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Morphological Study of the Central Sulcus in Formalin Fixed Human Brain

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Abstract

Central sulcus is very crucial regarding identification of other sulci on the superolateral surface of the cerebral hemisphere of human brain. Surprisingly, cortical sulci and gyri attracted little attention until the 19th century, when clinical neurology, neuropathology and comparative anatomy start to unveil the complexity and functional significance of the cortical mantle. The central sulcus is of special importance because it separates the main motor and sensory areas of the cerebral cortex. Central sulcus is one of the important sulcus and is often difficult to identify. It begins superiorly on the medial surface approximately midway between the frontal and occipital poles and crossing the superomedial border, extends antero-inferiorly to end just superior to the posterior ramus of the lateral sulcus, 2-3 cm posterior to the origin of the lateral sulcus. Contrary to this usual finding we can say from the present study that central sulcus is continues one and is shifted more posteriorly i.e. behind the 50% area from frontal pole when measured at superomedial border of cerebral hemisphere. Central sulcus may not always cut the superomedial border and may not always be arched by prominent arched gyrus at the posterior ramus of the lateral sulcus.

Keywords: Central Sulcus; Posterior Ramus; Lateral Sulcus; Brain.

Introduction

The surface of the cerebral hemisphere shows a complex pattern of convolutions, or gyri, which are separated by furrows of varying depth known as fissures, or sulci. Some of these are consistently located. They partly provide the basis for division of the hemisphere into lobes. On the superolateral cerebral surface two prominent furrows, the lateral (Sylvian) fissure and the central sulcus, are the main features that determine its surface divisions. The central sulcus is the boundary between the frontal and parietal lobes. It starts in or near the superomedial border of the hemisphere, a little behind the midpoint between the frontal and occipital poles. It runs sinuously downwards and forwards for about 8-10 cm which is always limited by an arched gyrus. Its general direction makes an angle of about 70^0 with the median plane. It demarcates the primary motor and somatosensory areas of the cortex, located in the precentral and postcentral gyri, respectively [1].

The superolateral surface of human fetal cerebral hemispheres show the changes in size, profile, and the emerging pattern of cerebral sulci with increasing maturation. By the 6th month the central, precentral, postcentral, superior temporal, intraparietal and parieto-occipital sulci are all clearly visible. In the subsequent stages all the remaining principal and subsidiary sulci rapidly appear and by 40th week all the features which characterize the adult hemisphere in terms of surface topography are present in miniature. The central, precentral and postcentral sulci appear, each in two parts, upper and lower, which usually coalesce shortly afterwards, although they may remain discontinuous [1].

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There are great individual variations in the details of the sulci and gyri, so attention should be given mainly to the major sulci and gyri. According to Cunningham's manual, central sulcus is one of the important sulcus and is often difficult to identify. It begins superiorly on the medial surface approximately midway between the frontal and occipital poles and crossing the superomedial border, extends antero-inferiorly to end just superior to the posterior ramus of the lateral sulcus, 2-3 cm posterior to the origin of the lateral sulcus. The central sulcus is of special importance because it separates the main motor and sensory areas of the cerebral cortex [2].

Central sulcus is also called as fissure of Rolando is a limiting sulcus. It developes in two parts- upper and lower, separated by a transverse gyrus. Later the two parts unite and the gyrus becomes submerged. Thus the depth of the central sulcus is shallow in the middle. Upper end of the sulcus appears partly in the para-central lobule on the medial surface of the hemisphere [3].

Central sulcus is very crucial regarding identification of other sulci on the superolateral surface of the cerebral hemisphere of human brain. So present study was conducted to know the variability in the central sulcus and to add the knowledge to the existing text and reduce confusion regarding identification of sulci on the superolateral surface of cerebral hemisphere among medical tecachers, students and researchers. Sulcus identification is also important among the neurosurgeons while performing lobectomy and other procedures to treat various neurological disorders.

Materials & Methods

Total 80 formalin fixed adult human cerebral hemispheres were examined to study the central sulcus. Brain was removed by dissection method following the Cunningham's dissection manual [2]. Cerebral surface was cleared of arachnoid matter and underlying blood vessels to identify the central sulcus. Distance of the central sulcus from frontal and occipital pole was measured along the superomedial border of cerebral hemisphere using non-elastic tailors measuring tape. Extent of the central sulcus from medial surface to posterior ramus of the lateral sulcus was studied on cerebral hemisphere.

Results

We have studied central sulcus considering different parameters like distance from frontal pole and occipital pole along the superomedial border; whether central sulcus cuts the superomedial border or not, whether it meets posterior ramus of lateral sulcus or not; whether it is interrupted by any gyrus or not. We have tabulated our findings in Table 1,2,3 and 4.

In present study area covered in front of central sulcus upto frontal pole was found to be 50% to 65%; while the area covered behind the central sulcus upto occipital pole ranges from 35.1% to 50% (Table 2).

No central sulcus was found to be interrupted by any gyrus during its course.

Table 1: Distance of the central sulcus from frontal pole (FP) and occipital pole (OP) along the superomedial border

Distance of Central Sulcus	Mean ± SD (cm)	%	Maximum Distance (cm)	Minimum Distance (cm)
From Frontal pole	13.90±0.70	55	16	12.5
From Occipital pole	11.22±0.74	45	12.5	10
Total distance from frontal to occipital pole	25.15±0.89	100	27	22.7

Table 2: Percentage wise distribution of distance of the central sulcus from frontal (FP) and occipital pole (OP)

% wise distribution of area in front and behind the central sulcus	Number of specimens with area covered in front of central sulcus upto FP	Number of cases with area covered behind the central sulcus upto OP
35.1-40%	0	2
40.1-45%	0	36
45.1-50%	0	42
50.1-55%	42	0
55.1-60%	36	0
60.1-65%	2	0

Table 3: Extent of the central sulcus to supero-medial border above and posterior ramus of lateral sulcus

Central sulcus	Supero-median border in number of cases	Posterior ramus of lateral sulcus in number of cases
Does not extend upto	16 (20%)	44 (55%)
Extend upto	64 (80%)	36 (45%)

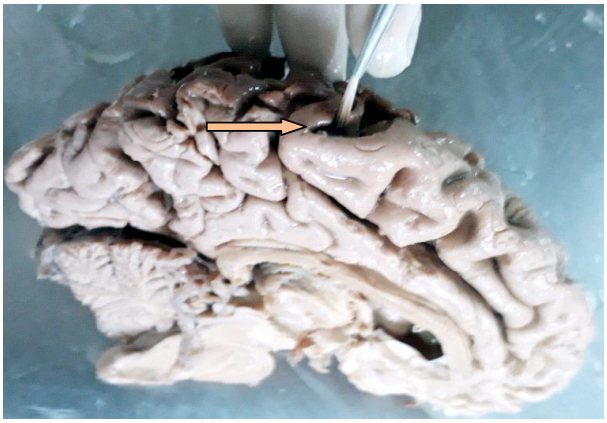

Fig. 1: Arrow shows central sulcus terminating before extending to superomedial border

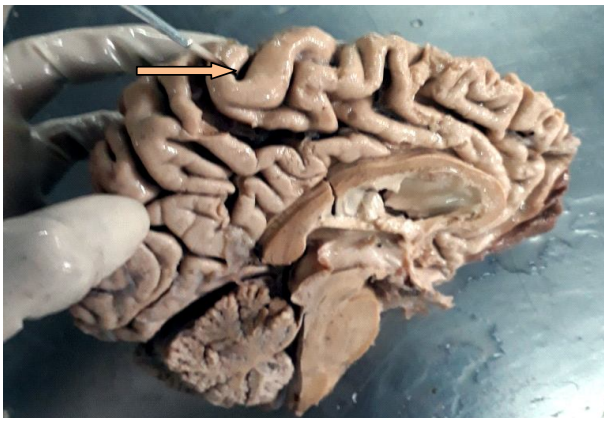

Fig. 2: Arrow shows central sulcus extending beyond the superomedial border on medial surface

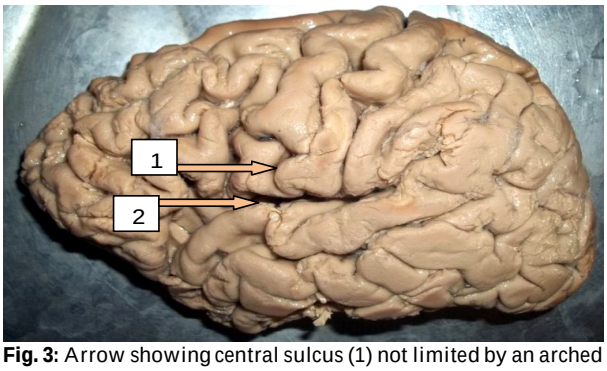

Fig. 3: Arrow showing central sulcus (1) not limited by an arched gyrus and meets the posterior ramus (2)

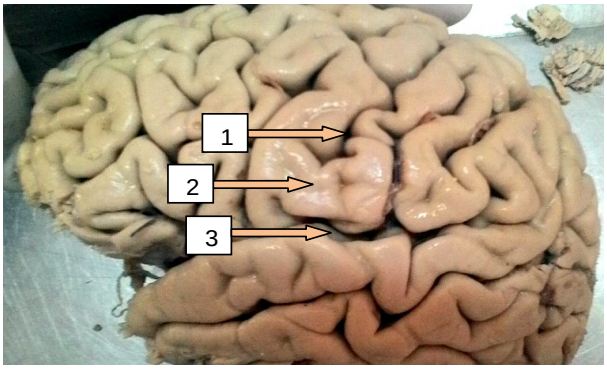

Fig. 4: Arrow showing central sulcus (1) limited by an arched gyrus (2) and doesn't meet the posterior ramus (3)

Discussion

Cortical sulci and gyri attracted little attention until the 19th century, when clinical neurology, neuropathology and comparative anatomy start to unveil the complexity and functional significance of the cortical mantle. This assay is devoted to the Louis Pierre Gratiolet (1815-1865), who was one of the first anatomists to systematically exploit the comparative approach as a tool to map the cortical surface in primates. He undertook a detailed study of brains of human and nonhuman primates and soon realized that the organizational pattern of cerebral convolutions was so predictable that it could serve as a criterion to classify primate groups. He noted that only the deepest sulci exist in lower primate forms, while the complexity of cortical folding increases markedly in great apes and humans. Vicq d'Azyr appears to have been the first to delineate the central sulcus, but he did not name it. It is the French anatomist and alienist François Leuret (1797-1851) who, having apparently misread Vicq d'Azyr's work, associated the name of the Italian anatomist Luigi Rolando (1773-1831) to the central sulcus [4].

The factors that are responsible for the development of the human brain and presumably for such variations across individuals involve both genetic and environmental mechanisms. Genes, however, do not appear to account for most of the variance within a primate species. A study of casts of rhesus macaques found that though brain size is highly heritable, the lengths of most sulci are much less so previously described. In humans, there have been occasional reports of gross inspection of cortical surfaces of stacks, followed by removal of the skull and brains of monozygotic twins, similarities and differences in gyral patterns. Recent preliminary studies of cortical surfaces of human brains suggested likewise, that in monozygotic twins considerable the brains were split into hemispheres, the cerebella and variation in gyral patterns exist. From these various observations it seems that genes influence gyral patterning of the primate brain on a basic level, but that other factors contribute a major portion of the variance across individuals. Anatomical studies in rodents and nonhuman primates have established that genetic programs are major determinants of overall brain size. The differential contributions of genes and environment to the development of gyral patterns are also unknown. Earlier in this century the prevailing view was that gyral size was largely a result of nongenetic mechanical forces. But the existence of taxon, family and genus-specific gyral patterns is evidence of importance of genes [5].

Detailed knowledge of the structure and form of the cerebral sulci and gyri continues to be mandatory for neuro imaging as well as intra-operative guidance. Once identified, the cerebral sulci can be used by the neurosurgeon either as microneurosurgical corridors or simply as cortical landmarks. The macroscopic study of the sulci and gyri of each cerebral hemisphere should therefore begin with the identification of the sylvian fissure, which clearly separates the superolateral surfaces of the frontal, central, and parietal lobes from the temporal lobe, and should be followed by the identification of the precentral and postcentral gyri, which divide the portion of this surface that is superior and posterior to the sylvian fissure into its anterior and posterior halves [6].

The precentral and postcentral gyri are situated obliquely in relation to the interhemispheric fissure, being less serpiginous than the other gyri of the cerebral convexity, and are connected to adjacent gyri via the usual interruptions in the precentral and postcentral sulci. The precentral and postcentral gyri are consistently united inferiorly by the subcentral gyrus and superiorly by the paracentral lobule, which is located on the medial surface of each hemisphere. The precentral and postcentral gyri together resemble an elongated ellipse that is furrowed by the central sulcus, which is usually continuous, and are respectively delineated anteriorly and posteriorly by the precentral and postcentral sulci, which are typically discontinuous. This morphological unit, together with the functional interaction between motricity and sensitivity, justifies the characterization of these gyri as constituting a single lobe [6].

In the study done by Singh GC et al [7] on length and depth of the central sulcus they concluded that the length and depth was found to be more in the left hemisphere than that in the right hemisphere. Mashouf M et al [8] has studied the central sulcus in cadaveric brain specimen. They studied the distance of midpoint of the central sulcus from the frontal pole on superolateral surface of brain and also the length of the central sulcus. Mean (range) distance from right and left frontal pole to midpoint of right and left central sulcuse were 81.27 (55-105) and 82.63 (60-105) mm, respectively. Mean (range) length of right and left central sulcus were 94.85 (75-115) and 97.24 (65-125) mm, respectively.

Therefore after lateral sylvian fissure, central sulcus is important to differentiate between frontal lobe and partial lobe and its gyrus and related functional areas. Knowledge in variability of the central sulcus will be helpful for proper location of the central sulcus and adjacent sulci, gyri and functional areas. When compared with existing study material which state that central sulcus cuts the superomedial border in most of the brain here we found in 20% of the cases central sulcus does not cut the superomedial border of cerebral hemisphere (Figure 1 & 2). Also as stated in previous literature that central sulcus is limited by arched gyri at posterior ramus of lateral sulcus present study shows that limitation by arch gyrus is seen in 55% of cases and rest 45% cases gyrus is not much prominent so central sulcus appear to meet the posterior ramus (Figure 3 & 4). So, this study contributes to the existing knowledge regarding the central sulcus.

Conclusion

Central sulcus is continues one and is shifted more posteriorly i.e. behind the 50% are from frontal pole when measured at superomedial border of cerebral hemisphere. Central sulcus may not always cut the superomedial border and may not always be arched by the prominent arched gyrus at the posterior ramus of the lateral sulcus.

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Original Article

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A Study on Dimensions of Condyles and Intercondylar Region of Femur in Wayanad Population

Sushanth N.K.[1], Lakshmikantha B.M.[2], Javeed Hussain Sharieff[3]

Abstract

Context: The knee joint is a complex synovial joint. It is subjected to considerable loads in locomotion and hence the joint is highly unstable and prone for injuries and degeneration particularly during ageing. This may require knee replacement and internal fixation. The various dimensions and area of knee components are very essential during placement of prosthesis. Hence, the study on dimensions of condyles and intercondylar region of Femur is taken up to provide useful information. *Aims*: To measure various dimensions of condyles and intercondylar region of femur in Wayanad population. *Settings and Design*: Sixty seven (38-left and 29-right) adult fully ossified femur were collected from the department and were properly labeled. Vernier caliper, thread, paper to record observations were kept ready. *Methods and Materials*: Various dimensions of the Lower end of Femur were measured using Vernier caliper. *Statistical Analysis Used*: Mean, SD was calculated from data using the SPSS software version 16. *Results*: Results obtained for right and left femur were as follows. Left: Mean ±SD of Intercondylar depth-2.94±0.42cm; Area of medial condyle-15.021±2.354cm^2; Area of lateral condyle-14.880±2.29cm^2 and Intercondylar area-3.853±0.954 cm^2. Right: Mean±SD of Intercondylar depth-2.83± 0.31cm; area of medial condyle 14.359±2.4cm^2; area of lateral condyle 15.026±2.549cm^2 and Intercondylar area 4.193±1.011 cm^2. *Conclusion*: This study gives various dimensions of condyles and intercondylar regions of Femur which will of great significance to anatomists, anthropologists and orthopedicians in cases of surgical procedures for implantation of prosthesis in knee joint.

Keywords: Condyle; Femur; Intercondylar Region; Prosthesis.

Introduction

The knee is probably the most stressed joint in the human body. It is a complex joint which is subjected to considerable loads during locomotion. Hence the joint is highly unstable and prone for injuries and degeneration as age advances. In essence the knee is perceived as just a joint that bends and straightens lower leg on the thigh, but the complexity of movement also involves a gliding and a rotation of the femur on the tibia. Hence the knee is vulnerable to twisting injuries such as when skiing or playing football, leading to cruciate ligament damage and also damages to the menisci. Therefore knee replacement and internal fixation becomes necessary. A knee-joint prosthesis comprises a femoral condyle component and a tibial condyle component secured, respectively, to the femoral and tibial condyles by a cement in resected areas of the bones [1]. To manufacture a knee prosthesis the measurements of the condyles (quantitative anatomy) and intercondylar areas of femur and tibia are important for the design of total joint replacement and internal fixation. In the present study the dimensions of the lower end of the femur were measured. Since morphometry of tibial condyles are also equally important as femoral condyles, it has been studied by the same authors in a different study. The dimensions both condyles of right and left femurs were measured and correlated.

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Materials and Methods

Sixty seven adult fully ossified femurs irrespective of age and gender were selected from the Department of Anatomy, DM-WIMS, Wayanad as samples for the present study. First, the femora were segregated into Right and Left and then they were numbered separately. Out of these 38 were left sided and 29 were right sided. Measurements were taken twice for each entity using vernier calipers.

Fig. 1: Showing photograph of the femur bones used for the study

The parameters measured were,

- Anteroposterior measurements of right medial condyles
- Anteroposterior measurements left medial condyles
- Anteroposterior measurements right lateral condyles
- Anteroposterior measurements left lateral condyles
- Transverse measurements of right medial condyles
- Transverse measurements of left medial condyles
- Transverse measurements of right lateral condyles
- Transverse measurements of left lateral condyles
- Anteroposterior measurements of right intercondylar fossa
- Anteroposterior measurements of left intercondylar fossa
- Transverse measurements of right intercondylar fossae
- Transverse measurements of left intercondylar fossae

All the measurements were taken by a single author in order to minimize human error. The data were recorded on a white sheet paper and later entered into the data entry sheet in computer. Statistical analysis of this data was done using SPSS software version 16 in Windows 8.

The mean of the anteroposterior and transverse measurements of the medial and lateral condyles and the intercondylar region of both right and left was calculated in Excel sheet. The standard deviations of the means of all these parameters were calculated using SPSS version 16. After obtaining the results, bar diagram was plotted for better interpretation of the results.

Fig. 2: Showing taking the anteroposterior measurements of the condyle using vernier caliper.

Fig. 3: Showing taking the transverse measurement of the intercondylar region of the femur using vernier caliper

Results

In the present study results obtained for right and left femur are shown in Table 1 and 2.

