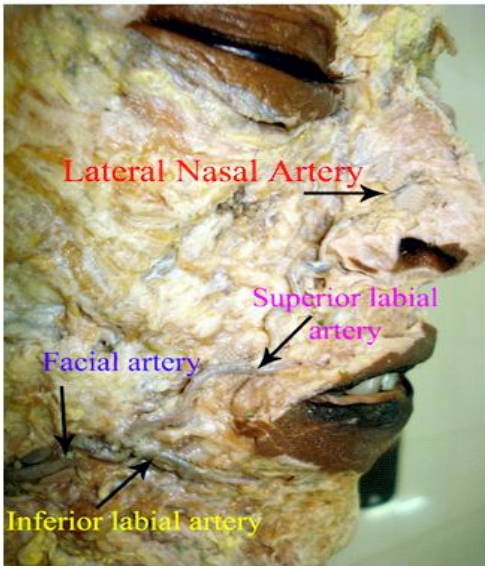

Fig. 4:

Discussion

Termination

The part of facial artery distal to its terminal branch is called angular artery.

In present study in 19 specimens(34 hemi faces) angular artery is observed which is in conformity with Susan Standring [1], Romanes G.J [2]., Hollinshead W.H[3]., Datta A.K [4]., Keith L. Moore [5]., Sahana S N [6]., Niranjan N.S [7]., Nakajima et al [8]., Koh KS et al [9]., Marios Loukas et al [10]., Sule Biyi K. Baysam et al [11]., (Type I) and Eid N [12].

In 1(1 hemiface) specimen facial artery terminated as angular artery that arose directly from facial arterial trunk which is in conformity with Marios Loukas et al. [10] (Type D). Marios Loukas et al. (Type C) [10] and Sule Biyik Bayram et al [11]., (Type II), described the terminal branch of facial artery as superior labial artery. In 4 (5 hemifaces) specimens in present work similar pattern is seen coinciding with their findings (Table 8).

Niranjan N.S., Nakajima et al., [8] (88 %), Koh KS et al. (44 %)[9] and Marios Loukas et al.[13] (Type B) described the terminal branch as lateral nasal artery. Similar pattern is seen in 7 specimens (10 hemifaces) in present work. Marx Chakravarthy et al.[13] described termination of facial artery as inferior labial artery which is in not seen in present work.

Summary and Conclusion

Termination of facial artery is normal on both sides in 68%. The final termination is superior labial artery

in 10% and as lateral nasal artery in 20%. In 2% it is by a separate twig from the main arterial trunk.

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Stature Prediction & Anthropometric Hand Dimensions: A Relationship Unearthed

Khwaja Moizuddin*, Zuberi Hussain Riyaz, Azhar Ahmed Siddiqui*****

Abstract

One of the most vital and useful anthropometric parameter that determine the physical identity of a human is stature or body height. Height Estimation of an individual is important not only for anthropologists and forensic medicine personnel but also for physical assessment of status of nutrition in an individual by nutritionists and physicians. Prediction of stature from incomplete and decomposing skeletal remains is one of most demanding criteria in establishing the identity of an unknown individual. It is a useful tool in medico legal and forensic examination. *Study Design*: Descriptive cross sectional study. *Place of Study*: Department of Anatomy, MGM medical college, Aurangabad. *Material*: 185 young and healthy college students aged between 18 to 24 years having no disease or deformity were examined anthropometrically in respect to their height and length of right and left hand. *Method*: After applying exclusion criteria proper selection of subjects were made. Measurement of height, hand length, hand breadth, and middle finger length of right and left side was taken with a standard anthropometer and a vernier callipers using standard reference points for measurements. *Result*: The present study showed there exists a significant sexual dimorphism in male and female population. Males have higher values than the females in dimensions of hand and foot. The correlation of stature and middle finger length is on the higher side (p= 0.00). In fragmented bodies, the multivariate regression formulas used to calculate the stature from the hand dimensions in both sexes gives a better prediction of stature than the univariate type.

Keywords: Anthropometric Measurement; Skeletal Remains; Height; Stature; Hand-Length; Hand-Width.

Introduction

Since many years, the dimensional relationship between body segments and stature has been the interest of artists, scientists, anatomists, anthropologists and medico legalists [1]. It also helps in ergonomics like designing of machines and fashion designing.

Establishing the identity of an individual has become an important need in mutilated, decomposed, & amputated body fragments in recent times due to natural disasters like earthquakes, tsunamis, cyclones, floods and man-made disasters like terror attacks, bomb blasts, mass accidents, wars, plane crashes etc. The determination of stature is an important step in the identification of dismembered remains [2]. So, estimation of stature from extremities and their parts plays an important role in identifying the dead in forensic examinations in establishing personal identification of the victims [3]. The body parts show biological correlation with stature. Evaluation of various anthropological parameters with proportions plays a role in sports medicine, designing of instruments and education. Height of an individual is affected by diverse factors such as race, gender and nutrition. The height achieved by the individuals is also under the control of genes and environment. The body size such as height and weight can be assessed by growth, nutritional status, body surface area and pulmonary function of children [4,5]. In human evolution, one of man's greatest achievements over a long period of time is upright posture. Natural height or stature of a person is

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usually taken in upright position. The hand dimensions can be used as a basis for estimating stature related to age [6-8].

Aim

Sexual dimorphism study and correlation between various dimensions of hand and stature, in 18-24 age groups.

Objectives

1. To obtain dimensions of hands (i.e. hand length, hand breadth, middle finger length) and stature of Medical students in age group 18-24 years in MGM Medical College, Aurangabad, with documentation of gender.
2. To find out the correlation between dimensions of hands with the stature of the individual.
3. To devise linear univariate and multiple regression formulae to estimate stature from these dimensions

Materials and Methods

Method of Collection of Data

The study was done after necessary permissions from authorities and written consent from subjects. Measurements were taken of 185 students consisting of 81 males and 104 females in the age group of 18-24 years studying in MGM Medical College, Aurangabad.

Measurements of male and female adult subjects were taken by selecting them as below:

Inclusion Criteria

1. Healthy and normal adult subjects of age group 18-24 years.

Exclusion Criteria

1. Subjects with musculoskeletal deformity like kyphosis, scoliosis, poliomyelitis, trauma etc, hormonal disorders like gigantism, dwarfism, etc and genetic disorders like turners syndrome, etc which will affect the normal measurements of stature and hand dimensions.

The following instruments were used to carry out this study:

1. Anthropometer (Stadiometer).
2. Vernier (Sliding) calipers (digital type).
3. Steel tape.

Method of Measurements [9,10]

Stature

It is measured as vertical distance from vertex (the highest point on the top of head) to the floor in mid-saggital plane with subject standing barefooted, on an even floor and the head being oriented in the Frankfurt's plane. Stature was measured with the help of Stadiometer (Anthropometer).

Hand Length

It is the straight distance from mid-point of a line connecting the styloid processes of radius and ulna to the anterior-most projection of the skin of the middle

Fig. 1:

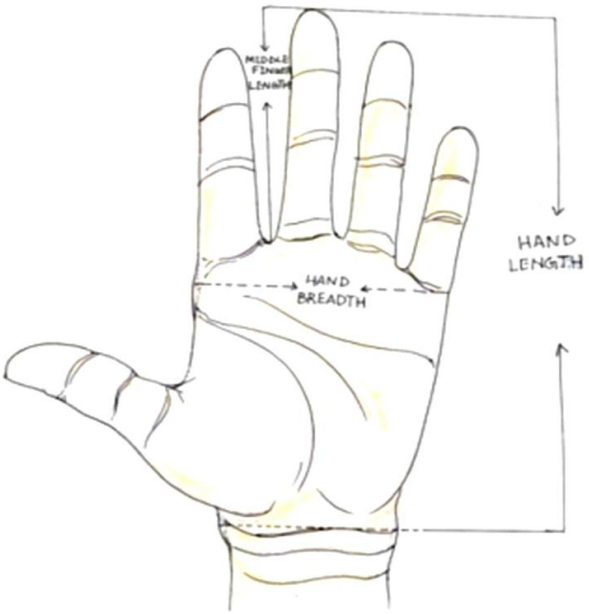

Fig. 2:

finger. It was measured with the help of Digital Vernier calipers. The hand is laid flat on a table.

Hand Breadth

It is the distance between the most prominent point on the lateral side of head of second metacarpal and the most prominent point on the medial aspect of the head of fifth metacarpal. It was measured with the help of Digital Vernier calipers.

Total Length of Middle Finger

It is measured from the proximal flexion crease at the base of the middle finger to tip of the middle finger. The wrist is neutral in position and hand is fully extended. The measurement is taken on the palmer aspect of the hand. It was measured with the help of Steel tape.

These measurements were taken from both the hands of the body. Male and female readings for each parameter were separated and analyzed. All the measurements were taken in a reasonably well lit room, at a fixed time between 3:00 p.m. and 5.30 p.m. to eliminate diurnal variation. It was measured and recorded only by one person, to avoid inter observer error in methodology. All the measurements were recorded thrice and then their mean was calculated for accuracy.

The height, hand length, hand breadth and middle finger length of subjects were used to assess the relationship between the hand dimensions and stature. For all parameters, analysis was done by calculating Mean, STD error of mean, STD deviation, Maximum, Minimum separately, Skewness and Kurtosis.

Then correlation and coefficients between these anthropometric measurements were calculated. The regression equations of stature as dependable variable were fitted with hand dimensions as independent variables. And effectiveness of these regression equations was tested. For every parameter, Stature (Height) was considered to be independent and correlation was checked between the height and other parameters. Later on univariate and multivariate regression formulas were derived for each parameter. The data were subjected to statistical analysis using statistical package for social sciences (SPSS).

Observation

The following things were observed as shown in table 1 below:

It is seen from above table no.1 that values here are showing negatively skewed distribution in males and positively skewed distribution in females. It also shows platykurtic distribution.

Table 2: One way ANOVA shows F value as 170.143 with 0.00 significance suggesting statistically significant difference in male and female height as shown in table 1.

Table 1: Height (in Centimeters)

	Male	Female
Mean	171.116	157.578
Std. Error of mean	0.843	0.637
Std.deviation	7.684	6.348
Maximum	188	175
Minimum	147	141
Skewness	-0.283	0.228
Kartosis	0.660	-0.090

Table 2:

One way ANOVA			Sum of Squares	DF	Mean Square	F	Sig.
Ht (cm)	Between Groups	(Combined)	8561.364	1	8561.364	170.143	0.000

Table 3: Hand Length (in Centimeters)

	Male		Female	
	Right	Left	Right	Left
Mean	18.607	18.631	16.922	16.851
Std. Error of mean	0.081	0.084	0.082	0.079
Std.deviation	0.744	0.769	0.857	0.829
Maximum	20.4	20.4	19.9	19.3
Minimum	17.3	17.3	15.3	15.2
Skewness	0.617	0.460	0.555	0.456
Kartosis	-0.436	-0.503	0.540	-0.020

It is observed from above Table 3 that the hand length is showing positively skewed distribution of values in both males and females. Kurtosis shows platykurtic distribution.

One way ANOVA shows F value as 197.140 and having significance of 0.0, suggesting statistically significant difference in male and female hand.

It is seen from above Table 5 the mean hand breadth of males is more than females with standard error of mean being 0.054 cms in males and 0.04 cms in females. Hand length is showing positively skewed distribution of values in both males and females except a minute negatively skewed right side in males. It also shows platykurtic distribution.

One way ANOVA shows F value as 221.050 with 0.00 significance, suggesting statistically significant difference in male and female hand breadth.

Table 8

Table 4:

	One way ANOVA		Sum of Squares	DF	Mean Square	F	Sig.
HL (cm)	Between Groups	(Combined)	129.375	1	129.375	197.140	0.000

Table 5: Hand Breadth (in Centimeters)

	Male		Female	
	Right	Left	Right	Left
Mean	8.741	8.658	7.707	7.555
Std. Error of mean	0.0538	0.054	0.0422	0.038
Std.deviation	0.479	0.491	0.441	0.397
Maximum	10	9.9	9	8.5
Minimum	7.79	7.6	6.9	6.7
Skewness	-0.084	0.363	0.201	0.070
Kartosis	-0.335	-0.199	0.182	0.329

Table 6:

	One way ANOVA		Sum of Squares	DF	Mean Square	F	Sig.
HB (cms)	Between Groups	(Combined)	47.125	1	47.125	221.050	0.000

Table 7: Middle Finger Length (in Centimeters)

	Right	Left	Right	Left
Mean	8.171	8.185	7.310	7.282
Std. Error of mean	0.043	0.043	0.044	0.042
Std.deviation	0.398	0.393	0.462	0.447
Maximum	9	9	8.5	8.4
Minimum	7.3	7.3	6.2	6.2
Skewness	-0.052	-0.071	0.308	0.187
Kartosis	-0.613	-0.582	0.296	-0.048

Table 8:

	One way Anova		Sum of Squares	DF	Mean Square	F	Sig.
MFL (cm)	Between Groups	(Combined)	34.505	1	34.505	181.737	0.000

Mean middle finger length is observed of males is 8.17 cms and that of female is 7.3 cms indicates that the mean middle finger length of males is more than the females with a standard error of mean in males being 0.043 and females is 0.04.

The values are slightly negatively skewed in males and positively skewed in females. Values show platykurtic distribution.

One way ANOVA shows F value as 181.737 with 0.000 significance suggesting statistically significant difference in male and female middle finger length.

Following regression formulae has been derived using SPSS of one variable and multi-variables. They are as follows:

Univariate Analysis

1. Hand Length (Equ.Uni-1)

   R Value = 0.765

F Value = 266.126

Height = 49.398 + [6.458 * (Right Hand length)]

2. Hand Breadth (Equ.Uni-2)

   R Value = 0.644

   F Value = 134.256

   Height = 87.885 + [9.266 * (Right Hand breadth)]

3. Middle Finger Length (Equ.Uni-3)

   R Value = 0.720

   F Value = 203.966

   Height = 74.651 + [11.544 * (Right Middle finger length)]

Multivariate Analysis

1. Height versus Right Hand length and Right Hand breadth. (Eqution. Muti-1)

   R Value = 0.772

   ANOVA is significant

   Height = 48.524 + [5.428 * (Right Hand length)] + [2.340 * (Right Hand breadth)]

2. Height versus Left Hand length and Left Hand breadth. . (Equation. Muti-2)

   R Value = 0.778

   ANOVA is significant

   Height = 52.013 + [5.1 * (Left Hand length)] + [2.678 * (Left Hand breadth)]

3. Height versus Right Hand length, Right Hand breadth, Left Hand length and Left Hand breadth.. (Equation. Muti-3)

   R Value = 0.783

   ANOVA is significant

   Height = 50.037 + [3.186 * (Right Hand length)] + [2.049 * (Left Hand length)] – [1.567 * (Right Hand breadth)] + [4.207 * (Left Hand breadth)]

4. Height versus Right Hand length, Right Hand breadth, Left Hand length, Left Hand breadth, Right Middle finger length and Left Middle finger length .(Equation. Muti-4)

   R Value = 0.784

   ANOVA is significant

   Height = 51.285 + [2.847 * (Right Hand length)] + [1.635 * (Left Hand length)] – [1.566 * (Right Hand breadth)] + [3.873 * (Left Hand breadth)] + [0.345 * (Right Middle finger length)] + [1.571 * (Left Middle finger length)]

Discussion

One of the earliest to use such anthropological rules for stature prediction was ancient Egyptians (Richer and Hale, 1971). Studies by Pearson (1899), Trotter and Glesser (1952) [11,12] have reported on the prediction of stature from skeletal remains or mutilated limbs, mostly from long bones.

On the Indian side, Athwale et al (1963), Patel et al (1964), Joshi et al (1964, 65), and Jasuja et al (1991, 1993, 1997) [13-17], also studied stature estimation by significant dimensional relationship of length of foot, hand, hand with forearm, arm, upper extremity, length of head, height of head etc. Crown to rump and rump to heel ratio etc and found that there exists significant correlation between body segments and height.

There also exist population variations in anthropometric dimensions. Stature is partly determined by length of bones in upper limb and lower limb. It is also influenced by many other factors such as genetics, environment, gender, age and physical activity [18]. Also, till the ossification being complete and skeletal maturity attained by the age of 25 years, the rate or growth in males and females varies during the course of development.

All parameters show significant sexual dimorphism in this present study. There was a strong positive correlation between hand measurements (hand length, hand breadth and middle finger length) and stature ($p < 0.01$), which was highest for middle finger length. Hence these can be successfully used for estimation of stature. Anatomists, archaeologists, anthropologists, design engineers and forensic scientists can now predict height of an individual more accurately by the regression equations derived in this study. The only precaution to be taken into consideration is that these formulae are applicable to the Indian region population from which the data has been collected. It is due to the inherent population variation in these dimensions, which may be attributed to genetic, lifestyle differences and environmental factors like nutrition, climate etc [19].

Thus, in males and females, middle finger length is the best parameter for estimation of stature. The relatively low standard estimate of standard error of mean for the middle finger length in males (±0.043) and for middle finger length in females (± 0.042) ensures better accuracy in stature estimation.

The presence of a positive linearity between the anthropometric parameters and estimation of stature facilitates formulation of regression equations which can be successfully utilized for stature estimation in

Indian population. In the present study, males showed higher mean values in all parameters studied when compared with mean values of female parameters.

Studies done to estimate stature by Kaur [23] and OP Jasuja [6] has reported significant higher mean values for males amongst Indians, and both their study groups were from North India. Danborno B

Table 9: Stature

S. No	Name of the author	Sex	Min. Stature	Max. Stature	Mean	± SD	± SE
1.	Thakur[19] (1975)	-	-	-	167.4	6.4	-
2.	Jasuja[6] (2004)	Male	166.2	185.6	175.2	5.24	0.957
		Female	152	167.9	159.7	5.17	0.945
3.	Patel[19] (2007)	Male	-	-	170.96	5.13	-
		Female	-	-	156.14	5.15	-
4.	Danborno B[20] (2008)	Male	-	-	173.73	7.13	-
		Female	-	-	160	6.22	-
5.	Ilayperuma[21] (2009)	Male	-	-	170.14	5.22	-
		Female	-	-	157.55	5.75	-
6.	Rahul[22] (2013)	Male	157	192	169.97	5.71	
		Female	139	167	154.2	7.15	
7.	Kaur et al[23] (2013)	Male	-	-	175.98	6.76	-
		Female	-	-	160.91	5.75	-
8.	Srivastava[24] (2014)	Male	-	-	170.9	-	0.371
		Female	-	-	156.21	-	0.49
9.	Present Study (2014)	Male	147	188	171.11	7.68	0.84
		Female	141	175	157.57	6.34	0.63

Table 10: Middle Finger Length

S. No	Authors	Measurements	Sex	Side	Min	Max	Mean	± SD	± SE
1	Rahul[22] (2013)	Middle Finger Length	Male	-	7.1	9.5	7.92	0.420	-
			Female	-	6	8.4	7.3	0.550	-
2	Present Study (2014)	Middle Finger Length	Male	Right	7.3	9	8.17	0.390	0.043
				Left	7.3	9	8.18	0.390	0.043
			Female	Right	6.2	8.5	7.31	0.460	0.044
				Left	6.2	8.4	7.28	0.440	0.042

[20] also reported higher value as the study was conducted on Nigerians which belongs to different race groups. These differences of mean in stature between males and females are due to the fact that fusion of epiphysis of bones occurs earlier in females than in males. Males have about two more years of bone growth than females [4].

This present study was done in medical students of all India region of age group 18-22 years and the mean of stature came as 171.11 cms in males and 157.57 cm in females.

Rahul [22] studied the middle finger lengths in age groups of 16-50 yrs of Andhra pradesh population and mean in his study was 7.92 cm for males and 7.3 cms for females.

This present study was done in medical students of all India region of diffused areas of age group 18-22 years and the mean of middle finger lengths came as 8.17 cms (right side), 8.18cms (left side) in males and 7.31 cm (right side), 7.28 (left side) in females.

The table shows that the mean hand lengths of males are significantly more than the females in all the studies. Higher values also have been reported by Kaur [23] for north Indian population especially in females.

Ilayperuama [21] reported higher mean hand lengths in both genders in Srilankan population. Danborno B[20] reports higher values and his measurements of female is having less difference to male and his study group being Nigerians.

Present study shows average values of mean hand length values 16.95 cms in females but average values 18.60 cms in males in scattered random group of Indian population

In the above table, the mean values of hand breadth in the studies of Danborno B [30], Srivastava [24] and the Present one is in the nearer range suggesting that

Table 11: Hand Length

S. No	Authors	Measur-Ments	Sex	Side	Min	Max	Mean	± SD	± SE
1	Thakur[19] (1975)	Hand length	-	-	16.7	22.15	19.34	1.7	-
2	Bhatnagar[25] et al (1984)	Hand length	-	Right	-	-	19.3	1.3	-
				Left			19.42	1.6	
3	Jasuja[6] (2003)	Hand length	Male	Right	18.4	21.3	19.8	0.73	0.13
				Left	18.2	21.2	19.79	0.76	0.13
			Female	Right	19.1	19.7	17.51	0.81	0.14
				Left	19.1	19.9	17.57	0.8	0.14
4	DanbornoB[20] (2008)	Hand length	Male	Right	-	-	19.85	0.86	
				Left			19.93	0.93	
			Female	Right	-	-	18.51	0.66	
				Left			18.52	0.77	
5	Ilayperuma[21] (2009)	Hand length	Male	-	-	-	19.01	5.22	-
			Female	-	-	-	17.62	0.93	-
5	Kaur[23] et al (2013)	Hand length	Male	-	-	-	18.8	1.09	-
			Female				18.54	10.72	
6	Srivastava[24] (2014)	Hand length	Male	-	-	-	18.4	-	0.08
			Female	-	-	-	16.74	-	0.11
7	Present Study (2014)	Hand Length	Male	Right	17.3	20.4	18.6	0.74	0.081
				Left	17.3	20.4	18.63	0.76	0.084
			Female	Right	15.3	19.9	16.95	0.85	0.082
				Left	15.2	19.3	16.85	0.82	0.079

Table 12: Hand Breadth

Sr. No	Authors	Measurements	Sex	Side	Min	Max	Mean	± SD	± SE
1	DanbornoB[20] (2008)	Hand Breadth	Male	Right			8.9	0.95	-
				Left			8.68	0.92	
			Female	Right	-	-	7.82	0.49	-
				Left			7.72	0.46	
2	Srivastava[24] (2014)	Hand Breadth	Male				8.17	0.04	
			Female				7.26	0.1	
3	Present Study (2014)	Hand Breadth	Male	Right	7.79	10	8.74	0.47	0.053
				Left	7.6	9.9	8.65	0.49	0.054
			Female	Right	6.9	9	7.7	0.44	0.042
				Left	9.7	8.5	7.55	0.39	0.038

there is less difference between the hand breadths of Nigerian population studied by Danborno B [20] and the Indian one. Although still the Nigerian population the values are on higher side in both genders. All the mean values show significant sexual dimorphism, the female mean values being lower than the male values.

Conclusion

It is found that there exists a significant sexual dimorphism in male and female population. It is well predicted in hand dimensions. Males have higher values than the females in dimensions of hand and foot. The correlation of stature and middle finger length is on the higher side (p= 0.00).

In case of fragmented bodies, the multivariate regression formulas used to calculate the stature from the hand dimensions in both sexes gives a better prediction of stature than the univariate type.

This prediction values are more closer to the actual in multivariate regression formula (equi.multi.1) with correlation coefficient (r) of 0.772:

Height = 48.524 + [5.428 * (Right Hand length)] + [2.340 * (Right Hand breadth)]

In case of univariate type the following gives a good predictive value of stature than the others. (equi.uni.1)

with correlation coefficient (r) of 0.765 and (equi.uni.3) with correlation coefficient (r) of 0.720:

Height = 49.398 + [6.458 * (Right Hand length)] and

Height = 74.651 + [11.544 * (Right Middle finger length)]

The regression equations derived from present study give a better predictive value than the formulas that have been derived by other authors as evident from the correlation coefficient. These formulas can be used effectively to estimate the stature of the individual in case mutilated bodies and also can be used effectively in ergonomics such as furniture designing, machine designing and sports as well as forensic cases.

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A Morphometric Study of Infraorbital Foramen and Its Laterality in Dry Adult Skulls North Karnataka Population

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Abstract

Background: Infraorbital foramen is located in the maxilla and it conveys infraorbital vessels and nerves, the knowledge of its morphometry and variations is therefore mandatory to do therapeutic infraorbital nerve block or any surgical procedures. *Aims & Objective:* To study morphometry of infraorbital foramen and its laterality in dry adult skulls of north Karnataka population. *Materials and Methods:* In this study we examined 100 infraorbital foramina and measured its distance with bony features adjacent to it and the shape, presence of accessory foramina were observed . The infraorbital foramen was the landmark from which the distance between the following bony structures were examined; Nasion (NAS), Zygomatico-maxillary suture (ZMS), Anterior nasal spine (ANS), and the distance between the inferior orbital rim(IOR) to optic canal (OC), infraorbital foramen IOF), inferior and superior orbital fissure (IF & SF). The average mean and standard deviation were calculated for every measurement. Paired t– test was used to compare the parameters between sides and gender for each measurement. *Results:* The most common shape of infraorbital foramen found in the present study is oval (39%) followed by semilunar (27%). Round shaped foramen was found in 22% of skulls, triangle shaped foramen was found in 12% and accessory foramina were present in 11% of the skulls. In the present study, we found triangle shaped foramen in 12% skulls and also the number of accessory foramina was found to be higher which emphasise the need to take ethnicity into account as triangle shaped foramen is unique in south Indian population as affirmed by previous authors. *Conclusion:* The results show significance with respect to gender and side which makes the knowledge of its morphometry obligatory for surgical procedures.

Keywords: Infraorbital Foramen; Infraorbital Nerve Block; South north karnataka Population; Accessory Foramina.

Introduction

The infraorbital foramen lies bilaterally in the maxillary bone, below the edge of orbital cavity. The infraorbital nerves and vessels pass through this foramen. The infraorbital nerve is sensory and it lengthens the maxillary nerve, which crosses the infraorbital foramen and branches to supply the skin over the upper portion of the cheek, maxillary sinus mucosa, maxillary incisor, canine, premolar teeth, adjacent gum portion, skin over the lower eye lid, conjunctiva, part of the nose, part of the skin and mucosa of the upper lip [1]. Its anatomy varies according to the location, shape, size, laterality and incidence of accessory foramina.

The study of the infraorbital foramen is significant in local anaesthesia procedures, in maxillofacial surgeries and consequently in protection against procedural neuro-vascular injuries. Therapeutic infraorbital nerve blocks are used in intractable and pharmacologically unresponsive trigeminal neuralgia. Knowledge of the precise anatomical location of the infraorbital foramen and its lateralization will invariably reduce the relative risks during surgical procedures. Gruber (1878) was the first person who evaluated the morphometric assessment of the infraorbital foramen and reported the presence of accessory supranumerarios foramina

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which he propounded as an important variable in anaesthetic valuation [2].

Various authors including Rouviere (1961)[3], Hollinshead (1982)[4], Bolini & Del Sol (1990)[5], Berge & Bergman (2001)[6] compared the morphometry of the infraorbital and supraorbital foramen and found that the infraorbital foramen has a relatively large diameter and can vary in form and situation with the supraorbital foramen and also variations with respect to ethnicity were reported by Hindy AM, Abdel Raouf (1993)[7]. Molliex, Navez and Baylot (1996)[8], Prabhu, Wig and Grewal (1999)[9] studied the sectional blockage of the infraorbital nerve and regarded it better than infiltration for facial anaesthesia, because it accounts for less local tissue edema during surgery, thus allowing for good intrasurgical conditions.

Materials and Methods

A total 50 skulls examined for 100 infraorbital foramina which are identifiable of their sex were examined. Foetal skulls and skulls with gross damages in the area of measurement were excluded. All the parameters were examined by a three observer using a divider, Vernier calliper and millimetre scale. three measurements were made for each parameter to get an average value.

The infraorbital foramen was the landmark from which the distance between the following bony structures were examined; Nasion (NAS), Zygomatico maxillary suture (ZMS), Anterior nasal spine (ANS), and the distance between the inferior orbital rim (IOR) to optic canal (OC), infraorbital foramen (IOF), inferior & superior orbital fissure (IF & SF) (Figure 1). The shape of the Infra-orbital foramen and the number of infraorbital foramina present were also examined in relation to the gender.

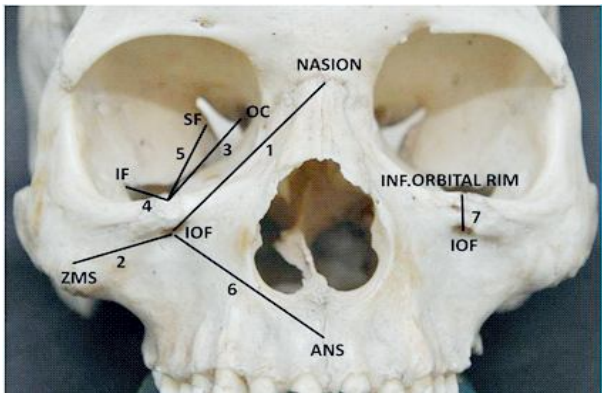

Fig. 1: Measurement of the parameters 1: Distance between infraorbital foramen to nasion; 2: Distance between infraorbital foramen to zygomatico-maxillary suture; 3: Distance between inferior orbital rim to optic canal; 4: Distance between inferior orbital rim to inferior orbital fissure; 5: Distance between inferior orbital rim to superior orbital fissure; 6: Distance between infraorbital foramen to anterior nasal spine; 7: Distance between inferior orbital rim to infraorbital foramen)

Results

In the present study, parameters were analysed with respect to gender and few of which showed statistical significance which are marked * in the tabular column.

The most common shape of infraorbital foramen found in the present study is oval (39%) followed by semilunar (27%). Round shaped foramen was found in 22% of skulls, triangle shaped foramen was found in 12% and accessory foramina were present in 11% of the skulls (Figure 2). The average mean and standard deviation were calculated for every measurement. Paired t – test was used to compare the parameters between sides and gender for each measurement. The formula used for statistical analysis:

Table 1: Measurements of the parameters

Measurement	Male (n=50)		Female (n=50)	
	Right (n=25)	Left (n=25)	Right (n=25)	Left (n=25)
IOF – NASION (mm)	38.45 ± 3.28	37.95 ± 3.33	32.86 ± 2.66*	30.16 ± 2.06*
IOF – ZMS (mm)	28.35 ± 8.57*	27.40 ± 9.33*	27.32 ± 7.50*	27.31 ± 6.31*
IOR – OC (mm)	47.60 ± 1.17*	46.60 ± 1.84*	44.52 ± 1.12*	44.61 ± 1.14*
IOR – IF (mm)	20.20 ± 2.39	19.50 ± 2.50	20.22 ± 2.31	19.12 ± 2.20
IOR – SF (mm)	43.30 ± 2.41	43.70 ± 2.67	41.32 ± 2.38*	41.70 ± 2.61*
IOF – ANS (mm)	36.30 ± 2.26	36.00 ± 2.36	34.31 ± 2.20	33.01 ± 2.31
IOR – IOF (mm)	7.60 ± 1.07*	6.80 ± 0.42*	7.11 ± 1.02	6.02 ± 0.41

Statistically significant differences were reported when p – values were less than 0.05 (Table 1).

Data are presented in Means ± SD. * P < 0.05 which

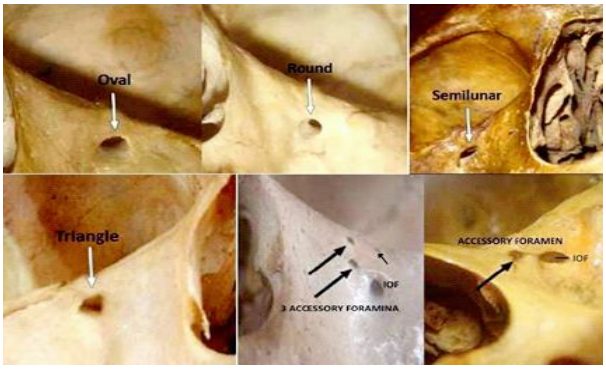

Fig. 2: Shapes of Infraorbital foramen

suggests statistical significance. IOF: Infraorbital foramen; ZMS: Zygomatico-maxillary suture; OC: Optic canal; IF: Inferior orbital fissure; SF: Superior orbital fissure; ANS: Anterior nasal septum. IOR: Inferior orbital rim

Discussion

The location of infraorbital foramen has become mandatory for different procedures to reduce the risk in orbital surgeries and Macedo et al[10] observed the infraorbital rim to be the easier way to locate the foramen. He found the mean distance between the inferior orbital rim to the infraorbital foramen as 6.28 ± 1.79 mm on the right side and 6.45 ± 1.76 mm on the left side in a sample of 295 adult Brazilian skulls. Whereas in the present study the distance between the inferior orbital rim to the infraorbital foramen found to be 7.60 ± 1.07 mm on the right side and 6.80 ± 0.42 mm on the left side in males and for females it is found to be 7.11 ± 1.02 mm on the right side and 6.02 ± 0.41 mm on the left side. The observation in the present study signifies an increase of the distance in the south Indian population. The laterality of the infra-orbital foramen can be ascertained by measuring the distances from the Infarorbital foramen to the Nasion and found to be 38.45 ± 3.28 mm on the right side and 37.95 ± 3.33 mm on the left side in males and females the distance found was 32.86 ± 2.66 mm on the right side and 30.16 ± 2.06 mm on the left side, from which we can infer the laterality is more on the right side than the left. There is no other study available to compare the mean distance from the nasion to Infraorbital foramen and the present study will be more reliable as it has included many parameters.

Another parameter also proves to be of help in order to locate the infraorbital foramen, is the distance from Zygomatico-maxillary suture to the infraorbital foramen, it is 28.35 ± 8.57 mm on the right side and 27.40 ± 9.33 mm on the left side in males and 27.32 ± 7.50 mm on the right side and 27.81 ± 6.51 mm on the left side in females. The values are similar to the observations by Isurani Ilayaperuma[11] in Sri Lankan Tamil Population which is ethnically similar to north karnataka population. The mean horizontal distance in the present study is found to be 41.44 ± 2.08 mm on the right side and 40.56 ± 2.24 mm on the left side in males and 41.23 ± 2.04 mm on the right side and 40.04 ± 2.10 mm on the left side in females which shows significant increase in the distance in males that proves to be valuable in the orbital approaches.

The shape of the infraorbital foramen found to vary significantly among the ethnic groups and gender which were verified by various authors. The present study corresponds so closely to the observations by Boopathi et al [12], because both the studies were done in the same south Indian population. In the present study the most common shape found was oval (39%) which is similar to all the studies done previously. The second most common shape found was semilunar (27%) which is similar to Boopathi et al [12] (24%), Appinhasmit et al [13] (29%) in Bangkok population. But authors like kazkayasi et al [14] in Turkey population found round shape as the second most common type (38%).

More than all other shapes, in the present study we found Triangle shaped foremen in 12% skulls which is reported previously by Boopathi et al [12] only, this shows the pivotal role of ethnicity, as this shape is found only in south Indian population. In addition to this, the number of accessory foramina also found to be high in the South Indian population, previously Hanihara and Ishida[15] found the accessory foramina more commonly present in Northeast Asian skulls (16%). In the present study the accessory foramina were found in 11% skulls and it is 16.25% in the study done by Boopathi et al.[12] This shows the higher incidence of accessory foramina in Asian skulls.

Conclusion

Although these were comparable to several studies, some considerable differences that may be of clinical importance were demonstrated. Moreover, the significant differences between the sides and gender in several measurements were also observed in the present study. Comparison of results from previous studies makes the large variation of the anatomical characteristics of the infraorbital foramen evident, not

only due to the diversity of the used parameters, but also due to the distinct investigated population. With a possibility of these characteristics being dependant on population groups, this study makes the morphometric study and laterality of the infraorbital foramen relevant.

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Sternal Foramina: A Study in Marathwada Population

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Abstract

Background: The knowledge of sternal variations is important as this bone is usually chosen for bone marrow aspiration. One such developmental anomaly is the presence of foramina of varying dimensions, in manubrium, body of sternum (mesosternum) or xiphisternum. Usually, the defect occurs in the lower third of sternum, in the body, as a single midline foramen (oval or round) and is usually asymptomatic and can be demonstrated only by CT scanning. The observation and knowledge of these foramina are of utmost importance in clinical, forensic and acupuncture techniques. Hence, this observation could be a useful one. *Methods:* 71 dried adult human sternae from the Department of Anatomy, Govt. Medical College, Aurangabad were studied. Measurements of sternal foramina if present were made with sliding vernier caliper and photographic documentation was obtained. *Results:* Out of 71 human sternae studied, Sternal foramina were found in 3 male sternums, resulting in an incidence of 4.22 % while none were found in female sternum. The largest sternal foramina found measured 11 x 12 mm and smallest measured 7 x 5 mm. *Conclusion:* Sternal foramina are variant quite common in the population, which is not only a focus of attention to the anatomists but also of interest to Forensic experts, orthopedicians, paediatricians, cardiothoracic surgeons, physicians because it is in very close contact with heart and lungs.

Keywords: Sternal Foramen; Fusion Defect; Incidence; Sternal Puncture; Cardiac Tamponade.

Introduction

Sternal foramina constitute congenital midline defects in sternum, caused by incomplete fusion of the multiple sternal ossification centers. Presence of Sternal foramina was firstly documented in the 17th century. Eustachius (1707) noted the existence of this anomaly [1]. Sternal foramina have been observed in the manubrium, body and xiphoid process, however, they appear mainly in the inferior part of the sternum. Incidence of Sternal foramina ranges from 3.1 to 27.4 %, while the presence of xiphoidal sternal foramina has been reported up to 57.7 % as available in the literature [1,7-12, 14-22]. Their incidence varies among different populations. The aim of this study is to evaluate the incidence of Sternal foramina in marathwada population, compare results with other populations and discuss the importance of awareness concerning their existence and topography.

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Normal Anatomy of Sternum

The STERNUM (from Greek *sternon*, "chest"; plural "sternums" or "sterna") or breastbone is a long flat bony plate shaped like a capital "T" located anteriorly to the heart in the center of the anterior wall of the thorax (chest). Thus the sternum plays an important role to protect the lungs, heart and major blood vessels from physical trauma. Its average length in the adult is about 17 cms, and is rather longer in the male than in the female. From the front, the sternum is shaped somewhat like a sword / dagger. From the side, the sternum appears as a long, flat bone with a outward curvature.

The sternum consists of 3 parts: listed superior to inferior: the manubrium, the body of sternum

(mesosternum) or gladiolus, and the xiphoid process.

The Manubrium is the broad superior portion of the sternum which connects to the 1st pair of ribs. The superior end supports the clavicles (collarbones), and its margins articulate with the cartilages of the first seven pairs of ribs forming the front of the rib cage.

The Body or Corpus Sterni or Gladiolus is the longest part of the sternum connects with the next 6 pairs of ribs. Together, these 7 pairs of ribs are known as the true ribs. The sternal angle is located at the point where the body joins the manubrium. The sternal angle is a useful landmark when counting ribs because the second rib attaches here. In early life its body is divided in four segments, called sternebrae (singular: sternebra).

Photograph showing sternal foramina in present study

The Xiphoid Process or Processus Xiphoidus or Ensiform Appendix or Xiphoid Appendix —Located at the inferior end of the sternum is the pointed and the smallest of the three pieces. It articulates above with the body and on the front of each superior angle presents a facet for part of the cartilage of the 7th, 8th, 9th and 10th ribs. It gives attachment to the linea alba and, on the posterior surface, to the diaphragm[2].

Material and Methods

The study was conducted on 71 adult human dried sternae (45 male and 25 female) from the bone bank of Department of Anatomy of Govt. Medical College, Aurangabad. The bones were examined for the presence of Sternal foramina and photographic documentation was obtained. Measurements of the Sternal foramina were also obtained using a sliding vernier caliper.

Results

Out of 71 sternums (45 male and 25 female) studied, Sternal foramina were found in 3 male sternums, resulting in an incidence of 4.22 % while none were found in female sternum. The topography and measurements of the 3 sternal foraminas are summarized in Table 1. All 3 Sternal foraminas were found only in male sternums and they were seen on the body of sternum (mesosternum) in the midline. The largest sternal foramina found measured 11 x 12 mm and smallest measured 7 x 5 mm.

Discussion

Sternal foramen is an oval or round defect usually present in the lower third of body of sternum. Foramina have also been reported in manubrium sterni and xiphisternum.It may be of various sizes and shapes. Other sternal defects have been reported as complete midline sternal cleft, hybrid abnormalities like key-hole shaped deformity [3] and multiple sterna foramina [4]. All these are fusion defects of sternum [5].

Embryological Basis

In the fetus, the sternum consists of two cartilaginous bars (bars of mesenchymatous tissue)

Table 1: Topography and measurements of the sternal foramina documented in the present study

S. No	Sex	No. of sterna foramina seen	Location of sterna foramina	Measurements (transverse x vertical in mm)
1	Male	one	On the body of sternum (mesosternum) in the midline Corresponding to articulating facet of 5th rib & extending upto articulating facet of 6th rib	11 x 12
2	Male	one	On the body of sternum (mesosternum) in the midline corresponding in between 5th & 6th articulating facets for ribs	7 x 5
3	Male	one	On the body of sternum (mesosternum) in the midline corresponding exactly opposite to the articulating facet of 5th rib	9 x 12

called sternal bars which become attached to the upper nine costal cartilages on each side of the midline. During the eighth week of gestation, these bars migrate, converge towards the midline and fuse with each other in a cranio-caudal pattern. This fusion is completed by the tenth week, forming the manubrium and body. The xiphisternum is formed as a caudal extension of the sternal bars.

The ossification of sternum is by six centres: one for manubrium, four for body and one for xiphoid process. They appear between the articular facets for costal cartilages and divide the sternum into six transverse pieces. The fourth and fifth pieces are often formed from paired ossification centres.The third and fourth appear during the fourth and fifth months of fetal life respectively. The fifth usually appears an year after birth. Incomplete fusion of sternal bars in this region accompanied by eccentric centres of ossification account for the occurrence of sternal foramen or sternal fissure. Ossification of sixth part (xiphoid process) does not begin until the fifth to eighteenth year of life and partial cartilaginization may persist into adult life. Thus, xiphoid abnormalities are rare as compared to manubrial and gladiolal defects [5,6].

The complete fusion defect leads to cleft sternum whereas partial fusion defects lead to sternal foramina. Failure of fusion may be due to an early disturbance affecting midline mesodermal structures during sixth to ninth weeks of gestation.

Incidence

Incidence of Sternal foramina present show great variability in different studies and populations, while literature data of Sternal foramina incidence are documented in Table 2. In the literature, Sternal foramina incidence ranges between 3.2 and 18.3 % in studies using dried sterna [1,7-10], whereas in the present study, incidence of the Sternal foramina is found to be 4.22 % in the population of Marathwada. The existence of multiple xiphoidal Sternal foramina has been noted in 1.2–9 % of the total population [1,8,10,11]. Multiple Sternal foramina located at the sternal body have been documented in the literature [4,12,13], while presence of Sternal foramina in the manubrium has also been noted [12,14]. However, manubrial foramen or xiphoidal foramen were not found in the present study.