Table 1: Showing Standard deviation and mean of right and left medial and lateral condyles and intercondylar region of femur

Particulars	Right	Left
Medial Condyle	14.359± 2.4cm^2	15.021± 2.354cm^2
Lateral Condyle	15.026± 2.549cm^2	14.880 ± 2.29cm^2
Intercondylar fossa	4.193±1.011 cm^2	3.853 ± 0.954 cm^2
Intercondylar Depth	2.83± 0.31cm	2.94±0.42cm

Table 2: The mean of anteroposterior and Transverse measurements of Right and Left medial and lateral femoral condyles

Measurements	Right-MC	Left -MC	Right-LC	Left-LC
Anteroposterior	5.52 cm	5.63 cm	5.54 cm	5.53 cm
Transverse	2.58 cm	2.65 cm	2.7 cm	2.67 cm

Abbreviations: MC- Medial condyle, LC- Lateral condyle, CM- Centimeter

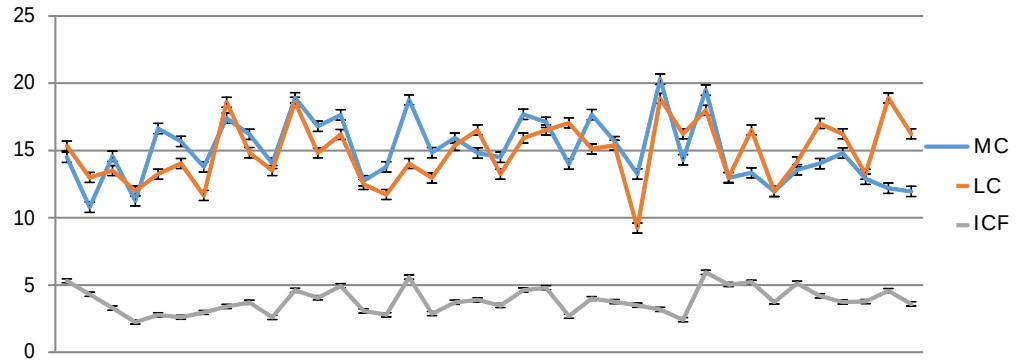

Fig. 4: Areas of Medial and Lateral condyles & Intercondylar fossa of Left Femur (mm^2)
Abbreviations:
MC- Medial condyle
LC- Lateral condyle
ICF- Intercondylar fossa

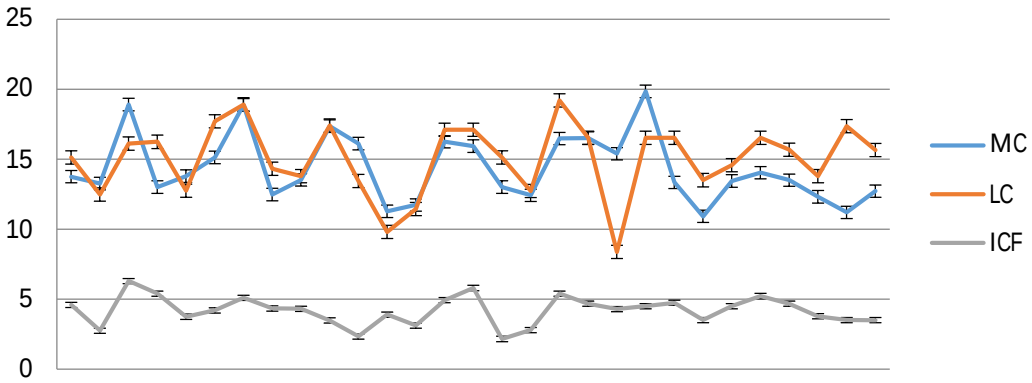

Fig. 5: Areas of Medial and Lateral condyles & Intercondylar fossa of Right Femur (mm^2)
Abbreviations:
MC- Medial condyle
LC- Lateral condyle
ICF- Intercondylar fossa

Discussion

An important factor required to achieve long-term success in total knee arthroplasty surgeries is

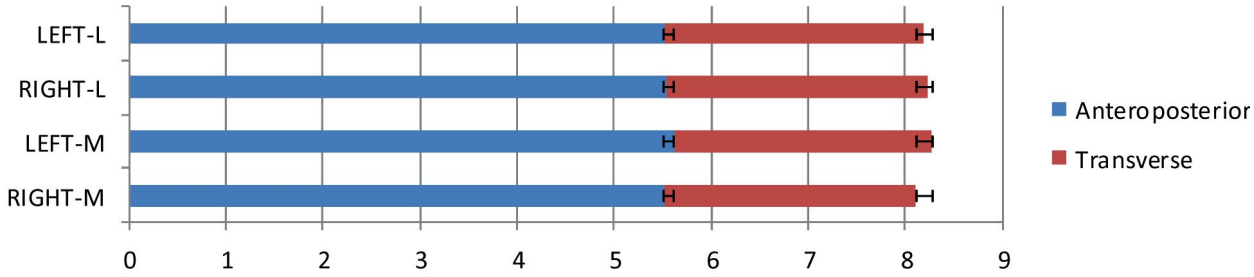

Fig. 5: Plot of Mean of Anteroposterior and Transverse Measurements of Medial and Lateral Condyles of Right and Left Femur (cm)
Abbreviations:
M- Medial
L- Lateral

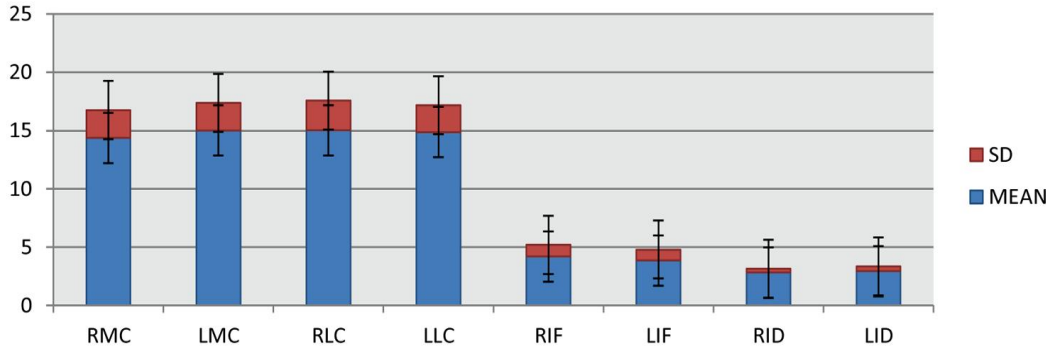

Fig. 6: Plot of standard deviation and mean of right and left medial and lateral condyles, intercondylar fossae and intercondylar depths of femur
Abbreviations:
RMC- Right Medial Condyle, LMC- Left Medial Condyle, RLC- Right Lateral Condyle, LLC- Left Lateral Condyle RIF- Right Intercondylar Fossa, LIF- Left Intercondylar Fossa, RID- Right Intercondylar Depth, LID- Left Intercondylar Depth, SD- Standard Deviation

the use of geometrically matched prosthesis, which simulates the natural conditions of knee joints [2]. Many researchers are working on generating anthropometric data for designing knee prosthesis [3-9]. Bicondylar width was measured by many researchers as sole or a part of some other study of lower femoral anatomy.

A study by Kirby Hitt et al (2003) measured medio-lateral and antero-posterior dimensions of the lower end of the femur and tibia (also bicondyar) and obtained an aspect ratio in order to correlate to the sizing of present knee arthroplasty systems. This study concluded that it is important to manufacture patient specific prosthesis for more successful and satisfactory postoperative experience in a patient, especially women, in whom knee joint prosthesis implantation, was the only option [6].

Another study conducted on Korean population by Dai- Soon Kwak et al (2010) also measured medio-lateral and antero-posterior diameters of the lower end of the femur along with length, height and width of the anterior, posterior and inferior sections of the resected distal femurs using three dimensional computer tomographic measurements in 200 knees. The authors got a slightly different aspect ratio from studies conducted by other authors on other group of people [7].

A morphometric study was performed by Sujay Mistri et al (2014) on Eastern Indian Population which considered bicondylar width of lower end of the femur in addition to other parameters such as width of the shaft, in contrast to the present study in which individual width and other measurements were taken. The authors were of the opinion that, the data obtained as a result of the study would greatly help the biomedical engineers who are involved in designing and manufacturing the knee joint prosthesis for Indian recipients [9].

All these studies and similar other studies necessitate manufacturing of a patient specific knee joint prosthesis, which would be possible only by studying a specific group of people residing in a particular region in whom the prosthesis is intended to be implanted. These variations in the

measurements of the dimensions of the lower end of femur in different regions of the world may be attributed to due to race and ethnicity.

Present study is different from those already done in the fact that here we measured the dimensions of individual condyles which may help to generate much more accurate prosthesis. In this study we noticed that the difference of mean areas between the medial and lateral condyles of left femora were 0.14±0.06 cm^2 and medial and lateral condyles of right femora were 0.67±0.14cm^2 respectively. Also difference of mean areas between right and left medial condyles were 0.662±0.05cm^2 & right and left lateral condyles were 0.146±0.259cm^2.

Conclusion

One of the factors which make human beings unique from his so called close ancestors, the primates is the bipedal mode of locomotion, which also enables upright posture. An important requirement for this is a healthy, fully functional knee joint. However with age, humans tend to lose the healthiness of the knee joint due to various known and unknown factors. For such patients, the total or partial knee replacement surgeries are done in order to regain most of the lost functions of the knee. The recent advances in knee replacement by prosthesis implantation has been the choice of treatment modality for many years now. Since its inception there has been tremendous research going on in this field for a simple reason that in various permanent knee diseases, replacement arthroplasty of knee is becoming fast popular mode of treatment. The knee prosthesis requires the measurements of the engaging parts of the condyles of femur and tibia which this study has attempted to provide the various dimensions of individual condyles and intercondylar fossae of femur. This information will be of much use to anatomists, forensic anthropologists and orthopedicians in cases of surgical procedures on knee joint. The present study may prove to be highly informative to the biomedical engineers engaged in prosthesis designing for recipients form Wayanad population.

Key message

The study was conducted in Wayanad population of South India. Purpose of this study was to give appropriate dimension of lower end of Femur which is useful for manufacturing correct size knee joint prosthesis for particular population with precision. The results were obtained by measuring the dimensions of lower end of the femur to calculate the area of the articulating surfaces and thereby arriving at a conclusion.

Conflict of Interest: NA

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Original Article

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Cadaveric Study of Incidence of Double Inferior Venacava in South India and its Clinical Relevance

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Abstract

Inferior venacava also known as posterior venacava,is the large vein that carries de-oxygenated blood from the lower half of the body into the right atrium of the heart. Double Inferior venacava is a congenital variation resulting from the persistence of the embryonic venous system. The embryogenesis of the inferior venacava [IVC] is a complex process involving the formation of several anastomoses between three paired embryonic veins. The percentage of incidence of dual inferior venacava is about 2.2–3%. The majority of cases are clinically silent and diagnosed in routine dissection studies, in retroperitoneal surgeries, incidentally on imaging for other reasons. Although venous variations are rare, their knowledge is crucial in diagnosis and treatment. *Aims*: The aim of the present study was to analyse the percentage of incidence of double inferior venacava and to identify it's clinical relevance. *Materials and Methods*: Forty formalin fixed cadavers allotted to first year MBBS students for dissection in Rajarajeshwari Medical college and hospital, Bangalore and ESIC Medical college & PGIMSR, Bangalore were studied over a period of 10 years for the double inferior venacava. *Results*: We came across the presence of double inferior venacava in one out of forty specimens, where in Right IVC was formed by right external iliac vein and right internal iliac vein at the level of fifth lumbar vertebra. The right IVC received the right gonadal vein, right renal vein and the right suprarenal vein [Figure 2]. The left IVC was formed by the left internal iliac vein and the left external iliac vein at the level of fifth lumbar vertebra. *Conclusion*: The variations of IVC should be recognized by radiologists and surgeons in order to avoid mistakes during imaging of the area or surgeries and in case of venous thromboembolic disease. These variations should not be mistaken for pathologic findings, but should be viewed as normal findings of abnormal embryogenesis.

Keywords: Inferior Venacava (IVC); Double Inferior Venacava; Venous Variation; Embryonic Venous System; Embryogenesis; Retroperitoneal Surgeries.

Introduction

The variations of the Inferior venacava and it's tributaries have been known to anatomists since 1793, when Abernethy described a congenital mesocaval shunt and azygos continuation of Inferior venacava in a 10 month old infant with polysplenia and dextrocardia [1]. Errors in the embryogenesis of the Inferior venacava can result in several anomalies. Congenital variations of the Inferior venacava originates during 4-8 weeks of embryogenesis of three paired veins, posterior cardinal veins, subcardinal veins and supracardinal veins. Variations of Inferior venacava occur in 3% of population with Double Inferior venacava being the most common.The other variations include Transposition of the Inferior venacava, Circumaortic renal vein, Retroaortic renal vein and absence of the hepatic portion of the Inferior venacava [2].

These variations are often incidental surgical and radiologic findings. Computed tomography , magnetic resonance imaging and ultrasound are all good methods of defining the anatomy, however the venogram best delineates the course of the Inferior venacava.

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However, it is important to recognize these anomalies as they can have significant clinical implications, especially for surgeons and for the treatment of thromboembolic diseases.

Materials and Methods

Forty formalin fixed cadavers allotted to first year MBBS students in Rajarajeshwari Medical college and ESIC Medical college, Bangalore were studied over a period of 10 years for the double inferior venacava.

Results

In one of an adult male cadaver, Right IVC was formed by right external iliac vein and right internal iliac vein at the level of fifth lumbar vertebra. The right IVC received the right gonadal vein, right renal vein and the right suprarenal vein (Figure 2).

The left IVC was formed by the left internal iliac vein and the left external iliac vein at the level of fifth lumbar vertebra. The persistence of left IVC is due do failure of regression of left posterior cardinal vein. The left IVC ran upwards and at the level of kidneys joined the right IVC. The left IVC received the left gonadal vein, left renal vein and the left suprarenal vein (Figure 2).

The oblique vein of communication was present between left internal iliac vein and right IVC at the level of fifth lumbar vertebra. This oblique vein of communication crossed from right to left side anterior to body of fifth lumbar vertebra (Figure 3) which belongs to Type 2b [13] (Figure 1).

Table 1: Study of Incidence of Double inferior venacava done by various authors

Author	Year	Type of study	Incidence
Palit S	2002	Cadaveric	1
Gayer G, Luboshitz J	2003	Radiologic	1 out of 9
Anupam K Kakaria	2007	Radiologic	1
Cannon Milani	2008	Venogram	1
S Morita	2009	Radiologic	28 out of 36
Ng WT, NgSS	2009	Radiologic	3
Mayuri Shah	2011-12	Cadaveric	2 out of 20
Present study	2017	Cadaveric	1 out of 40

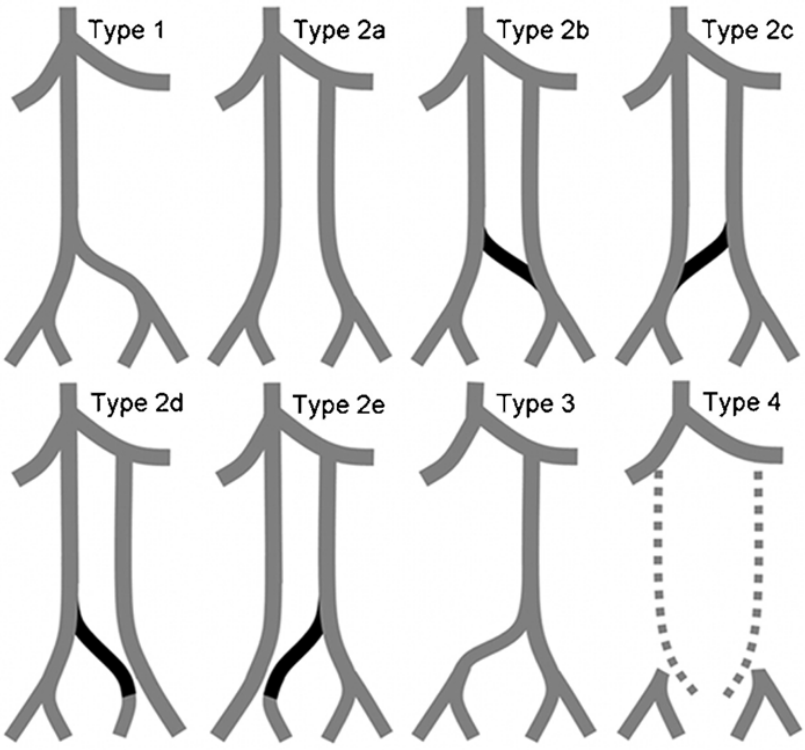

Fig. 1: Schematic drawings of the following pelvic venous variations of IVC anomalies: type 1, normal iliac connection (including azygous continuation); type 2a, double IVC with no interiliac communication; type 2b, double IVC with interiliac communication form the left CIV; type 2c, double IVC with interiliac communication from the right CIV; type 2d, double IVC with interiliac communication from the left IIV; type 2e, double IVC with interiliac communication from the right IIV; type 3, left IVC with symmetrical-to-normal iliac connection; and type 4, no iliac connection in the case of absence of the infrarenal IVC, with dilated bilateral gonadal veins (dotted lines). Interiliac communicating veins are in black. IVC: inferior vena cava; CIV: common iliac vein; IIV: internal iliac vein [13].

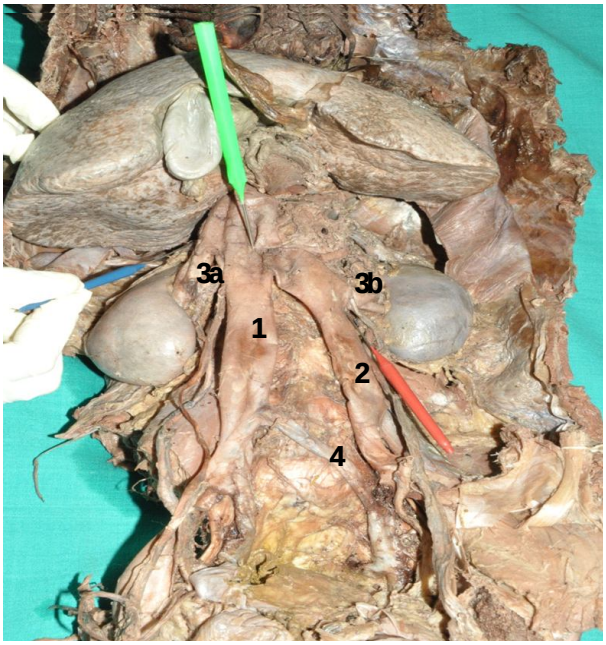

Fig. 2: Figure showing left inferior venacava[2] joining the right inferior venacava [1] at the level of renal veins[Right renal vein3a, Left renal vein 3b]. Further right & left inferior venacavae were joined by transverse caudal venous anastomoses-persistent inter-posterior cardinal venous channel [4]

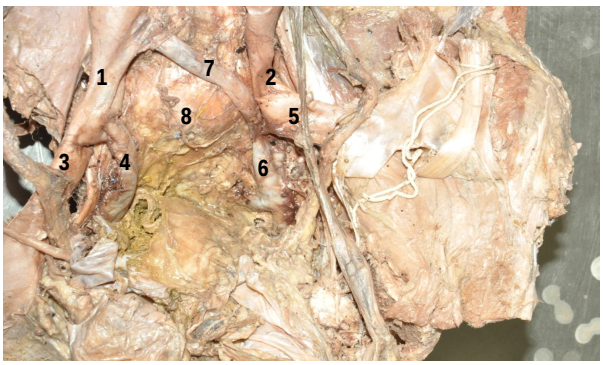

Fig. 3: Figure showing the formation of Right inferior venacava[1] by the union of right External iliac vein [3] and right internal iliac vein[4]. The formation of left inferior venacava [2] by the union of left external iliac vein[5] and left internal iliac vein[6]. Further the Oblique communication between the two venacavae[7] at the leval of fifth lumbar vertebra [8]

Discussion

The embryogenesis of the IVC is a complex process involving the formation of several anastomosis between three paired embryonic veins. The result is numerous variations in the basic venous plan of abdomen and pelvis . A left IVC typically ends at the left renal vein, crosses anterior to the aorta to form a normal right sided pre-renal IVC. In dual IVC, the left IVC typically ends at left renal vein which crosses anterior to aorta to join right IVC [1].

Double Inferior venacava should be suspected in cases of recurrent pulmonary embolism following placement of an IVC filter. As with left IVC, misdiagnosis of abberant vessel as lymphadenopathy should be avoided. The complexity of the antogeny of the IVC, with numerous anastomosis formed between the three primitive veins can lead to a wide array of variations in the basic plan of venous return from abdomen and lower extremity [1].

Variations in normal anatomy of IVC occurs in 3% of population. Double IVC results from failure of regression of left supracardinal vein, where as a left sided IVC is due to regression of right supracardinal vein [2].

Dual IVC occurs next to transposition and has been reported to occur in 0.2-3% of population. During the embryonic development, formation of IVC is a complex multistep process involving three paired venous channels (posterior cardinals, sub-cardinals and supra-cardinals). Dual IVC arises as a result of persistence of right and left supra-cardinal and sub-cardinal veins [3].

Dual IVC –Embryologically, the ventral vessel originates from the right sub-cardinal vein, whereas the dorsal vessel originates from the right supra-cardinal vein. Although extremely rare, radiologists should recognize it [4].

Two IVC, posterior to the level of the renal veins, anterior to these only one. The caliber of these paired trunks seems about the same, but the left is, of the two, the lesser.

Amongst Gibbons, divided IVC occurs most frequently in the female; this is probably true of the human race. The usual persistence of the right cardinal vein as the entire vena cava may be connected with the lower position of the right kidney; at any rate , in case of a left IVC and often in the cases of divided IVC, the left kidney was lower than the right [5].

Double IVC is a congenital anomaly resulting from the persistence of the embryonic venous system. The majority of the cases are clinically silent and diagnosed incidently on imaging for other reasons. However, these venous anomalies may have significant clinical implications, especially during retroperitoneal surgery and in the treatment of thromboembolic diseases [6].

If IVC is absent, blood from lower limbs may pass through the diaphragm into SVC by way of large vein in the location of ascending lumbar and azygos veins. As a result, the hepatic veins drain directly to the right atrium through the normal caval

opening in the diaphragm.It should be noted that any venous channel returning blood through the aortic hiatus of the diaphragm is called "persistent posterior cardinal vein [7]."

Anomalies of IVC appear during venous development between sixth to eighth week of fetal life. The retroperitoneal venous system develops from three pairs of veins, posterior cardinal, supracardinal and subcardinal veins. Thrombosed dual IVC mimicks para-aortic lymphadenopathy or other retroperitoneal mass. This is not surprising as paraaortic lymphnodes are a common site for metastases from local and distant tumours and for diseases of the reticuloendothelial system. Other differential diagnosis for soft tissue mass lying to the left of the aorta in the upper abdomen include enlargement of the left gonadal or hemiazygous vein, a circumaortic or retroaortic left renal vein,an extra renal pelvis or post-operative herniation of either stomach or bowel after a nephrectomy or splenectomy. Anatomical variants of IVC occur in upto 4% of population and may be complicated by thrombophlebitis, when their appearance may become even more misleading [8].

IVC also known as posterior venacava, is a large vein that carries de-oxygenated blood from the lower half of the body into the right atrium of the heart. Rare anomalies of IVC include the absence of a part of the IVC, azygos and hemiazygos, continuation of a duplicated IVC, double SVC, double IVC , hypoplasia, agenesis and interruption of IVC. Anomalies of IVC is more common in males particularly in western countries; that is probably due to gene mutations that appear in these populations. Additionally, surgeons must be aware of variations during organ transplantation, radical nephrectomy, sympathectomy, or ureteric surgery. It could be fatal to mistakenly injure the inferior venacava during an operation of abdomen. If there is undiagnosed double IVC, there may be re-occurrence of embolisms by thrombus from left IVC, giving rise to higher occurrence of thromboembolic disease and pulmonary embolism [9].

IVC is a composite vessel which develops caudo-cranially from persistent caudal part of right posterior cardinal vein, right supracardinal vein, anastomosis between right supracardinal and sub-cardinal vein, right subcardinal vein, new vessel extending between the right subcardinal vein and common hepatic vein which is derived from the suprahepatic part of the right vitelline vein [10].

Radiologically, the presence of dual IVC can be mistaken as a pathological lesion such as lymphadenopathy or left pyelo-uretric dilation [11].

Although such anomalies are generally asymptomatic, they have important ramifications in certain settings (eg; when pulmonary embolism occurs after filter placement in the right IVC because of t he presence of left IVC). They can also be a source of diagnostic uncertainity and make surgery more hazardous [12].

The gonadal veins may be misinterpreted as a double IVC because they run close to the ipsilateral IVC lumen, particularly the left gonadal vein that drains into the left renal vein. Evaluation of the peripheral connection of these veins is crucial in distinguishing them from IVC anomalies because the gonadal veins definitely originate from the ovaries or testis [13].