Location of the Sternal foramina may vary (Table 2). In 77.8 % of the Sternal foramina is present at the sternal body, the defects were encountered at the level of 5th intercostal segment[8], while in the present study, the Sternal foramina of the sternal body were located in the midline at the level close to the articulating facet for the 5th rib (Table 1). Some studies indicate a higher prevalence of Sternal foramina in the xiphoid process [10,15,16]; a finding that is not in accordance to the present study. None Sternal foramina were noted in the xiphoid process in the present study. However, some authors reported a greater incidence of Sternal foramina in the sternal body [8,9.14]; a finding which is in accordance to the present study. The size of Sternal foramina is also variable, ranging from 2 to 18 mm in the literature and 5 to 12 mm in the present research. The largest Sternal foramina detected in our study was of 11 x 12 mm size.

Although Sternal foramina are usually solitary malformations, association with accessory fissures and supernumerary left lung lobules has been noted during high resolution CT evaluation [7]. Coexistence with sternal cleft is also reported in the literature [3,11,14]. Moreover, coexistence of Sternal foramina and vertical sclerotic bands localized superiorly or inferiorly to the foramen was noted in 73 % of the multidetector computed tomography scans which revealed the presence of Sternal foramina [11].

The morphology of the xiphoid process constitutes a subject of interest in anatomical research. In the literature, the presence of xiphoidal Sternal foramina varies between 2.5 and 57.7 % (Table2). Xie et al. [15] have suggested a classification of different types of xiphoidal morphology in relation to the Sternal foramina existence. The authors, recommended four patterns: pattern L and pattern S include the presence of a single Sternal foramina with diameter more than 5 mm and less than 5 mm, respectively, while pattern LS includes specimens which present a large and a small Sternal foramina and pattern SS two or more small Sternal foramina. They report an incidence of 55.5, 28.5, 9.2 and 6.8 % for L, S, LS and SS pattern, respectively. Thus, the aforementioned researchers detected single xiphoidal Sternal foramina in 84 % of the subjects studied.

CT- computed tomography, MDCT- multi-detector computed tomography, HRCT- high resolution computed tomography. SF- Sternal foramina *****In this studies, only the xiphoid process was studied.

Clinical Implications

The clinical importance of this defect lies in the fact that a fatal cardiac tamponade can occur following insertion of needle (sternal puncture) in this region. If the needle is inserted without the knowledge of the presence of a foramen, it may easily penetrate the pericardium through the foramen. Sternum is one of the two bones chosen for bone

marrow aspiration in hematological diseases (the other site being the posterior part of iliac crest of hip

Table 2: Incidence of sternal foramina found in different studies are as follows

Author	Year	Population	Specimen	No. of sterna studied	Presence of sternal foramina		
					No. of sterna having SF	Location	Incidence (%)
Ashley[1]	1956	East africans Europeans	Dried sterna Dried sterna	98 573	13 23	--- ---	13.3 % 4 %
Mc Cormick[17]	1981	USA	X-rays (cadavers)	324	25	Sternal body (lower third)	7.7 %
Stark[18]	1985	USA	CT	140	06	Sternal body (lower third)	4.3 %
Moore et al.[19] Cooper et al[12]	1988	White, black, Hispanic,oriental , amerind	X-rays (cadavers)	Total 2016	135	---	16.1 %
Schratter et al.[20]	1997	Germans	CT	100	06	Sternal body	6 %
Aktan and Savas[7]	1998	Turkish	HRCT Dried sterna	350 62	19 02	--- Sternal body	5.4 % 3.2 %
Yekeler et al.[11]	2006	Turkish	MDCT	1000	45 274	Sternal body Xiphoidal	31.9 %
*Akin et al.[16]	2011	Turkish	MDCT	500	216	Xiphoidal	43.2 %
El-Busaid et al.[8]	2012	Kenyans	Dried sterna	80	09 02	Sternal body Xiphoidal	13.8 %
Ishii et al.[21]	2012	Japanese	MDCT	1053	33	Lower sternum	3.1 %
Bayarogullari et al.[14]	2013	Turkish	MDCT	250	14 01	Sternal body manubrium	6 %
Shivakumar et al.[9]	2013	Indian	Dried sterna	86	06 03	Sternal body Xiphoidal	10.5 %
Macaluso et al.[22]	2014	Spanish	X-rays (cadavers)	122	04	Sternal body (lower third)	3.3 %
*Xie et al.[15]	2014	Korean	Cadaveric MDCT	943	544	Xiphoidal	57.7 %
George et al.[10]	2015	Greek	Dried sterna	60	03 08	Sternal body Xiphoidal	18.3 %
Present study	2016	Marathwada	Dried sterna	71	03	Sternal body	4.22 %

bone). Improper sternal prick / puncture may lead to cardiac tamponade or great vessel injury.

Another importance of sternum is that the acupuncture point CV-17 (Danchu or Shanzong or sea of energy) is located at the level of nipples in the midline. Vertical insertion of acupuncture needle can lead to pericardial effusion followed by cardiac tamponade. An oblique insertion of needle is recommended in these cases. However, in lean individuals who can have skin-heart distance of only 1-2 cm, even correct needling could lead to pericardial perforation [23].

Another problem is in the diagnosis of this foramen. It is usually asymptomatic, usually not palpable because of the overlying muscles and not normally visible in a radiograph because of the underlying pericardium. But, it can be well demonstrated in a CT. Multiplanar and 3D reconstructed Multi-Detector CT (MDCT) images are the modality of choice for detecting sternal anomalies. Thus, a sternal puncture performed without the knowledge of these anomalies could be fatal.

Forensic Misinterpretations

The sternal foramen could be misinterpreted as bullet injuries. On the forensic side, they could also be confused with ante-mortem traumatic injuries. A close examination of the specimen should confirm the presence of sternal foramen: The defect will be located in the midline, usually the lower half of body of sternum;the measurement of this defect will be the same on both outer and inner surfaces of the bone; a careful examination of the edges would reveal it to be smooth and covered with cortical bone.In specimens exposed to insects,fauna,etc. , characteristic erosion,

teeth or claw marks maybe present around the foramen, but it should not be mistaken for ante-mortem traumatic injury.

The misinterpretation of such defects in medicolegal cases can be a serious pitfall in determining the nature and cause of death in some suspected cases of homicide and suicide [6].

Medico Legal Importance

1. In badly decomposed bodies or skeletonized human remains a sternal defect may present a problem that can lead to misinterpretation and wrong conclusions which have serious consequences.
2. Postmortem artifacts of advanced putrification can obscure and mask the gross and microscopic changes of associated trauma.
3. In skeletons the character of the edges of the defect may be altered by scavenger animals or, when evaluating human skeletons which have been exposed or buried for longer periods of time, demineralization and erosion of the margins of the defect may have occurred.
4. The possibility of an old or recent gunshot wound or a traumatic penetrating lesion caused by an object other than a missile. X-rays of the body or remaining tissue parts and organs are necessary to rule out the presence of a missile. A separate X-ray of the sternum will disclose small metallic fragments about the defect that would be undetectable by gross examination.
5. Imaging of sternal foramen simulating osteolytic lesion [6,24].

The defect in the body of sternum leaves only the skin separating the pleura and heart from the surface at the affected site, thus any penetrating injury would easily access the heart and cause more severe damage than would normally be. The longer manubrium is unusual and can be both a clinical, radiological and medico-legal challenge when encountered [25].

Applied Aspects

1. Clinicians should be aware of this anatomic variation, because needle insertions in this area may lead to fatal complications. Knowledge of the existence of such anatomic variants is important to avoid misdiagnosis as an osteolytic process [24].
2. The possibility of a sternal foramen should be mentioned to the clinician because infiltration, biopsy or acupuncture of this area may lead to fatal cardiac complications [8].
3. Sternal foramina may pose a great hazard during sternal puncture, due to inadvertent cardiac or great vessel injury. They can also be misinterpreted as osteolytic lesions in cross-sectional imaging of the sternum [24].
4. Variant xiphoid morphology such as bifid, duplicated, or trifurcated may be mistaken for fractures during imaging [24]. These variations may complicate sternal puncture, and due caution is recommended. The variant xiphisternal morphology may raise alarm for xiphoid fractures and may therefore be considered a differential [8].

Also, important in radiological diagnosis, therapeutic procedures, forensic and medico legal or pathological identifications. It is also essential to know for students of medicine, radiology, anatomy and forensic pathology just as each variation could have unique features different from others.

Conclusion

The knowledge of anatomical variants such as congenital foramina of sternum (sternal foramina) is essential, especially for medical professionals, radiologists and acupuncturists, because of the danger of penetration of needle into pericardium during bone marrow aspiration or acupuncture. As it is asymptomatic, proper MDCT imaging could help in avoiding the risk of fatal cardiac tamponade.

List of Abbreviations used

CT – Computed Tomography

MDCT - Multi-Detector computed tomography

HRCT- High resolution computed tomography

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Morphometric Study of Femur for Determination of Sex of a Person: Cadaveric Cross Sectional Study in North Karnataka

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Abstract

Background and Objectives: Most of the studies described anatomical parameters on X-ray. Here the measurements were carried out on adult human cadavers. This study will essentially help orthopedicians to make suitable hip joint prosthesis, also help forensic expert in disputed sex and help to understand biomechanics of hip joint. These parameters help us to understand etiopathogenesis of disease like osteo-arthritis of hip joint. *Methodology*: A total 60 hip joints were studied in 20 male and 10 female cadavers. Measurements taken with soft tissue in situ of vertical diameter of head of femur. These measurements were taken using vernier caliper and a steel scale. Mean values of parameters were recorded and compared between males and females. The mean values also compared with right and left side for males and females. *Results:* The mean vertical diameter of head of femur was found to be 43.75 mm in males and 40.30 mm in females. *Conclusion:* The parameters of hip joint are immense importance to orthopaedicians, radiologists, and prosthetists. These values are useful to identify the fragment of bone for sex determination sent to forensic expert.

Keywords: Femoral Head; Diameter; Vernier Caliper; Adult Cadaver.

Introduction

Determination of individual sex from the available skeleton is of great importance in the identification of a person. In medico-legal cases, determination of stature, sex and age from skeletal remains of deceased person is often referred to anatomists and anthropologists. Therefore most of the long bones either individually or in combination have been subjected to statistical and morphological analysis. Knowledge of the bony component of hip joint will not only help the radiologists but will also be of immense importance to orthopaedicians and prosthetists [1].

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Assessment of these parameters to detect the sex by radiograph, CT scan, MRI would include magnification errors and may not be cost effective for the developing countries like India. Awareness of average dimensions of hip joint in both sexes helps in determination of sex by forensic experts. As this is a cadaveric study, various parameters are almost near normal situations, as those encountered on operation table.

Review of Literature

Ruma Purkait and Heeresh Chandra (2002) studied 280 dry adult femora from 200 males and 80 females from resident of Central India. In their study the mean vertical diameter of head of femur was found to be 44.28 mm in males and 38.39 mm in females. They concluded that sexual dimorphism was maximum at the ends of femur. The ends of a bone are the areas where a number of muscles make their insertion and subjected to more pull than at the point of origin. If sex of a person has to be detected, then vertical diameter of head of femur is the single best determinant with an accuracy of 91.1 % and epicondylar width with 89.6% accuracy [2].

Michael Sean Patton et al. (2006) studied relationship between proximal femoral geometry and fracture of hip joint in England. For this he studied radiographs of 50 patients with intracapsular and 50 patients with extracapsular fractures of hip. The parameters studied on this radiograph are neck width, vertical head diameter, trochanter diameter, neck length. He found the vertical diameter of head of femur in males 60.20 mm and 53.93 mm in females. This shows that vertical diameter of head of femur is more in males than in females. They also concluded that increase in femoral neck length is the cause of increased proximal femoral fractures in elderly people. It has been suggested that variations in proximal femoral geometry also play important role in hip fracture [3].

Masood Umer et al. (2010) in Pakistan studied pelvic radiographs of 116 male and 20 female healthy volunteers. The purpose of the study is to measure the morphology of the proximal femur in Pakistan. They studied 12 parameters of proximal femur, among them one parameter was vertical diameter of head of femur. The mean vertical diameter of head of femur in Pakistani population was 50.10 mm. They also concluded that morphology of proximal femur in studied population differed significantly from those of western population indicating the regional variation. So these parameters can be utilized to construct population specific prosthesis in Pakistan [4].

Thomas K Black (1978) studied 114 skeletons from Ohio USA, which included 63 males and 51 female skeletons. He measured femoral head circumference and femoral length for the determination of sex from fragment of femur. They recorded that individuals with femur circumference greater than 81mm were classified as males, those with circumference less than 81mm classified as females.

Of the 107 individuals who were assigned sex by femoral head circumference, 85% were correctly classified. From this they concluded that femoral head circumference can be a useful tool in determination of sex, especially where skeletal remains are fragmentary or poorly preserved. For skeletal collections in good condition, femoral head circumference can serve as rapid and reliable method of sexual assessment [5].

Javadekar BS (1961) studied 108 femora from 86 adult male and 22 adult female cadavers in India. Measurements were taken from femora with articular cartilage in situ. In his study the average vertical diameter of head of femur in males was 45.26 mm and in females 40.37 mm. He studied that femur showing a diameter of less than 40 mm can be identified as female and one having diameter more than 45 mm should be considered as male. He also found that the maximum difference between right and left femoral diameter is 2 mm in a same individual [6].

Material and Method

A total 60 hip joints were studied in 20 male and 10 female cadavers. The measurements were taken with soft tissue in situ, which includes vertical diameter of head of femur. These measurements were taken using vernier caliper and a steel scale. mean values were compared with right and left side for males and females**.**

The followings steps were carried out to dissect hip joint on both sides as given in the Cunningham's Manual:

1. Femoral vessels and nerve were cut immediately inferior to inguinal ligament.
2. Sartorius and rectus femoris muscles were cut about 5 cm from their origins and turned downwards. Iliopsoas muscle was cut near its insertion and the two parts were turned upwards and downwards exposing the psoas bursa and capsule of hip joint. The bursa was removed and margins of thick iliofemoral ligament were identified.
3. Articular capsule was incised along the borders of iliofemoral ligament and all parts of capsule were removed.
4. Open the hip joint to disconnect the round ligament of femur or cutting the round ligament with scalpel [7].

With soft tissue in situ, using vernier caliper and metallic scale, diameter of head of femur have been calculated as follows :-

Vertical Diameter of Head of Femur

Vernier caliper was used to measure vertical diameter of femoral head. It was taken at right angle to long axis of neck of femur, which meant the straight distance between the most superior to most inferior points of the femoral head. The transverse diameter was not taken because there was not any significant difference between vertical and transverse diameter of head of femur.

Intraobserver variation was avoided by measuring parameter three times by each of the three investigators and mean of the three readings were taken as final value and recorded.

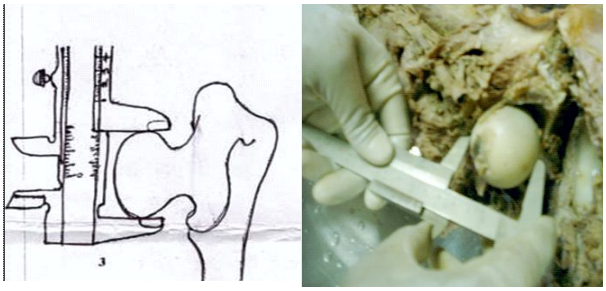

Fig 1: Method used for measuring vertical diameter of head of femur

Results

In this study parameter of sixty hip joints were measured using vernier caliper. In 30 human cadavers of age group 18-85 years belonging to 20 male cadavers and 10 female cadavers with soft tissue in situ. All measurements were taken three times by three separate investigators. The mean of the three readings were considered as the final reading and recorded. The data thus collected was analyzed and tabulated.

Table 1: Mean vertical diameter of head of femur for 20 right and 20 left hip joints in males

Serial No	Cadaver no	Vertical diameter of head of femur	
		Right	Left
11	17	44	44
12	19	38	37
13	20	45	47
14	21	44	44
15	22	44	44
16	23	47	45
17	25	37	36
18	26	46	44
19	28	45	45
20	29	47	46

Table 2: Measurements taken in female cadavers (in mm)

Serial No	Cadaver no	Vertical diameter of head of femur	
		Right	Left
1	2	41	42
2	5	40	40
3	8	37	36
4	11	40	36
5	13	44	43
6	15	43	42
7	18	40	39
8	24	42	41
9	27	39	38
10	30	42	41

Table 3: Mean vertical diameter of head of femur (in mm)

	Male(n=20)		Female(n=20)	
	Right (20)	Left (20)	Right (10)	Left (10)
Minimum value	37	36	37	36
Maximum value	47	47	44	43
Mean	44.00	43.50	40.80	39.80
Standard deviation	2.57	2.81	2.04	2.48

Table 4: Comparison of parameters (in mm) between males and females

Parameters	Side	Male			Female			P Value
		n	Mean	S.D.	n	Mean	S.D.	
Vertical diameter of head of femur	Right	20	44.00	2.57	10	40.80	2.04	0.002 S
	Left	20	43.50	2.81	10	39.80	2.98	0.0015 S

Observation

Males

a. The mean vertical diameter of head of femur on right side was 44.00 mm and left side was 43.50 mm with range of 37 mm to 47 mm on right and 36 mm to 47 mm on left side (Table 3).

b. The mean vertical diameter of head of femur was 40.80 mm and 39.80 mm on right and left side respectively. The minimum value is 37 mm and 36 mm on right and left side respectively. . The maximum value for right side is 44 mm and for left side it is 43 mm (Table 3).

c. From above data comparison was made for male and female hip head of the femur. It was noted that the parameters are more in males than females. The difference of values between males and females are statistically significant. The difference was significant for all the parameters of vertical diameter of head of femur.

Discussion

Hip joint is one of the major joint of the body. It is a multiaxial, synovial ball and socket (spherical, cotyloid) type of joint. Menschik (1997) described it as rotational conchoids.

Knowledge of anatomical parameters of the bony components of hip joint is very essential because it will help in early detection of disputed sex of a person. We can also identify the race of a person by these parameters. Awareness of the normal parameter of hip joint can also help in diagnosis of acetabular dysplasia. In turn it opens a new horizon into understandings of etio-pathogenesis of diseases like primary osteoarthritis. An abnormal joint is more prone to develop osteoarthritis rather than joint with normal parameters.

The normal values for vertical diameter of head of femur in males and females are given in Table 5 for different set of populations

Table 5: Comparative study of vertical diameter of head of femur

Serial No	Authors	Male	Female
1	Gita malla et al. (2006) in Germany[7]	49.00 mm	44.00 mm
2	Aasis Unnanuntana(2002) in USA[8]	55.46 mm	48.73 mm
3	P S Igbigbi et al. (2000) in Malawi[9]	48.30 mm	44.56 mm
4	Asala SA et al. (1998) in Nigeria	54.16 mm	47.00 mm
5	Singh et al. (1986) in Nigeria	52.02 mm	46.80 mm
6	Clarke et al. (1987) in England[10]	51.30 mm	45.10 mm
7	Akhtari Afroze et al. (2005) Bangladesh[11]	51.55 mm	45.65 mm
8	Ruma Purkait et al. (2005) in India	44.28 mm	38.39 mm
9	Thomas Dwight (1905) in USA	49.68 mm	43.84 mm
10	Khan (1959) in India[12]	48.00 mm	41.00 mm
11	Javadekar BS (1961) in India	45.26 mm	40.37 mm
12	V.Davivongs(1963) in Australia	43.05 mm	38.16 mm
13	B.R.Kate (1964) in India[13]	41.50 mm	39.00 mm
14	Yasar Iscan M et al. (1995) in China	46.16 mm	41.13 mm
15	Rajendra Prasad et al. (1996) in India	43.00 mm	39.10 mm
16	Gonazalo et al. (1997) in Spain	47.15 mm	41.13 mm
17	Chauhan R et al.(2002) in India	45.64 mm	44.27 mm
18	Present Study in North Karnataka	43.75 mm	40.30 mm

From above said values the vertical diameter of head of femur for both males and females in Africa and Western world was greater than the present study. But the values of present study are very near to the study done by V.Davivong on femora of Australian Aborigine population.

From above studies it was also concluded that the vertical diameter of head of femur was more in males than in females. This sex difference in vertical diameter of head of femur was based on the fact that the males skeleton was longer and more robust than skeleton of an average females.

Conclusion

Present study provides valuable parameters which will help the forensic expert in early detection of disputed sex, race, and stature of a person. In this study it was found that the parameters vary from males to females and parameters also vary from right and left side.

The values are more in the males than in the females. It was due to longer and robust bones in males than in the females. This above said fact was also proved by the present study. In the sixty hip joints we have

studied it was found that the values are more for male cadavers than the female cadavers. It was also observed in this study that values are little more on the right side than on the left side for all hip joint parameters. This finding was stastically insignificant.

It was observed in the study that average vertical diameter of head of femur was 42.02mm, in males it was 43.75 mm and in females it was 40.30 mm. From these observations it can be concluded that if vertical diameter of head of femur was more than 44 mm, then the given bone belongs to the male. If vertical diameter of head of femur was less than 40 mm, it can be said that the given bone belongs to the female in North Karnataka population.

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A Morphometric Study of Lumbar Vertebra Pedicles and Its Use in Transpedicular Screw Fixation

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Abstract

Pedicle screws are used with an increasing frequency for fixation in spinal fractures. Thus it is imperative to have adequate knowledge of morphometry of lumbar pedicles. *Aim:* To measure various dimensions of pedicles in lumbar vertebrae and to suggest dimensions for pedicular implants in the Indian population and to improve the pedicular screw placement technique. *Methods and Materials:* Two hundred and ten dry human lumbar vertebrae of unspecified gender and age obtained from Department of Anatomy of Medical colleges. The lumbar vertebrae were divided into two groups typical (L1-4) and atypical (L5) depending on the atypical features of L5. Various parameters of pedicles were measured. *Results and Conclusions:* In typical Lumbar vertebra Pedicle width was almost always less than the pedicle height. In atypical Lumbar vertebra pedicle height is lesser than typical lumbar vertebra. The chord length is more than 35mm in all lumbar vertebras. The measurement in this study will help in finding the appropriate screw to be implanted in the lumbar region of the spine for spine immobilization and fixation.

Keyword: Lumbar Vertebra; Chord Length; Pedicle.

Introduction

Vertebral pedicles are short, thick rounded dorsal projections from the superior part of the body at the junction of its lateral and dorsal surfaces. It has been proved that the pedicle is the strongest part of the vertebra even in osteoporotic bone[5,8]. Spinal fusion by transpedicular fixation has been in practice for many years so as to treat different painful conditions of the lumbar spine. With increasing popularity, there has been dramatic improvement in the way the spinal fusion operations are performed using fixation devices including the pedicle screws [2]. Pedicular fixation is more stable and versatile because it provides three dimensional fixations. Due to increased use of various pedicle screw instrumentations, there is concern about injuries to the pedicle cortex, nerve root, facet joint, and adjacent vital structures by oversized pedicle screw size. Choice of the screw for the operation is determined by the minimum diameter of the pedicle [2,4]. Detailed knowledge of pedicle morphometry is critical for proper placement of the transpedicular screw and to avoid inadvertent penetration of the pedicular wall. The purpose of this study was to obtain the anatomic morphometric data of the pedicles so as to provide reference guide to the choice of the size of the pedicular screw for transpedicular screw fixation.

Methods

The present study was carried out on dry human lumbar vertebrae obtained from Department of Anatomy of Medical colleges. Two hundred and ten lumbar vertebrae were selected for study of which 180 was typical lumbar vertebra and 30 were atypical. The vertebrae were of unspecified gender and age. Serial numbers were assigned to lumbar vertebra. Measurements were taken using a vernier caliper (0-300mm with a precision of 0.01 mm). Photographs were taken of lumbar vertebra with a digital camera and the angular measurements were recorded using Markus-Bader (MB) ruler software [7]. MB ruler is software which is free to use for non-commercial purposes. Measurements were taken of right and left

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pedicles. Two authors made all measurements at separate sittings, one measurement serving as a check to the other. The mean was then calculated for that pedicle.

The following parameters were recorded in a proforma:

1. *Pedicle width at the midpoint of the pedicle:* It is the distance between medial and lateral surfaces of pedicle at its midpoint.
2. *Pedicle height at the midpoint of the pedicle*: It is the distance between superior and inferior border of pedicle at its midpoint.
3. *Transverse pedicle angle*: It is the angle between a line passing through the pedicle axis and a line parallel to the vertebral midline.
4. *Sagittal pedicle angle:* It is the angle between a line passing through the pedicle axis and superior vertebral body border in the sagittal plane.
5. *Chord length (Screw path length)*: It is the distance from the most posterior aspect of the junction of the superior process and the transverse process to the anterior cortex of the vertebral body along the pedicle axis.

Results

1. The pedicle width of typical lumbar vertebra at the midpoint of the pedicle on the right side ranged from 4.25 - 16.2 mm with a mean of 8.38 ± 2.13 mm and on the left side ranged from 4.4 – 18.9 mm with a mean of 8.53 ± 2.34 mm
2. The pedicle width of atypical lumbar vertebra at the midpoint of the pedicle on the right side ranged from 10.1 – 20.7 mm with a mean of 15.39 ± 2.81 mm and on the left side ranged from 10.9– 20.4 mm with a mean of 15.62 ± 2.54 mm.
3. The pedicle height of typical lumbar vertebra at the midpoint of the pedicle on the right side ranged from 9.8 -19.5 mm with a mean of 14.01 ± 1.56 mm and on the left side ranged from 9.8 – 16.7 mm with a mean of 13.75 ± 1.49 mm.
4. The pedicle height of atypical lumbar vertebra at the midpoint of the pedicle on the right side ranged from 9.8 -16.7 mm with a mean of 13.23 ± 1.93 mm and on the left side ranged from 9.9 - 18.3 mm with a mean of 12.58 ± 1.90 mm.
5. The transverse pedicle angle of typical lumbar vertebra on the right side ranged from 4.8 - 21.77 degrees with a mean of 10.94 ± 2.98 degrees and on the left side ranged from 4.7 – 22.39 degrees with a mean of 10.87 ± 2.93 degrees.

Table 1: Comparison of pedicle width at the midpoint of the pedicle with other studies

Lumbar vertebra	Study	Year	Country	Material for study	Mean (mm)	Std.Dev	Range (mm)
Typical Lumbar vertebra L1-L4	Alon Wolf et al [10]	2001	Israel	CT scans	L1 -5.6 L2-7.7 L3-8.9 L4-11.4	L1 -1.3 L2 -1.5 L3-1.9 L4-1.8	
	Acharya S et al [1]	2010	India	CT scans	L1 -7.20 L2-7.62 L3-8.97 L4-11.12	L1 -0.93 L2 -0.84 L3-1.09 L4-1.01	6.57–12.2 9.25–14.26
	Aruna N et al [2]	2011	India	Dry bones	L1 -7.39 L2-7.87 L3-9.88 L4-11.42	L1 -0.16 L2 -0.15 L3-0.18 L4-0.13	L1 -4.5-11 L2 -5-11.5 L3-6.5-15 L4-9-20
	Dhawal et al [3]	2014	India	Dry bones	Right: 8.41 Left: 8.57	Right: 1.62 Left: 1.69	Right: 5.02 - 13.02 Left: 4.32 -13.44
	Present study	**2016**	**India**	**Dry bones**	**Right8.38 Left: 8.53**	**Right: 2.13 Left2.34**	**Right :4.25 - 16.2 Left: 4.4 – 18.9**
Atypical Lumbar vertebra L5	Alon Wolf et al [10]	2001	Israel	CT scans	13.7	2.2	
	Shiu-Bii Lien et al [6]	2007	Taiwan	Dry bones, cadaveric	Right17.7 Left: 17.5	Right: 2.7 Left2.6	
	Acharya S et al [1]	2010	India	CT scans	13.91	1.16	10.65–16.4
	Aruna N et al [2]	2011	India	Dry bones	12.33	0.23	13-22
	Present study	**2016**	**India**	**Dry bones**	**Right15.39 Left: 15.62**	**Right:2.81 Left2.54**	**Right: 10.1 – 20.7 Left: 10.9– 20.4**

6. The transverse pedicle angle of atypical lumbar vertebra on the right side ranged from 9.78 - 23.5 degrees with a mean of 17.74 ± 4.09 degrees and on the left side ranged from 9.11 - 23.98 degrees with a mean of 17.64 ± 4.03 degrees.
7. The sagittal pedicle angle of typical lumbar vertebra on the right side ranged from 4.48 - 9.24 degrees with a mean of 6.94 ± 1.15 degrees and on the left side ranged from 4.6 - 9.4 degrees with a mean of 6.84 ± 1.11 degrees.
8. The sagittal pedicle angle of atypical lumbar vertebra on the right side ranged from 7.38 – 11.5 degrees with a mean of 8.33 ± 0.86 degrees and on the left side ranged from 7.1 – 11.3 degrees with a mean of 8.30 ± 0.92 degrees.
9. The chord length of typical lumbar vertebra on the right side ranged from 35.11 – 54.56 mm with a mean of 44.54 ± 4.17 mm and on the left side ranged from 35.61 – 54.12 mm with a mean of 44.65 ± 4.15 mm.
10. The chord length of atypical lumbar vertebra on the right side ranged from 35.89 – 54.33 mm with a mean of 42.33 ± 4.40 mm and on the left side ranged from 35.53 – 54.11 mm with a mean of 42.30 ± 4.37 mm.

Table 2: Comparison of pedicle height at the midpoint of the pedicle with other studies

Lumbar vertebra	Study	Year	Country	Material for study	Mean (mm)	Std.Dev	Range (mm)
Typical Lumbar vertebra L1-L4	Alon Wolf et al [10]	2001	Israel	CT scans	L1 -15.1 L2-14.8 L3-14.5 L4-14.8	L1 -1.9 L2 -1.6 L3-1.9 L4-2.1	
	Aruna N et al [2]	2011	India	Dry bones	L1 -14.81 L2-14.4 L3-14.15 L4-13.85	L1 -0.16 L2 -0.15 L3-0.14 L4-0.16	L1 :11.5-19 L2:12-17 L3:11.5-17 L4:10.5-20
	Dhawal et al [3]	2014	India	Dry bones	Right: 13.96 Left: 13.9	Right: 1.34 Left: 1.39	Right: 10.42-17.42 Left: 10.22-17.54
	Present study	**2016**	**India**	**Dry bones**	**Right** 14.01 **Left:** 13.75	**Right: 1.56** **Left 1.49**	**Right :** 9.8 -19.5 **Left:** 9.8 – 16.7
Atypical Lumbar vertebra L5	Alon Wolf et al [10]	2001	Israel	CT scans	15.6	2.3	
	Singel TC et al [9]	2004	India	Dry bones	Males 13.4 Females13.25	Males 6 Females 2.5	Males 11-17 Females 12-15
	Aruna N et al [2]	2011	India	Dry bones	17.52	0.14	10-16
	Present study	**2016**	**India**	**Dry bones**	**Right** 13.23 **Left:** 12.58	**Right:1.93** **Left: 1.90**	**Right:** 9.8 -16.7 **Left:** 9.9 - 18.3

Table 3: Comparison of transverse pedicle angle with other studies

Lumbar vertebra	Study	Year	Country	Material for study	Mean (degree)	Std.Dev	Range (degree)
Typical Lumbar vertebra L1-L4	Alon Wolf et al [10]	2001	Israel	CT scans	L1 -11.8 L2-11 L3-12.8 L4-14.1	L1 -1.3 L2 -1.7 L3-2.2 L4-2.1	
	Acharya S et al [1]	2010	India	CT scans	L1 -10.90 L2-12.12 L3-15.40 L4-18.37	L1 -3.13 L2 -2.89 L3-3.57 L4-4.31	
	Dhawal et al [3]	2014	India	Dry bones	Right: 11.79 Left: 11.67	Right: 4.03 Left: 4.09	Right: 4.44-23.42 Left: 4.02-23.69
	Present study	**2016**	**India**	**Dry bones**	**Right** 10.94 **Left:** 10.87	**Right: 2.98** **Left 2.93**	**Right :** 4.8-21.77 **Left:** 4.7-22.39
Atypical Lumbar vertebra L5	Alon Wolf et al [10]	2001	Israel	CT scans	18.5	3.9	
	Acharya S et al [1]	2010	India	CT scans	24.75	3.83	16.38–30.16
	Present study	**2016**	**India**	**Dry bones**	**Right** 17.74 **Left:** 17.64	**Right:**4.09 **Left:** 4.03	**Right:** 9.78 - 23.5 **Left:** 9.11 - 23.98

Table 4: Comparison of mean sagittal pedicle angle with other studies

Lumbar vertebra	Study	Year	Country	Material for study	Mean (degree)	Std.Dev	Range (degree)
Typical Lumbar vertebra L1-L4	Dhawal et al [3]	2014	India	Dry bones	Right: 4.78 Left: 4.67	Right: 2.06 Left: 2.04	Right: 1.39-9.88 Left: 1.4-9.31
	Present study	2016	India	Dry bones	Right 6.94 Left: 6.84	Right:1.15 Left 1.11	Right : 4.48 - 9.24 Left: 4.6 - 9.4
Atypical Lumbar vertebra L5	Shiu-Bii Lien et al [6]	2007	Taiwan	Dry bones, cadaveric	Right: 3.0 Left: 2.8	Right: 0.8 Left: 0.7	
	Present study	2016	India	Dry bones	Right : 8.33 Left: 8.30	Right:0.86 Left: 0.92	Right: 7.38 – 11.5 Left: 7.1 – 11.3

Table 5: Comparison of mean chord length with other studies

Lumbar vertebra	Study	Year	Country	Material for study	Mean (mm)	Std.Dev	Range (mm)
Typical Lumbar vertebra L1-L4	Alon Wolf et al [10]	2001	Israel	CT scans	L1 -44.8 L2-46.9 L3-47.6 L4-47.6	L1 -2.8 L2 -3.6 L3-3.7 L4-4.4	
	Acharya S et al [1]	2010	India	CT scans	L1 -47.00 L2-49.03 L3-47.21 L4-47.48	L1 -3.39 L2 -2.79 L3-3.95 L4-5.38	
	Dhawal et al [3]	2014	India	Dry bones	Right: 44.78 Left: 44.65	Right: 3.55 Left:3.54	Right: 36.46 -53.48 Left: 36.32 - 53.22
	Present study	2016	India	Dry bones	Right 44.54 Left: 44.65	Right: 4.17 Left 4.15	Right :35.11-54.56 Left: 35.61 – 54.12
Atypical Lumbar vertebra L5	Alon Wolf et al [10]	2001	Israel	CT scans	46.6	5.3	
	Acharya S et al [1]	2010	India	CT scans	48.91	4.42	
	MitraSR et al [8]	2002	India	Cadaveric	Male: 45.87 Female:41.65		
	Present study	2016	India	Dry bones	Right: 42.33 Left: 42.30	Right:4.40 Left: 4.37	Right: 35.89 –54.33 Left: 35.53 – 54.11

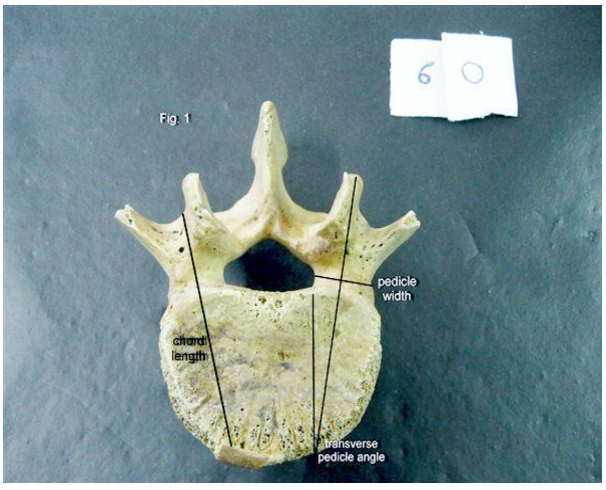

Fig. 1:

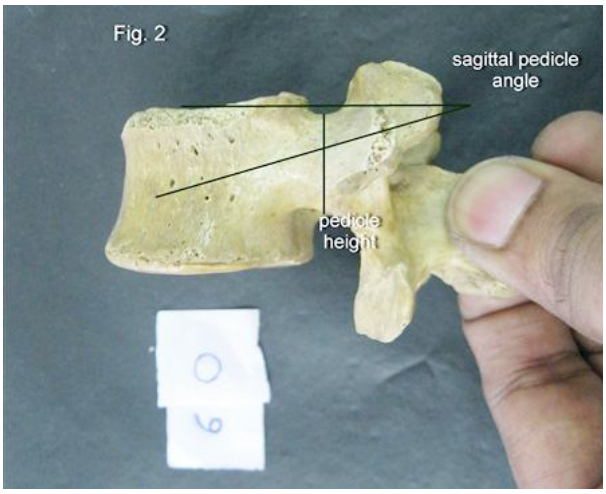

Fig. 2:

Discussion

Many authors have studied the pedicles of vertebrae using different methods such as direct specimen measurements, plain radiographs, computed tomography (CT) scans, Magnetic Resonance Imaging (MRI) scans, and quantitative 3-dimensional anatomic techniques.

Awareness of the racial variations in the size of the pedicles is very important when using international transpedicular screw systems.

In present study it is found that pedicle width of atypical lumbar vertebra is greater than typical lumbar vertebra, similar to findings observed by other studies (Table 1).

The range of pedicle height for typical lumbar vertebrae mentioned by Singel TC et al [9] is 11-17mm.

In present study and in the study conducted by Singel TC et al [9], it is seen that pedicle height of atypical lumbar vertebra is lesser than the typical lumbar vertebra.

However in all studies except present study and study conducted by Singel et al [9], it has been established that the pedicle height of atypical lumbar vertebra is greater than the typical lumbar vertebra (Table 2).

Knowledge of transverse pedicle angle is important while placing screws because any inadvertent medial perforation due to wrong placement of the pedicle screw can put the spinal cord at risk or cause vascular injury.

The result of the present study is in compliance with other studies (Table 3).

Sagittal pedicle angle is important in accurate screw placement as inferior migration of the screw may result in injury to the nerve root (Table 4).

Chord length determines the safest length of any screw that can be used for pedicular fixation. It is important in preventing anterior cortex perforation and therefore consequent injury to vital organs and major blood vessels which lie anterior to the vertebral body. The results of present study are in compliance with other study (Table 5).

Conclusion

Lumbar region is the mobile part of the vertebral column, and is often involved during accidents, degenerative disorders, congenital defects, and neoplastic metastases. With increasing usage of pedicle screw system, it becomes imperative to understand the vertebral pedicle anatomy better. Therefore, the present study provides a comparison with western studies and other Indian studies to deduce safety parameters based on anatomy for pedicle screw placement. Racial morphometric differences must be taken into account when using international transpedicular screw systems. The dimensions in this study may help in the development of pedicular screws for Indian population.

In typical lumbar vertebra the minimum pedicle width was more than 4.25mm and minimum pedicle height was more than 9.8mm. Thus in typical lumbar vertebra, pedicle width was almost always less than the pedicle height.

In atypical lumbar vertebra minimum pedicle width was more than 10mm and height was above 9.8mm.

It was also found that pedicle height in atypical lumbar vertebra is lesser than typical lumbar vertebra.

The chord length is above 35mm in all lumbar vertebras.

Detailed knowledge of the pedicle morphometry is critical for proper placement of a transpedicular screw because of the size and shape of the vertebral pedicle. The pedicle dimensions recorded in this study may help in the development of pedicular screws to be implanted in the lumbar region of the spine for spine immobilization and fixation for the population studied.

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Variations in the Morphology of Human Liver and Its Clinical Importance

Sonare Shilpa*, Nikam Praful, Fulpatil Milind*****

Abstract

Introduction: Liver is the large abdominal viscera occupying a substantial portion of the abdominal cavity. Size of the liver varies according to age, sex, & body size. The gross anatomical appearance of liver is divided into right, left, caudate & quadrate lobes by the surface, peritoneal & ligamentous attachments. The most widely accepted classification of liver is done by Couinaud (1957) & Healy & Schroy (1953) who divided liver into eight functional segments. A sound knowledge of normal & variant liver anatomy is a prerequisite to have a favorable surgical outcome. In the era of imaging & minimally invasive approaches, it is imperative to have a thorough knowledge of anatomy & normally occurring variations of this organ. *Material & Methods*: In the present study, we studied 50 embalmed human livers removed from adult human cadavers. Various shapes of right, left, caudate & quadrate lobes were observed. The presence of accessory fissures, lobes, pons hepatis & any other variation were noted. We also studied variations of liver according to Netter's classification. *Results and Discussion:* Out of the 50 specimens, 23 livers (46%) were normal i.e.without any accessory fissures and accessory lobes. Remaining 27 livers (54%) showed presence of accessory fissures and accessory lobes. Accessory fissures are most commonly observed on the inferior surface of right lobe & on the quadrate lobe. With advances in liver surgery like laparoscopic hepatectomy and laparoscopic thermal ablation for patients with hepatic tumor, these variations assume more importance. *Conclusion:* The findings of our study may be helpful to the radiologists & surgeons to avoid possible errors in the diagnosis and to assist in planning appropriate surgical approach.

Keywords: Liver; Caudate Lobe; Quadrate Lobe; Segment; Accessory Fissures; Pons Hepatis.

Introduction

Liver is the large abdominal viscera occupying a substantial portion of abdominal cavity. It occupies most of the right hypochondrium & epigastrium and frequently extends into the left hypochondrium as far as left lateral line. Size of the liver varies according to age, sex, & body size. The size increases from infancy to adulthood, reaches a plateau around 18 yrs & is followed by gradual decrease from middle age [1]. It has an overall wedge shape; the narrow edge of the wedge is directed towards left hypochondrium.

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Historically, the gross anatomical appearance of liver is divided into right, left, caudate & quadrate lobes by the surface peritoneal & ligamentous attachments. The most widely accepted classification of liver is done by Couinaud (1957) & Healy & Schroy (1953) who divided liver into eight functional segments. This classification is also accepted by Federative committee on anatomical terminology [1, 2].

A sound knowledge of normal & variant liver anatomy is a prerequisite to have a favorable surgical outcome. Netter classified the variations of liver into six types [3]. The major fissures are important landmarks for interpreting the lobar anatomy and locating the liver lesions. In the era of imaging & minimally invasive approaches, it is imperative on the part of the radiologists and operating surgeons to have a thorough knowledge of anatomy & normally occurring variations of this organ. Although segmental anatomy of liver has been extensively researched, a very few studies have dealt with surface variations of liver [4]. the aim of our study is to

determine gross anatomical variations of liver & their clinical & surgical variations.

Material and Methods

The study was conducted on 50 embalmed human Livers in the department of Anatomy, Government medical college, Nagpur. The liver specimens were removed from adult human cadavers during routine dissection of medical undergraduate students & then fixed in 10% formalin. The livers were apparently normal & free from any disease. Various shapes of right, left, caudate and quadrate lobes as well as the presence of other variations on the surface of the liver were noted.

Observations & Results

Out of the 50 specimens, 23 livers (46%) were normal i.e.without any accessory fissures and accessory lobes (Figure 1). Remaining 27 livers (54%) showed presence of accessory fissures and accessory lobes (Table 1). Accessory fissures are most commonly observed on the inferior surface of right lobe & on the quadrate lobe.

In 3 specimens, quadrate lobe showed a transverse fissure which divided it into superior & inferior quadrate lobes (Figure 2), while in 2 specimens quadrate lobe showed a vertical fissure.

Fig. 1: Inferior surface of liver without accessory fissure. Caudate and quadrate lobes are quadrangular

Fig. 2: Showing accessory fissure on quadrate lobe dividing it into superior and inferior quadrate lobes. Accessory fissures also present on caudate and left lobes.

Fig. 3: Inferior surface of liver showing pons hepatis (PH) joining quadrate lobe with left lobe & caudate lobe showing caudate process(CP) joining to right lobe

On the right lobe , fissure running from right margin of fossa for gall bladder into the inferior surface was most commonly observed .

Presence of pons hepatis of variable dimensions joining the quadrate and the left lobes was present in 12% cases. In the majority of cases, the pons was bridging the upper third of fissure for ligamentum teres (Figure 3). In one case, the pons was present in the depth of this fissure (Table 1).

Various shapes of caudate and quadrate lobes were encountered. In case of caudate lobe, most common shape is rectangular in 56%, then bicornuate in 20% and had different shapes (pear shaped, triangular, quadrangular, inverted pear shaped) in remaining 24%. Prominent caudate process was observed in 30% cases (Figure 3).

Table 1: Different morphological variations of Liver

Morphological Features	Number of specimens
Normal (i.e.without any accessory fissures and accessory lobes)	23
Accessory Fissures	27
Pons Hepatis	6
Superior & inferior quadrate lobe	3

In case of quadrate lobe, the shape was rectangular in 64%. In 6% cases, quadrate lobe is very narrow (Figure 4). In remaining cases, different shapes (pear shaped, triangular with apex up, presence of tongue

Table 2: Classification of variations of liver according to Netter

Types	Number of Specimens
Type 1 (very small left lobe)	1
Type 2 (complete atrophy of left lobe)	Nil
Type 3 (Transverse saddle like liver, relatively large left lobe)	6
Type 4 (Tongue like process of right lobe)	3
Type 5 (very deep renal impression)	2
Type 6 (Diaphragmatic grooves)	3

Fig. 4: Liver showing elongated & narrow caudate & quadrate lobes.

Fig. 5 (A): Liver showing abnormal shape, almost disc-like, flattened from above downwards, from anterior aspect

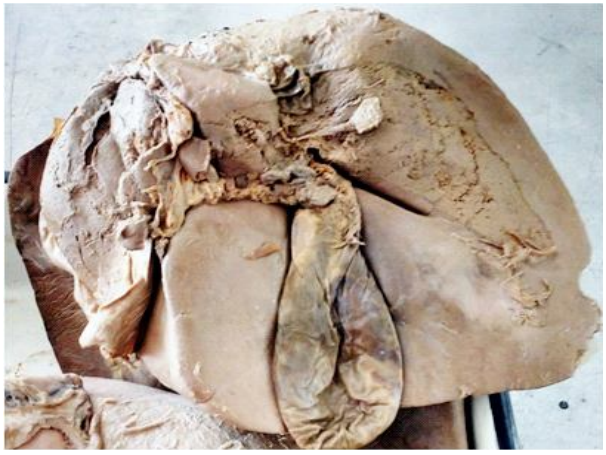

Fig. 5 (B): Disc like liver showing inferior aspect, left lobe even smaller than quadrate lobe

Fig. 6: Liver showing very small left lobe, Netter's type 1

Fig. 7: Liver showing transverse saddle like liver, relatively large left lobe(Netter's type 3 liver)

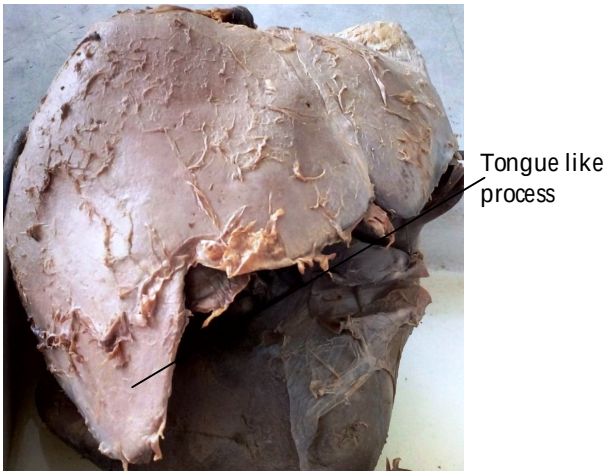

Fig. 8: Liver showing tongue like process of right lobe (Netter's type 4**)**

Fig. 9: Liver showing very deep renal impression (Netter's type 5)

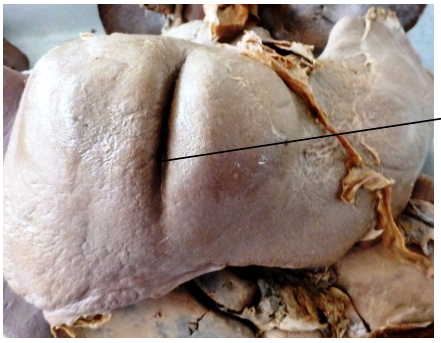

Fig. 10: Liver showing diaphragmatic grooves (Netter's type 6)

like process) were observed. In one specimen, very abnormal shape of liver is encountered. Liver appears almost disc-like. Its left lobe appears to be very small, even smaller than quadrate lobe (Figure 5 A & B).

The liver specimens were also classified according to six types of liver variations (Figure 6 to 10) as described by Netter [3].

Discussion

In the present study, 27(54%) livers showed accessory fissures, which resulted in the formation of accessory lobes. According to Auh et al, the accessory hepatic fissures are potential sources of diagnostic errors during imaging. Any collection of fluid in these fissures may be mistaken as a liver cyst, intrahepatic hematoma or liver abscess [5]. Mazziotti et al advocated the use of intraoperative utrasonography in liver surgery to determine the anatomical location and the extent of lesion, thereby minimizing unnecessary tissue dissections and traumatic surgical maneuvers [6].

Accessory fissures most commonly noted here were in the inferior surface of right lobe and then in the quadrate lobe. Mini accessory lobes reported here are surgically and radiologically very important due to its small size. It might be mistaken for a lymph node. It might be accidently removed during the surgeries in and around the porta hepatis. Torsion of the accessory lobe is a surgical emergency and it has to be attended early [7]. An accessory lobe could be formed by the displacement of the primitive rudiment of the organ or by persistence of the mesodermal septa during its proliferation[8].

The diaphragmatic sulci seen on the anterosuperior surface were present in 6% of the livers which result from uneven growth of the hepatic parenchyma caused by variable resistance offered by different bundles of the diaphragm muscle. But more recently, radiological and corrosion cast studies have attributed the formation of sulci to the existence of weak zones of hepatic parenchyma, represented by the portal fissures between the adjacent sagital portal territories. A higher incidence of such grooves was observed by Macchi et al [9] and Auh et al [5] and lower incidence observed by Sachin Patil et al [10].

The different morphology of all the lobes was noted. Variations of liver were classified according to Netter. The similar study was conducted by Sachin Patil et al in 2014 . Pons hepatis bridging the fissures for ligamentum teres was an important finding of this study, which was previously reported by Joshi et al and Sachin Patil et al. In cases of pons hepatis , normal visualization of the fissure would not be possible and dimensions of the right and left lobes may be mistaken [4].

Conclusion

With advances in liver surgery like laparoscopic hepatectomy and laparoscopic thermal ablation for patients with hepatic tumor, these variations assume more importance. In conclusion, this study highlights the frequent occurrence of morphological variations on the liver surface. The findings of our study may be helpful for surgeons and radiologist to avoid possible errors in interpretations and subsequent misdiagnosis and to assist in planning appropriate surgical approaches.

Conflicts of Interest

None

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Ethical Clearance: Obtained

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Augmenting the Visual Display of Museum Specimen Using Fabrica Acrylic Colors and Its Better Restoration

Pushpa Potaliya*, Surajit Ghatak**

Abstract

Background: Adding color to specimen presented in anatomical museum is a vital requisite to distinguish various structures as arteries, veins, nerves, muscles, ligaments, tendons etc. Here tactile discrimination is impossible for preservative fixed specimens sealed in jars. Besides the use of various coloring agents, protocols are developed for the color restoration with maximal long-lasting efficacy with instance, age and cost-effectiveness. *Method:* In our department we developed a protocol for coloring using readily available acrylic colors to color various regions and structures of anatomical specimen for visual enhancement. The specimens were than suspended in Kaiserling (I and II) preservative and stored in Perspex containers. *Result:* Institutional experience of handling specimen by preservation and imparting with readily available colors remain unchanged and displayed wet-specimen to their optimal elegance. *Conclusion:* This simple and easy method of coloring of specimen and the developed protocol for its longer restoration is immensely important in crafting a museum.

Keywords: Color; Wet Specimen; Anatomy; Museum**.**

Introduction

Early in the sixteenth and seventeenth centuries the Anatomical museums came into the picture. Human Anatomy is an investigative scientific stream that has wide spectrum varying in past from inspection and assessment of victims who were executed to the contemporary age of dissection of voluntarily donated bodies. It forms the bedrock substratum for the medical curriculum. Museum is an integral part of the Anatomy department and as in an excerpt by Fredrick Knox, without it the profession of anatomy would be in the state of an individual without a language [1]. The core rationale of a museum is to endow the students with a comprehensible visual exhibit with finest teaching quality within itself [2]. The display of each specimen in a museum is anticipated to not only have a pedagogical objective but also a supreme aesthetic appeal that ends up in making things apparent [3]. Variant factors involving trivial technological points are behind each flawless museum specimen. Execution of this demands a creative approach while planning and preparing the exhibits. Thus in incessant progressing museum technology came up varied means of compilation, preservation and presentation of museum specimen. Primitive manner of mounting the specimen in formalin as such with a monochrome tone was found to be nasty and ambiguous for understanding of the students leading them to be least engrossed. To discriminate and identify the structures most of them relied on the colored atlases in Anatomy. Thus it was concluded that coloring imparts a remarkable effect in visual interpretation of diverse anatomical structures.

To have a classical exhibit of prosected specimens to support teaching and learning of anatomy, we have formulated a novel cost-effective long-lasting method of coloring and preserving wet specimen with nominal upholding. The special emphasis was on augmenting the visual display of conventional Anatomy museum.

Material and Method

The Technique was carried out in the Department of Anatomy, All India Institute of Medical Sciences,

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Jodhpur (Rajasthan). The pre requisite for the procedure are commercially available acrylic colors (Brand: 'Camel' from Camelin limited), Type: Fabrica acrylic colors, different sized painting brushes, turpentine oil for clean-up of tint over brushes and routine dissection instruments. The entire modus operandi initiated from collection of specimen to mounting by means of Pulvertaft's modification of Kaiserling method [4]. The grossing of specimen was done initially by obtaining desired region cut largely followed by fine dissection at a centralized well-illuminated, ventilated clearing station. Specimen are immediately put into primary fixative after resection keeping volume of fixative twenty folds of volume of specimen with varying time for fixation depending on the size [5]. Ten percent neutral buffered formalin can be used for the primary fixation. Then it is shifted to Kaiserling I solution. The composition of various Kaiserling solution is

Table 1: Showing the solution and the composition

Solution	Composition
Kaiserling solution I (Fixing fluid)	Formalin (400 ml), Potassium nitrate (30 gm), potassium acetate (60 gm), tap water (to 2000 ml)
Kaiserling III (Mounting solution)	Glycerine (300 ml), Sodium acetate (100 gm), Formalin (5 ml), Tap water (to 1000 ml)

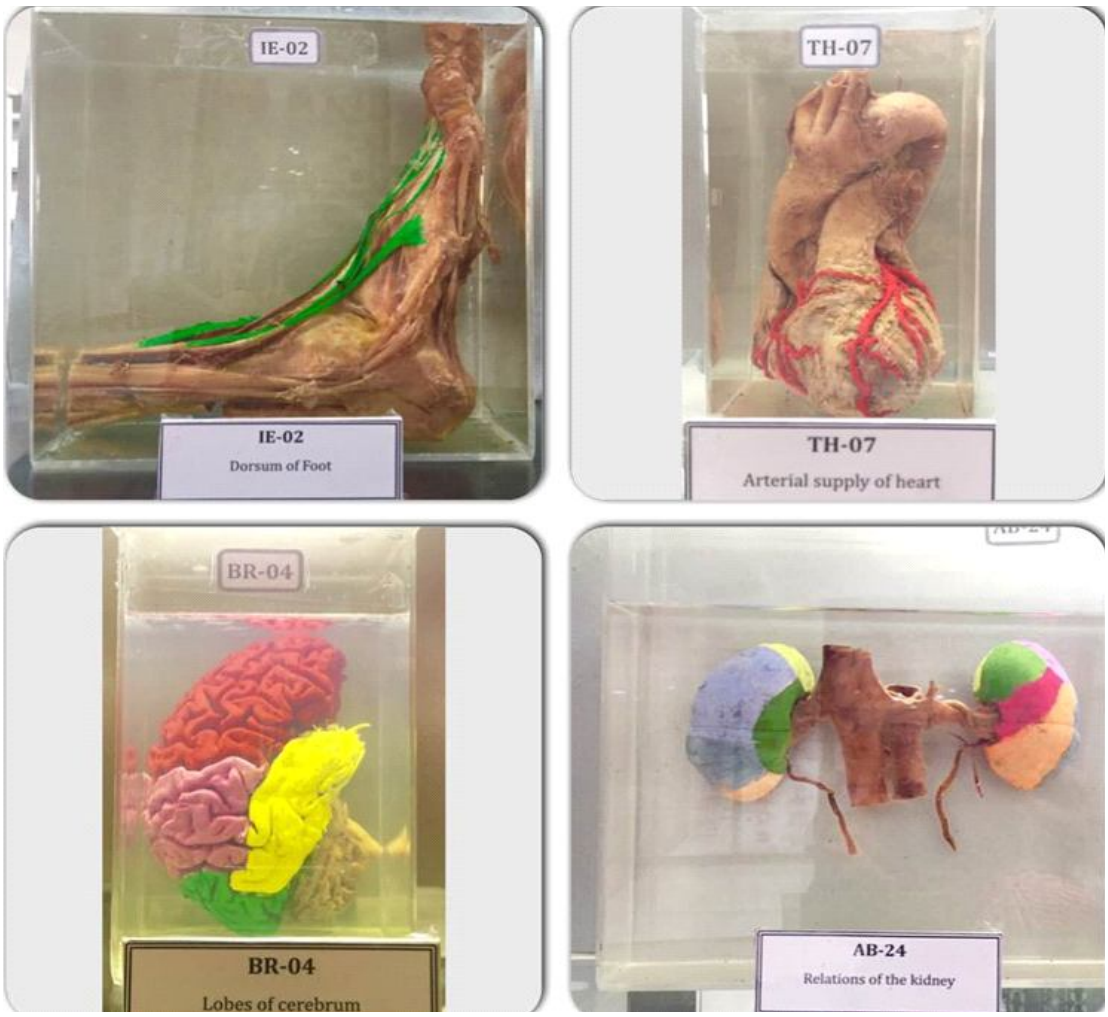

Fig. 1: Showing various colored specimen with better visual impact
IE-02: Green color showing Flexor tendons passing from leg to dorsum of foot
TH-07: Red color showing right and left coronary arteries & their branches
BR-04: Red: Frontal lobe, Pink: Parietal Lobe, Green: Occipital lobe, Yellow: Temporal lobe of superolateral surface of cerebral hemisphere
AB-24: Showing relations of Right and Left kidney. Yellow (both side): Suprarenal gland, Blue (Right): Hepatic area, Green(right): Duodenal area, Nude(right): Jejunal area, Light pink(left): Splenic area, Green(Left): Gastric area, Pink(left): Pancreatic area, Peach(left): Jejunal area, Blue(left): Colic area

summarized in table as:

For the further preparation specimen were kept for a day to dry up at room temperature. Blow dryer was also used for drying of viscera as Lungs, liver etc. Hollow organs and hilum of the organs were stuffed with cotton to absorb the excessive fluid. Complete drying is mandatory in the process as it prepares the surface of the structures to be colored. The structures should be well separated from each other as well as from underlying structure. That can be done by putting cotton in between and using forceps and glass rods. This also promotes early on drying of structures. An ample variant of shades of tint are readily available with commercially available fabric color packs but still other desired shades were also prepared by mixing. The classical color scheme was followed for painting as red for artery, blue for vein, purple of lymph nodes, yellow for nerves etc. Again the specimen was kept overnight for appropriate drying. When the specimens are retrieved they need scrupulous attention to minutiae of structure being actually mounted. The specimens were than suspended in Kaiserling mounting solution III, sealed and stored in the sealed Perspex containers. In case if the solution is not crystal clear it is preferred to filter it through a paper pulp. Cloudiness of the solution is by and large due to impurities in sodium acetate where instead of simple filtering; adding a saturated solution of camphor in alcohol is advised. Later on the containers were specifically labeled and organized cataloging was done.

Results

Institutional experience of handling specimen by preservation and imparting with readily available fabric colors remain unchanged and displayed wet-specimen to their optimal elegance.

This has not shown any visible changes in color for the last 2-2.5 year. To apply fabric color was extremely easy while coloring as it swiped smoothly on the surface with no lumping.

Discussion

The most common complexity encountered in museum is inability to distinguish between the various structures in given specimen merely by looking to it without touching. For example nerves, arteries and veins are not easily differentiated in conventional mounted specimens. Also to make the museum look more alluring, attractive and informative for all genres of visitors, the coloring is considered important. A simple lung specimen cannot give the idea of bronchopulmonary segments which a one with different colors for each segment can easily offer. The same works well for showing specimen the structures related to a particular region of it. Various workers reported in literature have worked on numerous regimes for coloring and preservation of wet-specimen, using different varieties of colors. In early sixteenth century the spirits of wine were discovered as the classic mean of preservative by Robert Boyle. The specimen preserved by spirit remained in excellent even after twenty decades and this practice is reported to be continued in literature up to nineteenth century. Here the major drawback related with the procedure was the inability of the preserved tissue to endure any subsequent staining.

In the mean time Melnikow-Raswedenkow, Jores and Kaiserling in 1896 working autonomously, revealed a procedure involving formalin with its effective fixative property. Here color restoration was done by adding ninety-five percent alcohol besides further use of glycerine in preservation. Ultimate modus operandi perpetuated by Kaiserling was extensively time-honored globally [6,7,8].

Literature reported various workers used diverse practices to color museum specimens. Among most pioneers was Congdon E. D. to use albuminous paints in early nineteenth century [9].But the discolouration resulted in due course. Thereafter, came the concept of injecting various substrates as silicone, gelatin, latex or epoxy etc. in the vessels [10-15]. Lacquer has been used earlier as well. Saunders established the utilization of lacquer in coloring the wet specimens. The procedure used in technique was sensitive, time consuming, and hence needs a trained individual. With time yellow coloration was observed and gelatin was found to liquefy, resulting bubbles. It has its own pros and cons as it worked well for comparatively outsized vessels. The minuscule ones showed imprecise hazing and it was readily washed off [16].

Robert W. Henry, Larry Janick, and Carol Henry used silicon to color plastinated specimens [17]. Utilization of mere plastinated specimens is a compromise caused of its precincts in terms of tactile and poignant emotional familiarity that is endowed with the wet specimen. Regarding the methods of color maintenance, most commonly used primary fixative is ten percent formaline saline [5]. Formalin preservation soon lost its importance due to associated irritable odor and unrealistic appearance in routine fixed specimen. The luminal architecture, dimensions and branching pattern etc. were impossible to

perceive in these single toned specimens. Various workers bespoke about different methods for coloring and its restoration for paramount domino effects. The majority of these methods were modification of the method used by Kaiserling in his early work in 1900 [18]. The fundamental apprehension of his method was on the importance of the elimination of air and the impediment of acid formation in the medium.

It comprised of three solutions as: Fixing, restoring and mounting fluid. Later, Pulvertaft further altered the solution and came up with the novel concept of restoring color. He supplemented a reducing agent i.e. sodium hydrosulphite to the mounting fluid. Excellent results which claimed the tint to be almost as such even after more than three decades, encouraged workers globally to induce more techniques in this arena [5]. Pulvertaft method was subsequently modified in various combinations by Wentworth in his subsequent series of work over the years [19-22]. Here the focal modification was exclusion of glycerol from the mounting solution. Kaiserling (1900) and Wentworth (1938) had fundamental apprehension concerning maintenance of pH of the medium [18,19].

Still, the color of specimens in Kaiserling's fluid left much to be desired and fading sets in a short span. The method was altered by Klotz and Maclachlan after couple of years [23].Various other compounds as carbon monoxide used by Schultz converted hemoglobin to carboxyhemoglobin [24].

Romhanyi G gave the concept of formation of haemochromogens in previously formalin-fixed specimen. The age old pragmatic view got a new-fangled direction. This work productively gave exceptional results for ten decades as reported in literature. Besides its advantages the hands-on workers claimed the glycerine deficient solution to be miserable to work on. Thus trivial modifications as per requisite turned it be an excellent solution for coloring and its restoration [25].

Wentworth later on came with the idea of omitting glycerin from the mounting medium. This was an economical attempt, but reduced the refractive index of the medium and eventually leading to loss of brilliancy [21].

Carbon monoxide has also been employed as a color-retaining agent, which gave luminous color distinction, but entails the risks of poisoning and explosion [24]. These may be avoided by the modifications of Robertson and Lundquist [26]. The method is also described by Lewis and Gaines [27]. Israel and Young recommended the use of pure liquid paraffin for reducing discoloration [28] but it resulted in spurt in cost.

Therefore in the series, our formulated procedure is highly recommended for procuring colored museum specimen in Anatomy. The cautions taken during the procedure were faultless drying of the desired part before painting, time period of exposure to various fixative and mounting medias. Cost-effectiveness, easy application, long lasting color restoration etc. are the common exquisiteness of our institutional experience.

Conclusion

Coloring made the monochrome specimens more beautiful and lively. The coloring by this simple, economical and long lasting method will certainly help the museum curators to create effectual anatomical specimen. The visitors of various sorts ranging from layman to medical students as well as experts will certainly have an augmented visualization and idea of structures in a glance. Crafting a museum with brightly hued long-lasting specimen creates a visual orientation by its polychrome effect on observer and can be of great help in medical education. This can be of great help in improvement of medical education and enthusiastic learning of the subject.

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Supratrochlear Foramen; Morphological Correlation and Clinical Significance in Western Maharashtrian Population

Pushpa Burute*, Suruchi Singhal*, Swathi Priyadarshini**

Abstract

Objectives: A bony septum separates the coronoid and olecranon fossae of humerus. At times, it is perforated, forming the supratrochlear foramen (STF) of the humerus. This study was intended to find out presence of STF and its correlation with humerus length and epicondylar breadth in western Maharashtrian population. *Materials and methods*: The present study was done in the Department of Anatomy. Humerii were observed for presence or absence of STF. Humerus length and epicondylar breadth were measured by standard laboratory osteometric board and a Vernier Calliper respectively. *Results and conclusion*: Of a total of 113 bones that were taken for study, a foramen was observed in 30 bones, percentage prevalence 26.55%; 12/58 i.e. 20.69% on the right side and 18/55 i.e. 32.73% on left side. As prevalent in other studies for the same, it was found more commonly on the left side. A comparison of the dimensions of epicondylar breadth and humeral length in bones with STF and bones without STF was done using SPSS V16 software. Students T test and Chi Square test were applied. It was found that the Epicondylar Breadth was larger when the foramen was absent and Humerii with foramen present were shorter than those that had no foramina. This is the first of its kind of a study done for Western Maharashtrian population.

Keywords: Epicondylar Breadth; Humerus Length; Supratrochlear Foramen.

Introduction

The humeri comprise of a shaft, upper end (head and two tuberosities) and lower end (Coronoid and olecranon fossae and the medial and lateral condyles with epicondyles). At the lower end anteriorly, the ulnar coronoid process articulates with the coronoid fossa and posteriorly the ulnar olecranon process articulates with the olecranon fossa to form the elbow joint. A bony septum separates the coronoid and olecranon fossae. This septum is occasionally perforated, forming the supratrochlear foramen (STF) of the humerus.

It has also been referred to as septal aperture, aperture in the coronoid-olecranon septum and intercondyloid foramen [1-4].

Prevalence of foramen is more on left side and in gracile arms indicates mechanical stress as contributory factor. Many Indian studies on STF are on its prevalence only and no morphological correlation. This is the first of its kind of a study done with morphological correlation for Western Maharashtrian population.

Anthropologists record it a non-metric skeletal variant, more frequently found in females [5].

Materials and Methods

The present study was done in the Department of Anatomy. A total of 113 adult dry humeri of both sides of unknown sex and free from any pathology were taken for study. The presence of supratrochlear foramen was noted. If the foramen was present, its shape was recorded and dimensions i.e. transverse diameter (TD) and vertical diameter (VD) measured using a Vernier Calliper.

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The epicondylar breadth was measured using a Vernier Calliper.

The humeral length was measured using a standard laboratory osteometric board.

A comparison of the dimensions of epicondylar breadth and humeral length in bones with STF and bones without STF was done using SPSS V16 software. Students T test and Chi Square test were applied.

In bones where the foramen was absent, translucency and opacity of septum was visually measured using an illuminating X-Ray Board.

Results

A total of 113 bones were taken for study, 58 right sided and 55 left sided. A foramen was observed in 30 bones, percentage prevalence 26.55% (Figure 1).

The supratrochlear foramen was observed in 12 / 58 i.e. 20.69% on the right side and 18 / 55 i.e. 32.73% on left side.

The foramen was more prevalent on the left side.

The shape of the foramen was varied; transversely oval in 16 (53.33%), vertically oval in 1 (3.3%), round in 5 (16.66%) and triangular or irregular in 8 (26.66%).

The majority of the foramen were oval in shape.

The average Transverse Diameter (TD) was 6.3 mm and average Vertical Diameter (VD) was 4.3.

Largest size of the foramen was 10 X 6 mm. Largest TD observed was10mm and largest VD 8mm.

Translucency of septum was seen in 19 / 46 = 41.3% on right and 20 / 36 = 55.5% on left side (Figure 2).

The mean length of humerii with foramen present was 29.71 ± 2.43 cm. (Table 1).

The mean length of humerii with foramen absent was 30.81 ± 1.76 cm.

Humerii with foramen present were shorter than those that had no foramina. Difference observed is statistically significant (t-2.628, p value-0.01)

The average Epicondylar Breadth (EB) of humerii with foramen present was 5.92 ± 0.37 cm.

The average Epicondylar Breadth (EB) of humerii with foramen absent was 6.06 ± 0.36 cm. Difference observed is statistically not significant (t-1.733, p value-0.086)

The Epicondylar Breadth (EB) was larger when the foramen was absent for each population.

The difference in prevalence of foramen on the right and left side was insignificant using chi square test.

The chi-square statistic is 2.0977. The p-value is 0.147517. This result is not significant at $p < .05$.

Fig. 1: Humerus with supratrochlear foramen

Table 1: Statistical significance at 5% level of significance

	Present (Mean±SD)	Absent (Mean±SD)	t- value	DF	Sig(2-tailed) p-value	Significance
HL (cms)	29.71 (±2.43)	30.81 (±1.76)	2.628	111	**0.01**	**Significant**
EB(cms)	5.92 (±0.37)	6.06 (±0.36)	1.733	111	0.086	Non -significant

HL- humeral length, EB- epicondylar breadth

Table 2: Percentage prevalence of STF in different populations

Sr. No.	Population studied	Incidence%
1	Ainus (Akabori, 1934)	8.8
2	Japanese (Akabori,1934)	18.1
3	Americans(Benfer & Mc kern, 1966)	6.9
4	Egyptians (Orztuk et al. 2000)	7.9
5	Eastern Indians (Chatterjee, 1968)	27.4
6	Central Indians (Kate & Dubey,1970)	32
7	North Indians (Singh & Singh, 1972)	27.5
8	South Indians (Singhal & Rao, 2007)	22. 20
9	Arkansas Indians (Nayak et al. 2009)	58
10	North Indians (RK Diwan et al. 2012)	24.1
11	Western Indians(Present study, 2016)	26.55

Fig. 2: Humerus with translucent septum

Fig. 3: Humerus with opaque septum

Discussion

Incidence of supratrochlear foramen in human populations shows a wide variation as evident from the present study and previous studies. The range is considerable; from very low in Greeks (less than 1%) to over 50% among Arkansas Indians [6] (Table 2).

Within the Indian population, considerable differences have been observed; a prevalence of 32% was found in Central India, whereas a lower prevalence was found among the South (28%), North (27.5%), and East Indian (27.4%) populations [7]. The highest recorded prevalence of 58% for Arkansas Indians has been reported [6].

In the present study of Western Maharashtrian region, the incidence is 26.55%. It matches the incidence found in South, North and East Indian population although there is a wide geographical and ethnical difference among the four population groups.

In all Indian studies, the prevalence of the foramen is more common on the left side and in females.

The size and shape of the foramen in various studies is also highly variable, although the most common shape for all populations and also in this study is the oval shape.

Despite the numerous studies on the foramen available, the function of the foramen and its possible aetiology when present are still topics of anatomical debate. It follows that due to its anatomical location, its presence and formation are related to the elbow joint.

The main movements at elbow are flexion and extension around a horizontal axis. The foramen lies on this axis. Hence mechanical stresses that involve the interaction between humerus and ulna lead to subtle changes in the bones at this site and probably lead to the formation of the foramen. Septal resorption, rather than deposition of bone is believed to be the causative agent as the foramen is absent in children [8,9].

On the other hand, possibility of it being a heritable feature cannot be ruled out as reflected in the observed population differences in its occurrence [8].

According to ''Wolff's law'', the mechanical strain applied to any bone influences its structure. This concept is termed 'bone functional adaptation' in recent literature [10]. Their review says that (i) organisms are able to adapt their structure to changing environmental conditions, and (ii) bone has the ability to respond to localized mechanical strain. High levels of strain result in increased bone deposition thereby reducing the strain. Conversely, low strain levels result in bone resorption, which in turn reverts to more strain.

We now discuss the application of Wolff's law in relation to the possible occurrence of the foramen.

The elbow is a link between the hand, the wrist, and the shoulder. Primarily, it helps in the positioning of the hand in space such as in reaching out to grab an object.

Animals such as pig, dog and hyena assume postures of extreme extension of forearms during feeding as they need to tear food morsels. This causes severe impact pressures on the elbow joint due to

which resorption of the bone and formation of the foramen happens.

Although in humans, these postures are not assumed, the formation of the foramen can still be explained. Anatomically, the left elbow exhibits a greater extension angle than the right; the foramen is more common on the left [11]. Also, women have a greater inward curvature of the angle of elbow and it has been universally proven that the foramen is more common in females. Although the majority of human population is right sided, as the humerus bears the weight of only the upper limb as compared to the femur that bears the weight of the whole body, it is subjected to relatively low strain levels. A possibility exist that the low strain levels result in bone resorption and subsequent foramen formation.

Our study has similar results. The incidence of foramen is more common on the left and hence we feel that mechanical stress is a major contributing factor to its formation. We do not have any similar study to compare with in Indian Populations.

In our study, the humeral length and epicondylar breadths were shorter in bone having the foramen as compared to bones without the foramen. These findings further bolster the mechanical theory. The prevalence of the foramen is greater on the generally more gracile arm (with smaller length of humerus and smaller epicondylar breadths) and on the left sided humerii [4,12,13].

Since sexual dimorphism contributes to length of long bones, a greater association between foramen and females is commonly observed [14].

It follows that robust bones are assumed to have a thicker and stronger olecranon septum that would withstand the stresses of humero-ulnar articulation and hence less prevalent on right side and in males.

No anatomical structure is known to pass through the foramen as yet and in life the foramen is covered by a membrane, it still has much clinical significance [6].

In bones with the foramen, the medullary canal has been found to be shorter and narrower than normal [7,15,16]. This may have implications in orthopaedic surgery, when a nail or rod is inserted into the medullary cavity (intramedullary fixation) in order to stabilize a diaphyseal fracture site. Knowledge of the dimensions of the humerus and the medullary cavity are therefore important for choosing the nail or rod of appropriate length and diameter to avoid secondary fractures during the surgical procedure.

As the incidence of the foramen in Indian population varies from 27% to 58%, it is inferred that for all surgical procedures of the humerii and elbow joint, the presence or absence of the foramen should become a part of the preliminary investigations for work up.

It is recommended for radiologists to be aware of the occurrence of the aperture to help avoid misinterpretation of radiographs as it may be interpreted as an osteolytic lesion [17]. The foramen is a weak link in the elbow joint, as it is a deficiency in the bone (good size foramen have been observed). Hence, its presence may also lead to low energy fractures of the distal aspect of the humerus.

On the other hand, it also adds to the range of motion at elbow as studies reveal that individuals with the foramen have the potential to hyperextend at the elbow joint [8]. The clinical assessment of the condition of a joint often requires Range of Motion (ROM) measurements [18]. When the foramen is present, the ROM tends to be greater compared to when it is absent [8]. This might be of use for subsequent rehabilitation management and assessment of disability following injuries to the elbow joint.

It can be concluded that the supratrochlear foramen has anthropological, morphological and surgical importance and should be looked for in studies pertaining to the elbow joint.

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Clinical and Histological Spectrum of Gall Bladder Lesions after Cholecystectomy

Waghmare Ramesh S.*, Sakore Shubhangi D.**

Abstract

Background: Chronic cholecystitis is one of the most commonly encountered lesions in India and worldwide. Cholecystitis, cholelithiasis and tumors of gall bladder constitute the bulk of gall bladder diseases among which gall stones being the most common. Long standing chronic inflammation due to gall stones is considered as an important etiological factor in carcinogenesis. This study was carried out to correlate clinical & histopathological findings of gall bladder lesions. *Materials and Methods:* This study included 120 cases that underwent for open or laproscopic cholecystectomy for cholecystitis, cholelithiasis or suspected cases of malignancy. Clinical details were collected. Formalin fixed tissues were embedded in paraffin, cut into thin sections and stained with haematoxylin and eosin (H&E) for studying the histopathology. *Results:* Out of total 120 cases maximum were females 98 (81.66 %), and 22 (18.33 %) males. Maximum cases were seen in 4th to 6th decade. Maximum cases were diagnosed as chronic cholecystitis. Other associated findings like xanthogranulomatous change, intestinal metaplastic change, and follicular cholecystitis were seen. Total six cases of adenocarcinoma was diagnosed out of which five cases showed features of well differentiated adenocarcinoma and one case showed papillary pattern. on histopathology examination. *Interpretation and conclusion:* Gall bladder diseases can have a varied presentation on both clinical and histopathological examination. The present study showed a female predominance. Cholelithiasis proved to be a major risk factor for inflammatory diseases. Constant erosion of the gall bladder wall by gallstones over a long period may constitute a risk for malignancy.

Keywords: Gall Bladder Histology; Gall Bladder Lesions; Cholecystitis; Adenocarcinoma.

Introduction

Chronic cholecystitis is the most commonly encountered lesions in India and worldwide with more than 78-90% associated with gall stones. Cholecystitis, cholelithiasis and tumors of gall bladder constitute the bulk of gall bladder diseases among which gall stones being the most common. Gall stones may remain for years without producing any symptom [1-3]. Incidence of cholelithiasis is increasing due to change in dietary habits and sedentary life style [4]. Pathological changes related to gallstone formation are still the focus of intensive research. The hypothesis most widely accepted is the stasis of bile caused by gallbladder dyskinesia, while dyskinesia may be the result of pathological changes in the gallbladder wall [5].

Presence of gall stones has been associated with development of carcinoma. Carcinoma gall bladder is one of the most common causes of cancer mortality. Long standing chronic inflammation by gall stones plays an important etiological role in carcinogenesis [6,7]. Incidental gall bladder carcinoma is found in about 0.3-1.5 % of cholecystectomies for gall stone diseaseformalin [8]. Therefore present study was carried out to correlate clinical & histopathological findings of gall bladder lesions.

Materials and Methods

This retrospective study of gall bladder lesions was carried out during the period from July 2014 to June 2015 in the department of pathology at tertiary health

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care centre. Total 120 cholecystectomy specimens were studied. We received the specimens after open cholecystectomy as well as laproscopic cholecystectomy procedures which were performed in the department of surgery. The cases were operated for cholecystitis, cholelithiasis and suspected cases of malignancy. Clinical notes, radiological findings and operative findings were collected from hospital record. Gross examination of each gall bladder was carried out. Detail description like gall bladder size, wall thickness, presence of gall stones were noted. Representative section from the lesions was taken. The formalin fixed tissues were embedded in paraffin, cut into thin sections and stained with haematoxylin and eosin (H&E) for studying the histopathology.

Results

Out of total 120 cases maximum were females 98 (81.66 %), and 22 (18.33 %) males. Maximum cases were seen in 4th to 6th decade. Common symptoms with which cases were presented were abdominal pain, followed by history of vomiting, fever, jaundice and oral contraceptive. On examination, clinician noticed abdominal tenderness, guarded rigidity and in a few cases palpable gall bladder. Duration of the symptoms was varied from 6 months to 5 years. Intraoperative diagnosis of chronic cholecystitis was made in 110 cases by operating surgeon. Out of which gall stones were found in maximum number of cases as shown in table 2.

On gross examination, gall bladder with stones were seen in 103 (chronic calculous cholecystitis in 98 and suspicious of malignancy in 5) cases. Gall bladder size was normal in 102 (85%), enlarged in 16 (13.33 %) and fibrotic in 2 (01.67%) specimens. The average gall bladder wall was found to be normal (<3 mm) in 113 (94.17 %) cases while it was thickened >3 mm) in the remaining 7 (05.83%) cases. The number of gall stones was ranging from single to multiple (Figure 1 A).

On microscopic examination normally gall bladder shows, mucosa which consists of single layer of uniform, tall columnar epithelial lining with microvilli, basal nuclei and pale cytoplasm. Lamina propria contains loose connective tissue with capillaries. Muscular layer consists of circular, longitudinal and oblique smooth muscle fibers without distinct layers. Adventitia consists of perimuscular connective tissue composed of collagen, elastic tissue, fat, vessels, lymphatics, nerves and paraganglia. In the present study, out of 120 cases maximum cases were diagnosed as chronic cholecystitis and two cases (01.67%) were diagnosed as acute on chronic cholecystitis. In some cases, gallbladder epithelium was normal; it covered lamina propria and protruded with it into the lumen of gallbladder (Figure 1B). Rokitansky-Aschoff sinuses with deep penetration of muscularis layer and moderate hypertrophy of muscularis externa were observed in some cases.

In the entire tissue material, the typical connective tissue of lamina propria with congested blood vessels was characteristic. Inflammatory infiltrate comprised of lymphocytes, eosinophils, mast cells, macrophages and neutrophils as noticed in chronic cholecystitis (Figure 1C). In one of the cases goblet cells were present in a fragment of the epithelium, features suggestive of intestinal metaplasia (Figure 1D). Lamina propria showed dense inflammatory cell along with lymphoid follicle formation, suggestive of follicular cholecystitis. In one case (0.83%), changes of adenomyomatosis noted like extensively fibrotic gallbladder wall with numerous Rokitansky-Aschoff sinuses but few / no smooth muscle bundles and an expanded subserosal layer containing abundant nerve-trunks.

In six cases (5%) gall bladder carcinoma was observed, all of them diagnosed as adenocarcinomas (one papillary and five well differentiated patterns). Tumor cell were arranged in glandular patter and individual cell with features of malignancy (Figure 1E). All diagnosed carcinoma cases were females. The youngest was 40 years old while the oldest was 67 years of age. Five cases were clinically suspected for malignancy and the sixth case was diagnosed on histological examination. The remaining one was incidental finding, which was diagnosed on microscopic examination.