Duplication of IVC is a rare finding in radiological studies, and it's main differential diagnosis is Lymphadenopathy, aortic aneurysm and retroperitoneal cysts [14]. In a few reported articles the duplication of IVC may be associated with recurrence of pulmonary thromboembolism, if the anatomical variation goes undiagnosed [15]. Duplicated venacava along with other vessel anomalies in the retroperitoneum can lead both to misdiagnosis and to surgical complications. Surgeons, radiologists, oncologists and urologists have to cope with retroperitoneum region, should not only have a thorough knowledge of normal anatomy of this region but also they should be familiarized with the potent anatomical variations and with the exact type of each variation as well [16].

The knowledge of caval variation can prevent misinterpretation of mediastinal masses, iliac occlusion with venous collaterals and paravertebral lymphnode enlargement.

Conclusion

Hence, the variations of IVC should be recognized by radiologists and surgeons in order to avoid mistakes during imaging of the area or surgeries and in case of venous thromboembolic disease. These variations should not be mistaken for pathologic findings, but should be viewed as normal findings of abnormal embryogenesis.

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Morphometric Study of Posterior Horn of Lateral Ventricle by Computerised Tomography and Dissection Method

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Abstract

Aims and Objectives: To analyze morphometrically the length of posterior horn of normal lateral ventrical of human brain and to study, if any, sex difference and/ or side difference in the length. *Material and Methods*: Five hundred (500) normal CT scans of patients in the age group of 20-79 years were taken. The study group included 250 males and 250 females. Length of posterior horn of right lateral ventricle in millimeters were taken from trigone to the end of posterior horn on both sides. *Results*: The data analysis showed that the length of posterior horns were found to be more in males and on left side. *Conclusion*: The present study defined the length of posterior horn of lateral ventricles of brain by CT which could have clinical correlations in diagnosis, treatment and management of neurological conditions.

Keywords: Posterior Horn; Lateral Ventricle.

Intrntroduction

The ventricular system of brain consists of two lateral ventricles, midline third and fourth ventricles connected by interventricular foramen of monro and aqueduct of sylvius respectively. The lateral ventricles are located in the cerebrum, the third ventricle in the diencephalon of the forebrain between the right and left thalamus; and the fourth at the back of the pons and upper half of medulla oblongata of the hindbrain [2]. Morphometric studies of lateral ventricles have been the focus by many scholars recently due to it is relation with pathologies evidences such as hydrocephalus, schizophrenia, tumors, trauma... etc., as well as gender and aging which could lead to dementia and or brain geriatric [3]. The posterior horn of the lateral ventricle is usually diamond shaped or square in outline and it has been often observed that the two ventricles may be asymmetrical [1]. The ventricles of the brain are well visualized, and their overall configuration can be reconstructed from a series of contiguous slices [4]. The evaluation of the normal measurements of the cerebral ventricles in the living human has great importance in the diagnosis and monitoring of several pathologies [5]. Computerised Axial tomography is a safe non-invasive technique which utilizes X-rays. It is developed by Hounsfield GN and provides images of transverse slices of brain with or without the use of contrast media [6].

Gross anatomy of cerebral ventricles can also be studied either by dissection or making casts of ventricular system of human cadaveric brain [7]. Understanding the normal and abnormal anatomy of the ventricular system of the brain is helpful for clinicians, neurosurgeons and radiologists in day-to-day practice [8]. Very few such anatomical studies of ventricular system has been done so far. The present work was undertaken to study the posterior horn of lateral ventricles of brain, both by CT scan and dissection method.

Materials and Methods

Data for the present study was collected from the CT scans performed in the Department of Radiology, Government Medical College and

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Hospital, Aurangabad. CT scans reported as normal by radiologists were selected. Five hundred (500) normal CT scans of patients in the age group of 20-79 years were taken. The study group included 250 males and 250 females.

Twenty-five (25) brain specimens were obtained from the cadavers belonging to the Department of Anatomy, Government Medical College Aurangabad.

Inclusion Criteria

CT scans of patients between 20-79 years age group with normal radiological findings.

- Dissected brain specimens without any visible gross abnormality .

Exclusion Criteria

CT scans of patients, with history of head injuries, previous intracranial surgeries or showing local mass lesion or cerebral infractions.

- Dissected brain specimens with history of head injuries, local mass lesions and cerebral infarctions .

1. *For Dissection*: Each brain was divided in the midsagittal plane.The arachnoid and pia mater were removed carefully. A parasagital section was taken about 2cm lateral to the midsagital plain, to measure the length of posterior horn from the centre of trigone (Trigone is a point where posterior horn, inferior horn and body meet).

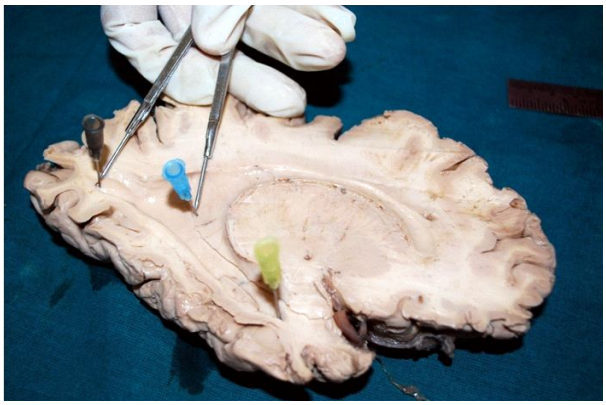

Fig. 1: Measuring length of posterior horn from trigone to the end of posterior horn

Two needles were placed, one at trigone (4), another at end of posterior horn (5). The length of the posterior horn was measured from trigone (4) to the end of posterior horn (5) on both sides.

For CT scan: The computerised tomography films were taken and measurements were taken at the level above the interventricular foramen of Monro.Length of posterior horn of right and left lateral ventricles in millimeter were taken from collateral trigone / atrium to tip of the posterior horn.

Observation and Results

Length of Posterior Horn

By CT Scan

The mean length of posterior horn in male was found to be 26.9 mm and 28.4 mm on right and left sides respectively. While in female it was found to be 25.2 mm and 26.8 mm on right and left sides respectively (Table 1). Though the mean length of posterior horn was found to be more in males than in females and more on left side as compared to the right side, the differences were not statistically significant.

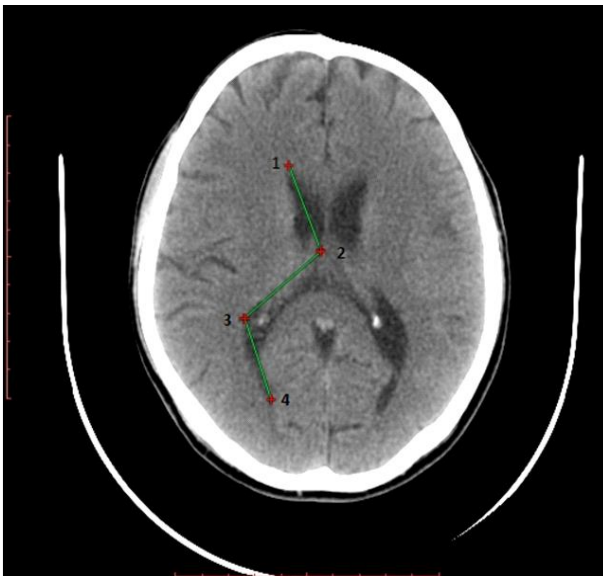

Fig. 2: CT scan at the level of interventricular foramen showing parts of lateral ventricle
3-4: Length of Posterior horn of Lateral ventricle

Table 1: Showing genderwise mean lenght and standard deviation of posterior horn on right and left sides

Side	Sex			
	Male(250)		Female(250)	
	Mean(mm)	SD	Mean(mm)	SD
Right	26.9	1.6	25.2	1.4
Left	28.4	1.5	26.8	1.4

Age wise analysis showed that mean length of the posterior horn to increased in the age group of 50-59 yr and 60-69 yr, while it decreases in the age group of 70-79 yr (Table 2). The mean length of left posterior horn was more as compared to that on right side and length of both left and right posterior horn showed variation with increasing age. However no statistically significant difference was found.($p>0.05$) (Table 2.1).

By Dissection Method

In present study,the mean length of posterior horn in male was found to be 22.8 mm and 23.7 mm on right and left sides respectively. While in female it was found to be 20.1 mm and 22.8 mm on right and left sides respectively. Though the mean length of posterior horn was more in males as compared to that in females and more on left side as compared to that on right side, the differences were not statistically significant (Table 3).

Comparison of Length of Posterior Horn Taken By CT and Dissection Method

The mean length of posterior horn by CT scan was found to be 26.1 mm and 27.6 mm on right and left sides respectively while by dissection

Table 2: Showing mean lenght and standard deviation of posterior horn on right and left sides in various age groups by ct scan

Parameter Side Age group	Posterior Horn			
	Right(500)		Left(500)	
	Mean(mm)	Standard Deviation	Mean(mm)	Standard Deviation
20 to 29	26.1	1.69	26.1	1.69
30 to 39	25.9	1.75	25.8	1.75
40 to 49	26	1.88	25.9	1.88
50 to 59	26.4	1.69	26.4	1.69
60 to 69	26.3	1.72	26.3	1.72
70 to 79	26.2	1.47	26.2	1.47

Table 2.1: Showing anova test for posterior horn on right and left sides

		Anova				
		Sum of Squares	Degree of freedom (DF)	Mean Square	F Value	P Value
Right Post Horn (mm)	Between Groups	15.46	6	2.6	0.817	0.557
	Within Groups	1555.56	493	3.2	0.870	0.500
	Total	1571.03	499	5.8	0.168	1.057
Left Post Horn (mm)	Between Groups	31.30	6	5.2	1.849	0.088
	Within Groups	1390.96	493	2.8	1.900	0.070
	Total	1422.27	499	7.1	3.749	0.158

Table 3: Showing genderwise mean lenght and standard deviation of posterior horn on right and left sides

	Sex			
	Male(10)		Female(15)	
	Mean(mm)	SD	Mean(mm)	SD
Right	22.8	6.1	20.0	3.5
Left	23.7	7.1	22.8	3.2

Table 4: Comparison of length of posterior horn of the lateral ventricle by ct and dissection method

	CT Scan(500)			Dissection (25)		
	Mean (mm)	SD	P- value	Mean	SD	P-value
Right	26.1	1.81	0.001	21.2	4.83	0.001
Left	27.6	1.49	0.001	23.1	5.02	0.001

Table 5: Showing comparison of the length of posterior horn

Parameter	Torkildsen study				Present study			
	Cast method (11)		Ventriculogram (13)		Dissection method (25)		CT method (500)	
	Right	Left	Right	Left	Right	Left	Right	Left
Mean length of posterior horn (mm)	14.5	13.9	11	9	21.1	23.1	26	27.6
Range (mm)	0-36	0-36	0-25	0-30	12-32	10-30	21-33	23-32

method it was found to be 21.2 mm and 23.1 mm on right and left sides respectively. A statistically significant difference (p=0.001) was observed when the measurements obtained by CT and dissection method were compared (Table 4).

Discussion

Length of Posterior Horn

• By Ct Scan

In present study, the mean length of posterior horn in males was found to be 26.9 mm and 28.4 mm on right and left sides respectively. While in females it was found to be 25.2 mm and 26.8 mm on right and left sides respectively. The mean length of posterior horn was found to be more in males as compared to females and also more on the left side as compared to the right side.

• By Dissection

In present study,the mean length of posterior horn in male was found to be 22.8 mm and 23.7 mm on right and left sides respectively. While in female it was found to be 20.1 mm and 22.8 mm on right and left sidesrespectively. The mean length of posterior horn was found to be more in males as compared to females and also more on the left side as compared to the right side.

Torkildsen in his study conducted in 1934, found the mean length of posterior horn to be 14.5mm and 13.9mm on right and left sides respectively by Cast method where as by Ventriculogram it was found to be 11mmand 9mm on right and left sides respectively [7].

The finding obtained by Torkildsen did not correlate with the findings of present study possibly because the parrafin which was used to make cast has a tendency to shrink when solidified, while incomplete filling of posterior horn with air occurs in ventriculogram.

Conclusion

The present study defined morphometric measurements of posterior horn of lateral ventricles of brain by both CT and dissection method.The findings of study could have clinical correlations in diagnosis, treatment and management of neurological conditions.

Differences were observed between the mean lengths of posterior horn on right and left sides and also between males and females. The length was more in males and on left side by both CT and Dissection methods, but the differences were not statistically significant. Age wise analysis showed the mean length of posterior horn to increase in the age group of 50-59 years and 60-69 years with a decrease in age group of 70-79 years on right and left sides by CT Scan, but there was no statistically significant difference between any age group. However a statistically significant difference was observed, when we compared the results of CT and dissection measurements.

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Formulation of Regression Equation to Estimate Stature from Hand Length

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Abstract

Many a times Forensic Experts are asked to identify the person from dismembered part of the body and skeletal remains by the Investigating Officer. If the whole skeleton is available it becomes easy for identification, but the problem arises when only dismembered part of the body, few bones or single bone is available. In identification stature is primary characteristic along with age and sex. The present study is carried out in J.J.M. Medical College, Davangere, Karnataka. Total 100 students (50 males and 50 females) are randomly selected. The height of the students and length of both right and left hand of each student is measured by the same observer and with the same instrument. In this study we formulated the Regression Equation for estimation of stature from right and left hand length for males and females separately. Co-efficient correlation of height with hand length is also calculated. The results of the present study indicate that the hand length can be efficiently used for estimation of stature.

Keywords: Stature Estimation; Hand Length; Regression Equation.

Introduction

Assessment of body height from different parts of body by anthropometric study of skeleton is an area of interest to Anatomists, Forensic Experts and Anthropologists.

In ancient time physician and surgeon like Charaka and Sushruta were well acquainted with the relation of different parts of body and height. According to Charaka, the height of an average man should be 84 anguls, thigh - 21 anguls, leg - 19 anguls, forearm - 15 anguls and arm- 16 anguls [1].

Estimation of stature from incomplete skeletal and decomposing human remains is particularly important in personal identification. The relationship between specific body dimensions/ proportions can be used to solve crimes in the absence of complete evidence. For example, it has been proved that stature can be estimated from imprints of the hand, foot or footprints or from a shoe left at the scene of a crime [2]. Similarly, the stature of a victim can be estimated when a part of body, such as a long bone, or hand, is all that remains [3].

It is shown in earlier studies that various hand measurements tend to differ in various ethnic groups [4]. Consequently, the formulae designed to estimate stature from various anatomical dimensions in one population do not apply to another [5,6].

Furthermore, the need for the alternative formulae for the genders is also proved as rate of skeletal maturity in males and females vary during the course of development [5].

And most studies have stressed that regression formula for stature estimation should be population specific. So there is a need to develop a separate regression formula for stature estimation from various parameters for a particular population.

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So the present study "Estimation of Stature from Hand Length" is taken up.

Materials and Methods

The present study is carried out in J. J.M. Medical College, Davangere, Karnataka. Total 100 students (50 males and 50 females) are randomly selected. The height of the students and length of both right and left Hand of each student is measured by the same observer with the same instrument and at the same time.

Hand length was defined as the direct linear distance between the distal wrist crease and the distal end of the most anterior projecting point, i.e., tip of the middle finger. The subjects were asked to place their hands supine on a flat hard horizontal surface with fingers extended and adducted, following which the hand length was measured. Care was taken to see that there was no abduction or adduction at the wrist joint, i.e., the forearm was directly in line with the middle finger.

Stature is measured as the vertical distance between the point vertex and the heel touching the floor (ground surface). Technique: The subject was made to stand in erect posture against the wall with the feet axis parallel or slightly divergent and the head balanced on neck and measurement was taken without any wear on head and foot using the Anthropometric rod. After collection of data, it is subjected to statistical analysis. Mean, Standard Deviation and Range for Height, Right Hand length and Left Hand length is calculated separately for males and females. Correlation of Height with Right Hand length and Correlation of Height with Left Hand length is calculated separately for males and females.

Table 1:

All in centimeters	Mean		Standard Deviation		Range	
	Male	Female	Male	Female	Male	Female
Height	167.94	155.33	7.57	5.321	139-179	146-171
Rt. Hand Length	18.598	17.05	0.641	0.891	17.2-19.7	15-18.7
Lt. Hand Length	18.682	17.23	0.768	0.770	17-20	15.5-18.7

Table 2:

	Male	Female
Correlation of Height with Right Hand length	0.514	0.770
Correlation of Height with Left Hand length	0.529	0.762

Results

The statistical data which are extracted from calculation are tabulated in Table 1 and Table 2 & Table 3.

Table 2 shows correlation co-efficient of Height with Right Hand length and Left Hand Length separately for male and female. For males, Correlation Co-efficient of Height with Right Hand Length and Left Hand Length are 0.514 and 0.529 respectively which shows moderate positive correlation.

Similarly for females Correlation Co-efficient of Height with Right Hand Length and Left Hand Length are 0.0.77 and 0.762 respectively which shows strong positive correlation.

Regression formulae for estimation of height;

In males

Y1 = 55.24 + 6.06**X1**

Y2 = 70.55 + 5.21**X2**

In Females

Y3 = 77.24 + 4.58**X3**

Y4 = 65.49 + 5.21**X4**

X1 & X3 - Right Hand Length

X2 & X4 - Left Hand Length

Y1 & Y3 - Height from Right Hand Length

Y2 & Y4 - Height from Left Hand Length

Discussion

Results of present study are in agreement with study done by Isurani Ilayperuma [7] et al (in his study correlation co-efficient (R) of Height with Hand length for male and Hand Length for female

Comparision Table

Sl. No.	Sex	Regression equations	S.E.E.	Value of r	Author
1	Female	S=68.89+4.96HL	5.40	0.679	Nath and Krishan
2	Female	S=85.22+4.05HL	5.43	0.594	Nath et al
3	Male	S=89.13+4.13HL	4.57	0.599	Kaur
	Female	S=88.13+4.04HL	3.99	0.639	
4	Male	S=123.22+2.37HL	11.57	0.345	Anand and Nath
	Female	S=96.27+3.56HL	9.31	0.597	
5	Male	S=88.243+4.39HL	5.17	0.609	Krishan and Sharma [9]
	Female	S=81.314+4.425HL	3.82	0.677	
6	Male	S=132.488+2.114HL	5.324	0.527	Jitender Kumar Jakhar
	Female	S=79.432+4.591HL	3.750	0.681	

are 0.58 and 0.59 respectively). According to Jitender Kumar Jakhar [8] et. al. correlation coefficients between stature and all the measurements of hands were found to be positive and statistically significant and the left hand length in both the sexes together exhibits the overall highest value of correlation (r = 0.768) with stature .

In this study we have derived a separate regression equations for both Right and Left Hand Length for males and females to estimate accurate stature of individual.

Conclusion

The results of the present study indicate that the hand length can be efficiently used for estimation of stature. Most authors have underlined the need for population-specific stature estimation formulae. The main reason for this is, the ratio of various body parts differ from one population to another. In addition to ethnic differences, secular trend [10] and even environmental factors such as socioeconomic and nutritional status can influence body proportion [11]. So in this study we derived a separate regression equation to estimate stature from hand length for Davangere region.

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Axillary Arch Muscle and Its Effect on Various Structures in Axilla

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Abstract

Introduction: Out of different variations in axilla, the most understood is a muscular or fibromuscular slip known as Axillary Arch Muscle. Different studies have shown presence of this muscle having incidence of 7-8%. *Material and Method*: The present study was conducted in Department of Anatomy,Dr. D.Y.Patil Medical College, Kolhapur, and Maharashtra. *Result*: The axillary arch was found unilaterally in two cadavers (one male and one female) and bilaterally in two female cadavers. All the 6 arches arose from the anterior border of the latissimus dorsi muscle, crossed over the neurovascular bundle in the axilla and inserted to the fascia covering the deep surface of pectoralis major or on inferior surface of clavicle. In Female cadaver found on left side, the axillary arch muscle was compression the axillary vein. The axillary vein showed dilatation proximally with narrowing at the site of crossing of the axillary arch muscle while distally the vein showed normal calibre. Very interesting Arch was noted in male cadaver of 58 years. Unilateral on left side Axillary Arch muscle was seen along with variation in Posterior cord of brachial plexus. Axillary Arch muscle is more common in female group. *Conclusion*: There is increase in number of females suffering from Carcinoma of Mammary gland, so it is need of the time oncosurgeons, plastic surgeons and radiologist know the details of this muscle. This muscle variant can lead to compression of vessels also nerves, so it is very important to understand signs and symptoms of the same.

Keywords: Axillary Arch; Axillary Vein; Posterior Cord.

Introduction

While performing surgery in axilla, like carcinoma of breast, reconstruction of axilla, axillary bypass, etc., it is mustthat surgeons understand the importance of Anatomical variations in the axilla [1]. In axilla, muscular variations described are chondroepitrochlearis, dorso-epitrochlearis, costo-corocoideus, and etc. [2]. The chondroepitrochlearis is an anomalous muscular slip which is responsible for limiting range of motion of the upper limb [3].

Out of different variations, the most understood is a muscular or fibromuscular slip which courses from the latissimus dorsi muscle to different areas of pectoral region. Themuscles or fibromuscular slip described by various authorsextendfrom latissimus dorsi to tendons, muscles or fasciae of pectoral region near the upper end of the humerus[4].The studies have shownan incidence of 7-8% [5]. It was first described by Ramsay in 1795. This variation was confirmed later by Langer in 1864, so also called as axillary arch of Langer. Sachatello named his variation as the axillopectoral muscle in 1977 [6].

Axillary Arch muscle is a muscular slip,arising from the upper border of the latissimus dorsi. It extends to the deep surface of the pectoralis major, the coracobrachialis or the fascia over the biceps brachii. It crosses over the neurovascular bundle of the axilla. It can be of varying dimension [7].

Materials and Methods

The present study was done in Anatomy Department, D.Y. Patil Medical College, Kolhapur,

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Maharashtra. The study was conducted over 4 years from 2013- 2017. In total 60 cadavers, that is 120 upper limbs we dissected to locate the axillary arch muscle. Wherever found, the arch was dissected meticulously from its origin to its insertion. The nerve supply and blood supply was noted, the dimensions of the arch were measured, its relations to the structures in the axilla were studied in detail. Any additional related variations were investigated.

Observation and Results

The axillary arch was found unilaterally in two cadavers (one male and one female) and bilaterally in two female cadavers. In our study all arches arose from the anterior border of the latissimus dorsi muscle. They were found to cross the neurovascular bundle in the axilla. There insertion were to the fascia covering the deep surface of pectoralis major or on inferior surface of clavicle.