Table 1: Age and sex distribution

Age (years)	Sex		Total
	Male	Female	
< 30	03	11	14
31-40	08	25	33
41-50	09	30	39
51-60	01	24	25
61-70	01	06	07
>70	-	02	02
Total	22	98	120

Table 2: Operative findings

Operative Findings	No of Cases	Percentage
Chronic Cholecystitis	110	92.50
With stone	98	81.67
Without stone	12	10.00
Carcinoma gall bladder	06	05.00
With stone	05	04.17
Without stone	01	00.83
Dilation of common bile duct	04	03.33

Table 3: Histopathological diagnosis

Sr. No	Histopathological Diagnosis	No. of cases	Percentage
1	Chronic Cholecystitis	101	84.17
2	Acute on chronic cholecystitis	02	01.67
2	Follicular Cholecystitis	01	00.83
3	Xanthogranulomatous Cholecystitis	06	05.00
4	Malkoplakia	02	01.67
5	Adenomyomatosis	02	01.67
6	Adenocarcinoma	06	05.00
	Well differentiated	05	04.16
	Papillary	01	00.83

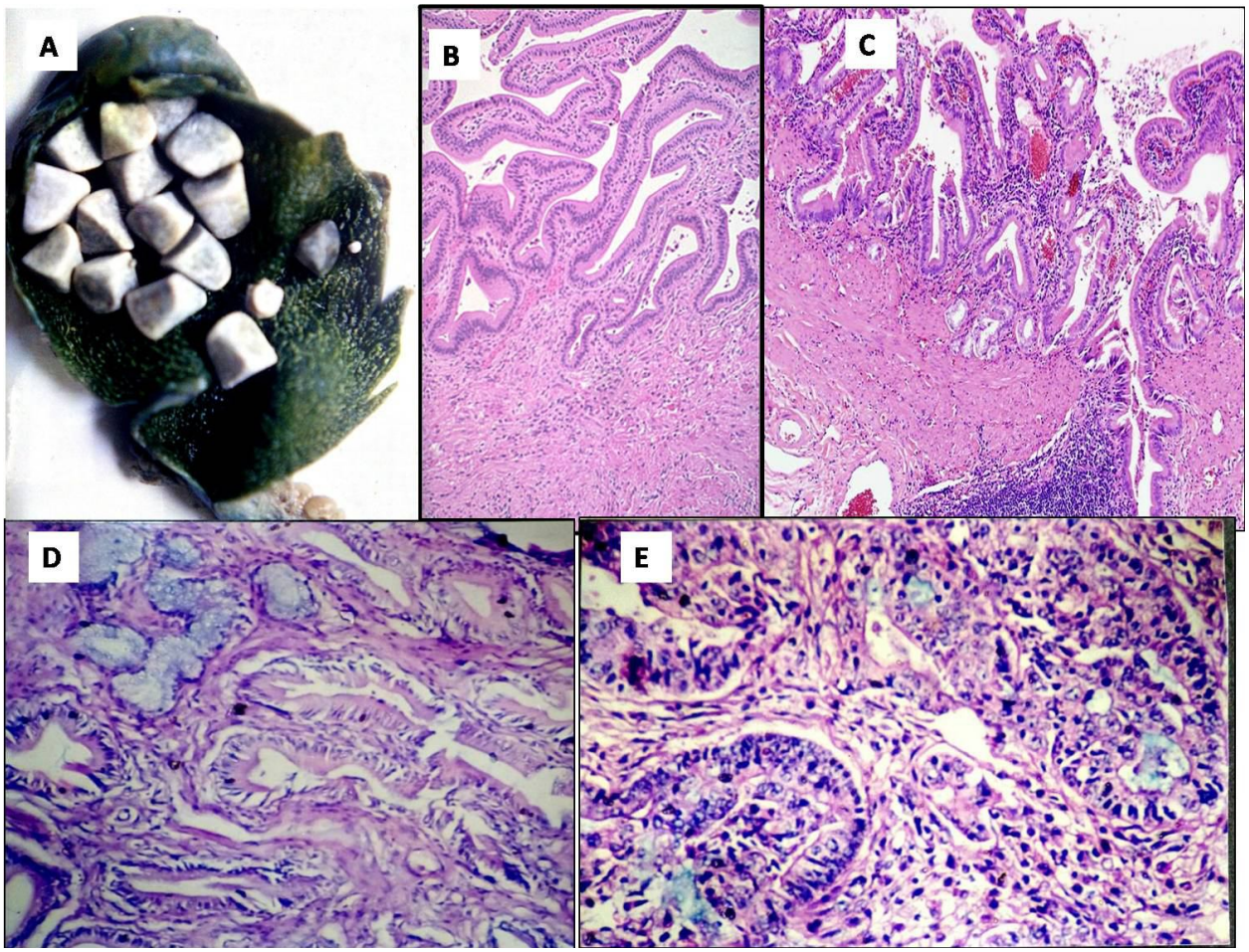

Fig. 1: **A.** Multiple large faceted mixed stones in thinned wall gall bladder. **B.** Normal histology: Gall bladder mucosa consists of single layer of uniform, tall columnar cells with, basal nuclei and pale cytoplasm. Lamina propria contains loose connective tissue with capillaries. Muscular layer showing smooth muscle fibers. (H & E, 100X). **C.** Chronic Cholecystitis: Ulceration of mucosa, lamina propria contains mixed inflammatory cell infiltrate and congested capillaries (H & E, 100X). **D.** Intestinal type metaplasia: Presence of goblet cell in the epithelium (H & E, 400X). **E.** Well differentiated adenocarcinoma : Normal histology of gall bladder is replaced by tumor cells arranged in glandular pattern and individual cell with features of malignancy (H & E, 400X)

Discussion

In this study, out of total 120 cholecystectomies, gall stones were present in 103 cases (85.83%) and correlates with other studies [8, 9]. Female cases were 98 (81.66%). Other studies have also reported preponderance of females among patients of gall bladder disease but the ratio has been higher as compared to this study [1, 3, 4, 6, 9, 10]. Reason for this female predominance has been attributed to female sex hormones, sedentary habits and genetic factors in various studies [1]. In this study, age of the patients ranged from 22 to 76 years. Maximum numbers of patients were in the 4th to 6th decade of life. This was in accordance with a few studies [8], but was higher than that reported in other study [11]. In the present study, among young patients subjected to cholecystectomy 14 patients were aged less than 30 years. The group was dominated by women. The results are consistent with other study [12]. Symptoms like abdominal pain, vomiting, fever, jaundice and signs like tenderness, guarded rigidity and palpable gall bladder were also observed by other study [7].

Lymphocytes, eosinophils as a dominating type of cells in the inflammatory infiltrate were noted in a great number of patients in cases of chronic cholecystitis. Microscopic lesions of mucosa most frequently included various grading and various stage of parietal fibrosis, this is consistent with previous studies [12, 13]. Presence of goblet cells, enterochromaffin cells or antral-type (pseudopyloric) glands in gallbladder epithelium in cases were thought to represent intestinal or gastric metaplasia, and to represent premalignant lesions in the organ. In one of the case in the present study found intestinal Metaplasia, which were also noted by studies [7, 9]. The most common histopathological finding in this study was chronic cholecystitis, seen in 101 cases out of 120 (84.17 %), which is consistent with previous study [13]. Follicular formation, active inflammation and antral metaplasia were associated with chronic cholecystitis in 0.83%, 1.67%, 0.83%, and 3.2%. Xanthogranulomatous change was seen in 5 %. These findings were also observed by other studies [3, 9, 14].

Multiple studies have been conducted in the recent past focusing on whether gall bladder histopathology must be done routinely or selectively. Gall bladder carcinoma always presents with some gross abnormalities. Therefore specimen sent for histopathology after intra-operative inspection of the mucosa by the operating surgeon can save time and cost, supported by previous studies. [8, 9, 14, 15]. Incidental gall bladder carcinomas on microscopy, with no evidence of gross abnormalities are not rare and therefore they advocate routine histopathology of all electively resected cholecystectomy specimens. In this series however, one case of incidental gall bladder carcinoma was seen and found consistent with the series [3, 7, 8].

Conclusion

Gall bladder diseases can have a varied presentation both clinically and histopathologically. The present study, in accordance with other studies showed a female predominance. Majority of patients were in third to fifth decade of life. Cholelithiasis proved to be a major risk factor for inflammatory diseases of this organ. The most common histopathological diagnosis was chronic cholecystitis. Constant erosion of the gall bladder wall by gallstones over a period of time may constitute a risk factor for malignancy.

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Digital Dermatoglyphics in Carcinoma Breast

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Absract

Background and Objectives: Dermatoglyphics is the science that deals with the study of carvings over the volar aspect of skin of palm, sole, fingers. The patterns are due to underlying interlocking dermal papillae with overlying corresponding epidermal ridges. The present study was carried out to analyze the digital dermatoglyphic patterns in carcinoma breast group and to compare it with control group. *Materials and Methods:* In the present study, the digital dermatoglyphic patterns were taken by INK METHOD of 100 breast cancer cases, confirmed on histopathology and 100 control cases were studied. The qualitative analysis of patterns like whorls, arches, loops, and composites as well as quantitative analysis of absolute finger ridge count, total finger ridge count were studied. Statistical analysis: the data was tested for its significance using the chi-square test and Student's t-test. *Results*: Number of whorls showed significant increase in the breast cancer group. Number of arches was decreased significantly in the cancer group in right hand and right plus left hand together. Ulnar loops were decreased while radial loops were increased in cancer group. Furuhata's index increased in cancer group whereas Dankmejer's index lowered in cancer group. Interpretation and conclusion: Digital dermatoglyphics may play an important role in identifying high-risk breast cancer population in developing country like India.

Keywords: Digital Dermatoglyphics; Carcinoma Breast; Whorls; Loops; Arches; Histopathology.

Introduction

Dermatoglyphics has an important role in clinical medicine. Its value will be enhanced as we acquire a better understanding of the ontogenetic development of dermal patterns particularly in relation to abnormal growth [1]. Dermatoglyphics is the study of carvings over the volar aspect of skin of palm, sole, fingers. The patterns are due to underlying interlocking dermal papillae with overlying corresponding epidermal ridges [2]. The dermal ridges develop in relation to volar pads, which are formed by 6th week of gestation and reach maximum size between 12th and 13th week [3]. The dermal pattern once formed, remains constant throughout the life. Many authors studied dermatoglyphic patterns in blood groups, diabetes, Turner's syndrome and many other conditions [4]. Pattern / intensity on fingertips like Absolute finger ridge count (AFRC) and Total finger ridge count (TFRC) gives an indication of complexity of ridge configuration. It is expressed by counting number of triradii present. Arch has no triradius so that it has zero pattern intensity, loop has one while pattern intensity of whorl is two. Furuhata's and Dankmejer's index were calculated in relation of dermatoglyphics in various other diseases [5,6].

Identification of people at increased risk of cancer before its development is an important objective of any cancer research study. Similarly many genetic studies were carried out to see breast cancer and identification of a high-risk group. About 90% of hereditary breast cancer involves mutation of the BRCA1 and BRCA2 genes [7]. Considering these factors the current study was undertaken.

Materials and Methods

The present study was carried out for the period of

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three years in the department of Anatomy, Indira Gandhi Government Medical College and Hospital, Nagpur. Permission from the institutional ethical committee was obtained. This study was carried out to analyze the digital dermatoglyphic patterns in carcinoma breast group and to compare it with control group. In this study, 100 female cases diagnosed as carcinoma breast on histopathology were taken from IGGMC and RST regional cancer hospital, Nagpur. The exclusion criteria were any other major illness, family history of any cancer or genetic disorder. Age of patients was between 20 to 80 years. The control group was of 100 females, selected from the age group of 20 to 80 years, who were not having history of carcinoma breast and any other hereditary disorders in the family. The fingerprints of study group and control group were obtained. INK Methods [8] was followed to take palmar and digital finger prints.

Written consent was taken, and then patient was asked to wash her hands with soap and water. She was also asked to dry her hands leaving some moisture for clear prints. Kores duplicating ink was spread uniformly on thick glass sheet by rubber roller, asked to put her hands on the inked slab. For smearing the ink uniformly on hands, special ball was used which was prepared from cotton gauze and linen. Clean smooth hard surface was used to take prints. The inked palmar aspect of hand was placed slowly on the paper with all fingers abducted to their maximum extent.

Each fingertip was rolled from side to side for the complete imprint of the pattern. If the print patterns coalesce either due to excess ink or pressure, second imprint was obtained (Figure 1A and 1B). The prints were studied with the help of hand lens, pencil, needle and protractor, and then analyzed. Fingertips were classified as per Henry's classification into elementary pattern types - whorls, ulnar loops, radial loops, and arches [9, 10]. Method of counting: In a loop: A line was drawn from the core to the triradius and the ridges crossing the line were counted. If the loop opens towards to ulnar side is labeled as ulnar loop and if it opens towards radial side is labelled as radial loop (Figure1C).). In a whorl: A whorl has two triradii and hence the counting was done with both triradii. From the core, a line was drawn to one triradius and in the same manner to other triradius and counting was done. In an arch: The triradius is the core and hence the count is zero [11]. Composite: The composite is combination of more than one pattern i.e. arch, loop, and whorls. It is further classified as central pocket loop, twinned loop and accidental loop [7].

Absolute finger ridge count (AFRC): It is the sum of ridge counts from all the separate triradii on the fingers taking both the counts of a whorl. It reflects pattern size as well as pattern intensity which depends on the pattern type. Numbers are given to digits from thumb to little finger. Thumb - digit 1, Index finger - digit 2, Middle finger - 3, Ring finger - 4, Little finger - 5 in both hands. To some extent ridge count reflects the pattern type.

Total finger ridge count (TFRC): It is the sum of ridge counts of all 10 fingertips taking the highest count of a whorl. TFRC gives an idea of pattern. A low ridge count corresponds to small loop while high ridge count is more likely indicative of whorl. It expresses size of pattern[11].

Furuhata's and Dankmejer's index were calculated as: -

Dankmejer's index = % arches / %whorls X 100.

Furuhata's Index = %whorls / %loop X 100

Results

The dermatoglyphic patterns in breast cancer group and control group were analyzed. Fingertip patterns were classified as per Henry's classification into elementary pattern types - whorls, ulnar loops, radial loops, arches and composites. Absolute Finger Ridge Count (AFRC) and Total Finger Ridge Count (TFRC) were calculated. Table 1 shows frequency distribution of fingertip patterns among breast cancer and control groups, Furuhata's index increased in cancer group whereas Dankmejer's index lowered in cancer group. The distribution of various whorl patterns is as shown in Table 2. Percentage of whorls is increased in cancer group; percentage of composites was slightly increased in cancer group. Table 3 showed distribution of arch patterns. Percentage of arches was decreased in cancer group. The percentage of loops was decreased on each hand of cancer group as compared to controls as shown in Table 4.

Finger print patterns were subjected to statistical test to evaluate identifiable differences whether significant or not. The distribution of fingertip patterns was assessed with the help of chi-square test as shown in Table 5. There was statistically significant difference for whorl pattern among cancer group and control group ($p < 0.05$). For arches the difference was found to be significant among cancer and control group for right hand, right hand plus left hand in cancer and control group ($p < 0.05$). For loops difference was significant in both hands in cancer and control group ($p < 0.05$). Comparison of ridge count i.e. AFRC and TFRC among the study groups

which were genetically important was compared with the help of student's t test and the difference was not statistically significant ($p > 0.05$).

Table 1: Frequency distribution of fingertip patterns among breast cancer group and control group

Group	Side	Total Whorls	Total Arches	Total Loops	Compo-sites	Furuhata's Index	Dankmejer's Index
Breast	RT	227	18	250	5	90.8	7.92
Cancer	LT	239	15	238	8	100.42	6.27
	RT+LT	466	33	488	13	95.49	7.08
Controls	RT	183	38	278	1	65.82	19.67
	LT	191	41	262	6	72.90	21.46
	RT+ LT	374	79	540	7	69.25	21.12

(RT- right, LT- left)

Table 2: Frequency distribution of whorl patterns on fingertip among breast cancer group and control group

Cases	Side	Concentric Whorls		Spiral Whorls		Composite		Total Whorls	
		No	%	No	%	No	%	No	%
Breast Cancer	RT	166	33.20	51	10.20	10	2.00	227	45.40
	LT	162	32.40	68	13.60	9	1.80	239	47.80
	RT+LT	328	32.80	119	11.90	19	1.90	466	46.60
Controls	RT	157	31.40	22	4.40	4	0.80	183	36.60
	LT	102	20.40	84	16.80	5	1.00	191	38.20
	RT+ LT	259	25.90	106	10.60	9	0.90	374	37.40

(RT- right, LT- left)

Table 3: Frequency distribution of arch pattern on fingertip among breast cancer group and control group

Cases	Side	Plain Arches		Tented Arches		Total Arches	
		No	%	No	%	No	%
Breast Cancer	RT	9	1.80	9	1.80	18	3.60
	LT	8	1.60	7	1.40	15	3.00
	RT+LT	17	1.70	16	1.60	33	3.30
Controls	RT	21	4.20	17	3.40	38	7.60
	LT	25	5.00	16	3.20	41	8.20
	RT+ LT	46	4.60	33	3.30	79	7.90

Table 4: Frequency distribution loop pattern on fingertip among breast cancer group and control group

Cases	Side	Ulnar Loops		Radial Loops		Total Loops	
		No.	%	No.	%	No.	%
Breast Cancer	RT	234	46.80	16	3.2	250	50.00
	LT	225	45.00	13	2.6	238	47.60
	RT+LT	459	45.90	29	5.8	488	48.80
Controls	RT	255	51.00	23	4.6	278	55.60
	LT	245	49.00	17	3.4	262	52.40
	RT+LT	500	50.00	40	8.0	540	54.00

Table 5: Significance test for different patterns on fingertips breast cancer

Type	Comparison	χ^2 Value	Significance at 5% level
/ Whorl	RB X RC	8.0033	Significant
	LB x LC	9.4002	Significant
	RB + LB X RC +LC	17.272	Significant
Arches	RB X RC	7.0077	Significant
	LB x LC	0.4490	Not significant
	RB + LB X RC +LC	21.275	Significant
Loops	RB X RC	3.1459	Not significant
	LB x LC	2.3000	Not significant
	RB + LB X RC +LC	9.7588	Significant

RB- right hand in breast cancer case, LB –left hand in breast cancer case , RC- right hand in control case, LC- left hand ic control case

The Significant c^2 Value for df 1 at 5% level is = 3.84

Fig. 1A: Procedure of taking palmar print

Fig. 1B: Procedure of taking digital print

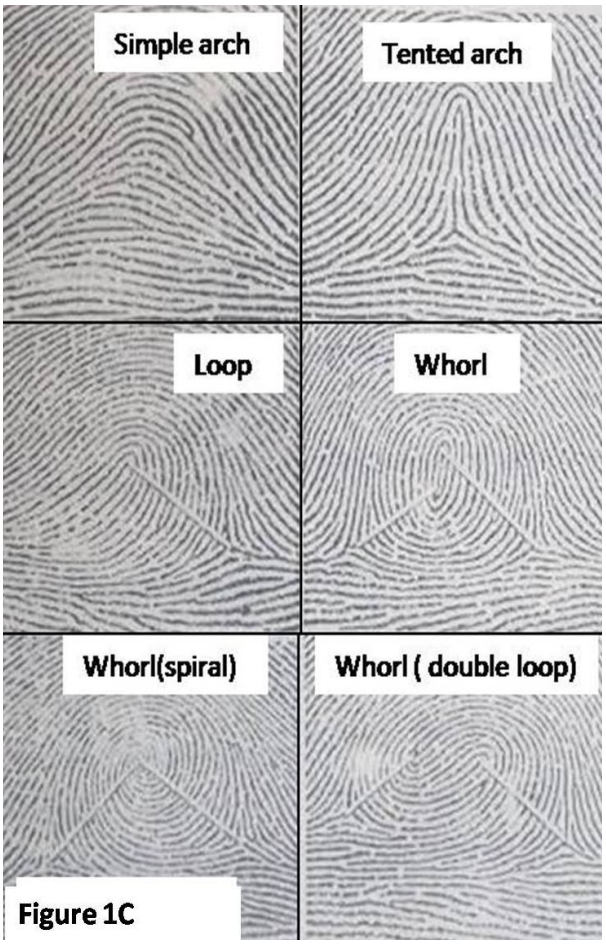

Fig. 1C: Digital dermatoglyphic patterns and scheme for ridge counting

Discussion

Qualitative and quantitative parameters were studied separately and observations were compared with previous studies in the literature. Seltzer MH [1982] noted that cases with six or more whorls are at high risk for carcinoma breast [12]. Sukre et al [13], Chintamani et al [14] showed that the whorls were increased in cancer patients as compared to controls. In the present study, percentage of whorls increased in cancer group than control group. The increased percentage of whorls was significant in right hand, left hand and right plus left hands than controls. It correlates with findings of previous studies. Seltzer MH[1990] quoted that 'the positive predictive value of 6 or more digital whorls is comparable to that of mammography and biopsy' [15]. However Raizada A et al found decreased number of whorls in relation to carcinoma breast cases [4].

Raizada et al [4], Sukre et al [13], Paranjpe et al[17] found increased arches in cancer group than control group. Arches were decreased in cancer patients than controls in the present study, which were similar to findings noted in previous studies by Chintamani et al [11], Birman et al [16]. However N.S.Sridevi et al [14] did not found any statistically significant difference in cases and control groups with respect to arches.

Birman HR et al [16] analyzed the four patterns of ulnar loops significantly associated with breast cancer and classified them as accidentals, transitionals, angled ulnar loops, and horizontal ulnar loops. Chintamani et al [11] also found more loops in breast cancer patients. Sukre et al [13], N.S. Sridevi [14], in their study found that ulnar loops were significantly more in breast cancer patients. P.E. Natekar et al [3] found more radial loops in left hand in breast cancer patients. In the present study, radial loops and ulnar lops were decreased in cancer group than controls, which correlates with the findings of Seltzer et al [12], Paranjpe et al [17].

Number of composites was slightly increased in cancer group than control group in present study; this finding was similar with the Bierman et al. Diversity of ridge count from finger to finger was under genetic control. Dissociation or distortion of dermal ridges was produced by chromosomal aberrations [16].

In the present study AFRC and TFRC were slightly increased in cancer patients than control group but statistically not significant ($p > 0.05$). Raizada A et al [4], Chintamani et al [11] in their study found significantly decreased TFRC and AFRC in breast

cancer patients. N.S. Sridevi et al [14] found increase in TFRC as well as AFRC in breast cancer patients. In the present study Furuhata's index increased in cancer group whereas Dankmejer's index lowered in cancer group.

Conclusion

Digital dermatoglyphics is simple, inexpensive, non-invasive, anatomical marker and may be used as a reliable indicator for screening of high-risk population in the developing country like India, for early detection and early therapy, thus reducing the morbidity and mortality in carcinoma breast. There is significant increase whorl pattern in breast cancer group. Six or more digital whorl pattern in carcinoma breast patient can be indicator for screening high risk population.

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Revised Rates for 2017 (Institutional)

	Title	Frequency	Rate (Rs): India		Rate ($):ROW	
1	Dermatology International	2	5000	4500	500	450
2	Gastroenterology International	2	5500	5000	550	500
3	Indian Journal of Agriculture Business	2	5000	4500	500	450
4	Indian Journal of Anatomy	3	8000	7500	800	750
5	Indian Journal of Ancient Medicine and Yoga	4	7500	7000	750	700
6	Indian Journal of Anesthesia and Analgesia	3	7000	6500	700	650
7	Indian Journal of Biology	2	5000	3500	400	350
8	Indian Journal of Cancer Education and Research	2	8500	8000	850	800
9	Indian Journal of Communicable Diseases	2	8000	7500	800	750
10	Indian Journal of Dental Education	4	5000	4000	450	400
11	Indian Journal of Forensic Medicine and Pathology	4	15500	15000	1550	1500
12	Indian Journal of Forensic Odontology	2	5000	4000	450	400
13	Indian Journal of Genetics and Molecular Research	2	6500	6000	650	600
14	Indian Journal of Law and Human Behavior	2	5500	5000	550	500
15	Indian Journal of Library and Information Science	3	9000	8500	900	850
16	Indian Journal of Maternal-Fetal & Neonatal Medicine	2	9000	8500	900	850
17	Indian Journal of Medical & Health Sciences	2	6500	6000	650	600
18	Indian Journal of Obstetrics and Gynecology	3	9000	6500	700	650
19	Indian Journal of Pathology: Research and Practice	3	11500	11000	1150	1100
20	Indian Journal of Plant and Soil	2	5500	5000	550	500
21	Indian Journal of Preventive Medicine	2	6500	6000	650	600
22	Indian Journal of Research in Anthropology	2	12000	11500	1200	1150
23	International Journal of Food, Nutrition & Dietetics	3	5000	4500	500	450
24	International Journal of History	2	6500	6000	650	600
25	International Journal of Neurology and Neurosurgery	2	10000	9500	1000	950
26	International Journal of Political Science	2	5500	5000	550	500
27	International Journal of Practical Nursing	3	5000	4500	500	450
28	International Physiology	2	7000	6500	700	650
29	Journal of Animal Feed Science and Technology	2	4100	3600	410	360
30	Journal of Cardiovascular Medicine and Surgery	2	10000	8600	910	860
31	Journal of Forensic Chemistry and Toxicology	2	9000	8500	900	850
32	Journal of Microbiology and Related Research	2	8000	7500	800	750
33	Journal of Orthopaedic Education	2	5000	4500	500	450
34	Journal of Pharmaceutical and Medicinal Chemistry	2	16000	15500	1600	1550
36	Journal of Social Welfare and Management	3	7500	7000	750	700
37	Meat Science International	2	5000	4500	500	450
38	New Indian Journal of Surgery	3	7500	6600	710	660
39	Ophthalmology and Allied Sciences	2	5500	5000	550	500
40	Otolaryngology International	2	5000	4500	500	450
41	Pediatric Education and Research	3	7000	6500	700	650
42	Physiotherapy and Occupational Therapy Journal	4	8500	8000	850	800
43	Urology, Nephrology and Andrology International	2	7000	6500	700	650
44	Indian Journal of Emergency Medicine	2	12000	11500	1200	1150
45	Indian Journal of Surgical Nursing	3	5000	4500	500	450
46	Indian Journal of Trauma & Emergency Pediatrics	3	9000	8500	900	850
47	International Journal of Pediatric Nursing	3	5000	4500	500	450
48	Journal of Community and Public Health Nurisng	2	5000	4500	500	450
49	Journal of Geriatric Nursing	2	5000	4500	500	450
50	Journal of Medical Images and Case Reports	2	5000	4500	500	450
51	Journal of Nurse Midwifery and Maternal Health	3	5000	4500	500	450
52	Journal of Organ Transplantation	2	25900	25000	2590	2500
53	Journal of Psychiatric Nursing	3	5000	4500	500	450
54	Psychiatry and Mental Health	2	7500	7000	750	700

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Objective Assessment of Students Performance before and After Joining Medical College

Surya Kumari N.*, Amit Singh Bharati*, V. Subashini Rani, Srinivas C.H.*****

Abstract

Aim and objectives: In general students have good percentage of marks in intermediate / plus 2 education, but fail to show same level of performance after joining medical colleges. Aim and objective of present study are to study how much percentage of students showing such decreased level of performance after joining the medical college and to understand the probable causes for their poor performance. *Materials and methods:* Data was collected from 167 second year MBBS students of GSL Medical College, Rajamahendravaram, A.P, in the form of questionnaire regarding marks obtained in the intermediate and marks scored in the anatomy subject in formative, summative and final examinations of Anatomy subject along with causes for their altered performance. *Results:* students have an average of 93.47% in their Plus2 and 1st internal-47.98%, second internal 44.62%, 3rd internal 53.40%, final exam 70.43% in anatomy subject and 70% in all three subjects in 1st year MBBS final exams. *Conclusion:* Students' performance decreased significantly after joining medical college in 1st year. In students point of view stress, procrastination and social media has negative influences on their academic performances.

Keywords: Medical Student Performance; Under Achievement; Factors Influencing.

Introduction

Majority of the students who opt for MBBS course will have very good academic track record in their schooling and junior college education. Surprisingly their level of performance drops drastically after joining the medical professional colleges. Many of these students who secured 85% to 95% of marks in their intermediate / +2 education are failing to secure 50% of marks in internal assessment examinations that are conducted in first 3-4 months of 1st MBBS. More disturbing is the fact that these internal assessment examinations will have only 30% of the total syllabus of each subject, though the burden is less, students are failing to secure decent percentage of marks. These common findings pose a great challenge to the medical teachers in understanding the academic competency of the new entrants in the field of medicine and to find reasons behind their detrimental performance.

Many factors were thought to be causes for their altered performance in the 1st year of medical profession, such as fear of ragging by the senior students which may even cause depression in the new comers, home sick, absenteeism may lead to low achievements [1], study patterns and study materials that they use [2], lack of planning and management of time and other influences like social media and availability of electronic gadgets like smart phones and laptops.

After joining the medical profession first big academic challenge faced by them is learning anatomy, which is a vast subject with 650 hours of teaching for the first year MBBS students as per the curriculum of Dr. NTR university of health sciences to which this medical college if affiliated. Keeping all these aspects in mind we have designed the study aimed to compare students marks (inter or +2) before joining the college with his performance in Anatomy examinations during 1st year and university examinations as well. The present study not just limited to compare the marks but it is also aimed to find the reasons for their decreased performance in their own perspective.

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Material and Methods

The present study was done at GSL Medical College, Rajamahendravaram, Andhra Pradesh. A total of 167 second MBBS students were voluntarily participated in the present study. Data collected for the study contained information regarding the performance of the students in various examinations like percentage of marks obtained in the intermediate /+2 examinations , 1st , 2nd, 3rd internal assessment marks in anatomy, first MBBS final examination marks in Anatomy and Total (all three subjects) Percentage of marks scored in the 1st MBBS university examination. The information given by the students was cross checked by verifying the records available at the various departments in the college. Out of 167 students, 165 of them participated in the answering the questionnaire that is given to them contained 8 questions which are prepared by the authors. Students have to give response to the score of 0, 1 or 2 for each question. Here, 0- no affect, 1- moderate affect, and 2- significant affect (Table 3).

Statistical analysis: All statistical analysis was performed by using SPSS trial version 21.0 and MS Excel 2007. Descriptive data was presented in the form of Mean ± SD and percentages. ANOVA was performed to assess the mean difference among various groups such as exam performance. For all statistical analysis, $p< 0.05$ was considered as statistically significant.

Results

When the data was presented for descriptive analysis (Table 1), to know whether there is any alteration in the performance of the student, before and after joining the medical college, we found that

Table 1: Showing over all comparison of marks (descriptive analysis)

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	P VALUE
					Lower Bound	Upper Bound			
INTER/+2	167	93.4725	4.10027	0.31729	92.846	94.0989	70.3	98.4	0.000
1st INT-Anatomy	167	47.988	11.71653	0.90665	46.198	49.7781	12	72	
2nd INT-Anatomy	167	44.6228	13.18799	1.02052	42.6079	46.6376	6	76	
3rd INT-Anatomy	167	53.4072	9.45449	0.73161	51.9627	54.8516	31	73	
FINAL ANATOMY	167	70.4311	7.28133	0.56345	69.3187	71.5436	50	86	
FINAL TOTAL	167	70.005	6.54409	0.5064	69.0052	71.0048	54.33	83.5	

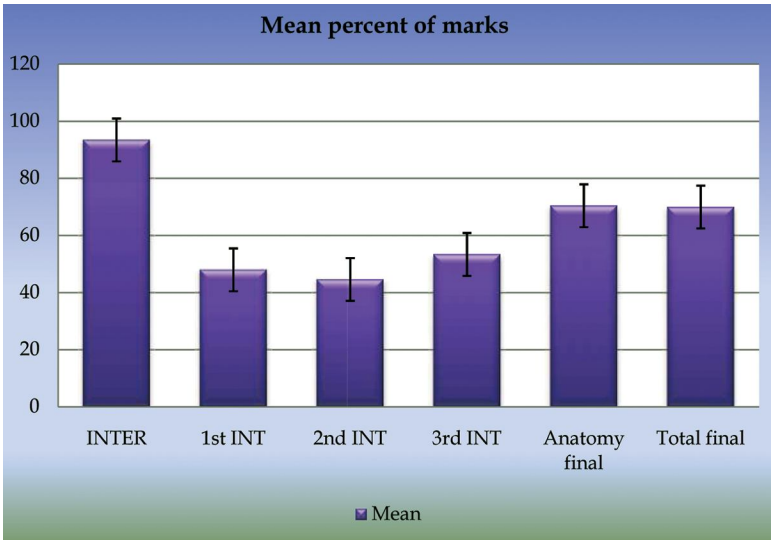
Table 2: Showing multiple comparisons between individual exam marks (ANOVA)

Dependent Variable: PERFORMANCE LSD						
(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
INTER/ +2	1st INT- Anatomy	45.48443*	1.01214	0.000	43.4983	47.4706
	2nd INT- Anatomy	48.84970*	1.01214	0.000	46.8635	50.8359
	3rd INT- Anatomy	40.06527*	1.01214	0.000	38.0791	42.0514
	ANATOMY FINAL	23.04132*	1.01214	0.000	21.0551	25.0275
	FINAL TOTAL	23.46747*	1.01214	0.000	21.4813	25.4536
1st int	2nd INT- Anatomy	3.36527*	1.01214	0.001	1.3791	5.3514
	3rd INT- Anatomy	-5.41916*	1.01214	0.000	-7.4053	-3.433
	ANATOMY FINAL	-22.44311*	1.01214	0.000	-24.4293	-20.4569
	FINAL TOTAL	-22.01697*	1.01214	0.000	-24.0031	-20.0308
2nd int	3rd INT- Anatomy	-8.78443*	1.01214	0.000	-10.7706	-6.7983
	ANATOMY FINAL	-25.80838*	1.01214	0.000	-27.7946	-23.8222
	FINAL TOTAL	-25.38224*	1.01214	0.000	-27.3684	-23.3961
3rd int	ANATOMY FINAL	-17.02395*	1.01214	0.000	-19.0101	-15.0378
	FINAL TOTAL	-16.59780*	1.01214	0.000	-18.584	-14.6116
Final anatomy	FINAL TOTAL	0.42615	1.01214	0.674	-1.56	2.4123

*. The mean difference is significant at the 0.05 level.

Table 3: showing questionnaire for with students' responses

	Question	0 (no affect)	1-(moderate affect)	2- (significant affect)
1	Stress due to adjustment to the new environment away from home	59 (35.75%)	76(46.06%)	30(18.18%)
2	Fear of ragging	80(48.48%)	70(42.42%)	15(9.09%)
3	I am from telugu medium unable understand the lectures	160(96.96%)	3(1.81%)	2(1.21%)
4	Unable to follow / prepare notes - from standard text books (lack of study material similar to inter education)	73(44.24%)	77 (46.66%)	15(9.09%)
5	Procrastination	68(41.21%)	60(36.36%)	37(22.42%)
6	Study hours under supervision needed	32(19.39%)	68(41.21%)	65(39.39%)
7	My mobile/ smart phone was a distraction from studies	52(31.51%)	68(41.21%)	45(27.27%)
8	I have personal problems not related to the college	107(64.84%)	46(27.87%)	12(7.27%)



Graph 1: Mean percentage of marks in various exams

the there is significant (p<0.000) change in the performance of the students. When mean differences were observed between the examination performances with ANOVA (Table 2), we found that there is significant alteration between the exam marks. No statistically significant change (p<0.674) is found between final anatomy and total final marks (all three subjects). The questionnaire answered by the student about various probable factors that influenced their decreased or altered performance was also presented in the table with percentages (Table 3).

Discussion

The present study on 167 student volunteers showed that they have a average 93.47% of marks in their intermediate / +2 examinations which is a very good performance. The descriptive analysis of marks revealed that their performance has significantly decreased (p<0.000) in the formative assessments in anatomy that is 1st and 2nd internal exams, summative assessments in anatomy that is 3rd internal examination, marks in first year university examination in anatomy and total percentage of marks which includes three subjects. Higher marks scored in +2 are due to the fact that the residential colleges or corporate junior colleges provide the students with readymade notes in question and answer pattern, not only that they also conduct compulsory study hours under supervision and periodical examinations, which is the main reason for their good performance.

The data showed that the students performance was less in first two formative assessments in anatomy that is first and second internal (mean47.98 & 44.62% respectively) and it has improved to a mean of 53.40% by 3rd internal i.e. summative assessment. Further improvement is in university examination of anatomy 70.43% and total 70%(Figure 1). But even these are significantly less than what they have scored in the intermediate or +2. The ANOVA test for multiple comparison of dependable variable (performance- marks) showed that significance. (Table-2). One exception is comparison between final anatomy marks and total final marks (p< 0.674) where

the difference if statistically not significant, because their anatomy marks represent part of total marks and their performance in anatomy is on par with other two subjects. This type of altered performance was also observed by other researchers [3-7].

After establishing the fact that the students' academic performance in the first year has decreased when compared to the intermediate education, we analyzed the answers given by the students, which revealed that more than 64% (1-46.06% & 2-18.18%) indicated that staying away from home and its stress affected their performance. This finding is in support of research by Abita Sultana [7] and Shah [8]. Next response by the students was regarding ragging, 48.48% of them said that their academic performances were not at all affected by fear of ragging. Even though rest of the students said fear of ragging somehow affected them but actual incidents of ragging were not reported by any of them. Strict vigilance in the campus by the authorities and over all awareness regarding punishments and adverse affects of ragging among student community has reduced incidences of ragging and its impact on academic performance.

Many authors have studied the influence of language on students coming from non-English medium schools and they found that, these students performance was less when compared to others [5,9,10], but in our study only 1.3% of the students said they have significant problem with language. We do agree with their findings, but our findings are different because most of the students coming to the medical colleges were from English medium schools. For one of the other questions More than 50% (1- 46.66% and 2-9.09%) of them said they need study material which are easy to read, like the ones which are provided by the residential corporate junior colleges, which is not practically possible to provide such a thing in medical profession and should not be encouraged because a medical professional student must read standard text books to understand the subject in depth.

In the present study students said that procrastination attitude has affected their academics (moderately 1-36.36% and significantly 2- 22.42%). our study is in agreement with the author Nagesh[3]. Another interesting finding is that 68% (1-41.21%, 2-27.27%) of the students confessed that usage of mobile / smart phones to access social media and for games was a distraction from the studies and it significantly affected their academics.

In conclusion, our present study clearly shows that students' performance has considerably decreased after joining the medical profession. Keeping the above finding in mind, the medical teachers must help the students to overcome the stress related to fear of ragging and staying away from home. By conducting supervised study hours in the first year by the qualified faculty may help the student in understanding the subject thoroughly. Regular assessments can prevent procrastination in the studies by the students. The must be advised to avoid unnecessary usage of electronic gadgets to asses social media which significantly affecting their academic performance. These findings can help medical faculty in understanding the students actual capabilities and having sound knowledge about students strengths and weaknesses, the present as well as future students can be trained in a better and meaningful way.

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Study of Correlation between Human Height and Foot Length in North-East Karnataka Population (Gulbarga and Bidar)

Amit Singh Bharati*, Surya Kumari N., V. Subashini Rani*****

Abstract

Even though the forensic value of correlation coefficient between foot length and height has been studied, there is lack of studies regarding this subject. Interrelations among different body measurements may be used to estimate one from another in case of missing body parts. The present study was carried out to establish correlation between individual's height and mean foot length. It was conducted on students of age group 14 to 24 years. *Aim:* To analyze the correlation between foot length and height in population of North-East Karnataka region. *Methods*: In the present study, 150 subjects were divided into two groups according to age and each subject was assessed. *Results:* Average of mean foot length in male and females

a. In Age group 14 to 18 years is 25.51 cm and 23.2 cm respectively

b. In Age group 19 to 24 years is 25.63 cm and 23.4 cm respectively

Correlation coefficient between height length and foot length also shows significant association for the age group of 14 to 24 years and sex.

Keywords: Height; Foot Length; Age.

Introduction

Growth – the vital process is measured by measuring the height of a person, which itself is a sum of the length of certain bones and appendages of the body which represent certain relationship with form of proportions to the total stature. This relationship is very useful anthropologically to find racial differences and medico-legally, when only parts of the deceased body are available. Hence it can be of great anthropological and forensic value and indeed would help many of the Anthropological and Forensic experts.

Height depends on many factors and of those, few factors like genetics, gender, geographical, eating habits and socioeconomic factors are most important and worth to mention. Estimation of height from foot length has been attempted by several people with variable degree of success. The present study is done in the population of North Karnataka region to find the correlation between height and foot length.

Rutishauer, for the first time showed in children that the reliability of prediction of height from simple measurements like foot length was as high as long bones [1].

Ashizawa studied the correlation between foot length and body size [2].

Musgrave and Harneja calculated height from various metacarpals amongst British adults and found significant degrees of association in both sexes (Male r = 0.58 to 0.67 and female r = 0.49 to 0.71) [3].

Patel S.M. found mean height was 170.96 cm in males and 156.14 cm in females in age group of 17 to 24 years [4].

Qamra et al., derived regression equation between foot length and height in North-West India population, there correlation coefficient between foot length and height was +0.69 in male and +0.70 in female [5].

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Materrials and Methods

The measurements of 150 individuals residing in North-East Karnataka (Gulbarga and Bidar) were studied in Department of Anatomy, Bidar Institute of Medical Sciences (BRIMS), Bidar. The subjects were divided as per their age and sex.

Group-1 included subjects of age group 14 to 18 years in which there were 40 males and 40 females.

Group-2 included subjects of age group 19 to 24 years in which there were 35 males and 35 females.

All the subjects were examined as under;

Height

Height was measured by Standiometer. The subjects were made to stand against the wall and height was measured. The measurements were taken by the same person and at a fixed time to avoid personal error and eliminate diurnal variation in methodology.

Foot Length

Nails were trimmed and measurement of foot length were taken on a paper in standing position. Outline of the foot was marked by proximal and distal point and measurements were taken between two points.

* Proximal Point – point of maximum curvature on the outline heel
* Distal Point – point of maximum curvature on the outline great toe

Measurement of Foot

The subjects were explained about the procedure, long sized paper was spread on a bench. Subjects were made to stand on the paper in erect but relax position. Proximal point was marked for the heel with sharp tip of the pencil holding at right angle to the heel. Distal point was marked for the great toe only holding pencil at right angle to the great toe. Mid point of the curve was taken as distal point. Distance between two points was measured with a ruler and same procedure was followed in all subjects. When analysed stasitically, difference between two groups was considered to be significant when P<0.005.

Fig. 1:

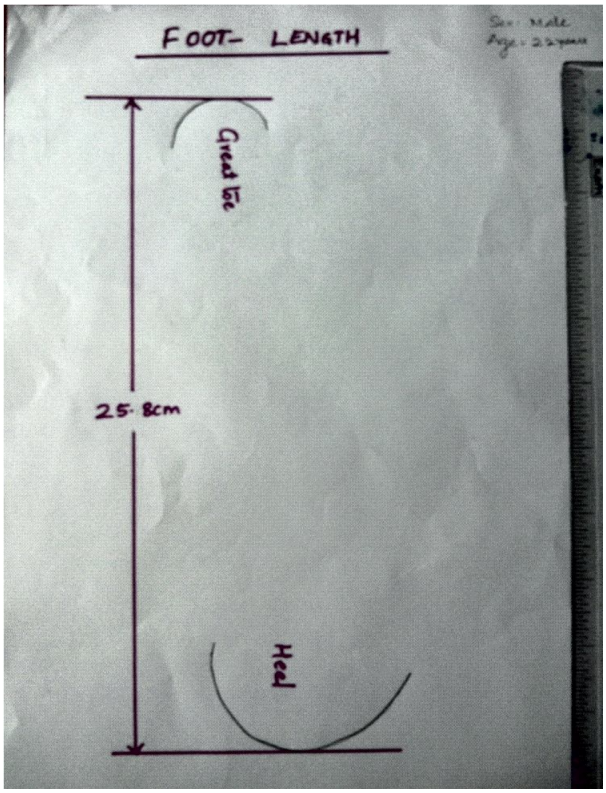

Fig. 2:

Result and Discussion

The present study shows that mean height in age group of 14 to 18 years in male was 163.95 cm and in females was 150.6 cm. Mean height of age group 19 to 24 years in male was 168.74 cm and in females was 152.7 cm.

In the study done by Patel S. M. it was found that the mean height was 170.96 cm in male and 156.14 cm in females of age group 17 to 22 years. Our study reveals that the mean length of foot in age group 14 to 18 years in male was 25.51 cm and in female was 23.20 cm. Mean length of foot in age group of 19 to 24 years in male was 25.63 and in females was 23.4 cm. Patel S. M. found that the mean foot length was 22.44 cm in males and 22.34 cm in females in age group of 17 to 22 years.

The correlation coefficient between height and length of foot also shows significant association for all age groups and sex in my study.

Jitendra P. Patel et al., found regression equation for male and female as under;

Age Group 14 to 19 years:

Height = 77.03 + (3.582) FL for males

Height = 55.35 + (4.59) FL for females

Age Group 20 to 25 years:

Height = 79.14 + (3.504) FL for males

Height = 33.18 + (5.480) FL for females

Table 1: height v/s rfl and lfl of girls

Age groups (In years)	No.of girls (n)	Actual Ht. Mean±SD	RFL Mean±SD	LFL Mean±SD	Correlation value (r)	Reg. coefficient b-value	Reg.equation
14-18	40	150.6±6.02	23.15±1.21	23.26±1.27	+0.69 +0.714 +0.99	3.43	Height = 71.3 +3.43RFL
						3.37	Height = 72.3 +3.37LFL
19-24	35	152.77±5.45	23.6±1.14	23.1±1.143	+0.368 +0.71 +0.989	1.75	Height = 113 +1.75RFL
						1.58	Height = 116 +1.58LFL

RFL = Right Foot Length, LFL = Left Foot Length, Ht = Height

Table 2: Height v/s rfl and lfl of boys

No.of boys (n)	Actual Ht. Mean±SD	RFL Mean±SD	LFL Mean±SD	Correlation value (r)	Reg. coefficient b-value	Reg.equation
40	163.95±7.547	25.38±1.47	25.64±1.61	+0.583 +0.547 +0.89	2.99	Height = 88.1 +2.99RFL
					2.56	Height = 98.4 +2.56LFL
35	168.74±7.45	25.56±1.09	25.70±1.14	+0.75 +0.729 +0.989	5.12	Height = 38 +5.12RFL
					4.76	Height = 46.5 +4.76LFL

RFL = Right Foot Length, LFL = Left Foot Length, Ht = Height

Conclusion

The data obtained was tabulated and analyzed statistically to derive the regression equation as under

In Age Group 14 to 18 years in male:

Height = 88.1 + 2.99 RFL

Height = 98.4 + 2.56 LFL

In Age Group 14 to 18 years in female:

Height = 71.3 + 3.43 RFL

Height = 72.3 + 3.37 LFL

In Age Group 19 to 24 years in male:

Height = 38 + 5.12 RFL

Height = 46.5 + 4.76 LFL

In Age Group 19 to 24 years in female:

Height = 113 + 1.75 RFL

Height = 116 + 1.58 LFL

Thus the formula derived can be used for the population residing in our area. It can be of great forensic and anthropological value for the people of North-east Karnataka region.

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Study of BMI in Junk Food Eaters of Both the Sexes in the Age Group 18-20

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Abstract

In the present study, of 100 students, 60% are consume junk food daily, 20% are occasional eaters and 20% are non eaters. In daily junk food eaters, 22 (36.66 %) students have normal BMI and 38(63.34%) have high BMI. In occasional eaters 39(15 %) students have low BMI and 17(85%) have normal BMI and in non eaters 5(25%) students have low BMI and 15 (75 %) have normal BMI. Mean values of daily junk food eaters is 26.13(S.D. ±2.89), of occasional eaters is 23.03 (SD ±2.05) and of non eaters is 18.15 (SD ±1.14) each which has highly significant P value (< .001) and F value = 75.22 statistically. In study of sexual dimorphism, normal BMI is found in 10 males and 14 females and high BMI in 18 males and 18 females which is statistically insignificant giving the important message that junk enhances obesity , irrespective of the sex. Raised BMI is the predictor of DM , CVS diseases, STN and stroke. Moreover, G.I.T. problems like reflux oesophagitis, Carcinoma colon and renal complications are more prevalent in junk food eaters. Increased BMI also leads to central obesity, lethargy and arthritis.This study helps to create awareness in parents and teachers of school going children and adults of Indian population in whom 60% are unaware about the side effects of the junk food.

Keywords: DM=Diabetes Mellitus; C.V.S.=Cardiovascular Disease; STN = Hypertension; Stroke; Nutritious.

Introduction

Body mass index is the ratio of wt in Kg / ht in mtr^2.The normal range is 18.5 – 24.9.The human physique has several aspects like size, form and composition. Difference in the size is obvious biologically and important sociologically. The conscious are somehow concerned with identification of the whole being of his bodily image and its relation to the outside world. The concept of BMI has been explored by the cardiologist and physicians as well. As per the WHO report, BMI is associated with non communicable diseases [1,2]. Hence attempt is made to compare the BMI in daily junk food eaters, Occasional junk food eaters and non eaters, so as to help the clinician to diagnose obesity, cardiac disease and diabetes mellitus which are predicted by obesity. It certainly indicates that junk foods promotes the weight irrespective of the sex. As per WHO [3] obesity is increasing in developing countries. It reminds the proverb " longer the belt, shorter is the life." Central obesity is a predictor of high prevalence of Diabetes, Hypertension and coronary artery disease. It is impotant that junk foods are delicious and non nutritious because they prevents consumption of nutritious foods which leads to Calcium and vitamin deficiency [4]. Our government has banned many junk foods as they contaln toxins which are delirious to our health [5].

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Materials and Methods

Total 100 students of both the sexes of 1st year MBBS students between the age group of 18 -19 are chosen for the study.

Observation and Results

Table 1 shows that out of 100 students. In that 60

are daily junk food eaters, occasional and non eaters are 20 each in number.

Table 2 shows in daily junk food eaters who are 60 in numbers, 22 have normal BMI within the range of 18-25 and 38 have BMI more than normal. In the occasional eaters who are 20 in number, 3 have got BMI below 18.17 of them had normal BMI. In the non eaters out of 20 .5 have low BMI and 15 have got normal BMI. This study of comparison is highly significant statistically(P value is < .001).

Table 3 -Total comparison of each group

1. In the daily junk food eaters , minimum BMI is 18.5.and the maximum is 32.2 and the mean value is 26.13 (SD ± 2.89).
2. In the occasional eaters who are 20 in numbers, minimum BMI is 18.10 and the maximum BMI is 24.9 .The mean value is 23.03 (SD ±2.05).
3. In the non eaters, again they are 20 in number, minimum BMI was 14.7 and maximum BMI was 19.8. and mean value is 18.15(S.D. ±1.14). And this study of comparison between all the 3 groups is also highly significant statistically. (p < .001). and amazon value is 75.22.

Table 4 shows sexual dimorphism of daily junk food eaters. Normal BMI is found in 10 males and 14 females. High BMI In 18males and 18 females and chi^2 value is 0.401. Difference is also 1 and it is statistically insignificant

Table 1: Classification of junk food eaters and their %

Junk Food	Number Of Students
Daily eaters	60(60%)
Occasional eaters	20(20%)
Non-eaters	20(20%)
TOTAL	100

Table 2: Showing % of low,normal and high BMI in each group

	LOW (<18.5 BMI)	Normal (18.5-24.49 BMI)	HIGH (>24.49BMI)	P Value
Daily eaters	0	22(36.66%)	38(63.34%)	<0.001
Occasional eaters	3(15%)	17(85%)	0	
Non-eaters	5(25%)	15(75%)	0	

Table 3: Comparative study of junk food eaters in all the 3 groups

No	Daily Eaters	Occasional Eaters	Non Eaters
n	60	20	20
Minimum	18.5	18.10	14.7
maximum	32.2	24.9	19.8
mean	26.13	23.03	18.15
SD	2.89	2.05	1.14
	F Value = 75.22		
	P value = < o.oo1		

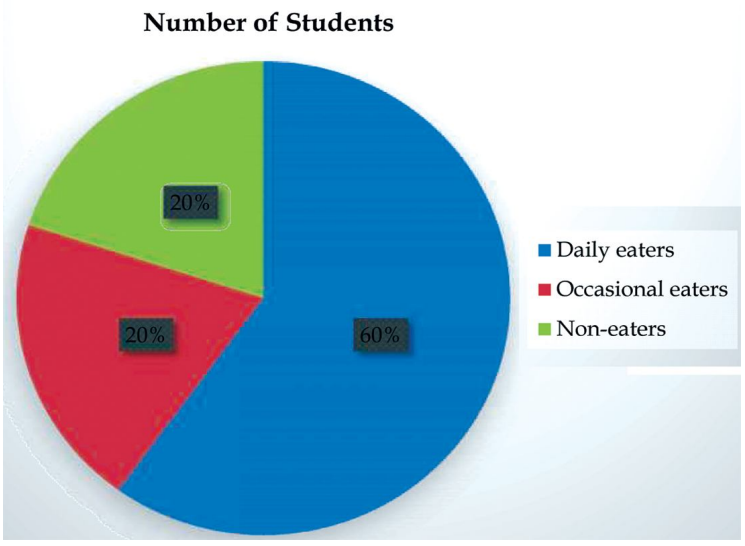

Fig. 1:

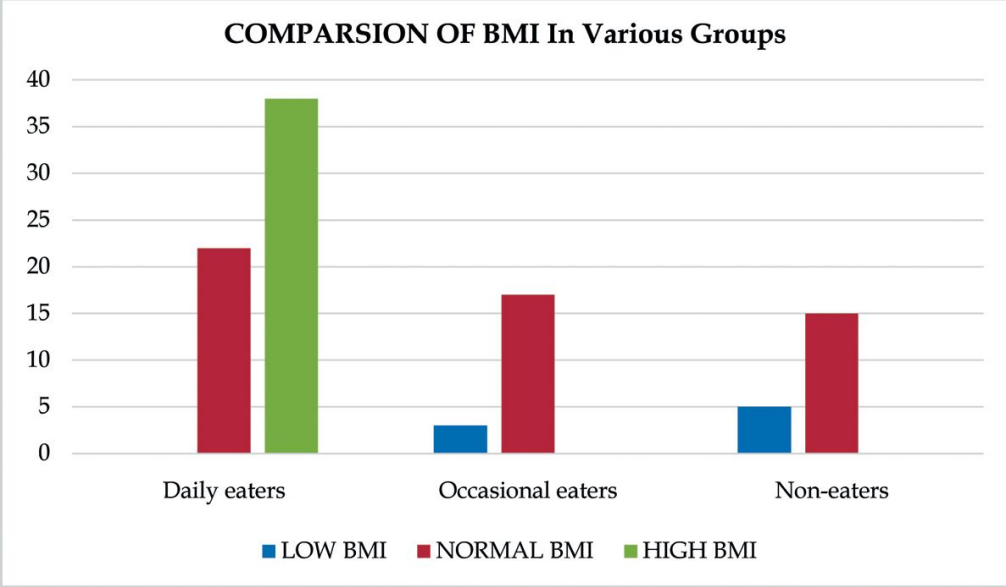

Fig. 2:

Table 4:

BMI Vs Sex in Junk Food eaters			
	Male	Female	Total
Low BMI	0	0	0
Normal	10	14	24
High BMI	18	18	36
	28	32	

chi s0.4018,df=1, P= 0.5262

*Low BMI has been excluded from Chi Square Analysis

Discussion

In the present study, the study of BMI is made in the 3 groups of junk food eaters. They are classified into 3 groups. A. daily junk food eaters (60%). B. occasional junk food eaters (20%) and non junk food eaters (20 %).

In the study of daily junk food eaters , it is observed that 22 (36.6.%) have normal BMI, while 38 (63.3%) have high BMI .In the occasional eaters, 3 students (15 %) have got low BMI and 17 (85%) have normal BMI. but in non eaters 5 students (25%) have low BMI and 15 (75%) have normal BMI. This comparative study shows significant P values statistically. (P <.001). When the mean value of all the 3 groups are studied, the mean value of junk food eaters is 26.13 (SD ±2.89)..,mean value of occasional eaters is 23.03 (SD ± 2.05) and mean value of non eaters is 18.15 (SD ± 1.14). Which is highly significant statistically. P < .001) and F value = 75.22 but in the study of sexual dimorphism it was observed that in males 10 have normal BMI and 18 have high BMI and in females 14 have normal BMI and 18 have high BMI. This value is insignificant statistically (P=0.52). chi^2 value is 0.401 and the difference is 1.

It is interesting to note that by eating the junk food, both males and female adults have gained the BMI considerably indicating that junk food adverse effects occurs irrespective of the sex. Apart from DM, HT, Coronary artery diseases, stroke the raised BMI leads to obesity which is associated with gastro oesophageal reflux diseases [5] and also impair the pharmacokinetics and pharmacodynamics of drugs, implying altered drug distribution leading to secondary complications [6]. As junk foods are rich in carbohydrates with high glycaemic index [7] which are sold outside the home are made delicious and hence popularly called supersized food [8]. It is also observed that daily junk food eaters have peculiar life style and prefer to have food outside the home and while having the food watch TV and games will be unaware of the quantity of food swallowed by them [9]. It is also reported that Ca colon , endometrium and kidney are more prevalent in the daily junk food eaters [10]. It is also observed that an increased BMI leads to obesity leading to lethargy, sedentary lifestyle and osteoarthritis.

Summary and Conclusion

The present study of classification of junk food eaters like daily, occasional and non eaters are very much useful to the nutritional experts, school authorities, paediatricians and physicians to create awareness among the parents and the children because raised BMI leads to obesity which will impair the physical activity and lifestyle in growing children. Instead of blaming the junk food sellers, it is the

responsibility of the parents to convince the children about the side effects of the junk foods and it is also the shared responsibility of the teachers to discourage the junk foods in the schools. This research paper has made an attempt and will be useful if only the awareness is created among unaware parents and negligent teachers because our country is inferior to many underdeveloped countries in participating in Olympic and and international games.

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Variation in Carotid System Anatomy in Central India

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Abstract

Introduction: The common carotid artery is an important artery of blood supply to head, neck and brain located in the carotid triangle. It is also the most important artery responsible for brain stroke. In this study we observed the branching level of common carotid artery and also whether it is bifurcation or trifurcation. *Method:* In the embalmed cadavers, after dissection of neck, we reached carotid sheath and carotid triangle. Carotid system was then identified along with the vagus nerve. Superior thyroid artery which is a branch of external carotid artery (mentioned in standard text books of anatomy) was also noted. *ResuIt:* Bifurcation of carotid artery was found equally distributed at the level of body of hyoid bone (32%) and superior border of thyroid bone (32%). In 50% cases superior thyroid artery arose from bifurcation of carotid artery. *Conclusion:* Terminology of bifurcation of common carotid artery is now invalid in our findings too. It is better to say trifurcation of common carotid artery. Superior thyroid artery is commonly a branch of common carotid artery. Level of bifurcation is also variable, hyoid must be considered for localizing the level.

Keywords: Common Carotid Artery; Bifurcation of carotid artery; Superior thyroid Artery.

Introduction

The Common carotid artery is one of the most important arteries of brain attack. Additionally, during neck surgeries and carotid angiography clinicians have to be very careful about the branches of carotid artery. Common carotid artery (CCA) gives no branch except two terminal branches in neck namely external carotid artery (ECA) and internal carotid artery (ICA). Bifurcation of CCA (CCAb) occurs at the level of superior border of thyroid cartilage [1]. Variability in level of origin of ECA and ICA is remarkable at regional level. Superior thyroid artery (STA) is known as a branch of ECA since long [2]. However, variation in origin of STA has been commonly reported recently [3]. STA may arise from proximal part of CCA or at the level of CCAb. Carotid sinus (CS) is an important structure in close relation to CCAb, the position of which also keeps changing with variation in CCAb. Compression of CS during neck palpation might result in activation of parasympathetic system and inhibition of sympathetic nuclei which may lead to syncope [4,5].

Aim of our study is to note the variability of CCAb location, superior thyroid artery origin, position of carotid sinus, and relation of vagus nerve with carotid system in cadavers of Chhattisgarh region.

Material and Method

We took twenty eight hemi-sections of fourteen cadavers which were donated by family member for research and teaching purpose to Department of Anatomy, All India Institute of Medical Sciences, Raipur, Chhattisgarh. Proper consents were taken from the family members of donors. Out of twelve cadavers, three were females and nine were males, age ranged between 35-80years. After removal of skin, platysma, fascia of neck we reached anterior triangle. Sternocleidomastoid was pushed to one side. Level

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of bifurcation of common carotid, origin of superior thyroid artery, carotid sinus position, relation of vagus nerve to carotid system was traced.

Results

Results of the study is tabulated. We did not have enough sample size for comparison between male and female. Bifurcation of carotid was common at two levels: at the level of body of hyoid bone and at the level of superior border of thyroid cartilage. Superior thyroid artery originated commonly from bifurcation of CCA (CCAb).

Table 1: Various level of bifurcation of common carotid artery in current study and comparing with other studies

S. N.	Position	Numbers (N=28)	Al- Rafiah et al	Ambali et al	Lo et al
1	At the body of hyoid bone	9(32.14%)	25%	42%	6%
2	At greater cornu of hyoid bone	2(7.14%)			15%
3	Above the greater cornu of hyoid bone	2(7.14%)	3.3%		-
4	Between hyoid bone and thyroid cartilage	2(7.14%)	18.3%		-
5	At superior border of thyroid cartilage	9(32.14%)	48.3%	57%	40
6	At the level of upper half of lamina of thyroid cartilage	4(14.28%)	5%	1%	39%

Table 2: Comparison of level of origin of superior thyroid artery from common carotid artery

S.N.	Study	Type I From CCAb	Type II From CCA	Type III From ECA	Type IV As a common trunk thyrolingual or thyrolinguofacial from ECA
1	Ozgur (2009)	40%	35%	25%	2.5%
2	Vazquez (2009) 216	49%	27%	23%	0.6%
3	Natsis (2011) 100	49%	12%	39%	3%
4	Al-Rafiah et al (2011)	76.7%	18.3%	3.3%	1.7%
5	Current Study	50%	25%	21.4%	3.6%

Table 3: Distribution of relation of vagus nerve with carotid system

S.N.	Relation of vagus with carotid system	Percentage %
1	Dorsolateral	64.28%
2	Dorsal	25%
3	Dorsomedial	10.7%

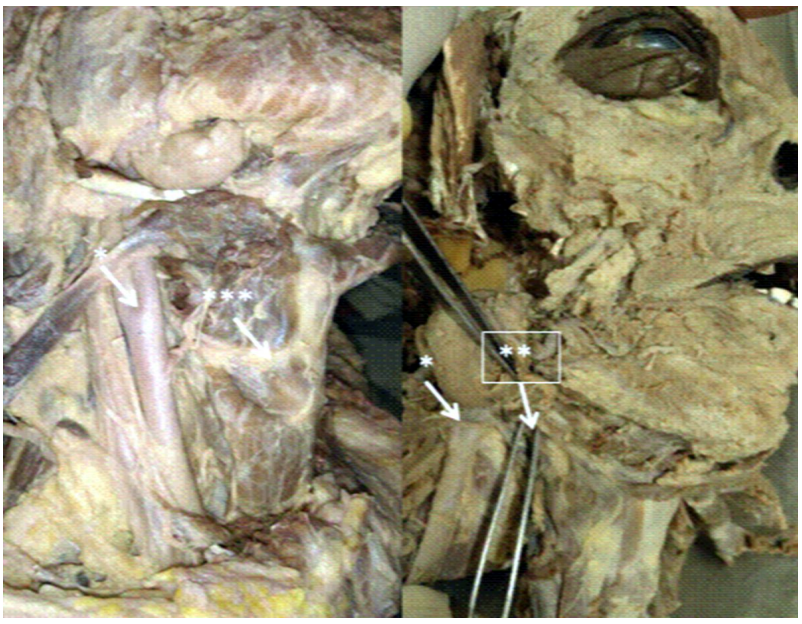

Fig. 1: Different levels of bifurcation of common carotid artery a. In between levels of thyroid cartilage and hyoid bone, b. At the level of hyoid bone; * bifurcation point, **level of hyoid bone, *** level of thyroid

Table 4: Distribution of situation of carotid sinus

S.N.	Presence of Carotid sinus	Percentage
1	At bifurcation	64.28%
2	At ICA	25%
3	At both ICA & Bifurcation	10.7%

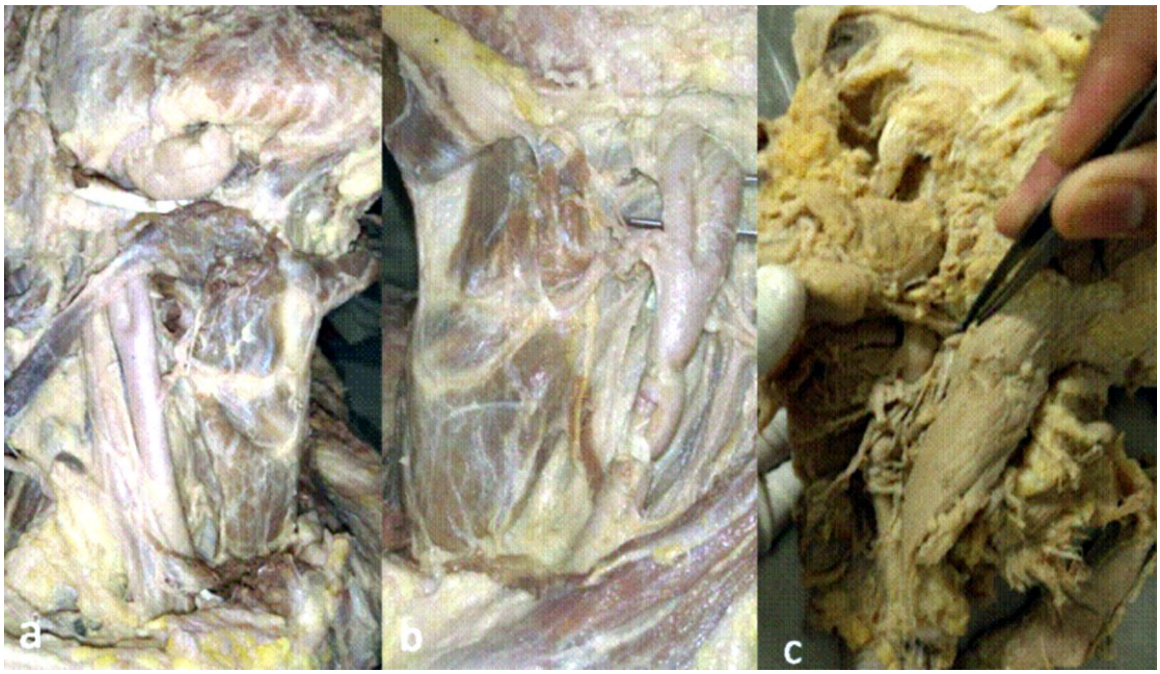

Fig. 2: Different levels of origin of superior thyroid artery a. from common carotid artery, b. from common carotid artery bifurcation as trifurcation, c. from external carotid artery

Discussion

Carotid system stroke is responsible for disabling paralysis in a significant number of patients. This is equally important in cadavers as embalming of cadavers through carotid system is one of the routinely used procedures. Hence, the level of division of CCA is of paramount significance as variation in level of CCAb may result in significant variation in related structures as well. The CCAb level has been discussed in Table 1. In our study, we observed level of CCAb to be both at the level of body of hyoid bone as well as at the level of superior border of thyroid cartilage in almost equal proportion of cases (Figure 1). It implies that the level of hyoid is also equally important while doing carotid angiography and carotid embalming. As per one of the previous studies, the incidence of higher level of bifurcation was relatively low in the south Indian population (11.25%)[6]. Al-Rafiah et al [7] also found the bifurcation above the level of thyroid cartilage in 46.6% cases. Out of which, 25% cases were located at the level of hyoid. Ambali et al [8] also reported nearly similar findings. Lo et al [9] also found bifurcation at the level of hyoid in 21% cases. In these cases, bifurcation point is closely related to the hypoglossal nerve. An unusual case of bilateral intrathoracic bifurcation has also been described in a patient with Klippel-Feil anomaly by Gailloud et al (2000) [10]. These findings suggest that the older concept of CCA bifurcation level at the superior border of thyroid cartilage now needs revision. Now, it extends from thyroid cartilage to hyoid cartilage. The cause for this shift in branching level is still obscure. In current study branching level was noted above the superior border of thyroid in 53.56% cases.

In our study, in almost 50% cases the CCAs had trifurcation and superior thyroid artery was found to be arising from CCAb (Table2, Figure 2). The findings of the current study was less than finding of Al-Rafiah et al, (76.07%) [7], Hayashi et al, (70%) [11] while it was more than the findings of Lucev et al (47.5%) [12] and Ozgur et al (40%) [13]. Vazquez et al [14] and Natsis et al [3] found the same in 49%. A new concept of trifurcation of common carotid is strongly evident in the present study as well as in the studies by Natsis et al, 2011[3], Al-Rafiah et al [7], Hayashi et al [10]. It may be because of regional variation. The STA origin from CCA was found in 10-48% of the cases [1,12,15]. In Indian study, STA was found to be a branch of

CCA including CCAb in 21% by Anitha et al [16], 35.14% cases by Sanjeev et al [17]. This frequent variation in origin of STA must be kept in mind because it is ligated during thyroidectomy by surgeons. In current study, 64.28% cases were found to have classical relationship between carotid system and vagus in carotid sheath, dorsal in 25% cases and dorsomedial in 10.7% cases (Table 3). In current study presence of carotid sinus at bifurcation was in 64 % (Table 4). The CS extended to internal carotid artery in 11% cases or confined to ICA in 25%.

Conclusion

In current study we found the level of thyroid cartilage and hyoid bone equally important with respect to bifurcation of common carotid artery. Origin of superior thyroid artery is also variable and it arose commonly from common carotid artery in the neck as trifurcation which must be considered by surgeons and radiologists. We think that the standard textbooks need to include these findings as it has been confirmed by many studies.

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Students' Perception on the Effectiveness of Various Teaching and Learning Methods in Anatomy

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Abstract

In the modern concept of medical education the role of the faculty member is to facilitate the learning process. Multiple techniques have to be used in order to reach as many different types of learners as possible. The students develop problems like difficulty in studying and understanding of the heavy volumes of the pre-clinical subjects (especially Anatomy),when they join for MBBS. So it is always essential to know the views of the students while revising the curriculum and to know the best teaching methodology which will facilitate the learning process.

Aims: Objectives:

- to assess students'perception of various teaching methods
- to get the opinion of students about the teaching method they feel most interesting
- to know the reasons behind the most accepted method
- to compare traditional and modern teaching methodologies
- to invite suggestions for improvement

Settings and Design: The data was collected from the first MBBS students (n=150) by using a specially designed questionnaire comprising of points relating to the teaching and learning methodology and assessment techniques in PKDIMS, Kerala. *Statistical analysis used*: epi info. *Results:* Students felt about the lecture hours as really interesting and majority favoured normal lecture and group discussions as effective methods. Short notes are considered as the best method among the different patterns of evaluation and many others suggested a combined form of evaluation. *Conclusions:* To conclude, eventhough the medical education is advanced with a variety of innovative learning technologies , students prefer lecture notes and hands on training in cadaver as the best methods of learning. The future learning sessions can be made more interactive considering the above facts.

Keywords: Teaching Methodology; Student's Perception; Problem Based Learning.

Introduction

Anatomy has been always recognized as an essential foundation for clinical sciences.

In the modern concept of medical education the role of the faculty member is to facilitate the learning process. Multiple techniques have to be used in order to reach as many different types of learners as possible. The students who are in the adolescent age group undergo a prior "spoon feeding" type of coaching by their parents and teachers. They develop problems like difficulty in studying and understanding of the heavy volumes of the pre-clinical subjects (especially Anatomy), when they join for MBBS. So it is always essential to know the views of the students while revising the curriculum and to know the best teaching methodology which will facilitate the learning process.

Key Message

Eventhough the medical education is advanced

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with a variety of innovative learning technologies, students prefer lecture notes and hands on training in cadaver as the best methods of learning

Objectives

- To assess students'perception of various teaching methods.
- To get the opinion of students about the teaching method they feel most interesting.
- To know the reasons behind the most accepted method.
- To compare traditional and modern teaching methodologies.
- To invite suggestions for improvement.

Subjects and Methods

The data was collected from the first MBBS students (n=150) by using a specially designed questionnaire comprising of points relating to the teaching and learning methodology and assessment techniques in P K Das institute of Medical Sciences, Ottapalm, Kerala.

The students were briefed about the questionnaire & asked to respond freely and fearlessly. They were also be informed that the information furnished by them is for the research and evaluation purpose only and will be confidential. The questionnaire were collected back from the students and analysed considering each question of the questionnaire.

Results

The questionnaires were found to be complete except for a few where they didn't respond to all questions. The important data were taken into account during the analysis part and are discussed as follows:

Students were asked how they felt about the lecture hours to which majority(n=87) strongly agreed that they felt it really interesting (Figure 1).

1-Strongly disagree

2-Disagree

3-Neutral

4-Agree

5-Strongly agree

Attitude of students towards the method of teaching when assessed, pointed to the fact that majority favoured normal lecture and group discussions as effective methods, while a good number(n=34) strongly disagreed to seminars as a teaching method (Table 1).

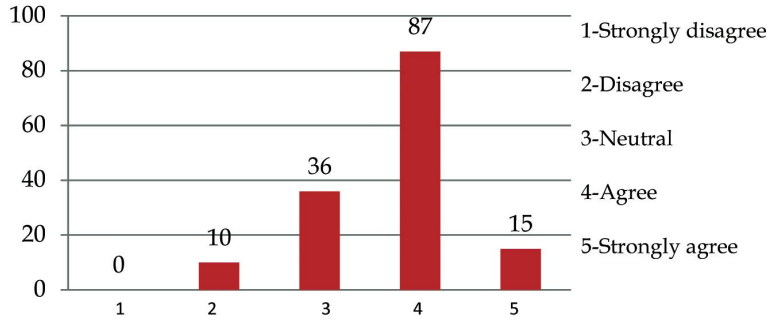

Fig. 1: Topics covered during normal lectures are interesting

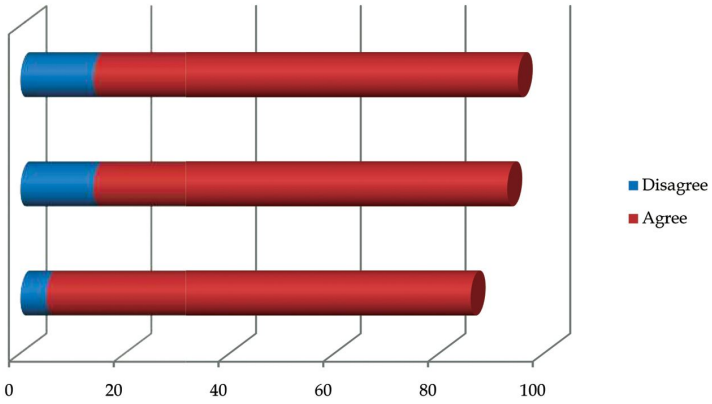

Fig. 2: Opinion about the Faculty Members

Table 1: The method of teaching you feel more effective

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	No response
(a) Normal Lecture	1	4	10	79	28	28
(b) Group Discussion	1	5	14	61	31	38
(c) Seminars	34	19	19	18	4	56

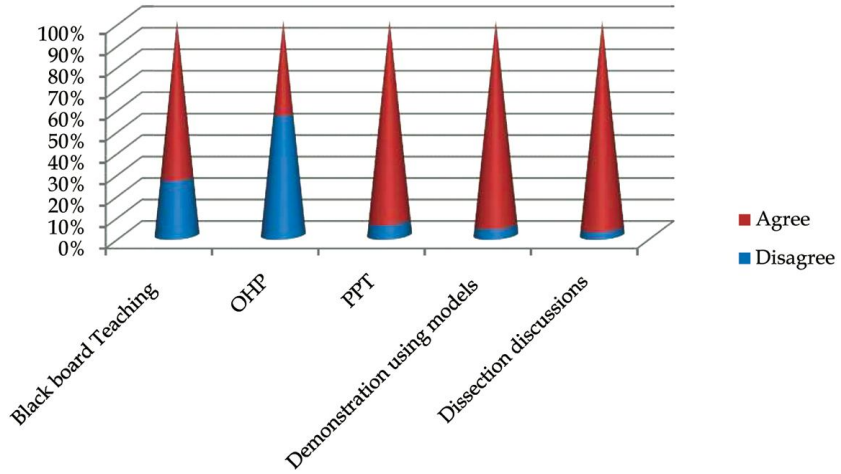

Fig. 3: Medium of teaching & their application

1 The faculties are approachable and helping to clarify the doubts.

2 Faculties are having good communication skill.

3 Faculties are making the lectures interesting.

Majority of the students agreed to the fact that faculties are having good communication skills and approachable in time of need (Figure 2).

The students were asked about the medium which they prefer for classes. Most of the students opinioned that power point, demonstration and dissection discussions helped them a lot while some disagreed to the methods using blackboard and OHP (Figure 3).

The students were asked to comment on the different patterns of evaluation. Majority (n=90) opinioned that Short notes are the best method and many others(n=60) suggested a combined form of evaluation. Long essays, discussions,viva voce and Multiple choice were not helpful according to some students (Table 2).

Table 2: Pattern of Evaluation

The method you feel better way of evaluation	Disagree	Agree
Long Essay Question	16	58
Short Essay Question	5	76
Short Notes	2	90
Multiple choice Questions	17	49
Viva voce	18	45
Discussion	19	56
A combined form of all the above	8	60

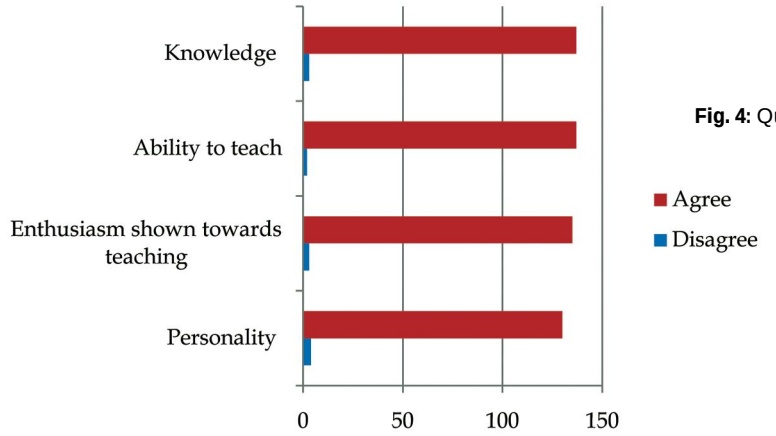

Fig. 4: Qualities of a teacher influencing students

Knowledge of the teacher, ability to teach, enthusiasm shown towards teaching and personality were considered as the criteria to assess qualities of a teacher. Majority of the students were influenced by all the mentioned qualities a teacher could possess (Figure 4).

Among the different learning methods lecture notes and self notes were acceptable to majority of students whereas some disagreed to reference method (n=23 + 8) and to the idea of following a single text book (n=26+5).

Table 3: Attitude towards learning methods

	Strongly Disagree	Disagree	Undecided/Neutral	Agree	Strongly Agree
Prefers lecture notes	2	7	16	78	42
Prepare self notes	2	1	21	64	51
Prefers Reference study	8	23	49	36	21
Prefers to follow single text book for a subject	5	26	21	54	36

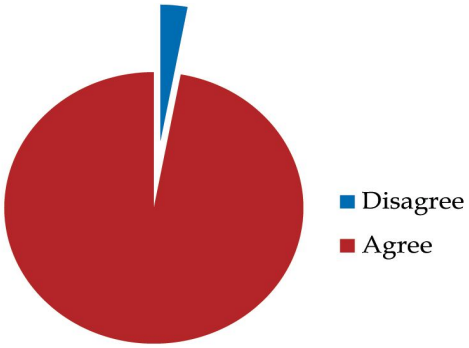

Fig. 5: Prefers clinical problem based approach

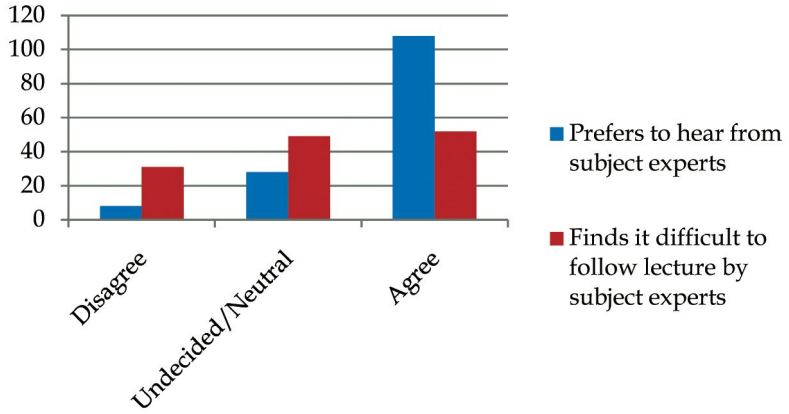

Fig. 6: Attitude towards vertically integrated lectures

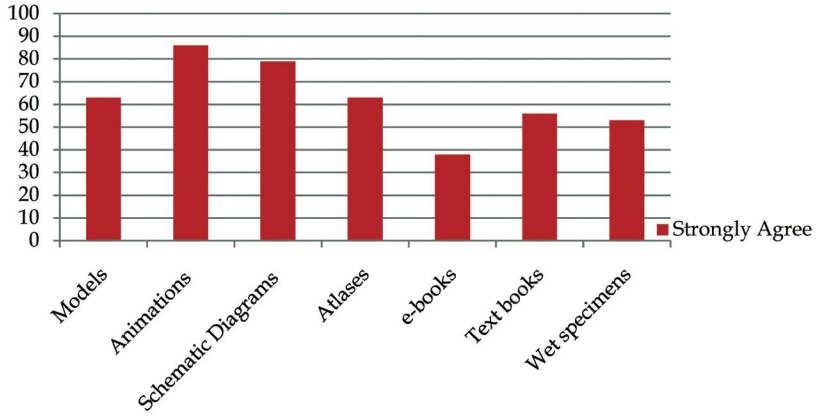

Fig. 7: Need for various teaching aids

The students were asked to make a comparison between classes based on basic theory and those based on problem based approach to which majority preferred the later, since it created an interest to the topic compared to blank theories (Figure 5).

Vertical integration with lectures by subject experts were found to be useful for many while some could not follow since the topic is dealt in detail. Since the students were not exposed to many lectures in this category a small group expressed their neutral attitude (Figure 6).

The different teaching aids used by the students were considered out of which majority found animations, schematic diagrams and models helpful and e-books were not favoured by many (Figure 7)

Discussion

Students felt about the lecture hours as really interesting and majority favoured normal lecture and group discussions as effective methods. According to some studies, as a teaching mode 59% of the students favored group discussion versus didactic lectures (14%). Almost 48% felt that those didactic lectures fail to create interest & motivation [1].

Almost all the students agreed to the fact that faculties are having

good communication skills and are approachable in time of need.

Short notes are considered as the best method among the different patterns of evaluation and many others suggested a combined form of evaluation.

Knowledge of the teacher, ability to teach, enthusiasm shown towards teaching and personality were considered as essential criterias for a good teacher .

Among the different learning methods lecture notes and self notes were acceptable to majority of students whereas some disagreed to reference method and to the idea of following a single text book. The students preferred classes based on problem based approach, since it created an interest to the topic compared to blank theories. Problem based learning (PBL) is explained by eminent scientist as 'In PBL students use "triggers" from the problem case or scenario to define their own learning objectives. Subsequently they do independent, self-directed study before returning to the group to discuss and refine their acquired knowledge [3].

Vertical integration with lectures by subject experts were found to be useful for many while some could not follow since the topic is dealt in detail.

The different teaching aids used like animations, schematic diagrams and models were helpful and e-books were not favoured by many. ÿþArora L & Sharma BR consider that the dissection forms important part in training of undergraduate students [2]. Using appropriate coeducational equipment and improving lecturer's teaching skills can make a big step in the elevation of students learning in Anatomy lesson [4].

Medical students would prefer that anatomy is taught practically (via dissection, use of prosection, with living and radiological anatomy) than theoretically (via didactic teaching, models [5].

Conclusion

To conclude ,eventhough the medical education is advanced with a variety of innovative learning technologies, students prefer lecture notes and hands on training in cadaver as the best methods of learning. However power point lectures are more acceptable than chalk and board and the knowledge and personality of teachers influenced them a lot. Problem based learning methods generate a curiosity in them rather than basic theories. The future learning sessions can be made more interactive considering the above facts.

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Clinical and Cytogenetic Study in Primary Amenorrhea

Vinayak Kulkarni*, SeemaKorgaonkar, Babu Rao Vundinti*****

Abstract

The failure to menstruate by the age of 16 years in the presence of normal secondary sexual characters or 14 years in the absence of other evidence of puberty defines primary amenorrhea and warrant investigations. Though its incidence is less than 0.1%, there is great challenge for clinician in compartmentalizing its etiology and cytogenetics, along with hormonal profile plays a major role in classification of primary amenorrhea. We have carried out a study in 100 cases of primary amenorrhea to evaluate the clinical and cytogenetic correlation in patients with primary amenorrhea. The patient's clinical details were recorded in the case record sheet. The chromosome preparation was done from the peripheral blood according to standard protocol. The chromosome preparations were subjected to GTG banding and karyotyped according to the International System for Human Cytogenetic Nomenclature (ISCN 2011). The fluorescence in situ hybridization (FISH) was carried out using centromeric probes for X and Y chromosome as per the standard protocol. Of the several different causes of PA, anatomical abnormality was seen in 26% cases, ovarian failure in 47% cases and remaining 27% cases were because of constitutional delay and other factors. The chromosomal aberrations were detected in 28% cases. The present study has emphasized that cytogenetic study (karyotyping and FISH) is one of the fundamental investigations for the diagnosis and management of primary amenorrhea.

Keywords: Primary Amenorrhea (PA); Cytogenetics; Fluorescence in Situ Hybridization (FISH) Chromosomal Abnormalities (CA); Karyotype; Secondary Sexual Characters; Follicle Stimulating Hormone (FSH); Ultrasonography (USG).

Introduction

The primary amenorrhea (PA) is defined as absence of menstruation by the age of 16 years in the presence of normal secondary sexual characters or 14 years in the absence of other evidence of puberty. Primary amenorrhea is not a disease but a symptom that may result from several different causes.These are compartmentalized into those related to the outflow tract (congenital malformation or receptor insensitivity), the ovary (abnormal or absent germ cells and abnormal folliculogenesis), the anterior pituitary (disrupted gonadotropin production or secretion) and the CNS (hypothalamic-pituitary dysfunction) [1]. Incidence of PA is 15% (WHO), the sixth largest major cause of female infertility [2]. Overall it is estimated that endocrine disorders account for approximately 40% of the causes of PA, with the remaining 60% having developmental (genetic or structural) origins [3]. Chromosomal abnormalities are found to be the most important factor in the causation of PA hence the genetic basis of it should be revealed. There is lot of variation in thefrequency of chromosomal abnormalities in primary amenorrhea and the other caseswith normal female karyotype may be associated with abnormal or absent gonads and hypoplastic or absent uterus.

In this study we have analysed the types of chromosomal abnormalities seen in primary amenorrhea and correlated these with different clinical and hormonal factors.

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Materials and Methods

100 cases of primary amenorrhea coming to our institute from Mumbai and surrounding region for cytogenetic analysis during the period of 2012 to 2015 were enrolled in the study. During presentation their age ranged from 14 to 30 years. After informed written consent from the patient, details like age, height, clinical features breast development, pubic hairs, axillary hairs, hormone profile and USG details were recorded in the case record sheet. Also at the time of referral consent was obtained from each patient or relative, that the information may be presented or discussed or published without revealing the identity of the patient.

Chromosomal preparation was done from the peripheral blood based on a short-term culture of activated T-lymphocytes stimulated with phytohemagglutinin. After sampling of 3-5 ml of peripheral blood in sodium heparin vacutainer tube; blood cells (T-lymphocites) were cultured (37° for 72 hours) on RPMI 1640 medium (9 ml), supplemented with fetal calf serum (1 ml), L - glutamine (0.1 ml), phytohemagglutinin and antibiotics (penicillin and streptomycin). Then, the culture was treated with a hypotonic solution, fixed, and dropped onto a microscope slide.The slides were stained and examined on optical microscope, direct or after application of G- banding (after trypsin treatment) and karyotyped according to International System for Human Cytogenetic Nomenclature (ISCN 2011).