In our study out of 120 upper limbs it was found in 6 upper limbs that is 5%. The muscle slips measured 09 to 15 cm in length and 6 to 9 mm in thickness, as shown in Table 1. Blood supply was derived from either a branch from circumflex scapular artery or any other branch from the third part of axillary artery. Nerve supply was derived from medial pectoral nerve or thoracodorsal nerve.

In female cadaver of 68 years, axillary arch muscle was found on left side. The muscular slip originating from the anterior border of left latissimus dorsi muscle, measuring 10 cm in length and 2cm in width at its broadest point. Theaxillary arch muscle was directed towards the humerus, crossing anteriorly over the axillary vein, axillary artery and the brachial plexus. The axillary arch muscle was divided into two slips; an upper and lower. The upper slip was larger and fleshier and was continuous with the fascia on the medial aspect of the short head of biceps brachi muscle. The lower slip was smaller and less fleshy and was continuous with the fibres of pectoralis major muscle on the deeper surface. The axillary vein also showed gross changes in the vessel wall in this region suggestive of compression effect by the axillary arch muscle. The axillary vein showed dilatation proximally with narrowing at the site of crossing of the axillary arch muscle while distally the vein showed normal calibre [8].

Very interesting Arch was noted in male cadaver of 58 years. Unilateral on left side Axillary Arch muscle originated from Latissimus Dorsi by two slips, which were aponeurotic. Insertion of the muscle was found on inferior surface of clavicle near insertion of subclavius muscle and into clavipectoral fascia. Total length was 9cms, upper aponeurotic slip was 2.5cms while lower aponeurotic slipwas 3 cms (Figure 1).

Between the two aponeurotic slips structures passing were Subscapular artery, Axillary nerve. Subscapular artery was arises from 3rd part of axillary artery. Axillary nerve was branch arises from posterior cord. In this specimen we found variation in Posterior cord of brachial plexus also. Posterior cord was formed 5cms below the clavicle in front of Axillary Arch muscle by union of two roots. We labelled these as upper and lower roots. These roots encircled the Axillary Arch muscle to form posterior cord. Later it continued as Radial nerve (Figure 2). Upper root of posterior cord gave Upper subscapular, Lower subscapular, Nerve to Latissimus Dorsi and axillary nerve.Nerve to Latissimus Dorsi after arising from upper root pierced the Axillary Arch muscle, after supplying the muscle descended downwards on subscapular muscle to supply Latissimus Dorsi muscle.

Axillary nerve after arising from upper root of posterior cord was found to pass posterior to Axillary Arch muscle and later emerged between two aponeurotic bands of Axillary Arch muscle (Figure 3). Axillary nerve later entered quarandular space along the posterior humeral circumflex artery toward surgical neck of humerus.

Table 1: Measurements of Axillary Arch Muscle

Sr. No	Sex	Age years	Side	Length CMS	Thickness M M
1	Female	68	Left	10	7
2	Male	58	Left	9	6
3	Female	64	Left	12	8
4	Female	64	Left	12	8
5	Female	62	Left	15	9
6	Female	62	Left	15	9
	6 out of 120 – 5%			73	47
			Mean	12.16	7.833

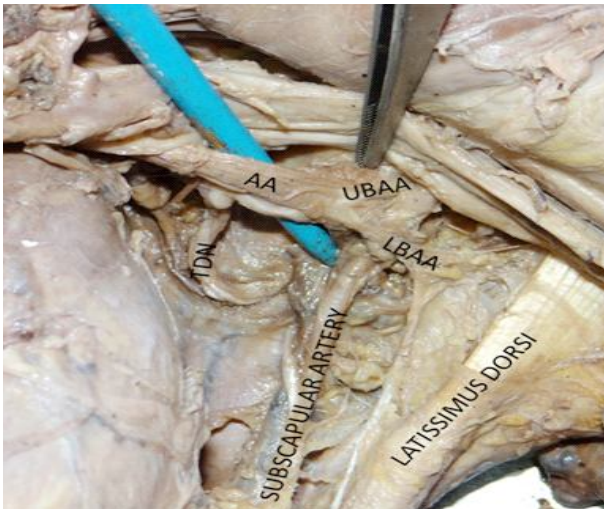

Fig. 1: AA -Axillary Arch Muscle
UBAA-Upper band Axillary Arch Muscle
LBAA-Lower band Axillary Arch Muscle

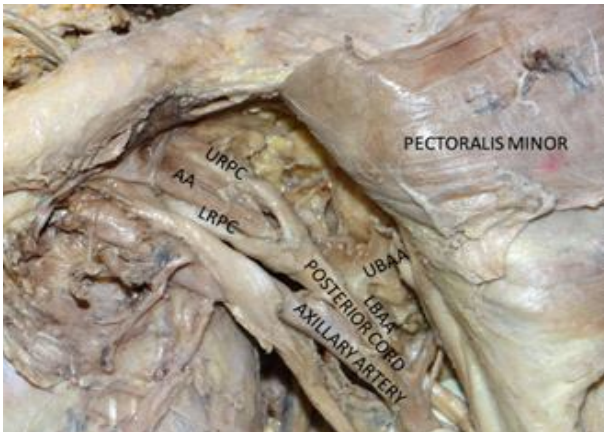

Fig. 2: AA- Axillary Arch Muscle
URPC- Upper Root of Posterior Cord
LRPC- Lower Root of Posterior Cord
UBAA- Upper band Axillary Arch Muscle
LBAA- Lower band Axillary Arch Muscle

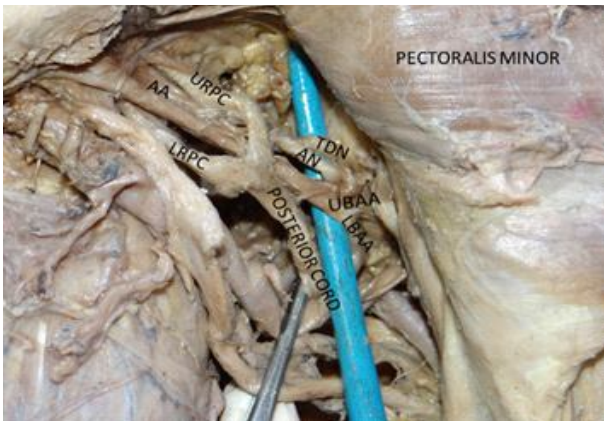

Fig. 3: AA- Axillary Arch Muscle
URPC- Upper Root of Posterior Cord
LRPC- Lower Root of Posterior Cord
UBAA- Upper band Axillary Arch Muscle
LBAA- Lower band Axillary Arch Muscle
TDN- Thoraco Dorsal Nerve
AN -Axillary Nerve

Discussion

An axilla or the armpit is the space between the upper part of the arm and the side of the thorax. It contains neurovascular bundle and lymph nodes draining the upper limb and the lateral wall of thorax.

Axillary arch muscle is an accessory muscle typically crossing the axilla from latissimus dorsi inserting into pectoralis major. Axillary arch muscle can receive nerve fibres pectoral nerve either medial or lateral, intercostobrachial nerve or thoracodorsal nerve [9]. This muscle has been implicated in axillary vein compression, deep vein thrombosis of upper limb and neurovascular compression syndromes [10]. It also plays an important role in the management and kinesiology of the overhead shoulder mobility [11].

Its embryonic origin is not clear but some Anatomists consider muscular arches of the axilla as rudimentary phylogenetic remnants of the panniculus carnosus [12]. Panniculus carnosus,sheet of skin along with muscle lying in subcutaneous fat just deep to superficial fascia is an embryological remnant [13]. In man it has regressed because its functional importance is decreased during evolution in favour of wider range of mobility of upper limb. Others suggest that, limb muscles generally arise in situ from the somatopleuric layer of lateral plate mesoderm around the developing bones [14].

Different studies havefound out Axillary Arch muscle to be present in 7-8% of subjects [7,15]. Population wise frequency differs. Literature shows about 1.7% in the Turkish population [16] and 43.8% in the Chinese population [17]. Axillary arch muscle in cases reported during surgery are less [18] ranging from 0.25% to 4.3% [19].

Clinical Importance

Surgeons operating in axilla need to have information of anatomical variations, particularly Axillary Arch muscle. Pressure by the muscle during contraction can cause axillary vein entrapment, lymphatic compression with subsequent venous thrombosis or lymphoedema [20]. Due to its close proximity to the neurovascular structures it can cause shoulder instability by neurovascular compression. Gradual contracture of the axillary arch muscle results in the patient inability to abduct the shoulder joint beyond 95° [21].

The axillary arch can be misdiagnosed as tumour while looking at enlargement of lymph nodes [22],

even while physical examination the palpation of the lymph nodes could be difficult [12,15,23].

During imaging investigations, lymph nodes in axilla could be missed or not seen due to the axillary arch muscle [12,23]. As axilla has important structures, entrapment of structure may lead to the compression of the brachial plexus, resulting in hyper abduction syndrome [24], also costoclavicular compression syndrome and to axillary vein entrapment [25].

During breast reconstructive surgery when using a musculocutaneous flap from latissimus dorsi, if Axillary arch muscle is present could lead to complications, as it is closely related to the neurovascular structures [26].

History from patients complaining of swelling in the axilla like discolorations of the arm, starting especially when physically active (e.g. swimmers) this muscular variant should be considered [27].

If we can sees a visible axillar fullness, careful palpable of the muscle in shoulder abduction and can be absent in adduction [15,18,27,28].

In case post-operative subject develops a contracture, and the subject has presence of this muscle, the subject faces severe difficulties in elevating or even moving their arms.

If this muscle causes compression symptoms, operatively removal of this muscular slip cures the problem [29,30].

Conclusion

Surgeons operating in axilla need to have information of anatomical variations, particularly Axillary Arch muscle. Axillary Arch muscle is more common in female group. There is increase in number of females suffering from Carcinoma of Mammary gland, so it is need of the time oncosurgeons, plastic surgeons and radiologist know the details of this muscle. This muscle variant can lead to compression of vessels also nerves, so it is very important to understand signs and symptoms of the same. If correct diagnosis is made than removal of this muscle operatively will help the subjects.

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Profundafemoris Artery and its Branches: A Cadaveric Study in South Indian Population with Clinical Correlations

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Abstract

Background and objectives: Profunda femoris artery (PFA) and its branches are known to have wide range of variations. The objective of this study was to report the variations in site of origin, level of origin of profunda femoris artery and variations in origin of medial and lateral circumflex femoral arteries. *Methodology:* In a descriptive cadaveric study, 64 lower limb specimens of 32 cadavers were studied (27 males and 5 females). After dissecting the femoral triangle, profunda femoris artery origin, distance from inguinal ligament, medial and lateral circumflex arteries were noted. *Results:* Out of 32 cadavers (64 specimens), PFA was arising from the posterolateral aspect of femoral artery in front of iliacus in 33 specimens. In 13 specimens it PFA was arising from lateral side of femoral artery. Mean distance in normal origin of PFA from femoral artery was 33±7 mm from inguinal ligament.Only in two specimens, PFA was originating above femoral artery above inguinal ligament. In 49 specimens (76.6%), circumflex arteries were arising separately from PFA. Only in two cases medial, lateral circumflex arteries and PFA was arising from common trunk, forming trifurcation of PFA. *Conclusion:* Profunda femoris artery most commonly arises below the inguinal ligament and posterolateral to femoral artery. Medial and lateral circumflex femoral arteries most commonly arise as separate branches from PFA. This study may be useful for surgeons working in the upper part of thigh either during hip surgeries or during treatment of ischemic lower limb revascularization.

Keywords: Deep Femoral Artery; Medial Circumflex Femoral Artery; Lateral Circumflex Femoral Artery; Variations.

Introduction

As the femoral artery is used for various angiographic procedures, the knowledge about its branches and their variations in the femoral triangle is of importance in radiological and surgical procedures [1]. The largest branch of femoral artery, profunda femoral artery supplies the thigh. The knowledge of its branches and distribution are of significance in revascularising the ischemic limb [2,3]. During intertrochanteric hip screw fixation for intertrochanteric femoral fracture, profunda femoris artery branches may be damaged [4]. During management of ischemic pressure sore of the thigh in paraplegic patients fasciocutaneous perforator propeller flap obtained from the posterior region having first perforator results in better outcome [5]. Very rarely proximal femoral fractures may lead to pseudoaneurysm of profunda femoris artery [6]. The branches medial and lateral circumflex femoral arteries differentially but significantly contribute to blood supply to femoral head [7].

Developmental variations rete femorale accounts for wide range of variations in the deep arterial supply of thigh [8]. Femoral vasculature is relatively newer offshoot from the axial vessels [9].

There are many reports highlighting variations in profunda femoris artery, concentrating on origin,

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length and branches. Many of the cadaveric studies focus on the metric values. Our study reports profunda femoris artery and its branches variations from the south Indian cadavers. The objective of the study was to describe profunda femoris artery and its branching pattern along with morphometric considerations like, level of origin, the length of main trunk and pattern of branching.

Methodology

In a descriptive cadaveric study, 64 lower limb specimens of 32 cadavers were studied (27 males and 5 females). All cadavers were unclaimed bodies from district hospital and age range could not be ascertained. All cadavers were formalin fixed via common carotid artery in the neckand femoral triangle was not dissected for the purpose of embalming.

In all cadavers, femoral triangle was dissected and the superficial inguinal lymph nodes along with the superficial vessels were identified and the fascia lata was incised to expose the femoral triangle. The inguinal canal was identified, followed by the adductor longus and sartorius muscles. The femoral sheath was identified and its compartments were dissected thus clearing the femoral artery (FA) and its major branches. The PFA with its medial circumflex femoral (MCF) and lateral circumflex femoral (LCF) branches were dissected and identified, their origin and course were traced. The relationship of the PFA at its origin to the femoral artery was noted. Origin of PFA within 10 mm from inguinal ligament was classified as high origin, from 10 mm to 50 mm was classified as normal and origin beyond 50 mm was classified as low origin. Among high origin of PFA, origin above and below inguinal ligament was noted.

The distance of the site of origin of the profunda from the midpoint of the inguinal ligament was measured in millimetres with a scale and a calipers. The sites of origin of the MCF and LCF were studied and the distance of site of origin of each of them from the origin of PFA was measured in millimetres. The branches of circumflex arteries were noted.

Results

Origin of PFA

Out of 32 cadavers (64 specimens), PFA was arising from the posterolateral aspect of femoral artery in front of iliacus in 33 specimens. In 13 specimens it PFA was arising from lateral side of femoral artery (Table 1). In 39 specimens, PFA was arising 10 to 50 mm from inguinal ligament. This was the most common level of origin of PFA. Mean distance in normal origin of PFA from femoral artery was 33±7 mm from inguinal ligament. Only in two specimens, PFA was originating above femoral artery above inguinal ligament. Distances were 9 and 14 mm above the inguinal ligament in these two cases.

Origin of Circumflex Arteries

In 49 specimens (76.6%), circumflex arteries were arising separately from PFA. Only in two cases medial, lateral and PFA was arising from common trunk (table 1). In cases where MCFA and LCFA was arising separately from PFA, mean distances of origin was 18 (±4) mm and 22 (±5) mm respectively.

Table 1: Profunda femoris artery (PFA) and its branches - medial circumflex femoral artery (MCFA) and lateral circumflex femoral artery (LCFA) parameters observed during study, n=64. (IL – inguinal ligament)

Parameter	Number of Cases	Percentage
Origin of PFA		
Posterolateral	46	71.9
Lateral	13	20.3
Posterior	3	4.7
Posteromedial	2	3.1
Level of origin of PFA		
High (above IL)	2	3.1
High <10mm (below IL)	11	17.2
Normal (from 10 – 50 mm from IL)	39	60.9
Low (> 5mm from IL)	12	18.8
Origin of MCFA and LCFA		
Common origin with MCFA	5	7.8
Common origin with LCFA	8	12.5
Trifurcation of circumflex arteries and PFA	2	3.1

Course of PFA and Circumflex Arteries

The most common course of PFA and circumflex arteries are as follows: In the femoral triangle, it was giving off its circumflex femoral branches. Then the main trunk of PFA was running above the adductor longus deep to sartorius and the arrangement of structures were found from superficial to deeply as femoral artery, femoral vein, profunda femoris artery and profunda femoris vein. The distal part of profunda femoris was giving the lateral perforating branches and the medial muscular branches. The artery finally was continuing as the fourth perforator.

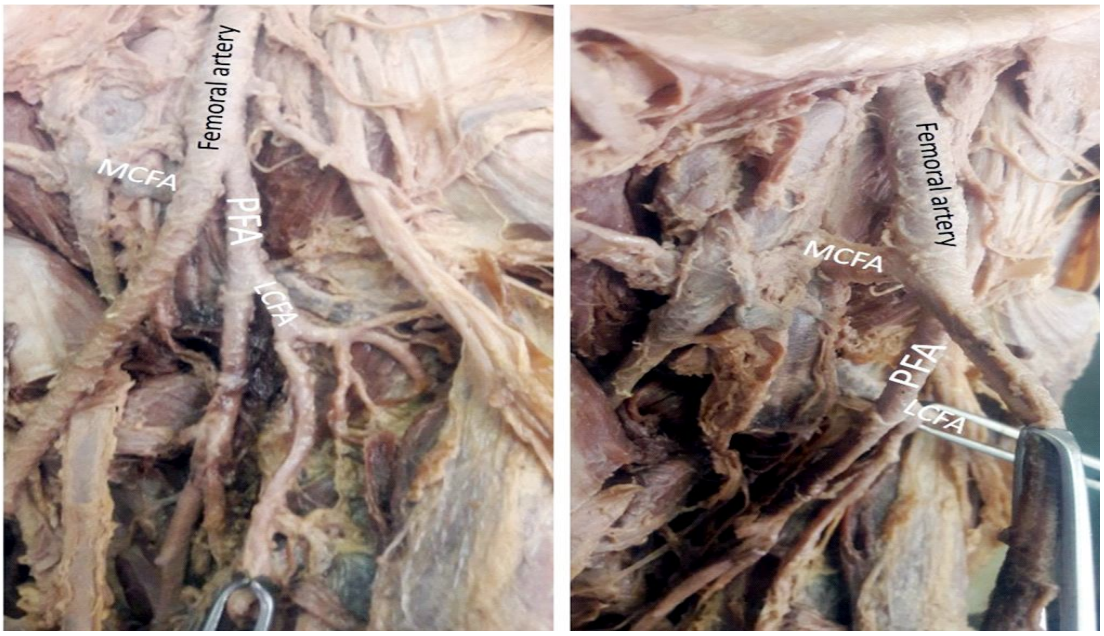

Fig. 1: Dissected specimens representing origin of profunda femoris artery (PFA) from lateral (A) and posterolateral (B) aspect of femoral artery. Medial circumflex femoral artery (MCFA) is arising from PFA in B and directly from femoral artery in A.

Table 2:

Study	Year	Number of Lower limbs studied
Rathnakar et al.[10]	2016	73
Darji et al.[11]	2015	130
Manjappa & Prasanna[12]	2014	40
Anwer, Karmalkar & Humbarwadi[13]	2013	60
Peera & Sugavasi[14]	2013	40
Shiny Vinila et al.[15]	2013	40
Dixit et al.[16]	2011	228
Prakash et al.[17]	2010	64
Dixit, Mehta & Kothari[18]	2001	48

Discussion

Profunda femoris artery is extensively studied arteries of lower limb. Variations are common and widely reported. The cadaveric studies reporting PFA and its branching pattern have been tabulated in Table 2. We have studied 64 lower limbs. Dari et al and Dixit et al have studied greater number of lower limbs as they have done a multicentre study involving more teaching institutes.

Most common site of origin of PFA reported by many are posterolateral aspect of femoral artery. All the previous literature have reported the same. The mean distance from inguinal ligament to the site of origin of PFA was 33 mm. Reported distances vary from 2 to 5 cm. However, in a study by Nasr et al, on the right side in male, the distance exceeds 5 cm [19]. We report two cases of PFA origin above inguinal ligament. In the previous reports the incidence of such high origin of PFA varies from 2

to 10% [16-18]. Sangeeta Rajani et al have found PFA arising from anterolateral and medial origin of PFA [20]. Such origin of PFA were not noted in present study.

The knowledge of site of origin, direction of PFA course and distance from inguinal ligament need to be established during intertrochanteric hip screw fixation for intertrochanteric femoral fracture in order to avoid iatrogenic injury to PFA. As noted in the study, mode of origin and distance of origin vary in each individual. At most care is advised while working in femoral triangle.

In 60–75% of the cases, the origins of medial and lateral circumflex femoral arteries in the previous studies are from PFA. Our study goes with the previous report with incidence of 76.6%. However, lower incidences of MCFA origin from PFA is reported by Clark [21] (62%) and Dixit et al [18] (53%).

During development of lower limb bud, the 5th lumbar intersegmental artery, being the axial artery forms the arterial patterns in the gluteal region along with sciatic nerve. Femoral artery and its branch, PFA are formed as newer offshoots from the existing vascular network. During this process which is not tightly regulated, many variations in level of origin of PFA, direction of PFA and its branches are subjected to wide variations.

Limitations of Study

Male and female differences were not noted. Right and left side differences were not accounted in this study. As there were more variations in the branches of circumflex arteries, their distances of origin were not noted. Medial circumflex femoral artery was traced till it gives branches – ascending and descending branches. Acetabular branch, deep and superficial branches of medial circumflex femoral artery are not reported in this write up. Similarly ascending, transverse and descending branches of lateral circumflex femoral artery are also not reported in this report. As the current study is descriptive study, more sample size would have provided a better depiction of variations. It is intended to extend the same study into multiple teaching colleges in the future.

Conclusion

This study reports that most common site of origin is within femoral triangle, below inguinal ligament and posterolateral to femoral artery. Mode of origin of medial and lateral circumflex femoral arteries also reported. This study may be useful for surgeons working in the upper part of thigh either during hip surgeries or during treatment of ischemic lower limb revascularization.

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Conflict of Interest

Authors declare no conflict of interest.