The metaphases were analysed with a Nikon microscope and images were captured with an automated image analysis system. For each case a minimum 30 metaphases were analysed.

A standard protocol was followed for FISH. The slides with metaphase chromosomes prepared as per standard cytogenetic procedure were dehydrated in 70%, 80% and 100% ethanol for 2 min each at room temperature and air dried. The centromeric, locus specific probes for X &Y chromosomes were used for FISH. Probes were mixed with hybridization buffer and deionized distilled water and applied to the slides. The metaphase chromosomes and the probes were co-denatured using Hybrite at 73°C for 3 minutes. The slides were sealed with coverslip using rubber cement and hybridization was carried out for 24 hours at 37°C. After 24 hours of hybridization, the coverslip was removed and the slides were rinsed in formamide wash solution (0.4X SSC / 0.3%NP-40) at 45°C and the slides were air dried. After air drying, the slides were counterstained with DAPI (7.5µl / slide), covered with coverslip, stored in dark prior to signal enumeration and observed under fluorescent microscope for appropriate signals.

Results

Distribution of clinical features such as absence of breast development, absent secondary sexual characters and stature were presented in Figure 1. In the present study 42% cases of PA presented as short stature. Frequency of abnormal breast development has been noticed in57% cases, pubic hairs was absent in 59 % cases and axillary hairs was absent in 61% cases of PA.The FSH levels (>20 mIU / ml) were found to be increased in 63 cases of PA.

The data on different causes such as mullerian agenesis, AIS, vaginal septum, imperforate hymen,

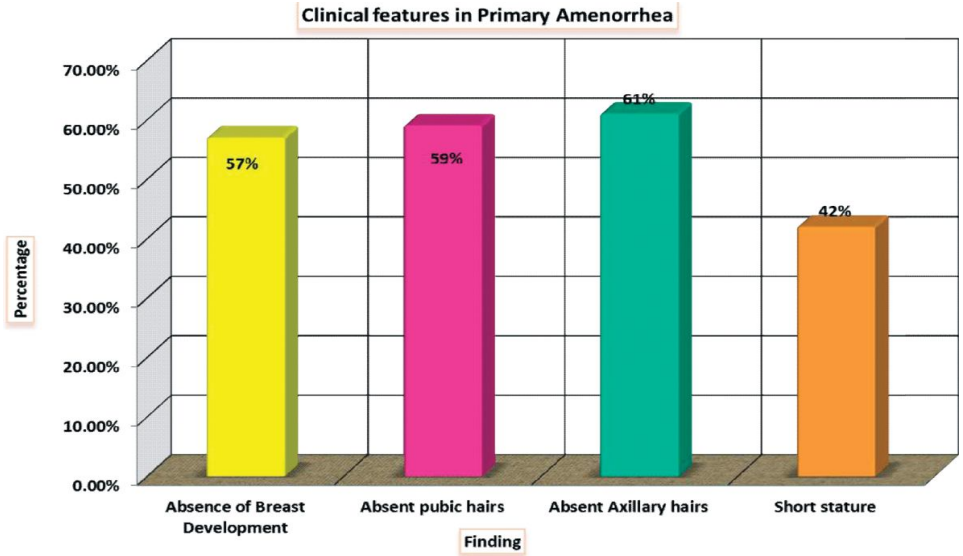

Fig. 1: Distribution of clinical features in PA

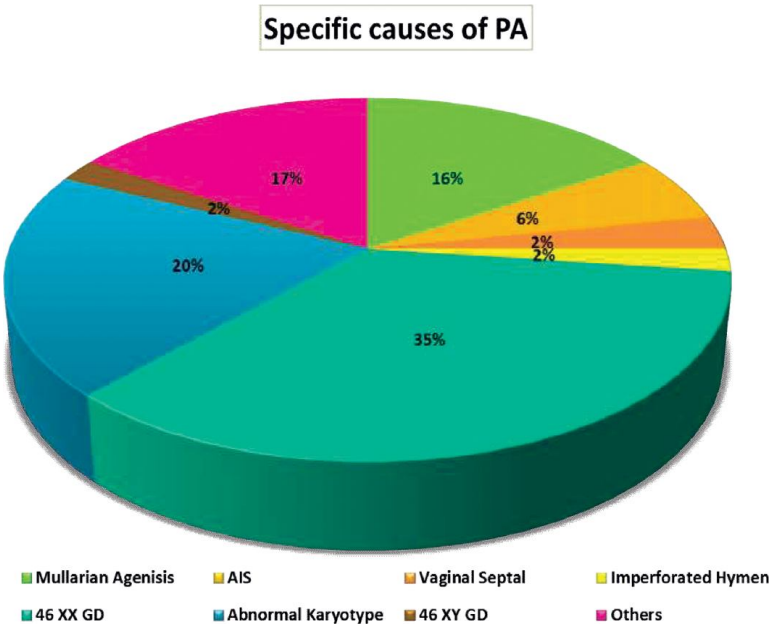

Fig. 2: Distribution of etiological factors in PA

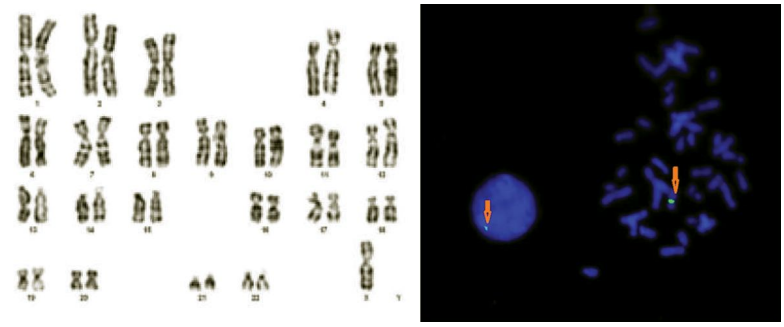

Fig. 3: Karyotype and FISH showing Monosomy X

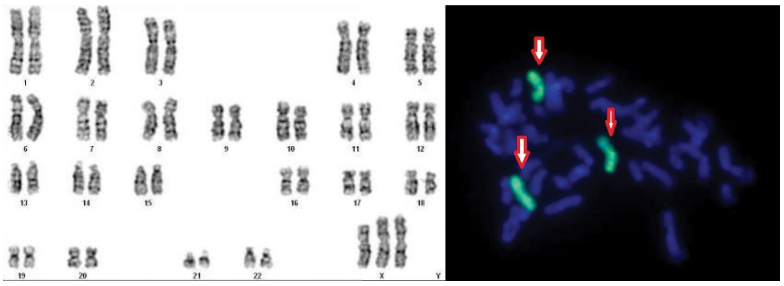

Fig. 4: Karyotype and FISH showing iso(Xq)

Table 1: Distribution of chromosomal abnormality in PA

Karyotype	No. of cases	Percentage
45,X	9	28%
45,X/46,XX	4	
46,X,i(Xq)& 47,X,i(q),i(q)	3	
46,X,del(X)	2	
46,X,der(X)t(X;10)q11:q11)	1	
46,X,X,inv9(p11:q13)	1	
46,XY	8	
46,XX	72	72%

ovarian failure due to 46,XX, 46,XY and abnormal karyotype is presented in figure 2.Among the several different causes ofPA, frequency of ovarian failure due to increased FSH levels is seen to be high in 46,XX GD in 35% cases, 46,XY GD in 8 %cases, abnormal karyotype in 20 % cases andanatomical factor such as mullerian agenesis is found in 16% cases, imperforate hymen in 2% , vaginal septum in 2% cases and other causes such as constitutional delay in 17% cases.

In this study, frequency of the chromosomal aberrations such as 45,X was found in 9% cases, followed by 46,XY in 8%, 45,X/46,XX in 4% 46,X,i(Xq) & 47,X,i(q),i(q) in 3%, 46,X,del(X) in 2%, 46,X,der(X) t(X;10)(q11.q11) in 1%; 46,XX,inv9(p11.q13) in 1% (Table 1).

Discussion

In the present study of Primary amenorrhea, it has been reported that genetic factors accounts of 28 % cases of amenorrhea which indicates that apart from endocrinological and structural causes, cytogenetic abnormality is playing important role.Hence knowledge of cytogeneticsis essential for further management of these cases. The aim of the present study was to find out the role of the cytogeneticsin PA and to correlate the cytogenetic abnormality with clinical and hormonal factors . Assessment of secondary sexual characters like breast development, development of pubic and axillary hairs plays important role as it reflects the normal gonadal activity. The patients having normal secondary sexual characters, pelvic USG is advised to identify presence of uterus, cervix and upper vagina (which rule out mullerian agenesis) and ovaries (which rule out gonadal dysgenesis).The reported incidence of PA in the previous studies ranges from 16-78% and the average frequency of CA in women with PA

was around 42% [4]. Lakshmi Kalpanaet al [5] found abnormal karyotype in 20 / 70(28.57%)cases, Mondel et al [6] in 24 / 72(33.33%) cases, Vijayalaksmi et al [7] in 39 / 140(27.85%) cases andRajangam et al [3] in 162 / 620(26.13%) cases of PAin Indian population. In the present study, out of the 100 cases of PA, normal female karyotype was seen in 72% cases and abnormal karyotype is seen in 28% cases.

Broadly the chromosomal abnormality in the PA cases are grouped as pure Turner (45,X), X mosaicism, structural abnormality and 46,XY female. In the present study the distribution of the CA in PA cases is found to be, 45,X (9%), X mosaicism (4%), structural abnormality of X and other chromosome (7%) and 46,XY female (8%) (Table 1). Those females who present as PA with karyotype 46,XY are phenotypically female since the abnormal gonadal tissue in these cases fails to producemullerian inhibiting factor and testosterone. Gonadal tumours occur in up to 25% of women with a Y chromosome; unlike complete androgen sensitivity syndrome, these gonads do not secrete hormones and should be removed at the time of diagnosis [8]. As the incidence of male karyotype in this study is high, the presence of Y chromosome should be confirmed by molecular cytogenetic technique like FISH. At the same time these cases needs to be further assessed for any mutation of SRY gene, SF1 gene and the other genes which are responsible for male karyotype in phenotypic female with PA [9].

Conclusion

The present study concluded that cytogenetic abnormalities plays an important rolein women with the absence of menstruation and secondary sexual characters. Hence these women should be investigated for chromosomal abnormality along with the routine hormonal and radiological (USG) investigations for the exact diagnosis and management. More emphasis should be given to cytogenetic investigations as the clinical signs and symptoms are found to be variable in these cases. After exclusion of non-genetic causes, patients with PA should receive prompt referral for genetic and molecular study. Genetic counselling should include the risk of premature menopause for patients with Turner's syndrome, possibility of pregnancy in cases with X mosaicism and the use of hormone replacement therapy, the risk of gonadal malignancy for patients with XY GD and the possibility of infertility in patients with other chromosomal aberrations.

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Evaluation of Teratogenic Potential of Ondansetron on Developing Chick Embryo

Bokariya P.*, Kothari R., Gujar V.*, Shende MR***, Doshi MA*****

Abstract

Objective: To determine the teratogenic potential on developing chick embryo after injection of ondansetronto the fertilised egg and comparing it withembryos of controls. *Methodology*: The present study was conducted inthe Department of Anatomy in our Institute.Fertilised chicken eggs were exposed toondansetron by injecting the drug through air sac on 3rd Embryonic Day (ED). The control group and the experimental group were examined intermittently by candling method to check death of embryos. Survived Chicken eggs were dissected out on day 19th of incubation and were carefully observed for any major congenital abnormalities. The embryos thus dissected out were subjected to estimation of crown-rump length (CRL), changes in weight of egg (before and after incubation), volume of embryos. *Results*:The mortality in experimental group was significantly higher as compare to control ones. All the other parameters studied in this study are non-significant statistically. *Conclusion*: The outcome of study is suggestive of no significant effect on various parameters used to evaluate teratogenicity but significant mortality is sign of concern.

Keywords: Chick Embryo; Ondansetron; Teratogen; Mortality.

Introduction

Ondansetron is a serotonin 5-HT_3 receptor antagonist used mainly as an antiemetic to treat nausea and vomiting, commonly following chemotherapy. It is also used off-label to treat hyperemesis gravidarum in women, but there is no conclusive data available on its safety in pregnancy, especially during initial months of pregnancy.

Chick embryo is a popular experimental model for developmental studies. It has certain practicaladvantages like easy experimental manipulation, richhistory in developmental biology and the shortincubation time, which emphasize the importance of thechick embryo, as a model animal forsuch developmental studies [1].

Early development of the embryo takes place in the blastoderm. The albumen surrounds the yolk and protects the potential life of developing embryo. It is an elastic, shock-absorbing semi-solid with high water content. The yolk and albumen are prepared simultaneouslyto sustain life - the life of a growing embryo- for twenty one days, in the case of the chicken. This entire mass is surrounded by two membranes and an external covering called the shell. The shell provides for an exchange of gases and a mechanical means of conserving the food and water supply within [2].

Early chick mortality may be associated with disease, inadequate brooding temperatures, heat stress and poor management in hot climates [3].

Aim

To determine the teratogenic effect of ondansetron on developing chick embryos after injecting the drug on 3rd day of incubation. Study also aims in comparing the mortality among two groups by noting the number of dead embryos.

Material and Methods

An incubator (Yorko make) with capabilities for

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maintaining and monitoring temperature and humidity and turning the eggs periodically, was used forincubating the eggs. The temperature in the incubator was maintained at 102°F and the relative humidity was kept between 70-80% [2].

Total of hundred developing chick embryos were utilized for this study with due permission from Institutional Ethics committee. Out of which first fifty were kept in control group and other half in experimental group. The eggs of experimental group were injected with 1.0 mg (this dosage was calculated as non-lethal from our previous experiments) of ondansetron dose [4]. The developing eggs were allowed to develop and were check intermittently for their survival with candling method. Weight of egg before putting them in incubator and weight of egg after 19th day(gm) were noted using digital weighing balance. The volume of embryos were estimated using fluid displacement principle. Crown Rump(CR) Length in cm for all the groups was also measuredfor each survived embryo by passing a thread from root of beak along the back to the tip of coccyx and then measuring length of thread.

The embryos were also grossly observed for

1) Abnormalities of head and neck.
2) Deformities of limb.
3) Abnormalities of beak.
4) Deficient abdominal wall.

Data collected was fed in the computer and statistical software (Epi info) was used. The variable fed into the data analysis software was termed as 'survivability' where a value of '1' denoted alive embryo and a value of '2'denoted dead embryo.

Results

The embryos were carefully examined for any gross malformations. None of the embryo treated with ondansetron showed any deviation from normal anatomical structure. The table shows the mortality of embryos in both groups. The number of embryos survived in control groups were 44 and number of survived eggs in experimental group were 41. The mortality in experimental group was bit higher and statistically significant when compared with the controls. The comparative account of mortality is shown in Figure 1.

The initial weight of eggs that was just taken prior to keeping them in incubator and final weight was the weight taken just prior to opening of egg. The difference of final and initial weights were treated as decrease in weight. The decrease in weight were statistically non-significant (Figure 2).

The mean values for volumes of embryos are also depicted in table 1 and Figure 3. These values for experimental group when compared statistically with their control counterparts also showed non-significant deviation. The mean values for CR length were also non-significant in two groups. Graphical representation of all is shown in Figure 4.

Table 1: An evaluation of teratogenic potential of ondansetron on developing chick embryo

S. No	Parameter	Control	Experimental	P value
1	Mortality	12%	18%	Significant
2	Decrease in Weight	3.99 ±0.92	3.81±1.12	0.212 (p>0.05), NS
3	CR Length in cm	5.93 ± 0.36	5.87 ± 0.44	0.225 (p>0.05),NS
4	Volume of Embryo	5.67±0.62	5.66±0.61	0.47 (p>0.05), NS

Fig. 1:

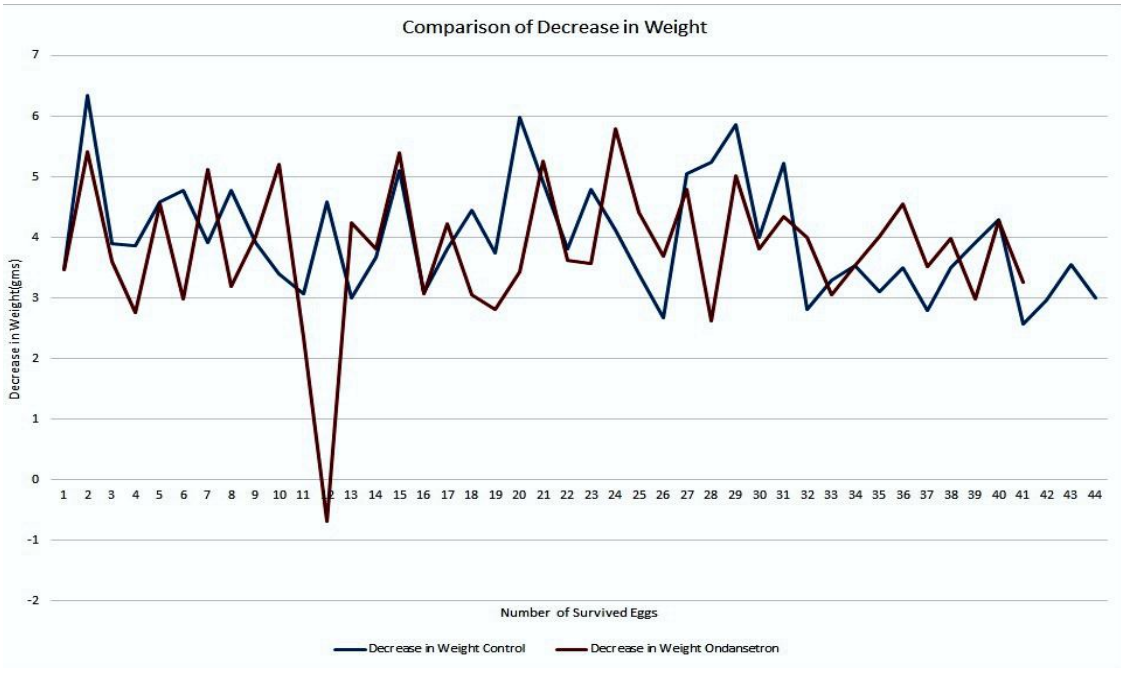

Fig. 2:

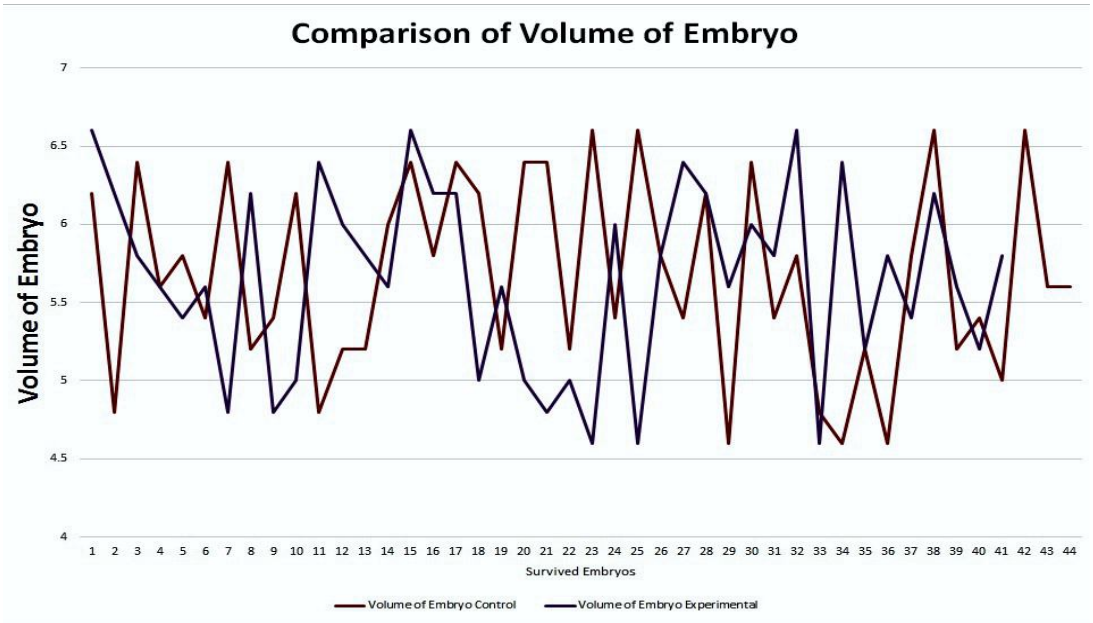

Fig. 3:

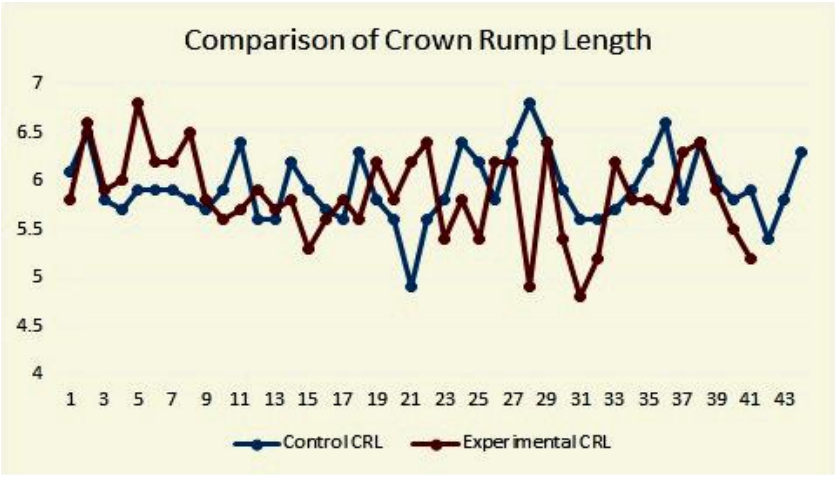

Fig. 4:

Discussion

The present study is an attempt to evaluate the embryotoxic effects of the Ondansetron. This is first detailed analysis of ondansetron toxicity in the chick embryo for which there are no detailed data available in literature to the best of our knowledge. We were not able to find single study which has employed ondansetron as target drug for developing chick embryo. We selected the ondansetron because of its widely usage during emesis. Moreover self-medication amongst people of this subcontinent is not so uncommon. The selection of drug dosage in this study was based on our own previous study.

Good hatchability depends on meeting all crucial incubation parameters and conditions. One of these important parameter is weight loss. In general, eggs should lose 11-13% of initial weight during the first 18 days of incubation. Weight loss in hatching eggs is caused by the regular evaporation of water from the eggs and inseparably linked to achieving optimum embryonic development during incubation.

This weight loss from the egg is essential for the formation of the air cell and at the same time, the evaporation of water from the egg facilitates optimized water, mineral balances in the different embryonic compartmentsformed during the embryonic development.

As soon internal egg temperature rises, evaporation through the shell and the transport of water from the albumen to sub-embryonic cavity increase. The reasons of weight gain in one case is beyond our knowledge and an extensive literature search for this observation did not yield any explanation.

We were not able to find any gross malformations in any chick and major reason behind it can be that chicks were allowed to hatch full term. Had there been any malformation the chick would have not survived. Many different researchers have reported malformations in development of organs or body with the use of chemicals specially insectisides [5].

Conclusion

The mortality of chicks in experimental group is very significant observation. The remaining parameters observed in experimental group showed non-significant deviation from control groups.This warrants further advance studies with larger sample size.

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Molecular Genetic study of Complete Hydatidiform Moles

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Abstract

Moles are abnormal pregnancies posing a reproductive health risk and are of two types, Complete hydatidiform moles (CHM) and partial hydatidiform moles (PHM) also commonly known as 'gestational trophoblastic disease'. The genetic constitution of complete hydatidiform mole is either 46,XX or 46,YY (uniparental paternal isodisomy) and 46,XY (uniparental paternal heterodisomy). Till date it is considered that CHM with 46,YY are rarely reported and such with 46,YY karyotype are more neoplastic and less viable, but extensive work is needed in developing and underdeveloped countries. PHMs are generally triploid having maternal contribution also, the genetic constitution of PHM is generally 69,XXY, 69,XXX or 69,XYY. The molar pregnancies are malignant in nature and its neoplasticity is more virulent in CHM as compared to PHM. Difference in the neoplasticity of CHM and PHM is due to its genetic constitution. There are reports where ultrasonic and pathologic investigations have failed to correctly diagnose molar pregnancies in first trimester. Even, sometimes β - hCG levels, which are hallmark for diagnosis shows false negativity. Hence, for confirmation and treatment of such high risk disease genetic diagnosis is must. We conducted molecular genetic study by polymerase chain reaction (PCR) on the genetic constituents of 10 complete moles to confirm their genetic constitutions.

Keywords: Complete Hydatidiform Mole; Patial Hydatidiform Mole; Neoplasticity; Genetic Constitution.

Introduction

Hydatidiform moles, are abnormal pregnancies, develop from an abnormal growth of trophoblastic cells that would otherwise normally develop into placenta. The name hydatidiform mole comes from the greek word 'hydatisia' which means drop of water and "mola" means false conception. They are of two types, Complete hydatidiform mole (CHM) and partial hydatidiform mole (PHM) and both are commonly known as 'gestational trophoblastic disease [1].

Complete hydatidiform moles are resulted from two haploid sets of paternal genomes with no maternal genomic contribution and foetal development or foetal tissues [2,3]. It often present with vaginal bleeding, ultrasound examination shows widespread and marked hyperplasia with swollen villi. It can be distinguished from partial moles by morphology, genetics(Partial moles are triploid) and immune staining of maternally expressed genes [1,4,5]. CHM most often have the karyotype 46,XX or 46,YY with both haploid sets chromosomes being paternally derived [2]. PHMs are generally triploid having maternal contribution also, the genetic constitution of PHM is generally 69XXY, 69XXX or 69XYY [2,6].

Mostly CHM prengnancies cases are sporadic, only a less number of cases are recurrent and often familial, generally diploid and biparental (contain paternal and maternal sets of chromosome). Two genes such as NLRP7 (NLR family, pyrin domain containg 7) and KHDC1 (KH domain containg 3-like) are identified as recessive gene responsible for recurrent hydatidiform moles [3]. Chromosomal and genetic anomalies have a significant adverse effect on human reproduction resulting in infertility, pregnancy loss, still births and molar pregnancy.

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Genetic investigations can provide important information on reproductive health risk, one such risk is molar pregnancy. A complete hydatidiform mole is a rare finding, however it can develop into gestational tropoblastic neoplasia, a malignant and life threatening disease. We have conducted a molecular genetic study of complete hydatidiform moles to see the frequency of different genetic constituents i.e. 46,XX or 46,YY.

Materials & Method

As it is a rare disease (0.5 to 1/1000 pregnancies) we could collect 10 samples of CHM from our pathology department, further it was used for DNA extraction by polymerase chain reaction (PCR).

Tissue Collections and Processing

Paraffin block were trimmed to remove extra paraffin and placed in xylene overnight. Give repeat changes of xylene for 2 hours to remove any traces of wax. Give three times change of absolute alcohol to remove xylene from the tissue and kept in 90% alcohol for overnight. Next day keep in 70% alcohol for 2 hrs and wash with tap water and kept immersed for 2 hrs by changing the water twice during this period. Wash tissue with PBS buffer for removing impurities.

DNA Extraction from Tissue

Total DNA from mole tissue was extracted according to following standard protocol. Take tissue in micro-centrifuge tube and minced it, add TE9 buffer in tube, kept for 37^{0}C for 24 hrs then remove supernatant and add 350 µl TE9 and add 50 µl of 20% SDS, 0.5% triton X 100, 15 µl of DTT and 25 µl of proteinase K and incubate at 55^{0}C in a water-bath for 24 hrs. After digestion, the lysate was extracted with phenol, followed by phenol/chloroform (1:1v/v) and one-tenth volume of 3M sodium acetate (pH5.6) and incubated at -20^{0}C overnight. After washing with 75% ethanol (v/v), the DNA pellet was dried by speed vacuum, and finally DNA pellet dissolved in 10 mM Tris-Hcl pH 8.3. Now, DNA sample was ready for further analysis.

Identification of Sex Chromosome Genotype by Polymerase Chain Reaction

In polymerase chain reaction study, specific primers were used for amplification of SRY gene on Y chromosome and DAX gene on X chromosome for the detection of X and Y chromosome. SRY gene primer sequences were followed as forward primer: 5'-GAATATTCCCGCTCTCCGGA-3', reveres primer: 5'-GCTGGTGCTCCATTCTTGAG-3' and DAX-1 gene primer sequences were followed as forward primer: 5'-CCGCGCCCTTGCCCAGACC-3, reveres primer: 5-GCCGCCTGCGCTTGATTTGT-3'. Segment of gene was amplified from 100 ng of mole tissue DNA in a 50 µl reaction mixture containing 200 µM of each dNTP, 1µM each of forwards and reverse primers, 1IU of Taq DNA Polymerase, 50 mM KCL, 2 mM $Mgcl_2$, 25 mM, and 10 mM Tris-HCl, pH 8.3. Each PCR was carried out for 30 cycles in a DNA thermal cycle using the standard protocol. PCR conditions of denaturation at 94^{0}C for 1 min, annealing at 55^{0}C for 1 min, and primer extension at 72^{0}C for 1 min after the required no. of cycles, an additional extension step at 72^{0}C for 3 min was performed. PCR product was checked on 1.5% agarose gel using 1x TAE buffer at 150 volts for 1.5 hrs using ethidium bromide containing agarose gel electrophoresis. After gel electrophoresis, gel documentation system was used for detection of SRY or DAX gene. Amplification of desired gene was detected on the basis of 100 bp DNA ladder (i.e. SRY-472 bp and DAX1-835bp) and positive control of DNA bands. Gel photography was done by gel documentation software.

Results

In our study, we analyzed 10 sample of

Table 1: PCR amplification results and genetic constitution of tissues

No. of Tissues	SRY Amplification	DAX-1 Amplification	Chromosome constitution	Remarks
Tissue-1	+	-	YY	Complete mole
Tissue -2	+	-	YY	Complete mole
Tissue -3	+	-	YY	Complete mole
Tissue -4	+	+	XY	Complete mole
Tissue -5	+	-	YY	Complete mole
Tissue -6	+	-	YY	Complete mole
Tissue -7	+	-	YY	Complete mole
Tissue -8	+	+	XY	Complete mole
Tissue -9	+	-	YY	Complete mole
Tissue -10	+	-	YY	Complete mole

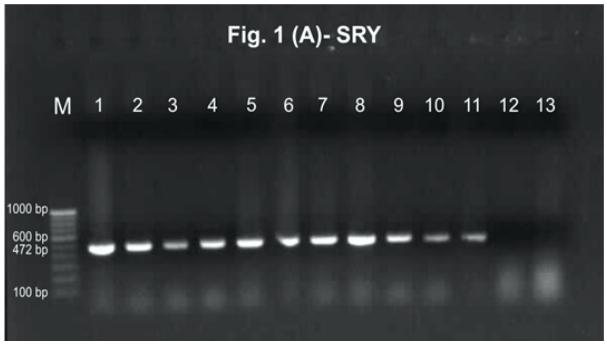

Fig. 1: A: Agarose gel electrophoresis analysis showed the amplification of SRY gene in hydatidiform mole tissue. Lane M-100 bp DNA ladder, Lane No. 1: positive control DNA of fertile male, Lane No.2-11: SRY amplification product from mole tissue DNA, Lane No.12: Negative control water sample, Lane No. 13: Negative control female DNA.

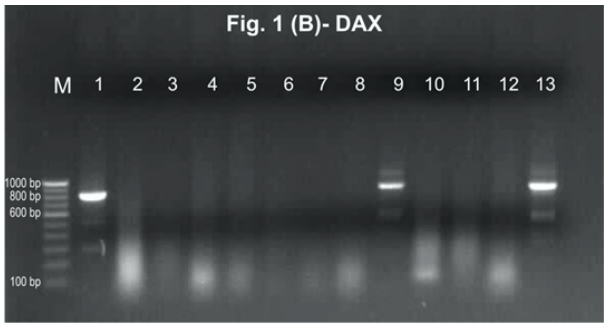

Fig. 1B: Agarose gel electrophoresis analysis showed the amplification of DAX-1 gene in hydatidiform mole tissue. Lane M-100 bp DNA ladder, Lane No. 1: internal positive control DNA of fertile male, Lane No.2-8,10,11: No amplification of DAX-1 product from mole tissue DNA, Lane No. 9: DAX-1 amplification product from tissue DNA, Lane No.12: Negative control water sample, Lane No. 13: positive control female DNA.

hydentidiform mole tissue for identification of XX and YY chromosome genotype by PCR amplification. All 10 mole samples shown complete hydentidiform mole type. Out of 10 samples, 1 CHM tissue shown XY genotype and 9 CHM tissue shown YY genotype (Table 1, Figure 1).

Discussion

Reports on the incidences of complete and partial hydatidiform moles are variable. IN Europe and North America the incidence ranges from 0.6 to 1.1 per 1000 pregnancies, in Australia ranges from 0.91-1.41 per 1000 pregnancies but in Southeast Asia and Japan the incidence is as high as 2.0 per 1000 pregnancies [1,7]. Women younger than 16 have a 6 fold increased risk and women older than 40 have 5 to 10 fold increased risk of mole development compared to women aged 16-40 years [1]. Maternal age appears to be the main risk factor with women at either end of the reproductive age having the highest risk [8,9,10]. Women aged over 50 years have a 1 in 3 risk of complete molar pregnancies. History of previous complete mole is also a risk factor and such women have 10-20 fold higher risk than that of the general population [11].

The abnormal foetal-placental development in a complete mole is due to abnormal effect of genomic imprinting. Loss of the maternal epigenetic imprint and abnormal gains of paternally imprinted gene expression together result in global genome demethylation and abnormal gene expression resulting in abnormal trophoblastic development [3,10]. Two genes NLRP7 and KHDC3L are identified responsible for recurrent hydatidiform moles which is a rare condition. NLRP7 is located at 19q13.4 and it was the first identified recessive gene involved in recurrent hydatidiform moles and the second is KHDC3L, located at 6q13 [2,3]. The exact causal mechanisms involving these two genes are not fully understood. However, possibly deregulation of imprinted genes result in aberrant cell proliferation and differentiation leading to pathogenesis [3]. Accurate diagnosis of a complete mole is of clinical importance because of the increased risk (18-29%) of a developing gestational trophoblastic neoplasia.

In present study, we have studied the frequency of genetic constituents Complete hydatidiform mole. We studied the 10 CHM samples for PCR based screening of sex gene identification by DNA extraction. Here, we observed 9 cases of YY genotype and 1 cases of XY genotype. The molar pregnancies are malignant in nature and its neoplasticity is more virulent in CHM as compared to PHM. Difference in the neoplasticity of CHM and PHM is due to its genetic constitution. In our finding we have got karyotype 46,YY predominantly whereas most of the literature from European countries shows commomon karyotype as 46,XX [12]. This might be due to geographical and genetic variation . Due to paucity of molecular genetic labs as well as the specimens of molar pregnancy, there is no genetic data available across India. Elaborative study is needed with larger sample size to standardize our own data for better patient management.

We believe that the management of HM requires an accurate diagnosis that should be based on a histopathology and conclusively supported by a genetic analysis. Even though this diagnostic pathway may put financial burden on patients, we consider that the efforts justify the benefit for the patient's management. Most of the PHM have been misdiagnosed on ultrasound as well as histopathological investigation as incomplete

abortion hence routinely genetic examination should be done in addition to pathological examination [6,9]. Most of the clinicians rely on β -hCG assay pregnancy test for diagnosing hydatidiform mole. Interestingly, chromatographic immunoassays such as qualitative β-hCG assays, may produce false-negative results in the presence of excessively high antigen concentrations in a phenomenon known as the *high-dose hook effect* [13]. Ultimately, it should prevent the development of choriocarcinoma, as most of these patients can be successfully treated with current chemotherapy. There are still few of the patients who dies from this disease or receive inadequate treatment, usually because of a delayed or erroneous diagnosis [8,9,13]. The authenticity of the diagnosis is key for proper counselling and to categorise patient into *short-term* or *longterm* follow-up to minimize the period during which patients are recommended to use contraceptive methods. Accurate line of treatment is of immense importance for all the patients, still it carries greater importance in higher age group. Patients with PHM can conceive after six months but patients with CHM cannot conceive for almost two years, which is traumatic for higher age group [4,14]. The risk of hydatidiform mole increases with higher age and previous history of molar pregnancy [8,11]. As the virulence of the disease changes with its genetic constitution it is of utmost importance to confirm it for treatment and subsequent rehabilitation of the patients.

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Buccal Smear Examination for Barr Bodies as Sex Determination Tool: Is it a Redundant Exercise?

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Abstract

Neuroanatomists Murray Barr and Ewart Bertram in 1949 provided first study on sex chromatin, later named as Barr body. This led to a theory proposed by Mary F. Lyon in 1961 called as "Lyon hypothesis". Since then the Barr body from buccal smear is used as a sex determination tool. However, with advent of modern molecular methodologies it is labeled as a useless tool by some investigators. Authors of this article wish to stress the importance of Barr body examination as a low cost effective tool.

Keywords: Sex Chromatin; Barr Body; Amenorrhea; Inguinal Hernia; Turner Syndrome.

Introduction

Neuroanatomists Murray Barr and Ewart Bertram in 1949 provided first study for a difference between cells of male and female individuals of the same species. They discovered a nuclear body that was present only in female and not in male neuronal cells in cats, which they termed "sex chromatin" and which is famously called "Barr body" after Murray Barr [1]. It is the inactive X chromosome seen in interphase nucleus of female somatic cell [2].

Mary F. Lyon in 1961 put forward a hypothesis. She proposed the concept of random X chromosome inactivation as the mechanism of dosage compensation in female mammals. Her hypothesis is known as "Lyon hypothesis" [3].

Inactivation of X Chromosome in Females [4]

The X chromosome to be inactivated is randomly chosen in somatic cells. But once decided whether the paternal or maternal X chromosome will be inactivated all the cells follow the inactivation process .Spontaneous, unprogrammed reactivation is extremely rare. The gene for inactivation process is located on long arm of X chromosome. The centre is called X inactivation centre.

The inactive X chromosome is distinguished from the active X chromosome by the following characteristics: (i) Overall transcriptional inactivation (apart from certain X-linked genes which escape inactivation and the XIST gene – X Inactive Specific Transcript); (ii) Heterochromatic condensation at interphase of the cell cycle, sometimes visible as the Barr body; (iii) Late replication during S phase; (iv) DNA methylation of cytosine residues at CpG dinucleotides in the region of X-linked genes; (v) Hypoacetylation of histone (vi) Expression of the XIST gene located at the X-inactivation center.

The Mechanism of X Chromosome Inactivation [5]

The basic mechanism appears to be DNA methylation Literature has reported that CpG islands of several genes are methylated on the Xi (inactive X) chromosome and unmethylated on the Xa (active X chromosome).

Turner Syndrome and Klinefelter's Syndrome [6]

Turner syndrome patients inspite of having female phenotype have Buccal smear negative for Barr body. On the other hand Klinefelter's syndrome (47, XXY) patients are phenotypic males with one extra X chromosome and hence Barr body positive.

Inguinal Hernia in Children and Barr Body [7, 8]

Few authors have reported that female children

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with inguinal hernia should raise a suspicion about child's nuclear sex as about 2% female children with inguinal hernia have been reported to have intersex differentiation syndrome.

Ambiguous Genitalia and Barr Body [9]

Studies suggest that female children presenting with Ambiguous genitalia as a result of genital virilization may have congenital adrenal hyperplasia (CAH). This is due to 21-hydroxylase deficiency. Authors have recommended having prenatal genetic diagnosis of CAH and fetal sex determination to identify affected female fetuses at risk for genital virilization so that prenatal dexamethasone treatment can be administered early in the first trimester.

The Positive, and Negative Barr Body [10]

A buccal smear showing 20-50% cells having Barr body is said to be positive smear. A normal female will show buccal smear positive for Barr bodies. A buccal smear from a normal male will show 2-5% cells with Barr bodies. This smear is said to be Negative for Barr bodies.

Barr Body Size and Numbers [11]

As evident from literature Buccal smears showing Barr bodies in the range between 5-20% along with small size of Barr bodies should raise suspicion of chromosomal abnormalities like deletion of a part of X chromosome.

Extra number of Barr bodies in females and males is suggestive of presence of extra X chromosome, like in case of Females having 47,XXX complement may present with menstrual disturbance and absence of secondary sex characters.

The frequency of Barr bodies is decreased during pregnancy as well as in women on oral contraceptive pills as reported in a few studies [12].

The Y Chromosome and F Body [13]

In a male, a smear of buccal mucosal scraping or peripheral blood stained with dye quinacrine hydrochloride will show bright fluorescent dot in the nucleus indicating presence of the Y chromosome which selectively takes up this dye, which has the property of fluorescing strongly under ultraviolet light.

Twenty years after the paper of Barr and Bertram, the fluorescent (F) body, or Y chromatin was discovered in interphase nuclei [14].

Limitations of Barr Body Studies [15]

Literature mentions that the buccal smear, as a test for sex chromatin, is of no use to the clinician investigating a reproductive problem. Irrespective of results of Barr body authors also suggest that it is essential to do full chromosomal analysis and. the sex-chromatin test is of use only to the cytogeneticist to complement his or her laboratory studies. The presence and frequency of Barr bodies is helpful in deciding whether the possibility of sex-chromatin mosaicism is great enough to warrant cytogenetic analysis of more cells or examination of other tissues.

Materials and Methods

This study includes patients referred to this department between January 2008 to December 2012 for Barr body in buccal smear for determination of sex. This investigation is done routinely in this department and is done free of cost.

The patients having Amenorrhea, ambiguous genital and inguinal swellings were referred from Gynecology, Pediatrics and Pediatric surgery departments.

The referred patients were re- examined in Anatomy department. All the findings and results of investigations were entered in the register maintained in the department for buccal smear studies.

The patients were instructed about the procedure.

After the patient had rinsed mouth thoroughly with water, Inner aspect of cheek was scraped gently with a blunt spatula. The superficial cells were taken on a sterile slide. The smear was spread evenly on slide and kept for drying. Then slide was processed as given below:

It was placed in 70% Alcohol solution for 5 minutes.

Rinsed in Distilled water.

Placed in 1N HCL for 5 minutes.

Again rinsed in Distilled water.

Stained in 5% Toluidine blue for 3-10 minutes.

Washed in slow running water.

Air dried.

Observed under high power and oil immersion lens.

The Barr body appears as mass of chromatin attached to inner aspect of nuclear membrane in the cell. Only those bodies which were situated at the periphery of the nucleus were considered to be Barr

bodies because human mucosal nuclei has high occurrence of other non-sex bodies present freely in the nucleoplasm, so can be confused with Barr body, also maximum studies show the occurrence of Barr body at periphery in human nuclei [16].

All patients were advised Karyotyping and FISH to confirm the results and decide line of treatment. Inspite of best efforts it was difficult to follow up the patients later.

Results

From observation table it is seen that buccal smear examination for Barr Body was advised as a primary tool of sex determination as it is noninvasive and less costly compared to Karyotyping or other molecular genetic studies. Also those cases having clinical features suggestive of some genetic abnormalities were referred for evaluation.