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Stature Estimation from Tibial Length in Maharashtra

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Abstract

Introduction: Estimation of stature has been found to have important role in anthropometry and forensic medicine. Stature is a very valuable measure of race. It is another unit character of greater value than skin color because there are extreme variations in human height. In present study an attempt has made to evaluate the anthropometric relationship between stature with that of lengths of tibia. *Objectives:* To evaluate the length of tibia in Indore population and to derive regression equation *Materials & Methods:* This study has been carried out in the Department of Anatomy, medical institute. Out of 180 healthy individuals; 90 males and 90 females of individuals in Maharashtra, with age ranging from 19 to 24 years. *Results*: There is positive correlation between length and stature of tibia *Conclusion*: It is observed and concluded that stature of an individual can be estimated with the help of anthropometric measurement of tibia.

Keywords: Maharashtra; Stature; Tibia.

Introduction

In the field of Anthropomentry and Forensic medicine; estimation of stature has received a utmost significant importance. Anthropometric characteristics have direct relationship with sex, shape and form of an individual & these factors are intimately linked with each other [1].

Johan Friedrich Blummenbach [2] (1752-1840) laid down the foundation of Science of anthropology. To correlate the stature of a person with measurement of various body parts great extensive work has been done in India & abroad. All studies have concluded that there is a linear relationship between measurements & stature.

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However they have been conducted in different races, hence their data & statistical formulae cannot be generalized. In this work an attempt is made to use length of ulna and tibia for calculating stature of a person [3].

Factor responsible for the height fo the person is mainly the length of lower limb bones. In viewing the above point in mind, the present work was planned to calculate the height of the body from the length of percutaneous tibia. The measurement was done between the two anatomical land marks: Palpable portion of medial condyle and medial malleolus of tibia. Later on the regression analysis was done and regression formula was derived separately for both sexes to calculate the body height by using length of percutnaeous tibia [4].

In 1997, N.K. Mohanty studied 1000 adult in Oriya individuals, that includes 500 males & 500 females and derived regression formula using percutaneous tibial Length (PCTL) [4]. In 2009, Bhavna and Surinder Nath have done the study to compute Multiplication factors and regression equations for estimation of stature among male of Delhi. The study constitutes 503 males. And they wereMeasured forlength of femur, tibia, fibula, foot length & bredth [5].

The recent study conducted by Agnihotri and his

group [6]. In his study of estimation of stature from percutaneous length of tibia in Indo-Mauritian population suggested that percutaneous length of tibia can be efficiently used for estimation of stature. They remarked that tibial length show linear relationship with stature.

Present study includes measuring the length of tibia and height of individual and is also helpful in forensic medicine if tibia specimen of medico legal case is found we can estimate probable stature of that person. This study will be helpful in artificial limb centers in calculating appropriate length of prosthesis.

The study will be helpful in corrective surgeries for leprosy patients, amputation of limb surgeries for accidental injuries. The derived formulae can help to calculate height in case of patients suffering from spine disorders like kyphoscoliosis. The data collected can be useful in further anthropological studies also.

Materials & Methods

This study has been carried out in the department of Anatomy, Krishna Institutes of Medical Sciences University, Karad, Maharashtra. Out of 180 healthy individuals included in the study 90 were males and 90 were females of Maharashtrian population, with age ranging from 19 to 24 years. Vernier caliper [7] (60 centimeter length with accuracy of 0.01 cm) and standard flexible steel tape [8] was used to measure height of the subject.

Anthropometric measurements taken include right tibial length, left tibial length Stature. Independently for each individual as well as stature of each subject was also recorded. Tibia lies medial to fibula & is exceeded in length only by femur. Its shaft is triangular in section & has expanded ends proximally i.e. condyles and a strong medial malleolus projects distally from smaller distal end. The anterior border is sharp & curves medially towards the medial malleolus & it is subcutaneous [9].

The individuals were asked ti sit with left knee placed in the semi flexed position and partly everted to relax the soft tissues, so that the bony land marks are more prominent. With the help of caliper the length of the bony marks of tibia are measured.

After collection of data, it is subjected to statistical analysis, recorded and tabulated. After analyzing data of each and every subject. Students't' test (unpaired't' test) [10] was applied to calculate the stature from tibial length and correlation between total body height and length of tibia was determined with the help of regression formula [11].

Observations and Results

The present study has been carried out in the department of Anatomy, Krishna Institutes of Medical Sciences University, Karad, Maharashtra. Out of 180 healthy individuals, there were 90 males and 90 females, with age ranging from 19 to 24 years.

Above table shows that mean stature of male subjects is 172.31 that of female subjects is 158.84 cm, Mean of length of right and left tibia in male subjects are 39.03 cm and 39.01 cm respectively and that of right and left tibia in female subjects are 35.57 and 35.47 cm respectively. The above table shows sidewise variation in tibial length of male and female subjects, which is not statistically significant Table shows regression equation for height with length of tibia in male and female.

Height = a (constant) + b (slope) X tibia length ± standard error.

Y = height / stature (cm). 74.39 & 76.25 are intercept (constant or a) and 2.50 & 2.46 are regression coefficient (b) for right tibia & left tibia respectively in males.

Table 1: Parameters (cm) in male and female subjects

Parameter (cm)		Stature	Right tibia	Left tibia
Mean	Male	172.31	39.03	39.01
	Female	158.84	35.57	35.47
Range	Male	188-158	44.31-35.24	43.85-34.34
	Female	174.5-145	41.24-30.19	42.13-30.18

Table 2: Comparision between length of right and left tibia

Subjects	Right tibia (cm)	Left tibia (cm)	P value	t value
Male	39.03	39.01	0.943	0.070
Female	35.57	35.47	0.737	0.336

Table 3: Correlation of stature between length of tibia

Subjects		Male	Female
Correlation Coefficient(r)	Right	0.783	0.768
	Left	0.782	0.801
Coefficient Of Determination(r^2	Right	0.613	0.590
	Left	0.612	0.641
P Value		< 0.0001	0.641

Table 4: Regression equation for height with length of tibia in male and female

Parameter	Sex	Side	Regression Equation	Correlation Coefficient
Length of tibia	Male	Right	Y = 74.39 + 2.50 right tibial length	0.783
		Left	Y = 76.25 + 2.46 left tibial length	0.782
	Female	Right	Y = 73.75 + 2.39 right tibial length	0.768
		Left	Y = 72.06 + 2.44 left tibial length	0.801

73.75 & 72.06 are intercept (constant or a) and 2.39 & 2.44 are regression coefficient (b) for right tibia & left tibia respectively in females.

Discussion

In present study mean value of right tibial length is 39.03 cm & left tibial length is 39.01 cm in males. Our findings correlate with I. Can Pelin [10] study. He studied 110 male subjects from Turtkish population. In this study, he presented a new method for estimation of stature from tibia length, Group-specific formula while present study slightly differ from Manisha R. Dayal [11], she studied 98 white males and 71 white females of South Africa.

Bhavna & S. Nath [5], did work on 503 shia Muslims of Delhi and they studied various percutaneous dimensions besides stature such as femur length, fibular length, tibial length, foot length and bredth. They concluded that tibial length provides best estimate of stature as it exhibits highest value of correlation (r = 0.765) & least value of standard error of estimate(SEE = +3.66).

In present study mean value of right tibial length is 35.57 cm & left tibial Length is 35.47 cm in females. Our findings correlate with N. K. Mohanty [4], who studied 500 males and 500 females from Oriya population in Berhampur, Orrisa and derived regression Equation using percutaneous tibial length.

Our study also correlate with Manisha R. Dayal [11], she studied 98 white males and 71 white females of South Africa. While present study slightly differ from Chavan S.K [3]. He studied 200 subjects (100 males & 100 females) in Maharashtra.

Conclusion

Database is prepared and tabulated. It is concluded that the lengths of tibia provide good reliability in estimation of stature in forensic examinations. In present study, It is observed that in males, the highest correlation is exhibited by right tibia length (r = 0.783) and lowest by left ulna length (r=0.733).

It is observed that in females, the highest correlation is exhibited by left tibia length (r = 0.801). Left tibia length in females depicts higher correlation coefficient than that of any other measurement. Thus tibia length is the best parameter for estimating stature for females. This is also supported by low SEE in case of tibia length in females. It is observed that in males, the highest correlation is exhibited by right tibia length, Thus tibia length is the best parameter for estimating stature for males. This is also supported by low SEE in case of tibia length in males.

Mean values of tibial length and stature in present study are comparable with the data of other workers. The data collected can be utilized for future anthropological studies.

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Original Article

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A Study of Anatomy and Landmarks for Third Common Palmar Digital Nerve and Its Variations

Bangale Shridevi P.

Abstract

Background: Third common palmar digital nerve / third carpal digital nerve (TCDN) has been described as the most commonly injured digital nerve during carpal tunnel release (CTR). Anatomic variations of the origin and course of the TCDN from the median nerve may place this structure at risk. Anatomic landmarks may be useful to predict the location of the TCDN to minimize the risk for injury to this structure during CTR. *Aim:* TO study the anatomy, landmarks and variations of origin and course of TCDN from median nerve. *Material and Methods:* THE study comprised of 30 upper limbs from 15 cadavers. TCDN in them were dissected using classical incisions given in Cunninghams' manual. *Results:* Type 1 TCDN origin was found in 33.33%, type 2 origin was found in 67% and type 3 origin was found in 10% cases. Mean distance of origin of TCDN was 5.9 mm distal to cardinal line and 23 mm proximal to cardinal line. As TCDN course distally, its trajectory compared with oblique vector denotes, in 60% cases TCDN runs along vector, in 36.67% cases nerve runs medial to oblique vector and in 3.33% cases nerve runs lateral to vector. *Conclusion:* Study of anatomy, landmarks and variations of origin and course of TCDN from median nerve may be helpful to predict location of TCDN to minimize risk of injury to TCDN during CTR.

Keywords: Third Carpal Digital Nerve; Superficial Palmar Arch; Carpal Tunnel.

Introduction

Medial branch of median nerve subdivides into two common palmar digital nerves which pass distally deep to superficial palmar arch and between the long flexor tendons. Medial common digital nerve/ third common palmar digital nerve / third carpal digital nerve (TCDN) divides and receives a communicating twig from the common palmar digital branch of ulnar nerve and it divides into two proper digital nerves to supply the adjacent sides of the middle and ring fingers, sometimes it gives a twig to the third lumbrical [1]. Carpal tunnel release (CTR) is a time-honored procedure for the treatment of carpal tunnel syndrome with uniformly excellent results and a relatively low risk of complications.[2] However, potentially devastating adverse outcomes do occur with both the open and endoscopic techniques of CTR [3-5].

TCDN is the most commonly injured digital nerve during carpal tunnel release (CTR) surgery, as it traverses vector of longitudinal incision of CTR [6].

Superficial palmar communication between the median and ulnar nerves occurs and it might cause iatrogenic injury during endoscopic carpal tunnel release [7]. So purpose of this study is to study branching pattern and to determine anatomical landmarks to predict the course of third carpal digital nerve / third common palmar digital nerve (TCDN) in hand and to determine the frequency with which superficial palmar communication between the median and ulnar nerves occurs. Objectives of present study are; 1) to determine Type 1/2 /3 TCDN origin 2) to measure distance of origin of TCDN from cardinal line 3) to determine relation to oblique vector 4) to note berrettini communication is present/absent.

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Material and Methods

The study was done on 15 formalin (10%) embalmed adult cadavers, 11 male & 4 female cadavers (30 sides). Decomposed, amputed, injured specimens and specimens from children were excluded from study. Vertical incision was taken on midline of Palm and skin reflected on either side. Palmar aponeurosis was identified with palmaris longus (PL) tendon. PL tendon was cut and aponeurosis reflected distally. Median and ulnar nerve & their branches in relation to arteries forming superficial palmar Arch & flexor retinaculum (FR) were identified and dissected meticulously till digital branches, the origin of the third carpal digital nerve (TCDN) was inspected in relation to the distal edge of the FR. This origin was further measured from Kaplan's cardinal line, which was used as an external landmark (Figure 1). Hurst's description of this line, which extends from the apex of the interdigital fold between the thumb and index finger, a point that remains consistent despite abduction or adduction of the thumb, to the hook of the hamate, which can be consistently palpated noninvasively [8,9]. TCDN origin was noted in relation to superficial palmar arch and classified into type 1, 2 and 3 as described in Engineer et al [6] study. Type 1 originated from median nerve within carpal tunnel proximal to the distal edge of the flexor retinaculum (FR) (Figure 2). Type 2 originated distal to flexor retinaculum but proximal to superficial palmar arch (Figure 3). Type 3 originated distal to flexor retinaculum and at or distal to superficial palmar arch (Figure 4). As the TCDN coursed distally, its trajectory was compared with another external landmark consisting of an oblique vector from the scaphoid tubercle to the midline of the ring finger palmar digital crease (Figure 5). Also frequency of occurence of superficial palmar communication between common digital nerves which arise from ulnar and median nerve, also known as the Berrettini branch, was noted.

Results

With respect to TCDN origin, out of 30, Type 1 TCDN origin was found in 10 cases (33.33%) (Figure 6), type 2 origin was found in majority cases i.e. 17 (56.67%) (Figure 7) and type 3 origin was found in 3 cases (10%) (Figure 8).

Mean distance of origin of TCDN was 5.9 mm distal to cardinal line and 23 mm proximal to cardinal line.

Distally, the trajectory of TCDN is compared with oblique vector and it denotes, out of 30, in majority of cases i.e. in 18 cases (60%) TCDN runs along vector (Figure 7, 8) and in 11 cases (36.67%) nerve runs medial to oblique vector (Figure 6) and in single case (3.33%) nerve runs lateral to vector.

It was also noted that out of 10 cases of type 1 origin in 3 cases (30%), nerve runs along vector and in 7 cases (70%) medial to vector. Out of 17 cases of type 2 TCDN origin, in 13 cases (76.47%) nerve runs along vector and in 4 cases (23.53%) nerve runs medial to oblique vector. Whereas out of 3 cases of type 3 TCDN origin, in 2 cases (66.67%) nerve runs along vector and in 1 case (33.33%) nerve runs lateral to vector.

Berrettini communication was present in 22 cases (73.33%) out of 30 (Figure 9).

Table 1: Comparison of types of origin of third carpal digital nerve

Parameters	Engineer et al.	Present study
Type I	15%	33.33%
Type II	70%	56.67%
Type III	15%	10%

Table 2: Comparison of mean of distance of origin of TCDN from cardinal line

Parameters	Engineer et al.	Present study
Origin of TCDN distal to cardinal line	5.0 ± 1.2 mm	5.9 mm

Table 3: Comparison of TCDN in relation to oblique vector

Parameters	Engineer et al.	Present study
TCDN coursed along olique vector	Type II and III	Type II (76.47%) > Type III (66.67%) > Type I (30%)

Table 4: Comparison of presence of berrettini communication in different studies

Parameter	Berrettini Communication
Marin F. Stancic et al.	81%
Heidi Bas et al.	67%
Loukas et al.	85%
Raviprasanna et al.	Rt. 7.8%, Lf 7.8%
Present study	73.33%

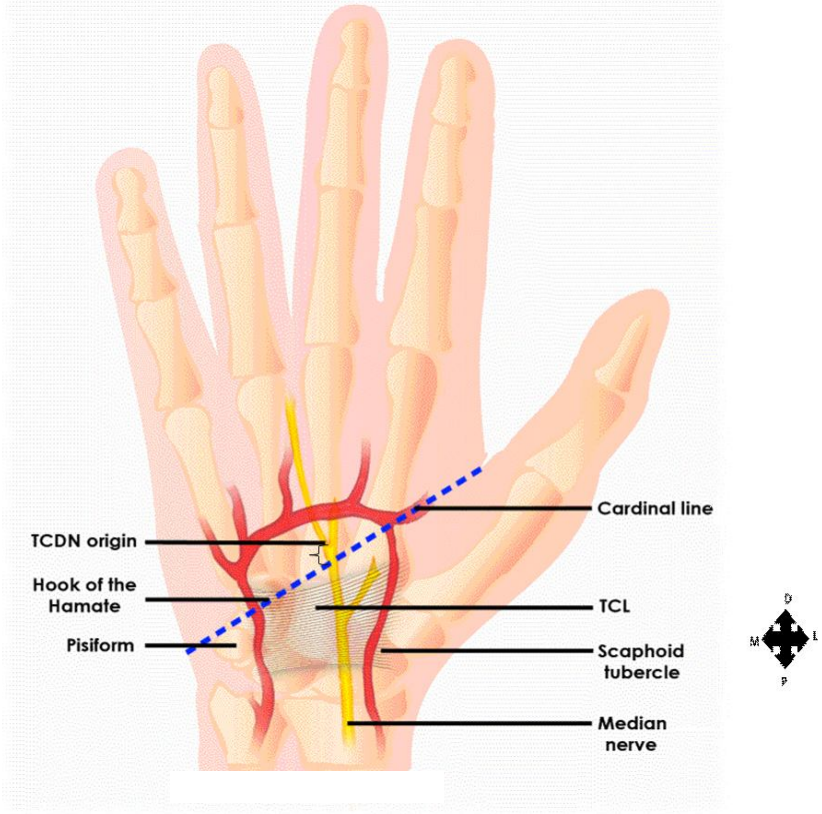

Fig. 1: The origin of the third common digital nerve (TCDN) was inspected in relation to the distal edge of the flexor retinaculum (FR) and measured from the cardinal line

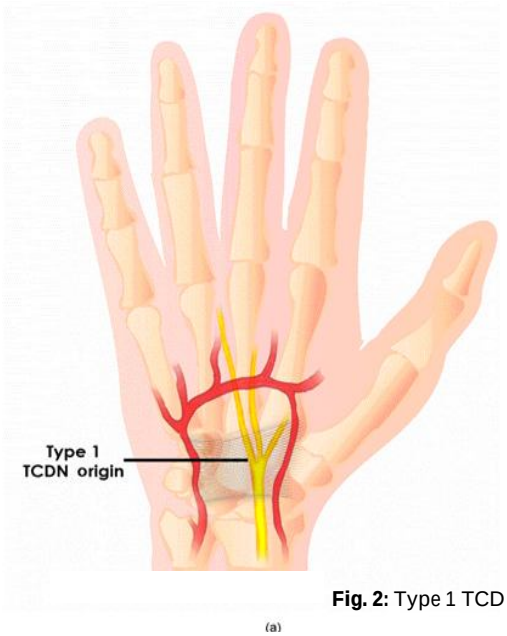

Fig. 2: Type 1 TCDN origin

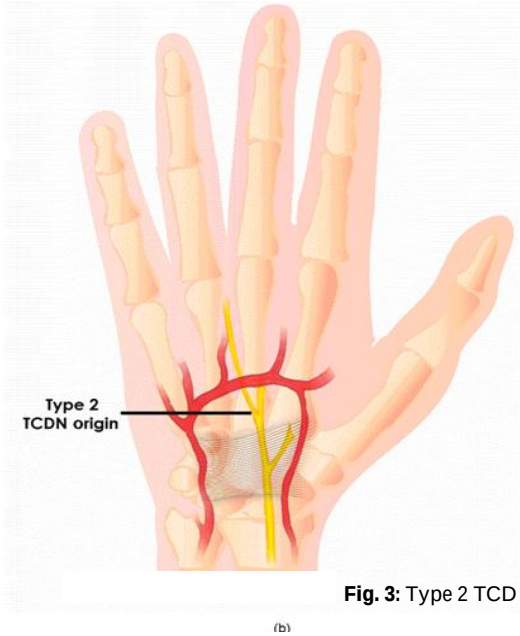

Fig. 3: Type 2 TCDN origin

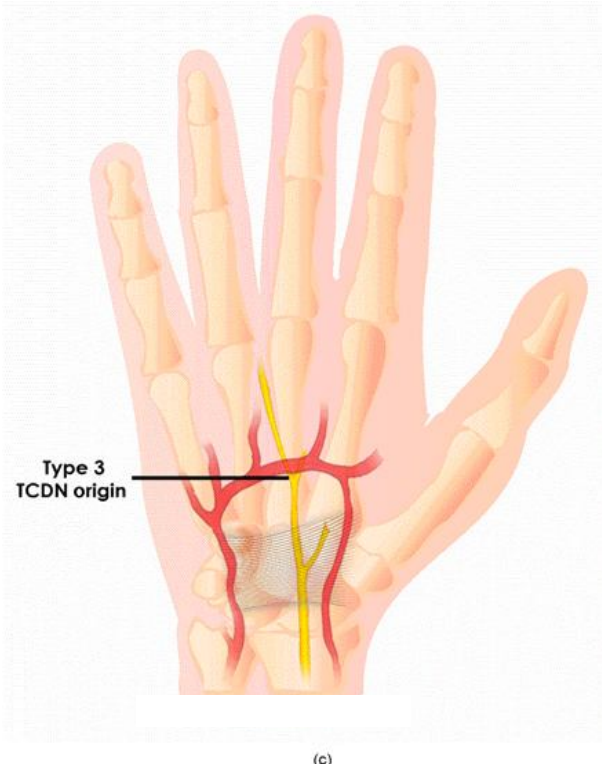

Fig. 4: Type 3 TCDN origin

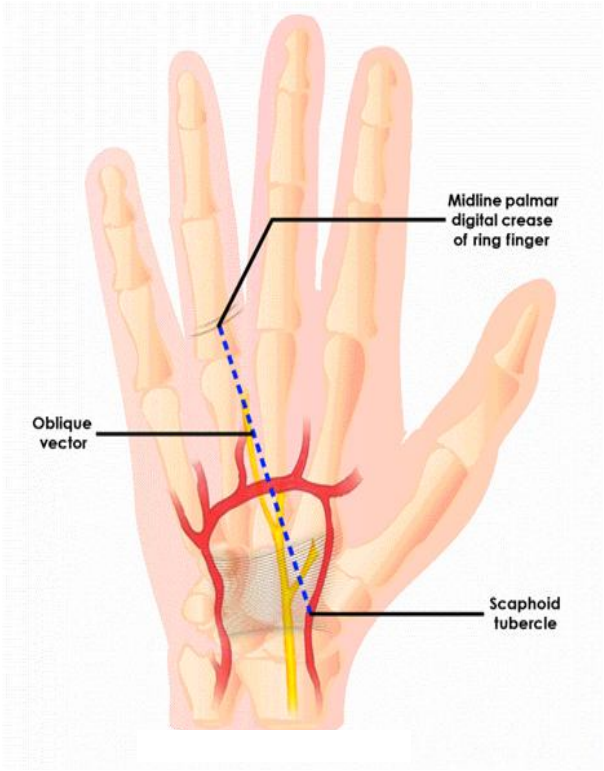

Fig. 5: Trajectory of TCDN compared with an oblique vector.

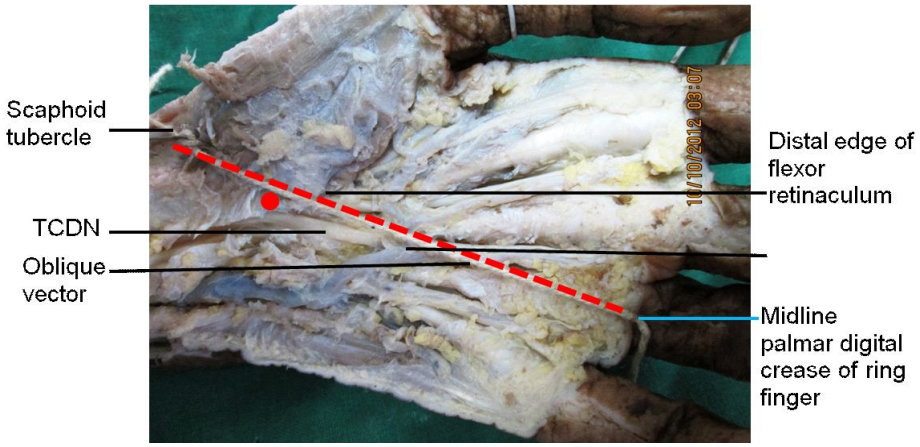

Fig. 6: Illustration showing Type 1 TCDN origin and TCDN running medial to oblique vector

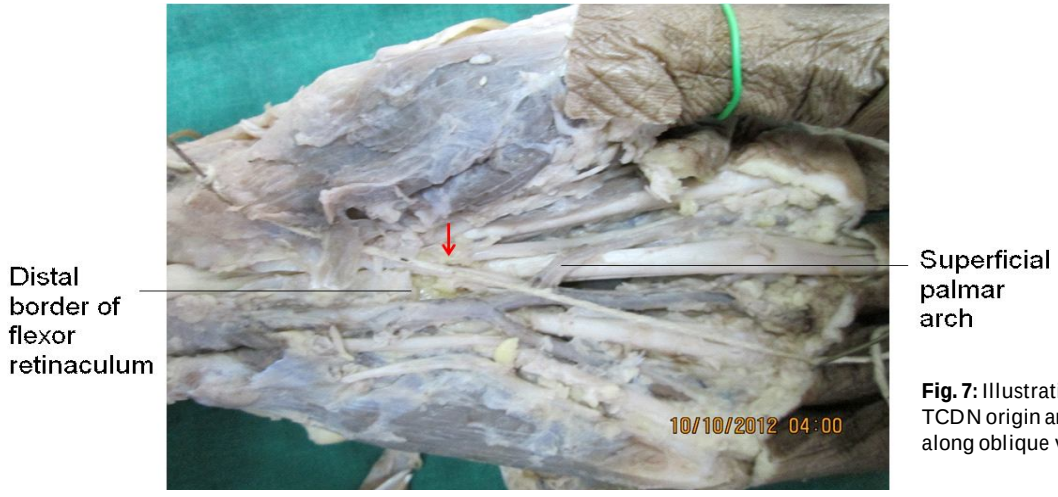

Fig. 7: Illustration showing Type II TCDN origin and TCDN is running along oblique vector

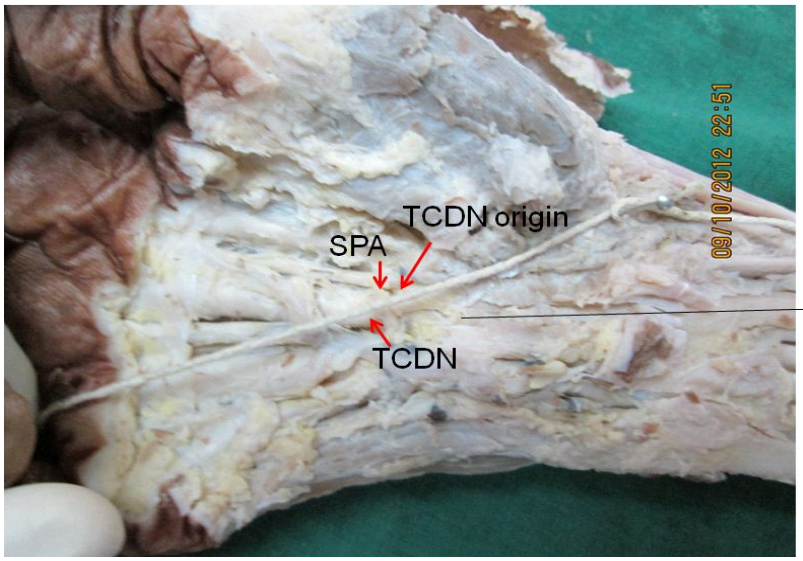

Fig. 8: Illustration showing Type III TCDN origin and TCDN is running along oblique vector

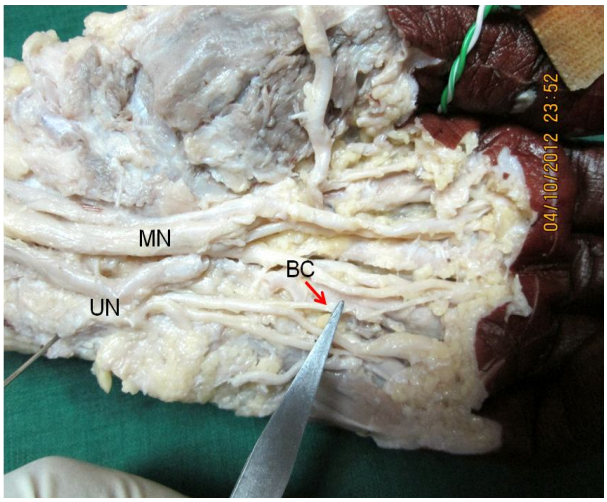

Fig. 9: Illustration showing berrettini communication (BC)

Discussion

Though the TCDN is susceptible to a high frequency of injury in either technique of carpal tunnel release (CTR), its branching pattern has not been specifically examined and documented [6]. In 2008, Engineer et al. studied TCDN origin in 20 cases. Results of engineer et al study were, presence of type 1 TCDN origin in 3 cases (15%) of cases, type 2 origin in 14 cases (70%) and type 3 origin in 3 cases (15%) [6]. In present study Type 1 TCDN origin was found in 10 cases (33.33%), type 2 origin was found in majority cases i.e. 17 (56.67%) and type 3 origin was found in 3 cases (10%). So findings of present study are comparable with engineer et al. study. It has been shown in Table 1.

In Engineer et al. study, on average, the origin of the TCDN was measured at 5.0±1.2 mm distal to the cardinal line [6]. And in present study mean distance of origin of TCDN was 5.9 mm distal to cardinal line. So, findings of present study are comparable with that of engineer et al study. Results are compared in Table 2.

Regarding distal course of TCDN with oblique line, in Engineer et al. study, the TCDN was found to reliably course along an oblique vector from the scaphoid tubercle to the midpoint of the palmar digital crease of the ring finger for type 2 and type 3 variations [6]. In present study, out of 30, in majority of cases i.e. in 18 cases (60%) TCDN runs along vector. Results are compared in Table 3.

Concerning presence of Berrettini communication, in 1999, Heidi Bas and James M Kleinert observed the communicating branches between the median and ulnar nerves in 20 palms (67%) out of 30 specimens used for study [10]. In 2000, Stancic et al. study, it was found in 81% of cases [7]. In 2007, Loukas et al observed the communicating branches between median and ulnar nerves in 170 hands (85%) out of 200 formalin fixed hands. Out of which 143 hands (84.1%) belonged to type I (ulnar to median nerve), 12 hands (7.1%) belonged to type II (median to ulnar nerve), 6 hands (3.5%) to type III (multiple, present horizontally) and 9 hands (5.3%) to type IV (mixed type, multiple combinations existed) [11]. Communicating branch between ulnar and median nerve was observed in 4 limbs (7.8%) on right and 4 limbs (7.8%) on left sides, in Raviprasanna et al study [12]. In present study, berrettini communication was present in 22 cases (73.33%) out of 30. So, findings of present study are comparable with stantic et al [7], Heidi Bas and James M Kleinert [10] and Loukas et al [11] studies. Results are compared in Table 4.

Conclusion

Type 2 origin of TCDN is more common, followed by type 1 and lastly type 3. Mean distance of origin of TCDN was 5.9 mm distal to cardinal line. In majority of cases TCDN runs along oblique vector.

Knowledge of the various branching patterns and external landmarks of the TCDN is useful to prevent unwanted injury to this structure while sharply transecting the flexor retinaculum (FR) in a longitudinal fashion during carpal tunnel release (CTR). The TCDN is at risk during this portion of the procedure because of its intimate relationship to the FR. The type 1 branching pattern of the TCDN is especially susceptible to inadvertent injury, because it originates from the median nerve within the carpal tunnel. In addition, the oblique course of all variations of the TCDN puts it at great risk for injury because it crosses the longitudinal vector of the incision made to divide the FR. If the surgeon fails to suspect its possible presence and visualize it at this potential site of injury, the TCDN may be inadvertently partially or completely divided during release of the FR [6]. These interconnections are at risk when releasing the distal aspect of the TCL during open or endoscopic carpal tunnel release. Aggressive retraction in this region and placement of the endoscope further distal to the TCL should both be avoided in order to prevent traction injury to these nerves which results in paraesthesia in the long or ring finger distribution [10]. Carpal tunnel release is one of the commonly done procedures in orthopaedics. TCDN is one of the most frequently damaged neurological structures during CTR. Injury to it results in development of painful neuroma. Landmarks used will preoperatively predict probable location and path, to avoid injury during CTR via open or endoscopic surgeries.

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Original Article

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Foot Arch Parameters in Adult

Beena Nambiar D.

Abstract

Background: Practically the height of the medial longitudinal arch provides acceptable outlook of the arch-height. *Aim:* Aimed to know inter-relationship of the radiological standing arch-heights with the arch-index for correlation and regression so that from the later we can derive the radiographical standing arch-height values indirectly, avoiding the actual maneuver. *Materials and Methods:* 90 subjectsstanding x-rays of foot, linear distance of the centre of the heel (say the point K) and the tip of the second toe (axis of the foot) (say the point J) was measuredfor standing navicular, talar heights were measured, and 'normalised' with the foot length. *Results:* The arch-index showed significant negative correlationsand simple linear regressions with standing navicular height, standing talar height as well asstanding normalised navicular and talar heights analysed in both sexes separately. *Conclusion:* Since arch-index is a time-tested reliable parameter for estimation of arch height so itself can be used regularly for measuring**.**

Keywords: Arch-Index; Standingnavicular Heights; Standing Talar Heights.

Introduction

The human foot is among the unique features of his anatomy that distinguishes him from other mammals. Its evolution from that of quadruped mammals to bipedal foot of humans includes the formation of foot arches and adduction of first metatarsal bone. These anatomical structures provide humans with the ability to receive and transmit weight to the ground effectively and to adapt to uneven surfaces to facilitate bipedal gait. The foot arches are composed of a longitudinal arch, consisting of medial and lateral parts, and a transverse arch. In fact, the development of the medial longitudinal arch of the foot is the most important stage in the evolution of human bipedal locomotion. Compared to other parts of the body, the foot is greatly affected by anatomical variations, particularly the medial longitudinal arch. These wide ranges of anatomical variations in the foot are consequences of heredity, age, gender, race, environmental conditions, and lifestyle as well as factors associated with footwear.

Foot posture can be classified into three categories based on the morphology of the medial longitudinal arch: (i) a normally aligned (normal) foot, (ii) pronated (low-arched or flat) foot in which the arch is below the normal range with the medial side of the foot coming into complete or near complete contact with the ground, and (iii) supinated (high-arched) foot in which the height of medial longitudinal arch is abnormally high.Variations in foot posture are thought to influence the function of the lower limb and may therefore play a role in predisposition to overuse injury. Despite these observations, there is still considerable disagreement regarding the most appropriate method for categorizing foot type [1]. A wide array of techniques have been used, including visual observation , various footprint parameters , measurement of frontal plane heel position and assessment of the position of the navicular tuberosity [2,3].

Normal values of several parameters of arches of the foot have been studied among various

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populations. However, despite its clinical significance, studies on arches of the foot inindia isvery limited. Hence we studied the normal ranges of foot arch parameters in adult inpopulation of local area, to find the effect of gender on these parameters and to make comparison with those values reported by previous studies in other population by using a radiographic approach.

Materials and Methods

This study was carried out at the Department of the Anatomy. A total of 90 consented subjects (50 males, 40 females) that have no history of lower extremity deformity, lumbosacral injury, neurological disorder, or any systemic disease affecting the lower extremity were randomly recruited to participate in the study. The study was approved by the Research and Ethics Committee.

X-rays of their left foot were obtained in standing position with both legs straight keeping aside to bear the body weight equally, as referred in literature [4,5]. From each set of X-ray film 'height of the talar dome' (henceforth mentioned as Talar Height); 'height of the navicular tuberosity' (henceforth mentioned as Navicular Height) and the 'truncated foot length' (henceforth mentioned as Foot length) were measured The 'truncated foot length' (FL) was determined by the distance of posterior calcanean tuberosity to the head of the first metatarsal excluding the phalanges. After that, a washable inkpad was rubbed on the plantar aspect of the subject's left foot and he/she was instructed to stand in same posture followed during x-ray, on a calibrated graph-sheet provided; so that it totally covers his/her left foot. Thus the standard imprint of the weightbearing left foot was taken, which was considered to be the foot-print of a 50% body-weight bearing foot (the other 50% of the body weight was borne by the right foot, whose print was not taken).

Following the description in literature in the footprint, the linear distance of the centre of the heel (say the point K) and the tip of the second toe (axis of the foot) (say the point J) was measured [6]. Next perpendicular line was drawn tangential to most anterior point of the main body of the foot print. Their point of intersection was marked (say the point L). Next the line LK was divided in equal three parts. Ultimately the main body of the footprint was divided in three areas from those points with the perpendiculars from the foot axis. The anterior, middle and posterior areas were marked as A, B, C respectively. Their areas were determined (in sq.cm). Arch Index = B ÷ [A+B+C].

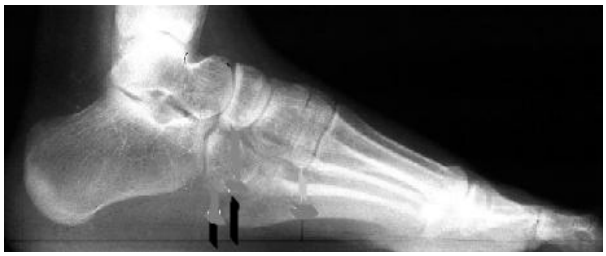

Fig. 1: Radiography for measurement of navicular height, talar height and truncated foot length

Values were put for statistical analysis in SPSS version 12.0 software for required analysis. Prediction of significant relationship amongst the pair of variables was determined by the "Correlation coefficient"

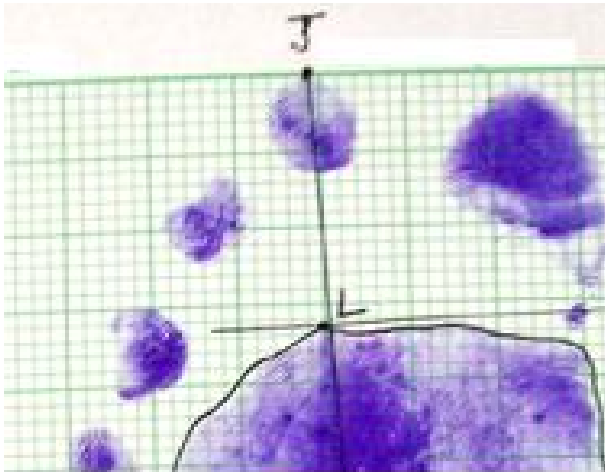

Fig. 2: Left footprint illustration to estimation of the arch index from a footprint

Results

Among 90 adult subjects, we could include 50 (55%) male and 40 (45%) females.

The mean-values of the navicular heighton Standingin males is 3.54 ±0.77 cm and in females3.09 ±0.81 cm. In both the groups the arch-index noted to bear significant negative correlation (Correlation coefficient -0.73 with p=0.000, and -0.76 with p=0.000) with the absolute value of navicular heighton Standing(NHSTD).

Similar trend also noted for 'normalised navicular heighton standing (NNHSTD)', with which arch-index maintained correlation -0.61 (p=0.000) and -0.80 (p=0.001) in male and female groups respectively.

The mean-values of the talar height on standing in males is 7.79±0.6 cm and in females7.04±0.42 cm respectively.

Significant negative correlation is documented for the dependence of talar height on standing (THSTD) on arch-index of an individual, as studied in both the sex-groups (Coefficients as -0.84 with p=0.000 and -0.64 with p=0.028 in males and females respectively).

Dependency of the 'normalised talar height on standing (NTHSTD)' was also confirmed with the arch-index as studied group-wise with correlation coefficient 0.84 / p=0.000 and -0.64 / p=0.001 in males and females respectively.

Table 1: Navicular heighton standing(NHSTD) from arch index in both sexes

	Male(N=50)		Female(N=40)	
	Arch index	**NHSTD**	**Arch index**	**NHSTD**
Mean	0.21	3.54	0.24	3.09
SD	0.04	0.77	0.03	0.81
Correlation coefficient	-0.73		-0.76	
Regression coefficient	-15.91		-8.87	
Std.Error of estimate	0.59		0.24	

Table 2: Normalised navicular heighton standing (NNHSTD) from arch index in both sexes

	Male(N=50)		Female(N=40)	
	Arch index	**NNHSTD**	**Arch index**	**NNHSTD**
Mean	0.23	0.19	0.24	0.14
SD	0.04	0.02	0.03	0.03
Correlation coefficient	-0.61		-0.8	
Regression coefficient	-0.56		-0.83	
Std.Error of estimate	0.03		0.02	

Table 3: Talar height on standing (THSTD) from arch index in both sexes

	Male(N=50)		Female(N=40)	
	Arch index	**THSTD**	**Arch index**	**THSTD**
Mean	0.21	7.79	0.25	7.04
SD	0.04	0.6	0.03	0.42
Correlation Coefficient	-0.84		-0.64	
Regression Coefficient	-13.56		-9.54	
Std.Errorof Estimate	0.36		0.35	

Table 4: Normalised talar height on standing (NTHSTD) from arch index in both sexes

	Male(N=50)		Female(N=40)	
	Arch index	**NTHSTD**	**Arch index**	**NTHSTD**
Mean	0.23	0.4	0.24	0.37
SD	0.04	0.02	0.03	0.04
Correlation coefficient	-0.84		-0.64	
Regression coefficient	-0.39		-1.29	
Std.Error of estimate	0.41		0.61	

Discussion

The values of the absolute standing navicular height, standing talar height as well asthose of 'normalised' standing navicular and talar heights and even the arch-index, asstudied here no doubt corroborate earlier studies [8-13]. We documented slight gender preponderance of the standingarch-heights values in male than in females which correlates with study ofHironmoy Roy et al [14], The arch-index showed significant negative correlations and simple linear regressions with standing navicular height, standing talar height as well as standing normalised navicular and talar heights analysed in both sexes separately with supporting mathematical equations. So far the values of arch-indicesare concerned, though almost 60% of the study population has normal arch, butnearly 36% has higher arches, which might be for their habitat in this areas.

The standing navicular height (NHSTD), talar height (THSTD) and normalisednavicular height (NNHSTD) along with normalised talar height (NTHSTD) individually has been correlated with

the arch-index at the margin of statistical significance. Findings of majorities of previous studies were same with the presentone. Patrick S Igbibi [15] determined the arch index of able-bodied indigenous Kenyan and Tanzanian individuals free of foot pain by using their dynamic footprints to classify the foot arch type. Males had a significantly higher arch index than females in both groups, and the prevalence of pesplanus in Kenyans was 432 per 1,000 population, the highest ever documented and twice as high as that in Tanzanians (203 per 1,000 population) [10]. Gilmour JC et al [16] described in both feet of two hundred and seventy two children aged between five years six months and ten years and eleven months were studied using a footprint technique called the arch index (AI), and the vertical height of the navicular (NH) as non-invasive techniques of objective measures of the medial longitudinal arch (MLA). In addition to age the study investigated the influence of gender, limb dominance, and body weight. The study found the existence of a relationship between the two measures of the MLA. There was no significant difference in NH measures between males and females and body weight did not affect the NH.

Conclusion

Since arch-index is a time-tested reliable parameter for estimation of arch height so itself can be used regularly for measuring such. Radiographical arch-heightestimation though preferred by clinicians, but usually approached in a wrong way tomeasure it in supine posture instead of measuring it in standing posture because ofheavy crowd with limited radiological machineries and expertisation.

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Original Article

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To Study Anatomical Basic (Shape and Dimensions) of Gall Bladder in Cadavers

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Abstract

The extra hepatic biliary apparatus usually shows anatomical variations. These variations are not noticed normally. They are commonly encountered during surgery or any radiological investigation. So the present study was carried out to determine the external morphology of gall bladder in 40 liver and gallbladder specimens obtained from 10% formalin fixed cadavers from dissection hall. In present study, most common shape of gall bladder was Pear shape(67.5%), the average length and max. transverse diameter were found to be 6.75cm and 3.05cm respectively. Maximum length of gall bladder range between 4.5 – 8 cm,out of which 52.5 % gall bladder range between 6.6–8 cm. Maximum transverse diameter of gallbladder range between 2–5 cm, out of which, 45% of gall bladder range between 2–3 cm.

Keywords: Gall Bladder; Morphology; Extra Hepatic Biliary Apparatus.