The distribution of types of cases referred to the department was as follows:

Swelling in groin or inguinal hernia (case numbers 4, 5, 6, 19, 20, 21, 22, 24, 25 = 9 cases).

Amenorrhea (Primary or secondary) was the second most common presenting complaint seen in 8 cases (case numbers 1, 2, 3, 7, 8, 10, 12, 14).

Ambiguous genitalia (3 cases), Congenital heart disease, Lymphadenopathy, Hypospadias, Turner Syndrome, Poor scholastic performance and delay in development were other presenting complaints.

Observation Table

Sr. No.	Age	Sex	Presenting complaint	Investigations	Buccal Smear Examination
1.	18	F	Primary. Amenorrhea	Ut- normal Ovaries not commented on	Positive
2.	20	F	Primary. Amenorrhea	Ovaries N Ut- Bicornuate Blind vagina	Positive
3.	17	F	Primary. Amenorrhea	No sec. Sex Characters. Ut- not palpable, Ext. Genitals infantile, Short stature	Negative
4.	1 1/2	F	Left Inguinal hernia	Nose bridge flat No Turner stigmata	Positive
5.	3 1/2	F	Right Inguinal hernia	Short neck, Low posterior hairline, widely spaced 2nd toe Arm span > height 1st cousin marriage in parents	Positive
6.	17	F	Right Inguinal hernia	Hypoplastic uterus	Positive
7.	18	F	Primary Amenorrhea	Ut and ovaries not visualized Sec. sex characters well developed	Negative
8.	18	F	Primary Amenorrhea	Hypoplastic uterus, Ovaries - normal	Positive
9.	4	F	Ambiguous genitals	Bilateral empty scrotal bags, Low set ears, Flat nose bridge	Positive
10.	18	F	Secondary Amenorrhea	Flat nose bridge, Short neck, Low posterior hair line, Arm span <height, Consanguinity	Positive
11.	8	F	Lymphadenopathy	Broad short neck, Increased blood flow in kidneys, Prominent hepatic veins, ascites, Coarctation of aorta, Splenomegaly.	Positive
12.	18	F	Primary Amenorrhea	Ut and Ovaries seen, Breast developed, no axillary hairs, Pubic hairs sparse, Ext. Genitals infantile	Positive
13.	12	F	CHD with short stature	Coarctation of aorta, Low set ears, Low posterior hairline, Flat nasal bridge, Axillary hairs absent	Positive
14.	16	F	Prim Amenorrhea	Rudimentary uterus, No vagina, blind pouch, Rectum and bladder adherent, Low set ears, Low posterior hairline, Cubitus valgus	Positive
15.	13	F	Poor scholastic performance	Short stature, Palmar creases are scanty, widely spaced nipples, High arched palate, Consanguineous	Positive
16.	9	F	Hypospadias with chordee	No uterus, ovaries, Undescended testis, well defined hypoechoic tissue in rectovesical pouch.	Negative
17.	12	F	Developmental delay	Ut and ovaries seen, Lt hydronephrosis with hydroureter,short stature, Neck webbed, No axillary or pubic hairs	Positive

18.	4	F	Ambiguous genitals	Ut seen, Ovaries normal, Enlarged clitoris, congenital adrenal hyperplasia	Positive
19.	8	F	B/L Inguinal hernia	Rt swelling smaller than left, Left has cough impulse	Positive
20.	5 1/2	F	B/L Inguinal hernia	Bilateral inguinal swellings, cough impulse +, Ext genitals normal	Positive
21.	3 1/2	F	Lt. Inguinal hernia	Swelling in left groin region which increases with straining and coughing	Positive
22.	11 month	F	Lt. Inguinal swelling	Cough impulse positive	Positive
23.	11	F	Turner Syndrome	Short stature , Neck webbing, Increased carrying angle, widely spaced nipples	Positive
24.	7	F	B/L Inguinal hernia	Cubitus Valgus	Positive
25.	6	F	B/L Inguinal hernia	Bilateral groin swelling	Positive

Abbreviations: F= Female, Ut= Uterus, Rt=right, Lt = left, CHD = Congenital heart disease, B/L= bilateral

Discussion

It is seen from the observation table that the cases presenting with primary or secondary amenorrhea have characteristic clinical findings. Of the 8 patients of amenorrhea, case no. 3 and case no. 7 have buccal smear negative for Barr bodies. Looking at their clinical features case no 3 (who has Primary amenorrhea, short stature, absent secondary sexual characters and infantile external genitals) and case no 7(Uterus and Ovaries not visualized on Sonography) which is suggestive of 46, XY gonadal dysgenesis [17]. In such cases, it will be a futile exercise to send these patients for expensive investigations like Karyotyping and FISH when buccal smear examination can give valuable insights in planning treatment for such patients.

Case No.11 (Broad, short neck, coarctation of Aorta), 13 (CHD with short stature), 17(short stature, webbed neck, absent pubic and axillary hairs),and case no. 23 (short stature, webbed neck, increased carrying angle, widely spaced nipples)have features suggestive of Turner phenotype [18] and the positive Barr body can be due to presence of mosaicism [19].

Case No. 15 is a phenotypic female with short stature and scanty palmar creases. As discussed earlier the short stature is indicative of Turner phenotype.

Case No. 16 with hypospadias and chordee is a case of wrong gender assignment as it is clearly evident by presence of undescended testis, absence of uterus and ovaries and a buccal smear negative for Barr body.

So as per authors of this study, this primary noninvasive and cost effective tool eliminates the need for detailed chromosomal analyses for sex determination in many cases e.g. in sports or intersex disorders where clinical features and Barr body examination correlation can establish a diagnosis. However due to availability of modern molecular diagnostic techniques this tool has been used less frequently and as specified earlier by some authors [20] it has been awarded only academic value.

Since Mary Lyon's hypothesis, a lot of progress has been made towards the understanding of this fundamental process of Barr body formation. Yet many things are left to be discovered. For instance correlation of Barr bodies and cancer [21].

It is also interesting to note that there are conditions under which this inactivated X chromosome in females becomes activated again. Physiological stress is one such condition reported by some investigators [22]. The part of X which carries the gene XIST required for inactivating X chromosome assumes essential role. It is left to be investigated if deletion of this gene will lead to failure of X inactivation in females and leading to genetic disorder.

From this study the corresponding author wants to suggest that even if modern techniques are made available for diagnosing clinical cases where sex determination is required, the Barr body examination can serve as a low cost and non invasive tool to supplement other investigations like Karyotyping. A further research is required to know if the Barr body shape and size changes with hormonal influence in menstrual cycle and if this tool can be used as a screening measure for early detection of cancers.

Conclusion

The role of this investigation as a diagnostic tool cannot be undermined so far as sex determination is concerned.

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Small Group Teaching: Easy Method of Learning Anatomy

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Abstract

As the medical undergraduate curriculum has been restructured, anatomy teaching methods have also progressed. Traditional teaching methods of dissection, tutorials and lectures are now supplemented by anatomical models, surgical videos and e-learning. The introduction of 'small-group teaching' in gross anatomy has emerged as noteworthy and has had a constructive impact on the academic achievement of students in anatomy. The interaction of 10-12 students and an instructor around a cadaver on a dissecting table in the traditional gross anatomy laboratory is an example of small group teaching in anatomy. Without refuting the significance of traditional lectures, a growing number of teachers are appreciating the importance of small group work, as an important supplement to lectures. The benefits are ample, including growing involvement by students, superior understanding, retention of material, finer skills, and an eagerness for self-directed learning—which can even motivate students for taking on independent research. *Conclusion:* Small group teaching has a plethora of benefits like positive interactions among students from diverse cultural backgrounds, exchange of information, academic achievement, possession of new knowledge and fine skills, aptitude to work out clinical problems, motivation to learn confidence and social development.

Keywords: Medical Undergraduate Curriculum; Anatomy; Teaching Methods; Dissection; Tutorials; Lectures; Anatomical Models; Surgical Videos; E-Learning; Small-Group Teaching.

Introduction

Anatomy is one of the most important medical science disciplines in the undergraduate curriculum and forms the foundation for the training of future doctors Anatomy is not only indispensible for surgeons but also essential for anyone who performs an invasive procedure on a patient; It is extremely vital for radio-logical imaging; and even for a simple physical examination of a patient. Thus all branches of medicine require Anatomy. Worldwide curriculum reforms have resulted in a reduction in the gross anatomy teaching hours. With diminishing time and resources devoted to anatomical education, it is crucial that the remaining teaching of anatomy be effective, efficient and evidence-based [1]. Small group teaching is frequently used in professional colleges and has a surplus benefits like positive interactions among students from diverse cultural backgrounds, exchange of information, academic achievement, possession of new knowledge and fine skills, aptitude to work out clinical problems, motivation to learn, confidence and social development. Moreover it has no detrimental effects at all. But if the fundamentals of how to administer and supervise small group teaching is not known, some of its benefits may be lost. This paper is designed to address planning and management of small-group learning activities so as to formulate this instructional design as an integral part of the anatomy curriculum [2].

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Discussion

Members of the group should be made to understand that they are mutually dependent on each

other. Each group member is accountable for the success or failure of every other member because group members will all succeed or all fail at completing the assignment. This can be accomplished by giving a common goal to the entire group to achieve [3]. At the same time each member must be held accountable for his or her share. This will keep the students focussed. Without individual accountability, two common problems are likely to arise: either some members may contribute very little, or a particular member may dominate and complete the entire assignment. Members of the group should be encouraged to interact with each other through discussing concepts, encouraging each other and sharing personal experiences; in this way they will help each other to learn concepts. One of the aims of small-group teaching is to develop the interpersonal and communication skills of the students, which are important in their later education and career [4]. Different members of the group should possess different social skills to be able to complete a task, like leadership qualities, communication and active listening qualities, conflict- solving abilities and decision making. The teacher should be aware of these qualities of the students and bring together such a group. In a small group, each student is expected to contribute equally. That means work as well as the time has to be equally divided among the members. For example, for a given concept, in the first half of the time, half the group will discuss and the other half will be actively listening and in the remaining half of the time roles are switched over [6]. For a small group learning session to be successful, an important pre-requisite is that students work in the same place and at the same time, so that they are able to discuss concepts, actively listen, and quickly solve problems [7]. Thus small group teaching provides students with a firm foundation, allowing the progression to more explorative self-directed learning methods. Ideally, groups should have upto five members, to allow everyone to contribute Members should be chosen based upon differing achievement levels, learning styles, career objectives, personalities or past experiences. Groups can be informal or formal. Informal groups are those which pick their own partners, but this should be avoided as such groups stray from their objectives. Formal groups can be co-operative or collaborative. Co-operative group learning procedures are more structured. They reflect upon a group session, to depict what member performances were supportive and unsupportive and on that basis, they make decisions about which actions to maintain and which to amend. They thus become better judges of quality work. Collaborative groups use more negotiation to solve conflicts among their members [8]. At the outset of a task, group members should be given explicit directions by the instructor, for example, the instructional goal - whether it is a problem solving or understanding of a concept. Students prefer this small-group learning method over a completely self-directed method in the gross anatomy, because the study materials are carefully chosen and the study objectives are clearly demonstrated by the instructor. The functioning of the group should be monitored discreetly. The instructor should circulate among the groups, but avoid being invasive unless a question needs to be answered or the group seems unable to proceed on the task [9]. The instructor's task is to lead and not to order what should happen amongst the group members. If, for example, group members grumble that someone isn't contributing enough, the instructor should make it plain that resolving the problem is up to the group and won't be solved by the intervention of the instructor [10]. Ideally groups should not be graded because it promotes competition and decrease cooperation. In these cases, the academically weaker students may be ostracized. In a competitive academic environment, where students have most often been rewarded for individual effort, collaboration may not come naturally for everyone. Some students at the outset express uncertainty about the significance of group work, or believe that class time is best spent hearing from the instructor rather than working with students who are acquainted with as little as themselves. Others may think that they have done well up till now on their personal effort, and don't want to be weighed down by other erstwhile students with different histories of success or different functioning styles. And some students are simply withdrawn and not used to contributing their work to their colleagues [11]. Lecture may be a faster way to convey information, but what remains to be seen is that how much information do the students retain after a lecture. According to Slavin et al there is an increase in academic achievement when small groups are used. Although students may not learn as much detailed information, they will learn other skills crucial to their academic success, such as problem solving, critical thinking, leadership, communication, and contributing to a group [12].

Anatomy is a living subject, not a collection of facts learnt early and then forgotten. Retaining anatomical facts requires constant practical application. Group activity is an intrinsic feature of the traditional dissection room. Benefits of cadaver study are learning teamwork, learning self instruction, appreciation of mortality.

During the study of gross anatomy, most medical students are faced with more material than they have

ever dealt with before in such a short time frame. They wonder if they will make it through the course. They do, and the confidence they gain helps them through even more difficult experiences later in their training. Dissection of a cadaver provides a deep learning experience that is not soon forgotten [13].

The major form of teaching in the medical gross anatomy course is small group teaching in the dissection hall lead by a medically qualified demonstrator.

Here there is a hybrid of three types of small group teaching – dissection sessions, discussion sessions and problem solving sessions. Even basic dysfunctional anatomy can be taught in groups, like for example - What would or would not happen if this nerve were cut? Would an infarct occur if this artery were occluded? What would be the result of tearing this ligament? An advantage of the large dissection hall space is that small group teaching can be applicable to the whole medical class within a single space; multiple rooms do not have to be reserved [14]. Small group teaching can also be carried out with bones and radiographic films and three-dimensional (3D) plastic models used as supplementary teaching material. Living anatomy sessions can also be small group sessions with the aid of videos.

These can later be used by the students for self study. As per study conducted by Davis et al, 99% of students felt that they learned more from small-group teaching with cadavers and with medically qualified demonstrators, as compared to didactic lectures or self-directed learning [15]. Although small group teaching in gross anatomy consumes a large amount of faculty time, it cannot overshadow the educational benefits described above [16]. Such strong preference for face-to-face, small-group cadaveric teaching as well as the surplus benefits of this type of teaching, suggests that this modality should be a major consideration in course design [17]. To teach complicated and intricate areas of the human body eg Perineum, the traditional cadaveric dissection, may not be enough.

For such topics, a dissection video is prepared which not only shows the steps of dissection, but also 2D diagrams of sagittal and coronal sections. Simultaneously a 3D model can also be shown to the students. All these aids help to simplify the topic. These kind of audio-visual aids are complementary to the traditional modes of teaching, A digital anatomical teaching tool with the combination of dissection, 2D diagrams and the demonstration of the 3D model adds to the perception of that region [18].

Conclusion

Small group teaching has a plethora of benefits like positive interactions among students from diverse cultural backgrounds, exchange of information, academic achievement, possession of new knowledge and fine skills, aptitude to work out clinical problems, motivation to learn, confidence and social development. Moreover it has no detrimental effects at all. But if the fundamentals of how to administer and supervise small group teaching is not known, some of its benefits may be lost.The instructor must address the importance of group work and the essentiality of its goals, since students will be far more motivated to participate if they see the application of the group assignments to larger course objectives. Determining how the groups will be formed can be more complex for the instructor, since ideally the groups should be varied enough to include students with a range of intellectual abilities, academic interests, and cognitive styles. Although students may not learn as much detailed information in small group teaching as they would in a lecture, they will learn other skills crucial to their academic success, such as problem solving, critical thinking, leadership, communication, and contributing to a group. Small group teaching with cadavers in the dissection hall is indispensible in the study of gross anatomy. Here the students learn not only normal anatomy, but also the basic language of medicine as well as the concept of biological variation. They develop manual dexterity. Dissection nurtures the group spirit thus assisting in social bonding and communication. In a climate of declining time devoted to anatomy teaching, small group teaching forms the basis of efficient anatomy teaching of the future.

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Steps in the Dissection of the Fibrous Skeleton of the Heart

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Abstract

The fibrous skeleton of the heart is best defined as those tissues at the base of the heart which consists of dense collagen fibers which remain stationary with respect to functionally moving parts of the heart namely myocardium, valve leaflets and elastically distensible arteries arising from the heart. So far no clear guidelines are available for dissecting the fibrous skeleton of the heart. The present study evolves the steps in dissecting the fibrous skeleton of the cadaverichearts. Its morphological features such as position, shape and extent are noted. Aim of the study is to dissect the fibrous skeleton of the heart andexplain its dissection steps. Fibrous skeleton is situated at the base of the heart where four functional apertures of the ventricles are crowded together. In fetal life the atrioventricular annuli are in the same plane but in adult they are oblique i.e. at 45^0 and are connected with each other by right and left trigone, which appears as figure of 8. The atrioventricular conducting bundle is only physiological connection between the atria and ventricle across the fibrous ring. The right and left trigone, aortic and pulmonary annuli, conus ligament, membranous septum, tendon of Todaro were dissected and observed. Fibrous skeleton of the heart & its three dimensional views are helpful for both undergraduate and post graduate students of anatomy and cardiology. It would also help cardio-thoracic surgeons in Annuloplasty operations.

Keywords: Fibrous Skeleton of the Heart; Key Stone; Left Trigone; Conus Ligament; Annuli.

Introduction

Operative surgery concerns itself with the production of therapeutically desirable change in the anatomy of the body. The introduction of surgery to any special region of body places it's anatomy in a new perspective. Certain anatomical features are of little interest to surgeons. On the other hand structure, which appear quite insignificant to the pure anatomist frequently are of primary importance to the surgeon.

In order to avoid injury to essential structures, surgeons need recognizable landmarks, which will indicate their presence or proximity. The limited exposure available to him must not hamper his appreciation of these relations. He must, therefore be able to see with his mind's eye structures which are not actually within his visual field.

Any student studying the anatomy of the heart is cognizant of the difficulty in describing this organ in terms, which are meaningful and readily understood. Since the two dimensional picture is most readily available teaching aid, the description of the heart, usually found in the standard anatomical texts, concentrate heavily on the inner and outer chambers.

In addition the heart is in state of incessant motion which cannot even temporarily be ignored or dissociated with its functional anatomy. Such framework is analogous to the skeleton as it is related to soft tissue of the body. At the base of the heart there does exist, in fact, such a structure which has been named by early French anatomist as "Fibrous skeleton of the heart" [1].

The cardiac skeleton, also known as the fibrous skeleton of the heart, is a high density single structure of connective tissue that forms and anchors the valves and influences the forces exerted through them. The cardiac skeleton separates and partitions the atria (the smaller, upper two chambers) from the ventricle (the larger, lower two chambers). This is

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important because it forms the primary channel that electrical energy follows from the top to the bottom of the heart.

The fibrous skeleton of the heart is best defined as those tissue at the base of the heart which consist of dense collagen fibers which remain stationary with respect to functionally moving parts of the heart namely myocardium, valve leaflets and elastically distensible arteries issuing from the heart. There have been no clear guidelines given so far regarding how to dissect out the fibrous skeleton of the cadaveric heart. The present paper evolves the steps for dissecting the fibrous skeleton of the cadaveric heart during routine dissection based on my personal experience. Such frame work is analogous to the body skeleton as it is related to the soft tissue of the body.

Aim

Aim of the study is to dissect the fibrous skeleton of the heart and explain its dissection steps.

Instruments Used

Scalpel, forceps, knife, dissection microscope, cotton, water and gauze piece, Chemicals used Formalin and Glycerin.

Material and Method

So far no clear guidelines are available for dissecting the fibrous skeleton of the heart. The present study evolves the steps in dissecting the fibrous skeleton of the adult cadaveric hearts .

Its morphological features such as position, shape and extent are noted.

The fibrous skeleton of the heart requires integration of three separate method of studies.

1. Gross dissection
2. Observation during the actual and stimulated functions.
3. Histological serial sections.

Before dissection, it is useful to appreciate the anatomy of the fibrous skeleton of the heart.

Fibrous Skeleton Comprises of (Figure- 1 & 2)

a. Inter valvular fibrosa -Right trigone, Left trigone and Conus ligament
b. Four valvular annuli - Tricuspid, Mitral, Pulmonary and Aortic.
c. Extensions- Tendon of Todaro and Membranous septum Conus ligament: It is the fibrous connection in between the aortic and pulmonary annuli.

Sub-aortic curtain, which is nothing but the continuation of anterior leaflet of the bicuspid valve attached to the aortic annuli in between the non-coronary and left coronary annuli. These annuli are connected with each other at the clinical base of the heart.

Dissection Steps

A. Removal of heart
B. Dissection of heart from superior aspects
C. Dissection of heart from inferior aspects.

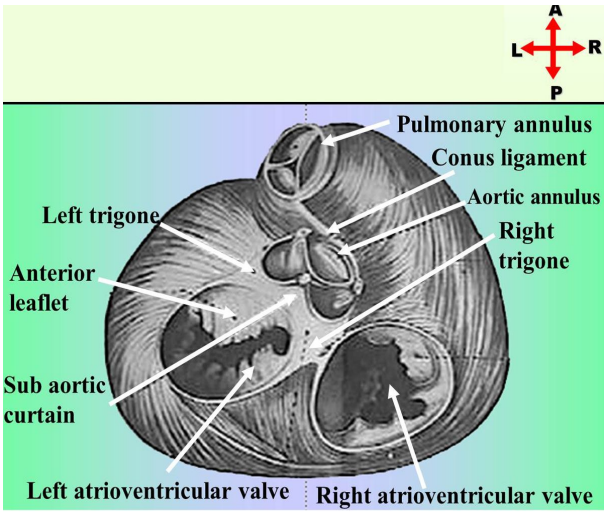

Fig. 1: Fibrous skeleton of the heart (Book Picture from Grey's anatomy)

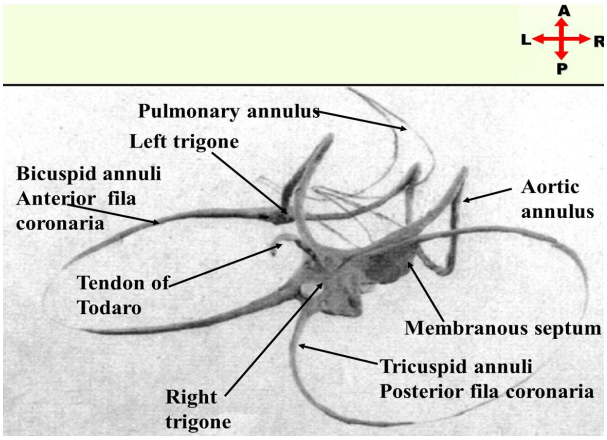

Fig. 2: Fibrous skeleton of the heart from journal of thoracic and cardiovascular surgery by Zocob Zimmerman and Charls Balley

Removal of Heart

Remove the heart from the pericardial cavity by placing the finger in the transverse sinus and cutting

through the aorta and pulmonary trunk as they leave the heart, inside of the pericardium. Sever the superior and the inferior vane cave as they enter the right atrium. Identify the four pulmonary veins on the posterior surface of the heart and, working from the oblique sinus, cut each. Review the cut edges of the pericardial reflection both on the heart and on the posterior wall of the pericardial cavity. Carefully examine the removed heart, using borders, ssurfaces, sulci, and great vessels for proper orientation. Heart is removed without cutting the root of aorta, pulmonary trunk, bicuspid and tricuspid annulus. To increase the hardness it is kept in the formalin for 2 to 3 weeks.

Dissection of Heart from Inferior Aspect.

Step I-

Put the heart in anatomical position with left hand and cut with the knife by right hand up to the annulus from inferior aspect.The section of two ventricles with the inter-ventricular septum is seen (Figure- 3).

Step II-

Interventricular septum is cut and with piece meal dissection. Heart is clean with the tap water and the clots are removed the glycerin is added to increase the shining.

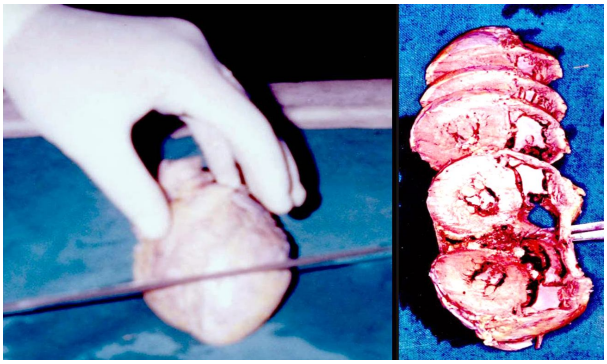

Fig. 3: Step 1: Dissection of heart : inferior aspect

Fig. 4: Step 2: Dissection of Heart: inferior aspect

Step III

Membranous septum of the heart is dissected which is inferiorly semilunar in shape. The annulus gives attachment to the ventricular as well as atrial muscles these muscles are dissected by piecemeal until you get the white fibrous annuli. The fixed part of the leaflets is also cut towards the fibrous ring by scalpel by keeping intact anterior leaflet of the bicuspid valve. Interventricular septum continues with the membranous septum which is the extension of the right trigone and anteriorly it extend up to the aortic annulus so you have to cut the muscular part of the interventricular septum with the scalpel. Dissection of bicuspid and tricuspid annulus both are connected with each other by aortic annulus, right and left trigone (Figure -5).

Dissection of Heart from Superior Aspect

All these annuli are attached to each other at clinical base of the heart Conus ligament is connection between the aortic annuli and pulmonary annuli.

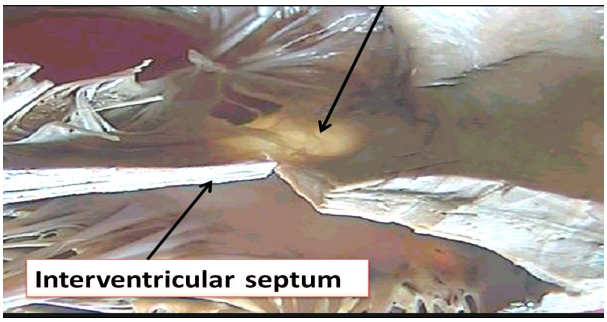

Fig. 5: Step 3: Dissection of heart from inferior aspect Membranous septum of the heart

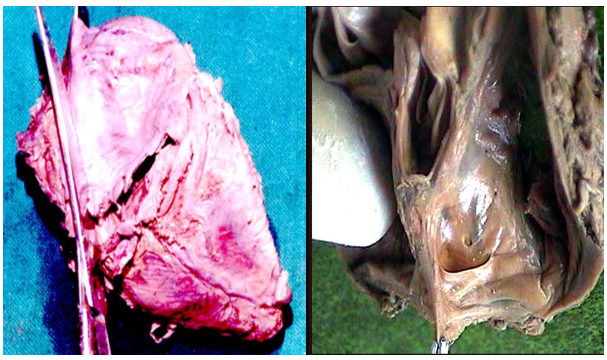

Fig. 6: Step 1: Dissection of heart: Superior aspect inferior of the right atrium with triangle of Koch's

Step I

Right Atrium is cut by passing the seizer in between the superior and inferior vena cava the tricuspid annuli is seen along with the tendon of todaro and right fibrous trigone (Figure 6). Cut the tendon of todaro, which is 1mm in diameter with the scalpel. Cut the atrial muscles and its wall by scalpel and

with the forceps with the forceps do piecemeal dissection of tricuspid annuli.

Step II

Left Atrium is cut by passing the seizer in between the pulmonary veins now you can see the bicuspid annuli and right fibrous trigone (Figure 7). Cut the left atrial muscles by scalpel and do piecemeal dissection up to the bicuspid annuli. Now you can see the right and left trigone at the root of aorta. (Figure 8).

Step III

Aortic Annuli is dissected with the scalpel the arterial part of the aorta is cut and simultaneously the aortic leaflet up to the annulus. The aortic annulus looks like as three scalloped lines. The subaortic curtain is kept intact because it is continuous with the anterior leaflet of the bicuspid leaflets. The tendon of todaro is the extension of the right fibrous trigone in right atrium which is subendocardial 1 to 2 mm. in diameter is also dissected by forceps and scalpel (Figure 8).

Step IV

The right trigone of the heart is dissected from superior, inferior, right and left aspect by piece-meal dissection. The peripheral parts of the atrioventricular valve were cut along with pulmonary annuli and aortic annuli.

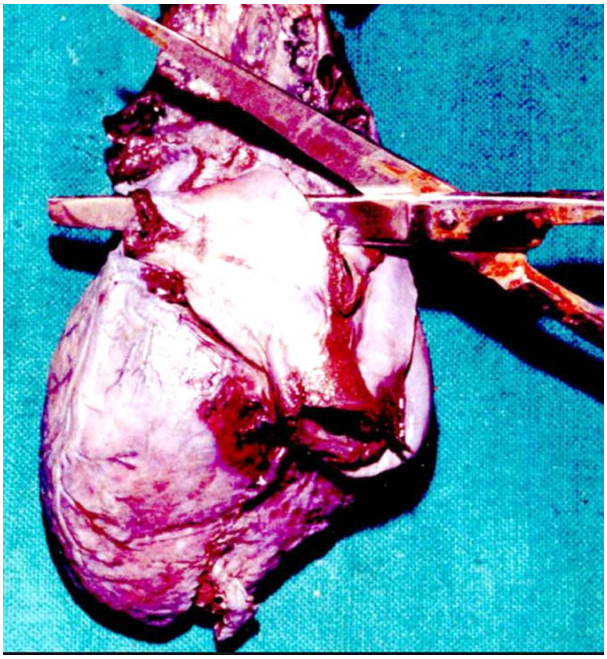

Fig. 7: Step–II Dissection of heart: superior aspect Left Atrium is cut by passing the scissors in between the pulmonary veins.

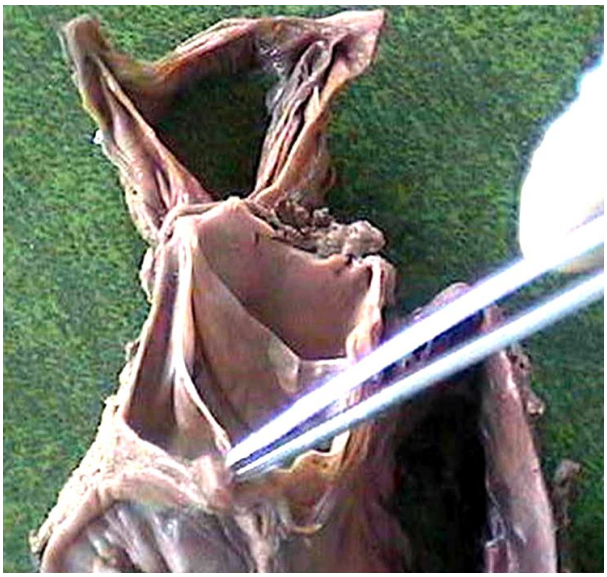

Fig. 8: Step–III: Dissection of heart: superior aspect Dissection of aortic annulus

Fig. 9: Step –IV: Dissection of heart from superior aspect Figure of -8

The membranous septum and tendon of todaro is kept intact. Two trigones provide anchorage for the structures which partitions the single left ventricular opening into inflow & outflow areas. Two atria & two ventricles attach to a pair of conjoin fibrous ring which is in the form of figure 8 lies in sagittal plane (Figure 7) [3].

Observation

Fibrous skeleton is situated at the base of the heart where four functional apertures of the ventricles are crowded together. The atrioventricular annulus moves forward and to left during systole and retraces the move during diastole.

In fetal life the atrioventricular annuli are in the same plane but in adult they are oblique i.e. at 45^0 and are connected with each other by right and left trigone. The atrioventricular conducting bundle is only physiological connection between the atria and ventricle across the fibrous ring. The right and left trigone, aortic and pulmonary annuli, conus ligament, membranous septum, tendon of todaro were dissected and observed [4].

Tricuspid Annulus

(Right Atrioventricular Annuli)

Largest valvular orifice diameter- 11.4 cm in males and females- 10.8 best seen from atrial aspect. Annulus of the tricuspid valve is an ill-defined term use without uniformity. All four valvular orifices as surrounded by uniform ring of collagenous tissue. These rings were interconnected by dense mass of collagenous ring with mitral and tricuspid valves, precisely at the atrioventricular junctions.

The connective tissue around the orifice of the atrioventricular valve, while serving to separate atrial and ventricular myocardial masses (Figure 1, 2 & 10) [5].

Extending from the right fibrous trigone the component of central fibrous body are a pair of curved, tapered, subendocardial tendons or 'prongs' (fila coronaria) which partly encircles the circumference: the latter is completed by more tendinous, deformable fibroblastic areolar tissue [5]. The tissue within the atrioventricular junction around the tricuspid orifice is less robust than the similar element found at the

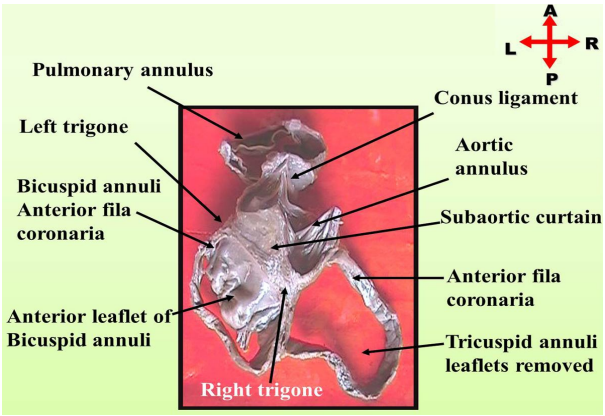

Fig. 10: Fibrous skeleton of the heart (Dissected)

attachment of the mitral valve.

In the tricuspid valve, the topographical 'attachment' of the free valvular leaflet does not wholly correspond to internal level of attachment of the fibrous core of the valve to the junctional atrioventricular connection tissue. It is line of attachment of the leaflet which is the best appreciated in the heart when examined grossly. The extent of fibrous tissue is varies age and sex [6].

Bicuspid Annulus

(Left Atrioventricular Annuli)

Is not a simple fibrous ring but comprises fibro-collagenous elements of varying consistency from which the fibrous core of leaflets take origin (Figure 1, 2 &10).

The annulus is strongest at the internal aspect of the left and right fibrous trigone. Extending from these structures the anterior and posterior coronary prongs (tapering, fibrous, sub-endocardial tendon) partly encircles the orifice at the atrioventricular junction.

Between the tips of the prongs the atrial and ventricular myocardial masses are separated by more tenuous sheet of deformable fibro-elastic connective tissue. Spanning anteriorly between the trigones, the fibrous core the central part of the anterior aortic leaflet of the mitral valve is the continuation of the fibrous sub-aortic curtain which depends the adjacent halves of the left and non-coronary cusp of the aortic valve [7].

The Right Fibrous Trigone

Shape: It is Triangular in Shape.

Situation: it is situated at the center of the heart, fused together at the medial aspect of mitral, tricuspid and aortic valves.

Apex: is at the base of the heart, it is directed backwards and downwards and slightly towards right side it continues as posterior fila coronaria of the right and left atrioventricular valves.

Base: At the root of the aortic annulus. It is directed upwards and left arising from base of right posterior annulus, it is half centimeter (Figure 11).

Measurements

Anterio-posteriorly 10 mm on length and breadth at base is 5mm. (viewed from above) It feels cartilaginous in palpation and shows two slopes superiorly convex and inferiorly concave. Its extensions are membranous septum, tendon of todaro fibrous tissue to the left trigone of attach to subaortic

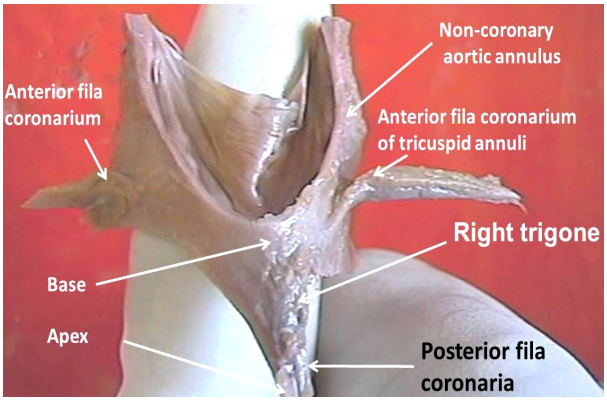

Fig. 11: Right fibrous trigone (Dissected)

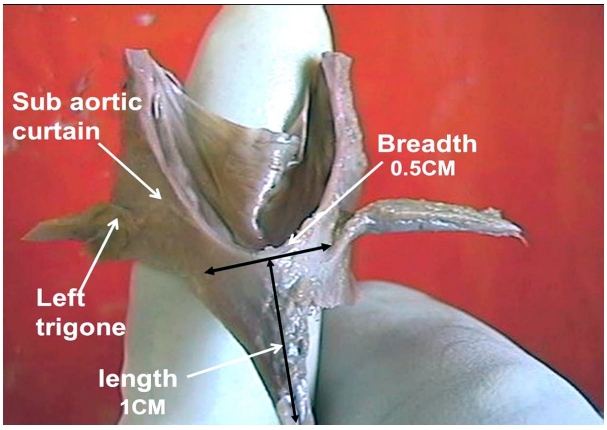

Fig. 12: Right fibrous trigone (Dissected)

curtain and fila coronaria (Figure 12).

Conus Ligament

It is the ligament, which is, attached to the aortic annulus to the subvalvular span of pulmonary annulus facing towards the aortic annulus (Figure-1&2). Its function is to prevent the separation of both the annuli during the ventricular ejection. It is wider

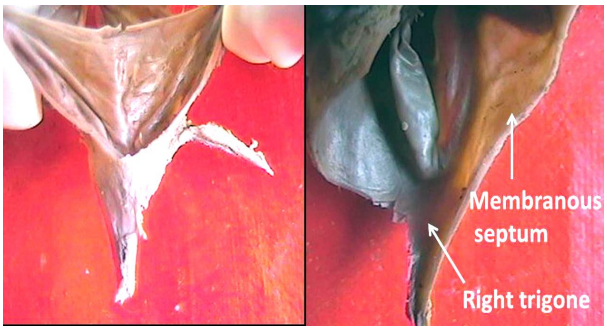

Fig. 13: Right fibrous trigone (Superior aspect) (Inferior aspect)

at the aortic annulus narrower at the pulmonary annulus

Aortic Annulus

It consists of three collagenous scallops anterior, posterior right and posterior left.

Each scallop presents a concavity distally. It provides attachment of the inner surface to the base of aortic cusp. The ascending limb of the adjacent scallops meets together at summit that corresponds with the intercuspid commissure.

The bottom of the right posterior aortic annulus forms the fibrous body known as right fibrous trigone. It continues as posterior fila coronaria of the mitral annulus and tricuspid annulus. The bottom of the left posterior aortic annulus forms the fibrous body known as left fibrous trigone. It continues as anterior fila coronaria of the mitral annulus (Figure13 &14) [2].

Shape: In transverse section it is triangular in shape.

Thickness: 1 to 2mm thickness.

Base: Is outer aspect it gives attachment Superior to the arterial part of aortic wall inferiorly it forms subaortic curtain

Apex: Inner aspects to the aortic leaflet.

Pulmonary Annulus

It consists of three collagenous scallops. Plane of pulmonary annulus faces posteriorly, left and Superior towards the left midscapula (Figure 1 & 2).

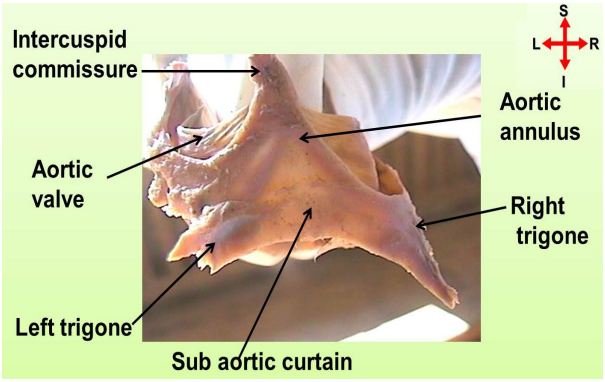

Fig. 14: Aortic annulus (Dissected)

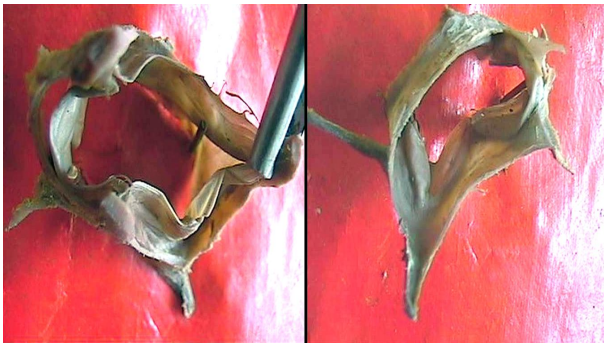

Fig. 15: Aortic annulus (Superior aspect) (Inferior aspect)

It is Triply Scalloped

In fetal life: Anterior, posterior & septal

In adult: Right, left & posterior

Situation: Anteriosuperior & right angle to aortic annulus

Attachment: Inner surface gives attachment to bases of pulmonary cusps.

Sub-valvular Spans: Are intervals between the two scallops and continuous with the myocardium of the

infundibulum.

In section it is triangular in shape, apex directed upwards and base is directed downwards

Membranous Septum

It appears to the necked eye arising from aortic annulus between the non-coronary and right coronary annulus

Situation: At the summit of the muscular part of the inter-ventricular septum.

Apex: Triangular and pointed attach to aortic annulus.

Base: Semilunar in shape attach to muscular septum.

Functions: Supports the right and non-coronary aortic cusp.

Measurements: 1 cm. from above downward and anteroposterior 1 to 1.8 cm.

Division: Atrioventricular part and inter-ventricular part

Demonstration: It is better seen when the bright light is placed behind it in the left ventricle it is seen to be translucent. When viewed from right ventricle after

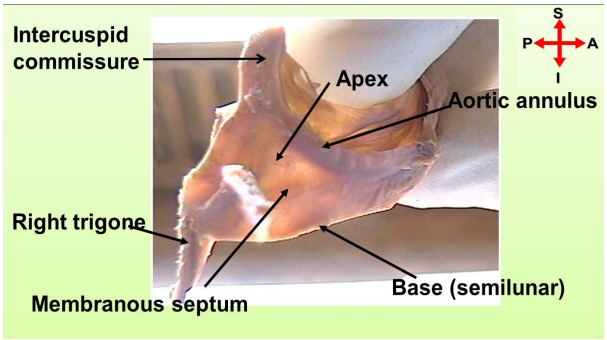

Fig. 16: Membranous septum (Dissected)

the septal cusp of the tricuspid valve is removed.

Attachment: Septal cusp of the tricuspid valve is attached to right side of the membranous septum. It should be noted that there is no thickening of septum in the line of attachment of cusp.

Tendon of Todaro: It is a small ribbon of connective tissue deeply located not connected to the endocardium. It is an extension of the right trigone of the heart (Figure 17).

Situation: It is situated between the triangle of Koch and fossa ovalis in the right atrium (Figure 18).

Contents: It contains collagen fibres (white glossy).

Shape: It is rounded it may be hook like or straight tendon.