Introductions

The gall bladder (GB) is a pear shaped hollow visceral organs, slate blue in colour situated obliquely in a non peritoneal fossa on the under surface of the right lobe, and extends from the right end of porta hepatis to the inferior border of liver. It measures about 7 cms to 10 cms in length, maximum breadth being 3cms and capacity is 30 – 50 ml. The presenting parts of gall bladder are from below upwards are fundus, body and neck. The fundus is the lower expanded free end of the gall bladder which projects below the liver. The liver, gall bladder and biliary ductal system develop from hepatic diverticulum of the foregut, in the beginning of the fourth week of development. This diverticulum rapidly proliferates into septum transversum and divides into two parts cranial part and caudal part. The cranial part is the primordium for liver and bile duct and caudal part give rise to gall bladder and cystic duct. Initially the extra hepatic biliary apparatus is occluded with epithelial cells, but later on it gets canalized because of degeneration of epithelial cells. Any arrest or deviation from normal embryological development may result in malformation of gall bladder and billiary system [1]. It is very much essential to have a basic knowledge regarding the development and normal anatomy of biliary tract which gives us a fuller understanding of the anatomical and embryological anomalies. The knowledge of these variants will make the laparoscopic procedures easier, though preoperative diagnosis sometimes goes unseen in few cases, which in turn is an unexpected finding during laparoscopic surgeries. This study will be an addition to the literature and will create awareness among anatomists, radiologist, to surgeons and also gastroenterologist to be thorough regarding the normal and abnormal aspects of Gall Bladder [2].

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Materials and Methods

This study was carried on 40 liver and gallbladder specimens obtained from 10% formalin fixed cadavers in the Department of Anatomy, Indira Gandhi Govt. Medical College, Nagpur. Cadavers

with obvious abdominal surgery and crush injury to the abdominal organs were excluded from the study. The parameters studied were the maximum length of gall bladder, maximum transverse diameter and shape. Maximum length and maximum transverse diameter were measured using metallic measuring tape gradated in centimeters. The shape of gall bladder was noted down.

Results

Shapes of Gallbladder

According to their shape, gall bladders were classified into pear shaped, cylindrical shaped, flask shaped, hourglass shaped, and retort shaped and irregular shaped. The commonest shape found was pear shape (67.5%). Their incidences are presented in Table 1.

Maximum Length of Gall Bladder

Minimum length of gallbladder was 4.5 cm and maximum length was 8 cm. Average length of gallbladder was found to be 6.75 cm. 52.5% gall bladder had length ranging between 6.6 to 8 cm.

Maximum Transverse Diameter of Gallbladder

Smallest transverse diameter was 2 cm and largest was 5 cm. Mean diameter was 3.05 cm. 45% gall bladder had transverse diameter ranging between 2 to 3 cm.

Table 1: Showing incidences of shapes of gall bladder

Sr. No.	Shapes	No. of Specimens	Percentage
1	Pear shape	27	67.5%
2	Cylindrical shape	4	10%
3	Flask shape	3	7.5%
4	Hour glass shape	2	5%
5	Retort shape	2	5%
6	Irregular shape	2	5%
	Total	40	100%

Table 2: Showing Measurements of gall bladder

Sr. No	Maximum Length in cm	No. of specimen	Percentage	Maximum Transverse Diameter in cm	No. of specimen	Percentage
1	< 5 cm	3	7.5%	2 – 3 cm	18	45%
2	5 – 6.5 cm	16	40%	3.1 – 4 cm	17	42.5%
3	6.6 – 8 cm	21	52.5%	4.1 – 5 cm	5	12.5%

Fig. 1: Pear shaped gall bladder

Fig. 2: Cylindrical shaped gall bladder

Table 3: Comparison of shape, length and transverse diameters of gall bladder with other authors

Sr. No.	Author	Shape of gall bladder	Length	Max. Transverse diameter
1	LeeMc Gregor et al(1986) [3]	-	7.5 – 10 cm	-
2	Turner & Fulcher (2000) [4]	Elliptical	10 cm	3 – 5 cm
3	Moore & Dalley (2006) [5]	Pear	7 – 10 cm	-
4	Chari & Shah (2008) [6]	Pear	7 – 10 cm	2 – 5 cm
5	Vakili & Pomfret (2008) [7]	Piriform	7 – 10 cm	4 cm
6	Standring(2008) [8]	Flask	7 – 10 cm	-
7	Jaba Rajguru et al(2012)[1]	Pear (85%)	5 -12 cm	2.5 – 5 cm
8	Prakash A V et al (2013) [9]	Pear (71.11%)	7 – 10 cm	2 – 5 cm
9	Rajendra R et al (2015) [10]	Piriform (53.2%)	4 – 11 cm	2.5 – 5 cm
10	J. Desai et al (2015) [11]	Pear (84%)	4.5 – 11 cm	2.8 – 5 cm
11	Chakka S. et al (2016) [2]	Pear (80%)	7 – 10 cm	2 – 5 cm
12	Present study	Pear (67.5%)	4.5 – 8 cm	2 – 5 cm

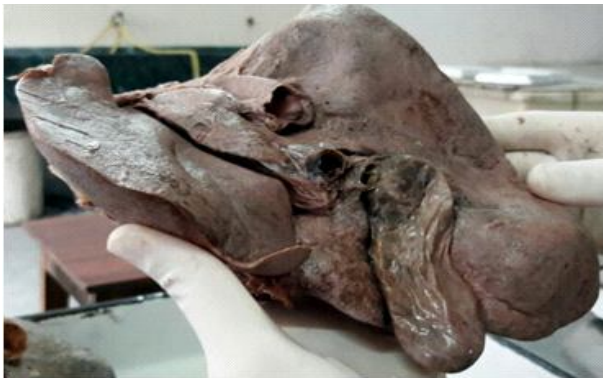

Fig. 3: Hour glass shaped gall bladder

Fig. 4: Flask shaped gall bladder

Fig. 5: Retort shaped gall bladder

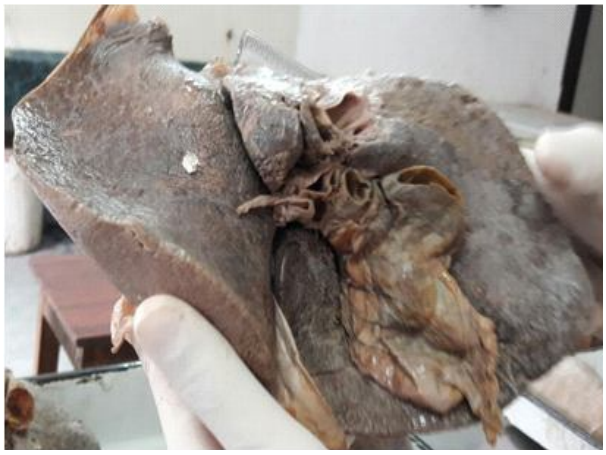

Fig. 6: Irregular shaped gall bladder

Discussion

Anatomy of gallbladder, extra hepatic billiary system and the arteries that supply them and liver are important for surgeons. Failure to recognize them may lead to inadvertent ductal ligation, billiary leaks and strictures after laparoscopic cholecystectomy.

The pear shape of gall bladder found in most of the specimens (67.5%) in the present study which is similar to the findings of previous authors Jaba Rajguru et al (2012) [1], Chakka S. et al (2016) [2], Moore & Dalley (2006) [5], Chari & Shah (2008) [6], Prakash A V et al (2013) [9], J. Desai et al (2015) [11]. Elliptical shaped gall bladder had been observed by Turner & Fulcher (2000) [4]. Standring (2008) [8] observed flask shape as most common shape. In the present study, cylindrical shape was found in 10%, flask shape in 7.5%, hour glass shape in 5%, retort shape in 5%, irregular shape in 5%.

Maximum length of gall bladder range between 7- 10 cm was observed by Chakka S. et al (2016) [2], Moore & Dalley (2006) [5], Chari & Shah (2008)[6], Vakili & Pomfret (2008)[7], Standring (2008)[8],

Prakash A V et al (2013)[9]. In the present study, Maximum length of gall bladder range between 4.5 – 8 cm. Out of which, 52.5% of gall bladder range between 6.6 – 8 cm. 40% range between 5 – 6.5 cm and 7.5% gall bladder <5 cm.

Maximum transverse diameter of gallbladder range between 2 – 5 cm was observed by Chakka S. et al (2016)[2], Chari & Shah (2008)[6], Prakash A V et al (2013)[9]. In the present study, 45% of gall bladder range between 2 – 3 cm, 42.5% gall bladder range between 3.1–4 cm and 12.5% gall bladder range between 4.1–5 cm.

Comparison of the length, breadth and the shape of gall bladder depicted in Table 3.

Conclusion

Variations of gall bladder generally remain symptoms free but often lead to complications and therefore must be correlated clinically. Awareness of these anomalies will decrease morbidity. Most of the interventional procedures in this modern era are done laparoscopically and there is tremendous increase in number of laparoscopic Cholecy-stectomies. So, thorough knowledge of possible variations in morphology of gall bladder is important.

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Original Article

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Assessment of Age of Epiphyseal Union Around Pelvis in Maharashtra

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Abstract

Age of union of epiphysis is an important objective method of age determination which is a difficult task for medico-legal person. However, this age varies with racial, geographic, climatic and various other factors. Because of this, many authors suggested need of separate standards of ossification for separate region. As no such standards were available for Maharashtra, present study aimed to study ages of epiphyseal union around pelvis, a rarely studied region. Present study was a cross sectional study. It was performed in total 400 healthy subjects having ages from 13 to 23 years and length of residence in Maharashtra more than 10 years. Chronological age upto the day of examination was determined and A-P view of pelvis was taken in each case. Age of union of epiphyses of iliac crest, ischial tuberosity, head of femur and greater trochanter was determined using criteria of union and compared with the other authors from other states of India and also with other countries and found to vary appreciably.

Keywords: Epiphysis; Hip Joint; Femur; Iliac Crest; Greater Trochanter.

Introduction

Age determination is considered important for various reasons e.g. medicolegal purposes, juvenile court procedures, entry to the government service or to enable a candidate to sit for university examination.

As registration of birth is still extremely incomplete in India and many times real age is concealed with various intentions, doctors are called to opine about the age. Many times mutilated skeletal remains are found and again age determination becomes important. In such cases, it becomes necessary to use some objective method to find out exact age of an individual.

Among various methods of age determination, ages of appearance and union of epiphyses with diaphyses, as observed radiologically is considered to be a reliable guide and in many cases it is the only guide for anatomists and medico-legal experts for the estimation of age of the individual. These ages of appearance and union of epiphyses vary with racial, geographic, climatic and various other factors. Appreciable variations in the time of fusion of epiphysis with diaphysis have been recorded not only by the workers belonging to different countries [3, 9,10,16,19,20] but even by the workers from the various provinces of the Indian subcontinent [1,5,12,15,18,22].

Because of the existence of such racial, geographic and climatic variations, need for separate standards of ossification for separate regions have been suggested [8,14,17].

Most of the time, epiphyses around wrist joint, elbow joint are studied. However, data for epiphyses around pelvis is sparse. Also, use of pelvis radiographs help to estimate the ages beyond 20-21 years, as epiphyseal fusion around pelvis is later than the limb bones.

Thus, the present work is undertaken to investigate the ages of epiphyseal union around pelvis radiologically in boys and girls in Maharashtra.

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Material and Method

Present study was cross-sectional study carried out over a period of three years from 2005-2008. Study was performed in total 400 subjects having ages from 13 to 23 years. The length of residence of each subject in Maharashtra was ascertained and those having less than 10 years stay in Maharastra were excluded from the present investigation. All the subjects belonged to middle socio-economic status. Freedom from musculo-skeletal, nutritional and endocrine disorders and also from any debilitating ailments in childhood was taken into account. Height, weight and general physical development were recorded in all cases and the menstrual history of girls was also accounted for. Dietetic history was also taken for all subjects.

Out of total 400 students examined, there were 180 boys and 220 girls. Accurate age, as for as possible, was determined in each case based on the statements of the subjects, supported by their school leaving certificates. The subjects were divided into ten groups as 13-14, 14-15,15-16, 16-17, 17-18, 18-19, 19-20, 20-21, 21-22, 22-23 years according to their ages. The distribution of boys and girls in each age group is shown in Table 1.

All these subjects were examined clinically and radiologically. Antero-posterior view of pelvis was taken in each case. Study was approved by ethical committee, Government medical College, Nagpur, Maharashtra. Written consent was taken in each case for participation in study and in case of minors consent was obtained from parents or gaurdians.

Epiphyses of Iliac crest , Ischial tuberosity, Greater trochanter and Head of femur were studied in present study and to determine age of union criteria for union was used as stated below—

Criteria for Union

The union was considered as complete when space between diaphysis (shaft) and epiphysis was fully obliterated and bony in architecture and density, indistinguishable from the epiphysis and diaphysis in its neighbour- hood. Periosteum between the epiphysis and diaphysis should be in continuity without any notching at the periphery of epiphyseal line. Cases of recent union, where a white transverse line was still seen in place of the epiphyseal cartilage, was also taken as complete union and the so called epiphyseal scar was disregarded. The youngest age group showing complete union in 100% subjects was taken as criteria for generalization.

Observations and Results

Earliest age at which complete union of iliac crest with rest of the ilium is found in 100% cases was 22 to 23 ysears in case of males and 21 to 22 years in case of females (Table 2).

Youngest age group showing complete union of ischial tuberosity in 100% subjects was 22 to 23 years in case of males and 21 to 22 years in case of females (Table 3).

Complete union of head of femur was first seen in 100% subjects at 18 to 19 years among boys and at 14 to 15 years among girls (Table 4).

Youngest age group showing complete union of greater trochanter of femur in 100% subjects was 18 to 19 years in case of males and 16 to 17 years in case of females (Table 5).

Table 1 shows distribution of no. of subjects and their percentage according to age and sex and there

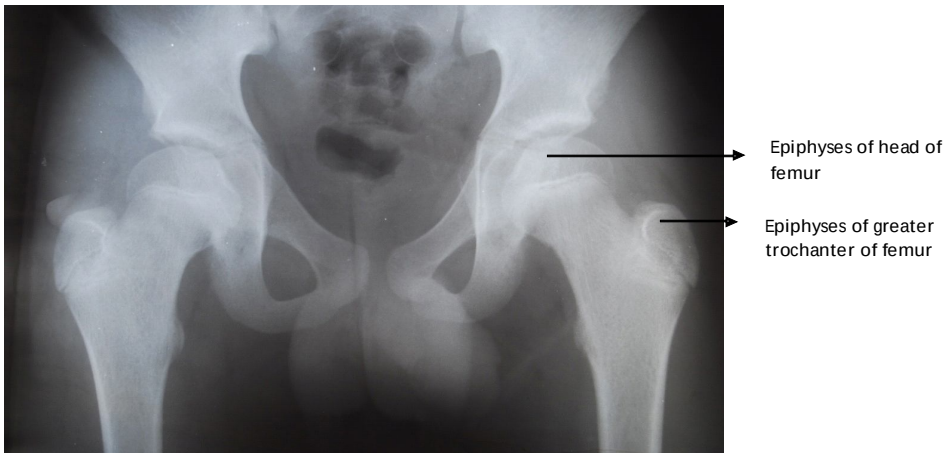

Fig. 1: Antero-posterior view of pelvis showing un-united epiphysis of head of femur and greater trochanter of femur

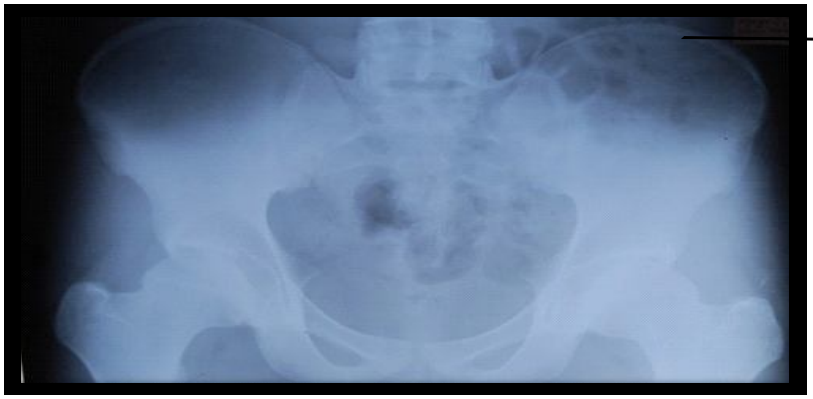

Fig. 2: Antero-posterior view of pelvis showing un-united epiphysis of iliac crest

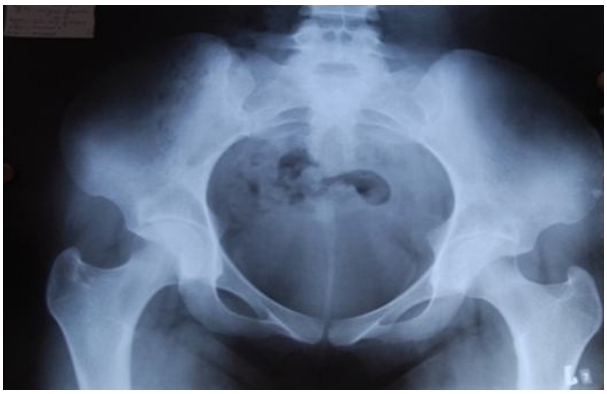

Fig. 3: Antero-posterior view of Pelvis showing completely united epiphysis

is no significant difference in distribution of number of subjects in different age groups.

Table 2 showing age of union of the iliac crest with rest of the ilium.

Table 3 showing age of union of the ischial tuberosity with ischium.

Table 4 showing age of union of the head of femur with the shaft.

Table 5 showing age of union of greater trochanter of femur with the shaft.

Table 1: Showing Distribution of no. of subjects and their percentage according to age and sex

Age (in years)	No. of cases		Total	%	ᵡ2-value
	Boys	Girls			
13-14	0	15	15	3.75	8.5
14-15	0	15	15	3.75	Non Significant
15-16	25	25	50	12.5	
16-17	20	25	45	11.25	
17-18	25	20	45	11.25	
18-19	25	30	55	13.75	
19-20	25	20	45	11.25	
20-21	20	25	45	11.25	
21-22	20	25	45	11.25	
22-23	20	20	40	10	
Total	180	220	400	100%	

Table 2: Showing age of union of the iliac crest with rest of the ilium

Age group (Years)	Number of cases examined		Number of cases showing complete union		%	
	Boys	Girls	Boys	Girls	Boys	Girls
13-14	0	15	-	0	-	0
14-15	0	15	-	0	-	0
15-16	20	20	0	0	0	0
16-17	20	25	0	5	0	20
17-18	25	20	5	5	20	25
18-19	25	30	10	5	40	16.66
19-20	25	20	10	10	40	50
20-21	20	25	10	15	50	60
21-22	20	25	10	25	50	100
22-23	20	20	20	20	100	100

Table 3: Showing age of union of the ischial tuberosity with ischium

Age group (Years)	Number of cases examined		Number of cases showing complete union		%	
	Boys	Girls	Boys	Girls	Boys	Girls
13-14	0	15	-	0	-	0
14-15	0	15	-	0	-	0
15-16	25	25	0	0	0	0
16-17	20	25	0	0	0	0
17-18	25	20	0	0	0	0
18-19	25	30	5	5	20	16.66
19-20	25	20	10	10	40	50
20-21	20	25	10	20	50	80
21-22	20	25	15	25	75	100
22-23	20	20	20	20	100	100

Table 4: Showing age of union of the head of femur with the shaft

Age group (Years)	Number of cases examined		Number of cases showing complete union		%	
	Boys	Girls	Boys	Girls	Boys	Girls
13-14	0	15	-	5	-	33.33
14-15	0	15	-	15	-	100
15-16	25	25	5	25	20	100
16-17	20	25	5	25	25	100
17-18	25	20	20	20	80	100
18-19	25	30	25	30	100	100
19-20	25	20	25	20	100	100
20-21	20	25	20	25	100	100
21-22	20	25	20	25	100	100
22-23	20	20	20	20	100	100

Table 5: Showing age of union of greater trochanter of femur with the shaft

Age group (Years)	Number of cases examined		Number of cases showing complete union		%	
	Boys	Girls	Boys	Girls	Boys	Girls
13-14	0	15	-	0	-	0
14-15	0	15	-	10	-	66.66
15-16	25	25	5	15	20	60
16-17	20	25	10	25	50	100
17-18	25	20	20	20	80	100
18-19	25	30	25	30	100	100
19-20	25	20	25	20	100	100
20-21	20	25	20	25	100	100
21-22	20	25	20	25	100	100
22-23	20	20	20	20	100	100

Discussion

A. Comparison of ages of epiphyseal union around pelvis found in present study with those reported by workers from other regions of India. (Table 6).

In present study, age of union of iliac crest and ischial tuberosity is found to be 22-23 years for boys and 21-22 years for girls. From Table 4 this age is later than the age reported by all other authors for other states in India in case of both sex except the age of union of ischial tuberosity reprted by Sharma et al (2013) [21] matches with the present study. Iliac crest epiphyses is widely studied but data available for ischial tuberosity is very sparse. In present study, both the epiphyses are studied using large sample size and exact age of union is found out for Maharashtra which is different from other states in India. This may be contributed to different environmental conditions in different states. [1,12,18,22] .