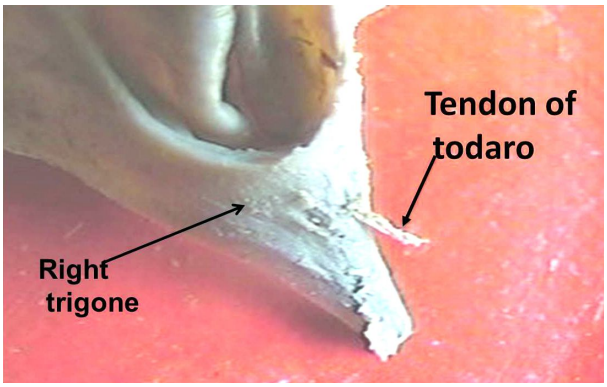

Fig. 17: Tendon of todaro (Dissected)

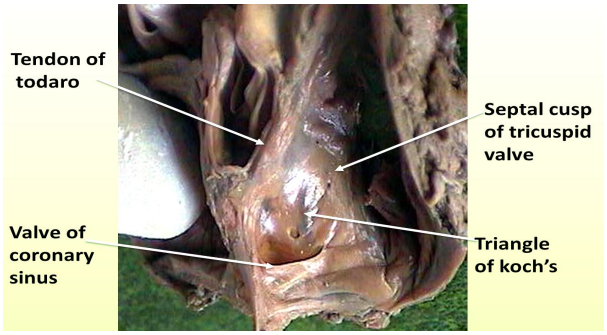

Fig. 18: Tendon of todaro (Dissected) observed in right atrium

Length: 4mm.

Diameter: 1mm.

Staining: Missions method

Importance- it forms superior boundary of triangle of Koch's.

Surgical Application

In general the fibrous skeleton of the heart is capable of holding the sutures securely under the persistent tension.

Suturing and patching up the perforation of the septum restores the heart complete integrity [7].

It is an important landmark for surgical orientation in case of the high ventricular septal defect in the most commonly encountered type these defect occupies the subaortic span between non coronary and right coronary cusp attachment.

Right trigone is the key stone of the skeleton, the rigid fixation to tricuspid, mitral valve and aortic wall to each other and ventricular septum is disrupted.

In mitral stenosis reorganization of the two dimples of the right trigone provide proper orientation for refashioning the distorted valves it may lead to aortic regurgitation. It is also an important landmark for surgical orientation of Surgery for infective

endocarditis with para-ventricular abscess and the fibrous body destruction have a highest mortality and morbidity in high surgical risk [2].

Membranous septum is the integral part of the fibrous skeleton it links together three of four chambers and three of the four valves. When it is defective and this by most congenital malformation consequences are not only depend on only the size of the defect but also upon whether it is an isolated lesion or part of complex combination of malformation such as are found in the endocardial cushion defect, tetralogy of Fallot and many varieties of transposition [9].

Fila coronaria can be used for the reduction of the size of atrioventricular passage to produce the competent valve mechanism. Shortening these tendons of myocardium tend to draw the rim of the ventricle with the attached mural portion of the valve closer to the septal component which is attached to the quasi stationary root of aorta [10].

Conclusion and Results

Fibrous skeleton of the heart & its three dimensional views are helpful for both undergraduate and post graduate students of anatomy and cardiology. It would also help cardio-thoracic surgeons in Annuloplasty operations.

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Original Article

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Dissection of the Right Trigone of the Heart

Kishor Dattatray Khushale*, Yuvaraj Jayaprakash Bhosale*

Abstract

Dissection of "Right trigone of the heart". The fibrous skeleton of the heart and right trigone is those tissues at the base of the heart which consists of dense collagen fibers which remain stationary with respect to functionally moving parts of the heart namely myocardium, valve leaflets and elastically distensible arteries arising from the heart. So far no clear guidelines are available for dissecting the fibrous skeleton of the heart and right trigone of the heart. The present study evolves the steps in dissecting the fibrous skeleton and right trigone of the cadaveric hearts. Its morphological features such as position, shape and extent are noted. Aim of the study is to dissect the right trigone of the heart and explain its dissection steps and morphology. Right trigone of the heart is situated at the base of the heart where four functional apertures of the ventricles are crowded together, which appears as figure of 8. In the central portion of the figure 8 right trigone of the heart is situated. The atrioventricular conducting bundle is only physiological connection between the atria and ventricle across the fibrous ring. The right and left trigone were dissected and observed. It feels cartilaginous and also called as key stone of the heart. It is triangular in shape and shoes extensions membranous septum, tendon of todaro, anterior fila coronaria of the right atrioventricular annulus. When it is viewed from superior aspect it looks like as head of the cow. Right trigone of the heart & its three dimensional views are helpful for both undergraduate and post graduate students of anatomy and cardiology. It would also help cardio-thoracic surgeons in Annuloplasty operations.

Keywords: Right Trigone of the Heart; Key Stone; Left Trigone; Conus Ligament; Annuli.

Introduction

Operative surgery concerns itself with the production of therapeutically desirable change in the anatomy of the body. The introduction of surgery to any special region of body places it's anatomy in a new perspective. In order to avoid injury to essential structures, surgeons need recognizable landmarks, which will indicate their presence or proximity.

Any student studying the anatomy of the heart is cognizant of the difficulty in describing this organ in terms, which are meaningful and readily understood. Since the two dimensional picture is most readily available teaching aid, the description of the heart, usually found in the standard anatomical texts, concentrate heavily on the inner and outer chambers.

In addition the heart is in state of incessant motion which cannot even temporarily be ignored or dissociated with its functional anatomy. Such framework is analogous to the skeleton as it is related to soft tissue of the body. At the base of the heart there does exist, in fact, such a structure which has been named by early French anatomist as "Fibrous skeleton of the heart" [1].

Right trigone of the heart is a high density single structure of connective tissue that forms and anchors the valves and influences the forces exerted through them.

The fibrous skeleton of the heart is best defined as those tissue at the base of the heart which consist of dense collagen fibers which remain stationary with respect to functionally moving parts of the heart namely myocardium, valve leaflets and elastically distensible arteries issuing from the heart. There have

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been no clear guidelines given so far regarding how to dissect out the right trigone of the heart.

The present paper evolves the steps for dissecting the right trigone of the cadaveric heart during routine dissection based on my personal experience. Such frame work is analogous to the body skeleton as it is related to the soft tissue of the body.

Aim

Aim of the study is to dissect the right trigone of the heart, explain its dissection steps and its morphology

Instruments used

Scalpel, forceps, knife, dissection microscope, cotton, water and gauze piece, Chemicals used Formalin and Glycerin.

Material and Method

So far no clear guidelines are available for dissecting the right trigone of the heart. The present study evolves the steps in dissecting the right trigone of the adult cadaveric hearts.

Its morphological features such as position, shape and extent are noted. Before dissection, it is useful to appreciate the anatomy of the fibrous skeleton of the heart.

a. Inter valvular fibrosa -Right trigone, Left trigone and Conus ligament
b. Four valvular annuli - Tricuspid, Mitral, Pulmonary and Aortic.
c. Extensions- Tendon of Todaro and Membranous septum Sub-aortic curtain, which is nothing but the continuation of anterior leaflet of the bicuspid valve attached to the aortic annuli in between the non-coronary and left coronary annuli.

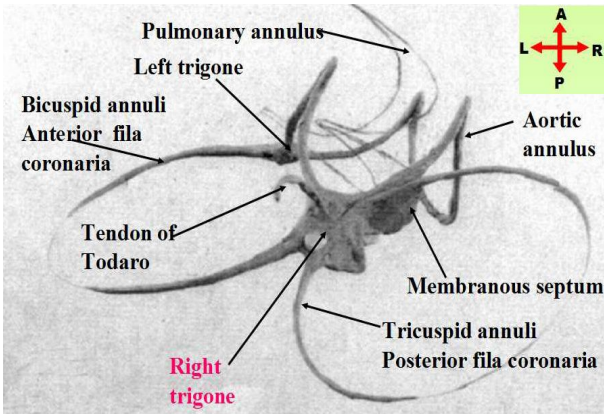

Fig. 1: Right trigone and fibrous skeleton of the heart from journal of thoracic and cardiovascular surgery by Zacob Zimmerman and Charls Bailey

Dissection Steps

A. Removal of heart
B. Dissection of heart from superior aspects
C. Dissection of heart from inferior aspects.

Removal of Heart

Remove the heart from the pericardial cavity by placing the finger in the transverse sinus and cutting through the aorta and pulmonary trunk as they leave the heart, inside of the pericardium. Sever the superior and the inferior vane cave as they enter the right atrium. Identify the four pulmonary veins on the posterior surface of the heart and, working from the oblique sinus, cut each.

Review the cut edges of the pericardial reflection both on the heart and on the posterior wall of the pericardial cavity. Carefully examine the removed heart, using borders, surfaces, sulci, and great vessels for proper orientation. Heart is removed without cutting the root of aorta, pulmonary trunk, bicuspid and tricuspid annulus. To increase the hardness it is

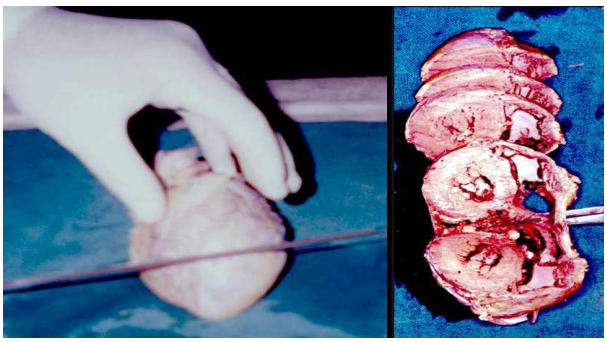

Fig. 2: Step- I Dissection of heart: inferior aspect

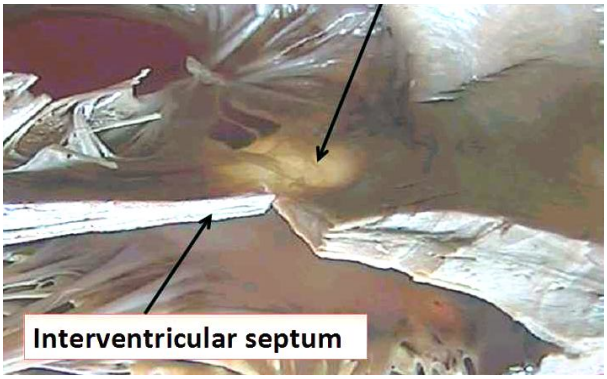

Fig. 3: Step-III Dissection of heart from inferior aspect Membranous septum of the heart

kept in the formalin for 2 to 3 weeks.

Dissection of Heart from Inferior Aspect

Step I

Put the heart in anatomical position with left hand and cut with the knife by right hand up to the annulus from inferior aspect.The section of two ventricles with the inter-ventricular septum is seen (Figure 2).

Step II

Interventricular septum is cut and with piece meal dissection. Heart is clean with the tap water and the clots are removed the glycerin is added to increase the shining.

Step III

Membranous septum of the heart is dissected which is inferiorly semilunar in shape (Figure 3).

The annulus gives attachment to the ventricular as well as atrial muscles these muscles are dissected by piecemeal until you get the white fibrous annuli [2].

The fixed part of the leaflets is also cut towards the fibrous ring by scalpel by keeping intact anterior leaflet of the bicuspid valve. Interventricular septum continues with the membranous septum which is the extension of the right trigone and anteriorly it extend up to the aortic annulus so you have to cut the muscular part of the interventricular septum with the scalpel. Dissection of bicuspid and tricuspid annulus both are connected with each other by aortic annulus, right and left trigone (Figure 3).

Dissection of Heart from Superior Aspect

All these annuli are attached to each other at clinical base of the heart Conus ligament is connection between the aortic annuli and pulmonary annuli.

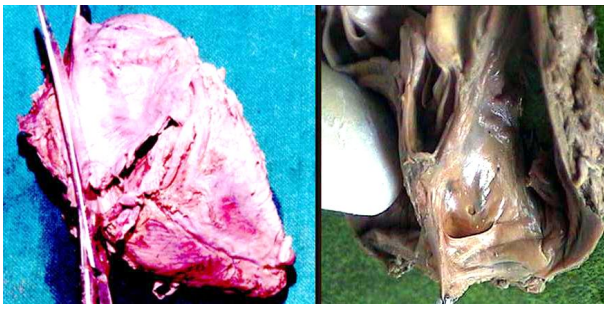

Fig. 4: Step- I Dissection of heart: Superior aspect Interior of the right atrium with triangle of Koch's

Step I

Right Atrium is cut by passing the seizer in between the superior and inferior vena cava the tricuspid annuli is seen along with the tendon of todaro and right fibrous trigone (Figure 4).

Cut the tendon of todaro, which is 1mm in diameter with the scalpel. Cut the atrial muscles and its wall by scalpel and with the forceps with the forceps do piecemeal dissection of tricuspid annuli (Figure 4).

Step II

Left Atrium is cut by passing the seizer in between the pulmonary veins now you can see the bicuspid annuli and right fibrous trigone (Figure 5). Cut the left atrial muscles by scalpel and do piecemeal dissection up to the bicuspid annuli. Now you can see the right and left trigone at the root of aorta.

Step III

Aortic Annuli is dissected with the scalpel the arterial part of the aorta is cut and simultaneously the aortic leaflet up to the annulus. The aortic annulus

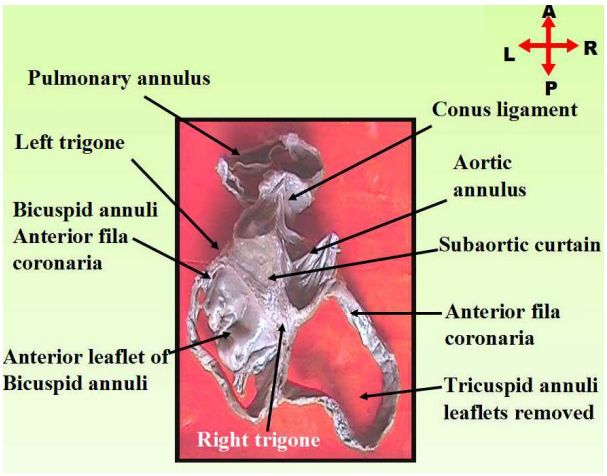

Fig. 5: Fibrous skeleton of the heart (Dissected)

looks like as three scalloped lines. The subaortic curtain is kept intact because it is continuous with the anterior leaflet of the bicuspid leaflets. The tendon of todaro is the extension of the right fibrous trigone in right atrium which is sub-endocardial 1 to 2 mm. in diameter is also dissected by forceps and scalpel (Figure 4).

Step IV

The right trigone of the heart is dissected from superior, inferior, right and left aspect by piece-meal dissection. It shows convex slope from superior aspect

so the trigone is clearly seen (Figure 6).

Superiorly all the musculature and the fine connective tissue is dissected with small scalpel up to the thin fibrous tissue which fells cartilaginous i.e. Right trigone of the heart

Right side trigone is related to the tricuspid valve and gives attachment to the septal leaflet of the tricuspid valve which is also dissected up to fibrous tissue and continues as membranous septum.

Left side trigone is related to the bicuspid valve and gives attachment to the small part of posterior and anterior leaflet of the bicuspid valve which is also dissected up to fibrous tissue

Posteriorly it is narrower and pointed shows posterior fila coronaria of the bicuspid valve on the left side which gives attachment to posterior leaflet of the bicuspid valve and on the right side posterior fila coronaria of the tricuspid valve gives attachment to the posterior leaflet of the tricuspid valve. The posterior leaflets on both the sides dissected with the scalpel.

From the left side tendon todaro arises and apex is narrower. The peripheral parts of the atrioventricular valve were cut along with pulmonary annuli and aortic annuli (Figure 6).

The membranous septum and tendon of todaro is kept intact. Two trigones provide anchorage for the structures which partitions the single left ventricular opening into inflow & outflow areas. Two atria & two ventricles attach to a pair of conjoin fibrous ring which is in the form of figure 8 lies in sagittal plane (Figure 7)[3].

Observation

The right trigone is situated at the base of the heart where four functional apertures of the ventricles are

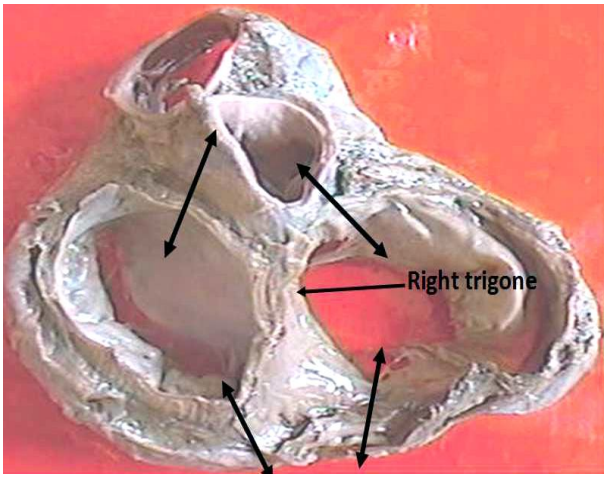

Fig. 6: Step- IV Right trigone of the heart dissected

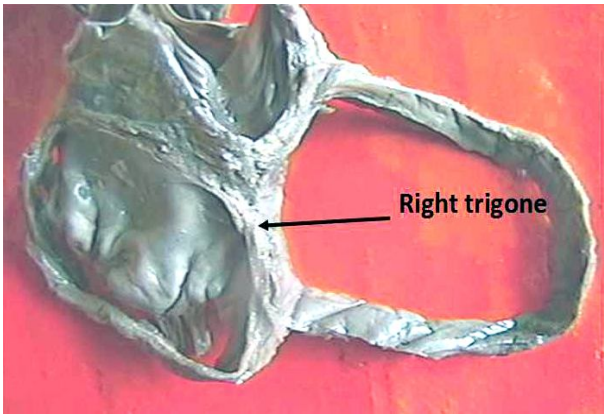

Fig. 7: Right trigone of the heart dissected figure of 8

crowded together. The atrioventricular annulus moves forward and to left during systole and retraces the move during diastole. In fetal life the atrioventricular annuli are in the same plane but in adult they are oblique i.e. at 45^0 and are connected with each other by right and left trigone [4].

Extending from the right fibrous trigone the component of central fibrous body are a pair of curved, tapered, sub-endocardial tendons or 'prongs' (fila coronaria) which partly encircles the circumference: the latter is completed by more tendinous, deformable fibroblastic areolar tissue [5]. The tissue within the atrioventricular junction around the tricuspid orifice is less robust than the similar element found at the attachment of the mitral valve.

In the tricuspid valve, the topographical 'attachment' of the free valvular leaflet does not wholly correspond to internal level of attachment of the fibrous core of the valve to the junctional atrioventricular connection tissue. It is line of attachment of the leaflet which it is best appreciated in the heart when examined grossly. The extent of fibrous tissue is varies age and sex [6].

The Right Fibrous Trigone (Figure 8 & 9)

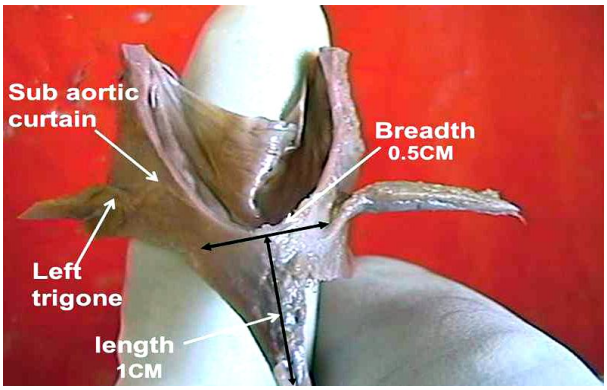

Fig. 8: Right fibrous trigone (Dissected)

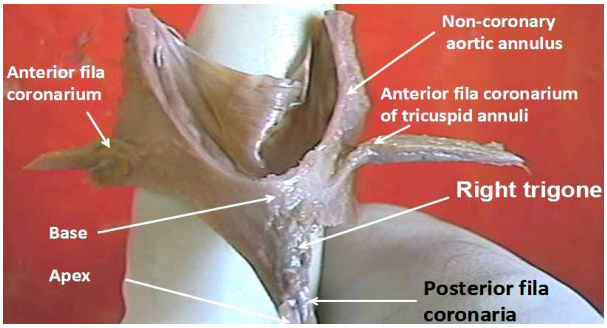

Fig. 9: Right fibrous trigone (Dissected)

(Trigonum fibrosum dextrum, Central body of the heart, Keystone of the heart)

Shape

It is triangular in shape.

Situation

It is situated at the center of the heart, fused together with mitral, tricuspid and aortic valves.

Apex

It is directed backwards and downwards and slightly towards right side it continues as posterior fila coronaria of the right and left atrioventricular valves.

Base

It is directed upwards at the root of the aortic annulus and left arising from base of right posterior aortic annulus, it is half centimeter

Measurements

Anterio-posteriorly 10 mm on length and breadth at base is 5mm. (viewed from above)

Palpation

It feels cartilaginous.

Slopes

Superiorly convex and inferiorly concave.

Extensions

Membranous septum, tendon of todaro fibrous tissue to the left trigone of attach to subaortic curtain and fila coronaria.)

Anchored to

Free edge of interventricular muscular septum between right ventricle inflow opening and common left ventricular aperture. Two trigone provide anchorage for the structures which partitions the single left ventricular opening into inflow and outflow areas.

Development

Derived from ingrowth of the dorsal mesocardium and atrioventricular sulcus.

Histology

Show dense bundle of collagen fibers, elastic fibers and fibroblast. The right trigone looks like as head of the cow (Figure 10 & 11) [1].

Two horns represents ascending limb of non-coronary aortic annulus arising from the base directed upward and laterally.

Fig. 10: Right fibrous trigone (Dissected) look like head of a cow

Fig. 11: Right fibrous trigone (Superior aspect) (Inferior aspect)

Two ears represents the anterior fila coronaria of the right atrioventricular annuli and on the left side it extend as a fibrous tissue to left trigone of the heart.

Upper and lower jaw represents posterior fila coronaria of right and left atrioventricular annuli extending from the apex of the right trigone

Tendon of Todaro (Figure 12 &13)

It is a small ribbon of connective tissue deeply located not connected to the endocardium. It is an

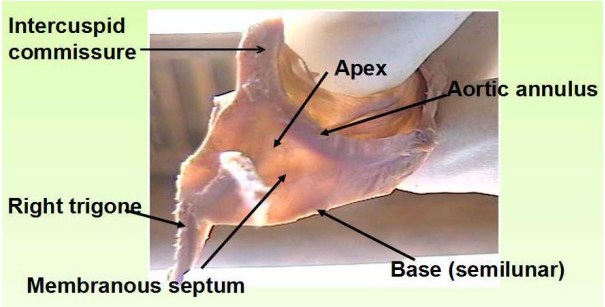

Fig. 12: Right trigone with Membranous septum (Dissected)

extension of the right trigone of the heart (Figure 13).

Situation: It is situated between the triangle of Koch and fossa ovalis in the right atrium. Contents: It contains collagen Fibres (white glossy)

Shape: It is rounded it may be hook like or straight tendon

Length: 4mm.

Diameter: 1mm.

Staining: Missions method

Importance- It forms superior boundary of triangle of Koch's.

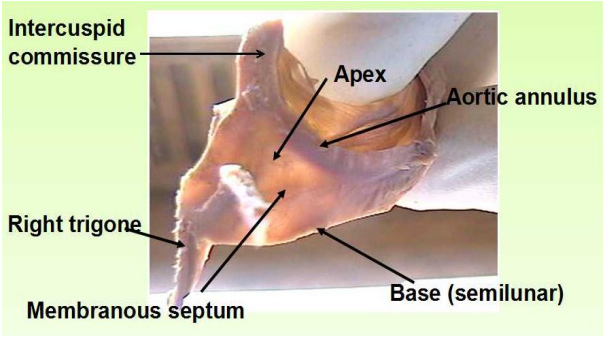

Fig. 13: Right trigone with tendon of todaro

Surgical Application

In general the fibrous skeleton of the heart is capable of holding the sutures securely under the persistent tension. Suturing and patching up the perforation of the septum restores the heart complete integrity [7].

It is an important landmark for surgical orientation in case of the high ventricular septal defect in the most commonly encountered type these defect occupies the subaortic span between non coronary and right coronary cusp attachment.

Right trigone is the key stone of the skeleton, the rigid fixation to tricuspid, mitral valve and aortic wall to each other and ventricular septum is disrupted [8].

In mitral stenosis reorganization of the two dimples of the right trigone provide proper orientation for refashioning the distorted valves it may lead to aortic regurgitation. It is also an important landmark for surgical orientation.

Surgery for infective endocarditis with para-ventricular abscess and the fibrous body destruction have a highest mortality and morbidity in high surgical risk [2].

Membranous septum is the integral part of the fibrous skeleton it links together three of four chambers and three of the four valves. When it is defective and this by most congenital malformation consequences are not only depend on only the size of the defect but also upon whether it is an isolated lesion or part of complex combination of malformation such as are found in the endocardial cushion defect, tetralogy of Fallot and many varieties of transposition [9].

Fila coronaria can be used for the reduction of the size of atrioventricular passage to produce the competent valve mechanism. Shortening these tendons of myocardium tend to draw the rim of the ventricle with the attached mural portion of the valve closer to the septal component which is attached to the quasi stationary root of aorta [10].

Conclusion and Results

The dissected specimen of the right trigone and Fibrous skeleton of the heart & its three dimensional views are helpful for both undergraduate and post graduate students of anatomy and cardiology. It would also help cardio-thoracic surgeons in Annuloplasty operations.

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Sutural Morphology of Pterion and Asterion among Dry Human Skulls in Marathwada Region of Maharashtra

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Abstract

Background: The pterion and asterion are the important landmarks seen on the lateral aspect of the human skull. Both these points are related to the various important structures intracranially. These landmarks are used for various neurosurgical procedures. This study was carried out to determine the different types of pterion and asterion in Marathwada region of Maharashtra. *Methods*: This study was done on 96 adult dry human skulls which consisted of 66 male and 30 female skulls. Data obtained were subjected to statistical analysis using chi square contingency table. *Results*: Most common type of pterion was sphenoparietal in both male as well as female skulls followed by epipteric, frontotemporal and stellate. In case of asterion type II was the most observed type in male and female skulls. *Conclusion*: This will be very useful for surgeons planning surgeries on cranium using these landmarks, radiologists for interpreting the radiological images as well as for anthropologists and forensic pathologists.

Keywords: Pterion; Asterion; Frontotemporal; Sphenoparietal; Epipteric; Stellate.

Introduction

The floor of the temporal fossa is formed by frontal and parietal bones, the greater wing of the sphenoid and the squamous part of the tempral bones. All bones meet on each side at an H- shaped junction termed as pterion. This is an important landmark on the side of the skull because it overlies both the anterior branch of middle meningeal artery and the lateral cerebral fissure intracranially (it is also known as Sylvian point). The pterion corresponds to the site of the anterolateral (sphenoidal) fontanelle in the neonatal skull, which disappears about three months after birth [1]. It is the thinnest part of the lateral wall of the skull [2]. The pterion is one of the most interesting bone meeting point in craniofacial osteology and its complex morphology derives from the fact that, the pterion is the contact point of the facial skeletal elements, skull base and calvarium. Knowledge of its peculiar morphology is mandatory for the pterional approach used in microsurgery and surgery [3]. Pterion is a crucial surgical landmark for surgical approaches to the middle meningeal artery particular lesions and tumors in the brain [4].

Various classifications of pterion have been proposed. The pterion was first classified into three types – sphenoparietal, frontotemporal and stellate, by Broca in 1875 [5]. Later on Murphy [6] defined four types of pterion – sphenoparietal, frontotemporal, stellate and epipteric while Wang et al [7] described six different types of pterion – sphenoparietal, frontotemporal stellate, epipteric, zygomaticoparietal and zygomaticotemporal.

The anatomic points of reference to analyze the topography of the posterolateral surface of the skull are asterion, external occipital protruberance, suprameatal crest, apex of the mastoid process, root of zygomatic arch, Frankfurt horizontal plane and the mastoid foramen. The asterion is the junction of the parietal, temporal and occipital bones. Occurrence of sutural bones in this craniometric point has been reported to vary among different populations [8]. Presence of sutural bones at these points may complicate the surgical orientation leading to pitfalls [9].

As not much literature is present on the studies of these landmarks in Aurangabad region of

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Maharashtra, the present study was done- 1) to determine the pterion and asterion types in dry human skulls of known sex of marathwada region. 2) To evaluate different types of these landmarks and compare the data in male and female skulls and also to compare this study with the other studies. The study will be of interest to anthropologists and forensic pathologists.

Material and Methods

This was a descriptive anthropometric study carried out in the department of Anatomy of JIIU's Indian Institute of medical Science and Research, Warudi, Jalna, Maharashtra. The study comprised 96 dry adult human skulls of known sex, comprising 66 male and 30 female skulls obtained from the museums of Government College Aurangabad, JIIU's IIMSR Warudi and MGM medical college Aurangabad.

This study was done by determining the sutural patterns of the pterion and asterion on both sides of each skull. Sutural morphology of pterion was done by using description given by Murphy [6]. The sphenoparietal type was defined as a sutural pattern in which the sphenoid and parietal bones are in direct contact (Figure 1a). The frontotemporal type is a sutural pattern in which the frontal and temporal bones are in direct contact (Figure 1b). The stellate type is characterized by articulation of four bones (frontal, temporal, parietal and sphenoid) at a point (Figure 1c). The last epipteric type was defined as presence of a small sutural bone between the parietal bone and the greater wing of the sphenoid bone (Figure 1d).

Fig. 1 showing different types of pterion

The sutural morphology of asterion was studied by conventional classification which consists of two types. Type I – sutural bone (wormian) located among the other bones that form the asterion. TypeI I –union of the parietomastoid, lamboid and occipitomastoid sutures i.e. absence of wormian bone.

Skulls with irregular shape, without obvious evidence of any dystrophy, deformity or trauma were selected for study.

While skulls showing fusion or breakage of adjacent bones leading to obscured pterion identification were excluded from the study. Also fetal, neonatal or children skulls were not included in this study.

The data obtained were subjected to statistical analysis using frequency distribution, and chi square contingency table with the aid of the statistical package for social sciences (SPSS) version 16. $P<0.05$ was considered statistically significant.

Results

Table 1 shows the frequency distribution of the pterion types on both sides of male and female skulls. All the four types of pterion types described by Murphy [6] i.e. spheno-parietal, fronto-temporal, epipteric and stellate were seen in the dry human skulls of Marathwada region (Table1). The dominant pterion type was spheno-parietal on both sides of skulls in males as well as in females. The sphenoparietal type occurred more bilaterally. The epipteric type was more frequently observed in female skulls. But frontotemporal type was not observed in female skulls (Table1). The statistical analysis showed no statistical significance for the degree of association between pterion type and sex of the skull.

Both types I as well as type II asterions were seen (Table 2). The predominantly variery was of type II which was 88.33%. Regarding the side, type I was more commonly observed on right side of male skulls.

Table 1: Showing % frequency distribution of different types of pterion in male & female skulls

Pterion type	Male				Total	Female				Total	Male + Female	
	L		R			L		R				
	No	%	No	%		No	%	No	%		No	%
Spheno-parietal	59	89.3	62	93.9	91.66	24	80	23	76.6	78.3	168	87.5
Fronto-temporal	3	4.54	2	3.03	3.78	0	0	0	0	0	5	2.60
Epipteric	4	6.06	1	1.51	3.78	5	16.6	6	20	18.3	16	8.33
Stellate	0	0	1	1.51	0.75	1	3.33	1	3.33	3.33	3	1.56

Table 2: Showing % frequency distribution of asterion in present study

Asterion type	Male				Total	Female				Total	Male + Female	
	L		R			L		R				
	No	%	No	%		No	%	No	%		No	%
Type I	7	10.6	15	22.7	16.65	3	10	1	3.33	6.66	26	11.65
Type II	59	89.39	51	77.27	83.33	27	90	29	96.66	93.33	166	88.33

Table 3: Showing % frequency distribution of pterion type among different regions of India

Authors	Region	Sphenoparietal	Frontotemporal	Stellate	Epipteric
Manjunath et al[11] (1993)	South India	93.55	3.52	2.93	17.3
Saxena et al[5] (2003)	Uttar Pradesh	84.72	10.01	5.17	0
Zalawadia et al[12] (2010)	Gujarat	91.7	2.4	1.2	4.8
Hussain Saheb et al[13] (2011)	Karnataka	69.25	17.35	9.7	3.7
Natekar et al[14] (2011)	Goa	85.33	8	10.6	51.4
Praba & Venkatramniah[15] (2012)	Tamilnadu	74	3	9	14
Present study (2016)	Aurangabad (Maharashtra)	87.5	2.60	1.56	8.33

Table 4: Showing % frequency distribution of different types of pterion among various population groups

Authors	Region	Sphenoparietal	Frontotemporal	Stellate	Epipteric
Asala & Mbajiorgu[20] (1996)	Nigeria	82.1	23.6	0	5.7
Lee et al[21] (2001)	Korea	76.5	0	0	40.3
Oguz et al (2004)	Turks	88	10	0	2
Apinhasmit et al (2011)	Thai	81.2			17.4
Mwachaka[22] (2009)	Kenya	66	15	7	12
Eboh & Obaroefe[23] (2014)	Nigeria	83	5	6	6

Table 5: Showing % frequency distribution of asterion in different populations

Authors	Region	Type I	Type II
Berry & Berry[8] (1967)	North America	12	88
Berry & Berry [8](1967)	South America	7.5	92.5
Berry & Berry [8](1967)	Egypt	14.4	85.6
Berry & Berry [8](1967)	India- Burma	14.7	85.3
Berry & Berry [8](1967)	India Punjab	16.9	83.1
Kellock & Parsons[24] (1970)	Australia	19.8	80.2
Gumusburum[25] (1997)	Turks	9.92	90.08
Mwachaka[22] (2009)	Kenya	20	80
Leon[26] (2013)	Mexico	25.6	74.4
Present study (2016)	India	11.65	88.33

Discussion

It has been reported that the pterion is also an important landmark for the anterior branch of the middle meningeal artery, Broca's area, the insula and the stem of the lateral sulcus. It is also a primary site during surgery to gain access to the sphenoid ridge and optic canal [5]. The pterion is also commonly used in cranial suture closure methodology as an important guide for age estimation and sex determination in archaeological and forensic specimens [10].

In the present study all the four types of pterion were observed in the dry human skulls of Aurangabad region (Table1). The most common type was sphenoparietal as was also observed by other different studies done in different populations (Table 3 & 4). The next type seen in this study was epipteric followed by frontotemporal. The least observed type was the stellate type.

The landmark pterion can mistakenly be assessed to be at the most anterior junction of bones in skulls with an epipteric bone variation where placement of a burr hole can lead to inadvertent penetration into the orbit [16].

Previous studies also showed the sphenoparietal being the most predominant type in different populations. But in nonhuman primates frontotemporal type is the most predominant type. In primate evolution, the anterosuperior segment of the squamous part of the temporal bone of lower primates detached from its parent and incorporated into the posterosuperior angle of the greater wing of the sphenoid bone of the humans. This changed the pterion pattern from frontotemporal type of nonhuman primates to the sphenoparietal type of humans. Furthermore it has been shown that the development of calvaria bones is tightly co-ordinated with the growth of the brain and requires interactions between different tissues in sutures [17]. The high occurrence of the sphenoparietal pterion could have an evolutionary basis [18]. Sphenoparietal type is the most common type in humans and biped primates such as bonobos, orangutans. Consequently the increase in brain size in bipeds may have caused morphological changes in neurocranium that lead to meeting of greater wing of sphenoid and parietal bone [19].

Although the control of pattern of articulation of bones forming the pterion and asterion is unknown, genetic factors may play some role [7]. The MSX2 gene, which encodes a home domain transcription factor, plays a crucial role in craniofacial morphogenesis by influencing fusion of sutures [18]**.** The basis for the ethnic variations observed could be genetic and environmental [20].

In case of asterion, type II was most frequently observed type in this study. This is in accordance with other studies in different populations (Table 5). The presence of sutural bones should be kept on mind by the radiologists and neurosurgeons while interpreting radiological interventions. The mechanism of formation of the sutural bones is not fully known. However they appear in great numbers in hydrocephalic skulls linking to pathological basis, while some believe that sutural bones develop from normal process and are genetically determined.

Conclusion

The sutural morphology of the pterion and asterion in the Aurangabad population does not differ from that of other populations. This data may be useful for planning surgeries to the cranium through these craniometrical points and also when interpreting radiological images.

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Title Page

The title page should carry

1) Type of manuscript (e.g. Original article, Review article, Case Report)
2) The title of the article, should be concise and informative;
3) Running title or short title not more than 50 characters;
4) The name by which each contributor is known (Last name, First name and initials of middle name), with his or her highest academic degree(s) and institutional affiliation;
5) The name of the department(s) and institution(s) to which the work should be attributed;
6) The name, address, phone numbers, facsimile numbers and e-mail address of the contributor responsible for correspondence about the manuscript; should be mentoined.
7) The total number of pages, total number of photographs and word counts separately for abstract and for the text (excluding the references and abstract);
8) Source(s) of support in the form of grants, equipment, drugs, or all of these;
9) Acknowledgement, if any; and
l0) If the manuscript was presented as part at a meeting, the organization, place, and exact date on which it was read.

Abstract Page

The second page should carry the full title of the manuscript and an abstract (of no more than 150 words for case reports, brief reports and 250 words for original articles). The abstract should be structured and state the Context (Background), Aims, Settings and Design, Methods and Materials, Statistical analysis used, Results and Conclusions. Below the abstract should provide 3 to 10 keywords.

Introduction

State the background of the study and purpose of the study and summarize the rationale for the study or observation.

Methods

The methods section should include only information that was available at the time the plan or protocol for the study was written such as study approach, design, type of sample, sample size, sampling technique, setting of the study, description of data collection tools and methods; all information obtained during the conduct of the study belongs in the Results section.

Reports of randomized clinical trials should be based on the CONSORT Statement (http://www.consort-statement.org). When reporting experiments on human subjects, indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1975, as revised in 2000 (available at http://www.wma.net/e/policy/l7-c_e.html).

Results

Present your results in logical sequence in the text, tables, and illustrations, giving the main or most important findings first. Do not repeat in the text all the data in the tables or illustrations; emphasize or summarize only important observations. Extra or supplementary materials and technical details can be placed in an appendix where it will be accessible but will not interrupt the flow of the text; alternatively, it can be published only in the electronic version of the journal.

Discussion

Include summary of key findings (primary outcome measures, secondary outcome measures, results as they relate to a prior hypothesis); Strengths and limitations of the study (study question, study design, data collection, analysis and interpretation); Interpretation and implications in the context of the totality of evidence (is there a systematic review to refer to, if not, could one be reasonably done here and now?, What this study adds to the available evidence, effects on patient care and health policy, possible mechanisms)? Controversies raised by this study; and Future research directions (for this particular research collaboration, underlying mechanisms, clinical research). Do not repeat in detail data or other material given in the Introduction or the Results section.

References

List references in alphabetical order. Each listed reference should be cited in text (not in alphabetic order), and each text citation should be listed in the References section. Identify references in text, tables, and legends by Arabic numerals in square bracket (e.g. [10]). Please refer to ICMJE Guidelines (http://www.nlm.nih.gov/bsd/uniform_requirements.html) for more examples.

Standard journal article

[1] Flink H, Tegelberg Å, Thörn M, Lagerlöf F. Effect of oral iron supplementation on unstimulated salivary flow rate: A randomized, double-blind, placebo-controlled trial. J Oral Pathol Med 2006; 35: 540-7.

[2] Twetman S, Axelsson S, Dahlgren H, Holm AK, Källestål C, Lagerlöf F, et al. Caries-preventive effect of fluoride toothpaste: A systematic review. Acta Odontol Scand 2003; 61: 347-55.

Article in supplement or special issue

[3] Fleischer W, Reimer K. Povidone iodine antisepsis. State of the art. Dermatology 1997; 195 Suppl 2: 3-9.

Corporate (collective) author

[4] American Academy of Periodontology. Sonic and ultrasonic scalers in periodontics. J Periodontol 2000; 71: 1792-801.

Unpublished article

[5] Garoushi S, Lassila LV, Tezvergil A, Vallittu PK. Static and fatigue compression test for particulate filler composite resin with fiber-reinforced composite substructure. Dent Mater 2006.

Personal author(s)

[6] Hosmer D, Lemeshow S. Applied logistic regression, 2nd edn. New York: Wiley-Interscience; 2000.

Chapter in book

[7] Nauntofte B, Tenovuo J, Lagerlöf F. Secretion and composition of saliva. In: Fejerskov O, Kidd EAM,

editors. Dental caries: The disease and its clinical management. Oxford: Blackwell Munksgaard; 2003. p. 7-27.

No author given

[8] World Health Organization. Oral health surveys - basic methods, 4th edn. Geneva: World Health Organization; 1997.

Reference from electronic media

[9] National Statistics Online—Trends in suicide by method in England and Wales, 1979-2001. www.statistics.gov.uk/downloads/theme_health/HSQ 20.pdf (accessed Jan 24, 2005): 7-18. Only verified references against the original documents should be cited. Authors are responsible for the accuracy and completeness of their references and for correct text citation. The number of reference should be kept limited to 20 in case of major communications and 10 for short communications.

More information about other reference types is available at www.nlm.nih.gov/bsd/uniform_requirements.html, but observes some minor deviations (no full stop after journal title, no issue or date after volume, etc).

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Tables should be self-explanatory and should not duplicate textual material.

Tables with more than 10 columns and 25 rows are not acceptable.

Table numbers should be in Arabic numerals, consecutively in the order of their first citation in the text and supply a brief title for each.

Explain in footnotes all non-standard abbreviations that are used in each table.

For footnotes use the following symbols, in this sequence: *, ¶, †, ‡‡,

Illustrations (Figures)

Graphics files are welcome if supplied as Tiff, EPS, or PowerPoint files of minimum 1200x1600 pixel size. The minimum line weight for line art is 0.5 point for optimal printing.

When possible, please place symbol legends below the figure instead of to the side.

Original color figures can be printed in color at the editor's and publisher's discretion provided the author agrees to pay.

Type or print out legends (maximum 40 words, excluding the credit line) for illustrations using double spacing, with Arabic numerals corresponding to the illustrations.

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Abbreviations

Standard abbreviations should be used and be spelt out when first used in the text. Abbreviations should not be used in the title or abstract.

Checklist

- Manuscript Title
- Covering letter: Signed by all contributors
- Previous publication / presentations mentioned, Source of funding mentioned
- Conflicts of interest disclosed

Authors

- Middle name initials provided.
- Author for correspondence, with e-mail address provided.
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- Identity not revealed in paper except title page (e.g. name of the institute in Methods, citing previous study as 'our study')

Presentation and Format

- Double spacing
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- References according to the journal's instructions

Language and grammar

- Uniformly American English
- Abbreviations spelt out in full for the first time. Numerals from 1 to l0 spelt out
- Numerals at the beginning of the sentence spelt out

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- No repetition of data in tables and graphs and in text.
- Actual numbers from which graphs drawn, provided.
- Figures necessary and of good quality (color)
- Table and figure numbers in Arabic letters (not Roman).
- Labels pasted on back of the photographs (no names written)
- Figure legends provided (not more than 40 words)
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