Present study gives age of union of head of femur as 18-19 years for boys and 14-15 years for girls. This is also rarely studied epiphyses. Among males, age is given by Galstaun (1937) [12] for bengalees

Table 6: Showing comparison of ages (years) of union of epiphyses around Pelvis given by various workers in India with findings of present study

Authors	Cases Examined			Iliac crest		Ischieil tuberosity		Head of femur		Greater trochanter	
	Sex	Number	Total	Age group (years)	Male	Female	Male	Female	Male	Female	Male	Female
Agrawal and pathak (1957) (Punjab)[1]	Female	99 but for pelvis x-ray 177		12 – 17 ½ 12 – 20 ½	-	17 – 17 ½ yrs	-	-	-	13 ½ - 14 yrs	-	-
Jit and Singh (1971) (Punjab)[12]	Male Female	572 406	978	11 – 25	17 – 22 (21) yrs	17 – 22 (21) yrs	17 ½ - 22 (21) yrs	17 ½ - 22 (22) yrs	14 – 18 ¼ (18) yrs	12 – 17 ¼ (17) yrs	-	-
Galstaun (1937) (Bengal)s[11]	Male Female	472 235	707	0 – 19	-	-	-	-	18 yrs	15 yrs	18yrs	15yrs
	Male Female	347 136	573	11 – 20	19 – 20 yrs	17 – 19 yrs	-	-	-	-	-	-
	Male Female	238 109	447	13 – 22	-	-	Around 20 yrs	Around 20 yrs	-	-	-	-
Basu and Basu (1938) (Bengal)[4]	Female	116		7 – 19	-	-	-	-	-	13-14 yrs	-	-
Gupta, et al (1974) (Uttar Pradesh)[10]	Male Female	44 31	75	16 – 23	21 – 22 yrs	19 - 20 yrs	21-22 yrs	Inconclusive	-	-	18-19 yrs	17-18 yrs
Bajaj et al (1967) (Delhi)[7]	Male Female	120 120	240	0 – 21	20 ± 1.3 yrs	19 ± 1.0 yrs	-	-	-	-	-	-
Saksena and Vyas (1969) (M.P)[23]	Male Female	50 25	75	16 - 21	20 - 21 yrs	18 – 19 yrs	-	-	-	-	-	-
Sharma et a l (2013) Rajstan	Male Female	50 50	100	18-23	21-22	20-21	21-22	21-22	18-19	18-19	18-19	18-19
Present study (2015) (Maharastra)	Male Female	180 220	400	13-23	22-23 yrs	21-22 yrs	22-23 yrs	21-22 yrs	18-19 yrs	14-15 yrs	18-19 yrs	16-17 Yrs

which corresponds to the lower limit of age in present study and Jit and Singh (1971) [13] for punjabees, higher limit of which matches with the lower limit of age in Present study. Agrawal and Pathak (1957) [1] and Jit and Singh (1971) [13] studied the epiphyses in Punjabi girls. The result of Agrawal and Pathak (1957) [1] is earlier than Present study. Age range given by Jit and Singh (1971) [13] is very wide and cannot be compared. Age found by Galstaun (1937) [12] for bengalee girls corresponds to the higher limit of age in Present study whereas in case of Basu and Basu (1938) [5] the same age corresponds to lower limit of age in Present study.

According to present study, age of union of greater trochanter of femur is 18-19 years for boys and 16-17 years for girls. On comparison, this age matches with the age given by Galstaun (1937) [12] for bengalees in case of boys but later in case of girls. It also matches with age given by Gupta et al (1974) [11] for Uttar Pradesh in case of boys but earlier in case of girls. Age of union of these two epiphyses given by Sharma et al (2013) [22] for Rajasthan could not be compared as he did not study age below 18 years.

Thus this comparison shows that ages of union of different epiphyses vary greatly even in the same country and medicolegal person cannot apply standards from one part to the other as stated by all previous authors.

B. Comparison of ages of epiphyseal union around pelvis found in present study with those reported by workers from other countries (Table 7).

For iliac crest, ischial tuberosity and greater trochanter, data is available only for European and it is given by Frazer (1958) [6] and Gray (2008) [2].

Frazer (1958) [6] gave age of union of iliac creast and ischial tuberosity for Europeans as after 20 years and according to Gray (2008) [2] union of iliac crest

unites between 15-25 years among Europeans which is a very wide range. Comparison cannot be done due to lack of exact figures. According to Gray (2008) [2], epiphyses of greater trochanter fuses after puberty. Exact age is not given by him. Age of union of this epiphyses given by Frazer (1958) [6] matches with the present study in case of girls but earlier in case of boys.

For English people age of union of head of femur is given by Davis and Parson (1927) [9] as 19-20 years which is later than present study. The same age given by Paterson (1929) [19] for English people is also later than that found in present study. The age commented by Flecker (1942) [10] for Australians is earlier in case of boys but matches with the lower limit of age for girls as found in present study. This age given by Frazer (1958) [6] for European is earlier for boys and later for girls than the present study and the same given by Gray (2008) [2] is earlier in case of boys but matches with the lower limit of age for girls found in present study.

This comparison indicates that greater height of white races than eastern is not due to the late epiphyseal union but it may be due greater growth per year which may be due to genetic factors.

Conclusions

The age of union of epiphyses found in present study is given in Table 8 for both the sex. Comparison of ages of epiphyseal union from different states of India and also from different

Table 7: Showing comparison of ages (years) of union of epiphyses around Pelvis given by workers from other countries with findings of present study

Authors	Cases Examined				Iliac crest			Ischial tuberosity		Head of Femur			Greater trochanter		
	Sex	Number	Total	Age group (year)	M	F	Mixed	M	F	M	F	Mixed	M	F	Mixed
Davies and parsons (1927)[9] (English)	Not Mention d	Examined over 5000 X-rays	-	0-23	-	-	-	-	-	-	-	19-20 yrs	-	-	-
Paterson (1929) (English)[18]	M F	100 100	200	0-22	-	-	-	-	-	18 yrs	17 yrs	-	-	-	-
Flecker (1942) (Australian)[9]	M F	98 106	204	15-20	-	-	-	-	-	17 yrs	14 yrs	-	-	-	-
Frazer (1958) (European)[6]	-	-		-	After 20 yrs	After 20 yrs	-	After 20yrs	After 20 yrs	17-18 yrs	16-17 yrs	-	17-18 yrs	16-17 yrs	-
Gray (2008) (European)[2s]	-	-		-	-	-	15-25 yrs	-	-	17 yrs	14 yrs	-	-	-	After Puberty
Present study (2015) (Maharastra India)	M F	180 220	400	13-23	22-23 yrs	21-22 yrs	-	22-23 yrs	21-22 yrs	18-19 yrs	14-15 yrs	-	18-19 yrs	16-17 yrs	-

Note:- M – Male, F—Female, Mixed — sex not mentioned by author

Table 8: Showing age of union of epiphyses

Name of epiphyses	Age of union for male	Age of union for female
Iliac crest	22-23 yrs	21-22 yrs
Ischial tuberosity	22-23 yrs	21-22 yrs
Head of femur	18-19 yrs	14-15 yrs
Greater Trochanter	18-19 yrs	16-17 yrs

countries it is concluded that the ages of epiphyseal union varies greatly not only all over the world but also within the same country. So, authors suggested need of separate standards of ossification for separate regions for medicolegal reporting of age based on epiphyseal union.

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Coronary Ostia: A Cadaveric Study

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Abstract

Background: Coronary ostia are the openings in the aortic sinus from which the coronary arteries arise. Coronary ostia may be situated at variable levels in the aortic sinus, at or below the sinutubular junction and also in the tubular part of ascending aorta. Knowledge of location of coronary ostia is essential is helpful in determining the blood flow in coronary vessels. *Purpose of the study:* Knowledge of coronary ostia is important, as procedures like coronary angiograms, angioplasty, bypass graftings and coronary artery stentings are becoming common. Accurate knowledge of coronary ostia is important for aortic graft repair or root replacement. *Results*: A total of 50 hearts were studied. Among them all 50 right coronary artery (RCA) arose from the anterior aortic sinus, 43 of left coronary artery(LCA) from left posterior aortic sinus and 7 LCA from right posterior aortic sinus. In 1 heart there was 2 openings in the anterior aortic sinus. 70% of RCA and 66% of LCA were below sinu tubular junction, 6% of RCA and 10% of LCA were at the sinu tubular junction, 24% of RCA and 24% of LCA were above sinu tubular junction. The width of right coronary ostia (RCO) was 2.90+1.1 and left coronary ostia (LCO) was 3.2+0.88.The distance of RCO from the bottom of sinus is 12.41+2.82 an LCO is 12.32+2.77. The mean distance of RCO from commissures of right side is 9.5 and from the left side 12.39 and that of LCO from commissures of right side is 10.8 and from left side 11.8 respectively. *Conclusion*: Due to the recent advances in coronary artery by pass grafts and modern methods of myocardial revascularisation a thorough knowledge of the morphology and morphometric analysis of coronary ostia is essential.

Keywords: Coronary Ostia; Sinutubular Junction; Commissures; Coronary Angiograms.

Introduction

The first system to function in the embryo is the cardiovascular system as early as 4th wk. Since then it undergoes rhythmic contractions and relaxation completing the cardiac cycle which never stops until cardiac death [1]. The heart is supplied by right and left coronary arteries. Each artery is a vasa-vasorum of ascending aorta [2]. The aortic root consists of leaflets of aortic valve which consists of aortic sinuses also called as sinuses of valsalva. The aortic sinus reach beyond the upper border of cusp and forms well defined complete circumferential sinutubular ridge. These are named as anterior, right and left posterior aortic sinuses respectively. The right coronary artery arises from the right anterior aortic sinus and the left coronary from the left posterior aortic sinus through the coronary ostia [3]. Coronary ostia are orifices located within the aortic sinus from which coronary arteries arise. Coronary ostia may be situated at variable levels in the aortic sinus, at or below the sinutubular junction and also in the tubular part of ascending aorta [4].

The peculiarity of coronary artery is that the blood flows in diastole. Knowledge of location of coronary ostia is essential is helpful in determining the blood flow in coronary vessels.If the location of ostia is below the sinutubular junction blood flows in coronary ostia only in diastole as the ostia remains

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closed by the valves. If they remain above the sinutubular junction it remains open both in contraction and diastole of the heart and coronary blood flows continuously. These people suffer less from coronary insufficiency [5]. The anomalous origin of coronary arteries among coronary artery disease leads to sudden death among young athletes. Knowledge of coronary ostia is important, as procedures like coronary angiograms, angioplasty, bypass graftings and coronary artery stentings are becoming common [3]. Knowledge of location and size of coronary ostia is vital for radiologists performing angiographies for diagnostic purposes and cardiac surgeons implementing interventional and theraupetic measures when managing cardiovascular disease. Size of coronary ostium is important as it gives insight for designing or acquiring of catheters for coronary angiography suitable for that particular population [4]. Accurate knowledge of location of coronary ostia in relation to aortic root is important for aortic graft repair or root replacement and percutaneous or transapical aortic valve replacement for symptomatic aortic valvular disease [6]. Since the coronary ostia is useful for various interventional and surgical procedure the present study was undertaken wherin topography, morphology and morphometry of the coronary ostia has been studied.

Materials and Methods

This study was conducted on 50 formalin fixed human hearts. The specimens were obtained during routine undergraduate dissection from the department of anatomy in Pondicherry Institute of Medical Sciences. The hearts were dissected,the pericardium involving the root of aorta was removed and the origins of right and left coronary artery identified. Then the ascending aorta was sectioned approximately 3 cms above the commissures of aortic leaflet. Next the aorta was longitudinally opened at the level of right posterior aortic leaflet to enable the visualisation and analysis of aortic leaflet and the respective coronary ostia. The following observations and measurements were made.

1. Origin of the right and left coronary arteries.
2. Number of coronary ostia in various aortic sinuses.
3. Location of coronary ostia in relation to sinu-tubular junction.
4. The width and height of right and left coronary ostia.
5. Distance of the coronary ostia from the bottom of sinus.
6. Distance of coronary ostia from commissures of aortic leaflets.
7. Location of coronary ostia whether in central or peripheral part of aortic sinus was recorded.

Results

The origin of right coronary artery was taken from anterior aortic sinus in 50 hearts out of 50 hearts. Left coronary artery was originated from left posterior aortic sinus 43 hearts and 7 hearts it was from right posterior aortic sinus (Table 1 and Figure 1). In all hearts the number of coronary ostia in aortic sinuses was one, but only in one heart it was two openings at anterior aortic sinus (Table 2 and Figure 2). The following observations were measured and tabulated, location of coronary ostia in relation to sinu tubular junction, diameter of coronary ostia, distance of coronary ostia from commissures, distance from bottom of sinus to coronary ostia, location of coronary ostia in relation to aortic sinus (Table 3,4,5,6,7).

Table 1: Origin of right and left coronary arteries

Heart	Anterior aortic sinus	Left posterior aortic sinus	Right posterior aortic sinus
Right coronary ostia	50	-	-
Left coronary ostia	-	43	7

Table 2: No. of coronary Ostia in various aortic sinuses

No. of openings	Anterior aortic sinus	Left posterior Aortic sinus	Right posterior Aortic sinus
0	0	0	50
1	49	43	7
2	1	0	0

Table 3: Location of coronary ostia in relation to sinu tubular junction (stj)

Level of Ostium	Right coronary ostia		Left coronary Ostia	
	Frequency	Percentage	Frequency	Percentage
Below STJ	35	70%	33	66%
At STJ	3	6%	5	10%
Above STJ	12	24%	12	24%

Table 4: Diameter of coronary ostia

Right coronary ostia		Left coronary ostia	
Height	Width	Height	Width
1.31-5 (2.58+ 0.81)	1.72-5.66 (2.90+1.1)	1.34-6 (2.85+0.90)	1.29-5.39 (3.2+0.88)

Table 5: Distance of coronary ostia from commissures

Coronary Ostia	Commissures of Aortic Leaflet	Mean	S.D
Right	Right Commissures	9.5	2.83
	Left Commissures	12.39	3.67
Left	Right Commissures	10.8	2.57
	Left Commissures	11.8	3.71

Table 6: Distance from bottom of sinus to coronary ostia

Coronary Ostia	Mean + S.D	Distance
Right Coronary Ostia	12.41+2.82	7.05-18.08
Left Coronary Ostia	12.3+2.77	5.03-20

Table 7: Location of coronary ostia in relation to aortic sinus

Coronary ostia	Central	Peripheral
Right Coronary ostia	10	40
Left coronary ostia	11	39

Table 8: Mean Diameters of Right and Left Coronary ostias

Study	RCO	LCO
Cavalcanti et.al.2003	3.46± 0.94	4.75±0.73
Bhimali et.al.2011	2.38±1.33	3.17±0.34
Nalluri et.al.2016	3.17±0.87	4.1±0.83
Kohlar et.al	3.83	4.83
Present study	2.9±1.1	3.2±0.88

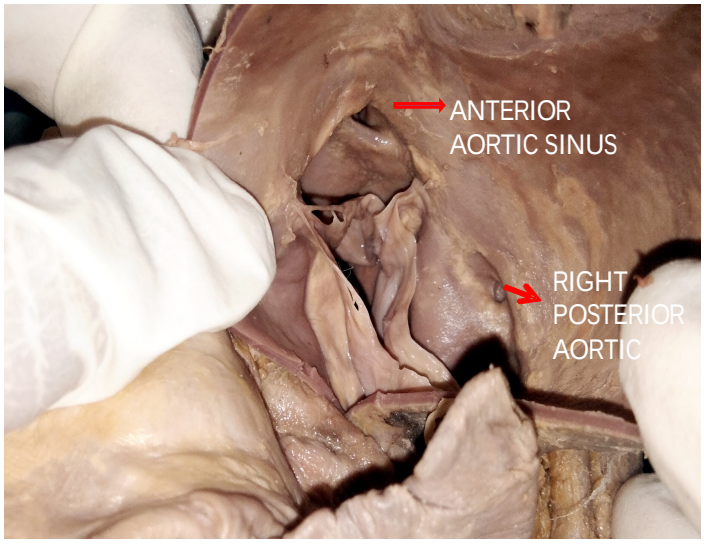

Fig. 1: Anamolous origin of left coronary artery from right posterior aortic sinus

Table 9: Location of coronary ostia in relation to sino tubular junction(stj)

	Relation to STJ	Cavalcanti et.al 2003	Muriago et.al1997	Gosva F et.al 2010	Nalluri et.al	Present study
RCO	Above	28%	13%	13%	11.25%	24%
	Below	60%	78%	78%	65%	70%
	At	12%	2%	9%	23.75%	6%
LCO	Above	40%	13%	29%	8.75%	24%
	Below	42%	78%	58%	52.50%	66%
	At	18%	2%	13%	38.75%	10%

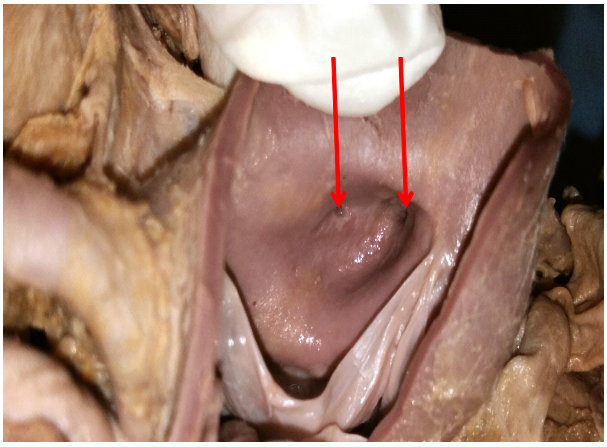

Fig. 2: Anterior aortic sinus showing 2 ostia

Discussion

The awareness of anatomic variants in topography and morphology of coronary ostiamaydecreasethe morbidity and mortality assosciated with various invasive procedures.The root of aorta is the frequent site for interventional procedures.So understanding the precise nature and relations of anatomical structure at the aortic root is valuable in percutaneous and transcatheterth eraupetic techniques for valve or device implantation.[1]

In the present study out of the 50 hearts studied the right coronary artery arose from the anterior aortic sinus in all the 50 heart whereas 43 left coronary artery arose from the left posterior aortic sinus and 7 LCA arose from the right posterior aortic sinus. It was slightly different from the studies conducted by Dombe et.al where out of 65 heart studied RCA arose from anterior aortic sinus and LCA arose from left posterior aortic sinus. In a study conducted by Nalluri et.al out of 78 heart studied RCA originated from anterior aortic sinus in 77 heart and 1 from left posterior aortic sinus.LCA from left posterior aortic sinus in all 77 heart and 1 from right posterior aortic sinus. This knowledge may be helpful for various procedures at the aortic root like aortotomy incision for aortic exposure, preparing a coronary button in root replacement,delivery of cardioplegia through coronary orifices and approach for aortic root enlargement (Table 8). The mean diameter of the left coronary ostia is higher when compared to the right coronary ostia. This observation was in agreement with the work done by Cavalcanti et.al, Bhimali et.al, Nalluri et. al and Kohlar et. al. Knowledge of coronary ostial diameter is helpful in designing the perfusion cannula which is used to administer cardioplegic solution into right and left coronary arteries in aortic insufficiency (Table 9).

The location of the coronary ostia in relation to the sinotubular junction varies widely. In the present study about 70% of the right coronary ostia and 66% of the left coronary ostia is below the sino tubular junction.24% of both RCO and LCO lies above and 6% of RCO and 10% of LO lies at the sinotubular junction. It is similar to the study conducted by Gosva et.al, Muriago et.al. A coronaryostia is considered ectopic if it lies 0.5 cm above the ST junction. It is difficult to insert the catheters in patients with ostium above the level of ST junction, and in open heart surgeries difficult to cannulate the vessels [3] (Table 10).

In the present study the mean distance between the coronary ostia and bottom of coronary sinus is more or less equal in both right and left coronary ostia. It is slightly different from other studies where the right ostia is at a higher level when compare to left ostia.This knowledge is essential in percutaneous and transcathetertheurapetic techniques for repair or replacement of aortic valve [7] (Table 11).

In the present study about 80% of RCO and 75% of LCO were peripherally located. The rest of the ostias were centrally located. In the present study it is seen that right coronary ostium is deviated more towards the right and even left coronary ostium towards right side. This is similar to the work done by cavalcanti et. al, Srikonda et. al and jyotiet.al.Thiscirumferential deviation of coronary ostia is helpful for radiologists in interpreting images of coronary angiograms.

Conclusions

Due to the recent advances in coronary artery bypass grafts and modern methods of myocardial revascularisation a thorough knowledge of the morphology and morphometric analysis of coronary ostia is essential. These data may be helpful for surgeons to modify their surgeries involving aortic root and radiologists for interpretation of the results.

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Active Learning in Undergraduate Students by Seminars

Mehera Bhoir

Abstract

Background: The subject of Anatomy is taught to undergraduate students primarily using traditional teaching learning methods like lectures and small group tutorials. These methods do not involve the students actively in the teaching learning process to a very great extent. Seminars prepared and presented by students are an example of collaborative learning which is student centred and promotes active learning leading to a better comprehension of the subject. *Aim:* The present study was undertaken with the aim of promoting the practice of active learning in undergraduate medical students. *Methodology*: Groups of students presented seminars in the presence of the entire class and faculty with help of using audiovisual media, models, charts, videos and skits. *Observations*: Student feedback was gathered taken pertaining to various aspects of seminars using a questionnaire having a 3 point Likert scale and by asking open ended questions. *Conclusions*: The findings of this project suggest that group seminars presented by students are an effective way to inculcate the practice of active learning amongst students. Besides motivating students towards self directed study, seminars also improve other desirable attributes like communication skills, teamwork, improved use of audiovisual aids and lead to a better student teacher interaction.

Keywords: Active Learning; Seminars.

Introduction

The purpose of teaching is to facilitate learning and to encourage the learners to learn more effectively. It means not merely dispensing information, but to develop skills and attitudes also. It is said that "*To teach is to learn twice".* Learning is more effective with an active involvement of the learner in the process [1]. If skills in independent, self-directed education are not developed in medical school it is unlikely that they will be developed when the graduate is confronted with the pressures and demands of medical practice [2]. Group learning motivates each member of the group to learn and also allows to build on each others' knowledge [1]. One of the principles of learning is that active involvement is more effective than uninvolved one [2]. In the syndicate method of learning a topic is divided into sections and each section is presented by a group of students [2]. The student presentation can include techniques to encourage discussion during or after the presentation [2]. In medical education, collaborative learning can be regarded as a term which includes a range of teaching and learning techniques generally encompassing small group work and learning from each other. Collaborative learning techniques offer an effective way of delivering medical education with several advantages over traditional didactic teaching methods. Group learning facilitates not only acquisition of knowledge but also several other desirable attributes such as communication skills, teamwork, problem solving, independent responsibility for learning, sharing of information and respect for others. Acquired at an early stage, the generic skills associated with active, collaborative learning in small groups are of immense value for students moving forward into postgraduate and continuing

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education and in their clinical careers. The role of the teacher in collaborative learning is that of a facilitator. He/she provide academic support by acting as a resource person when necessary [1].

The teacher's task shifts from taking responsibility for expounding the whole subject to providing sufficient input for students to become self-learners [2].

Use of different resource materials from teacher or fellow students are welcome [1]. The community of learners method for collaborative learning mentions that students work using range of learning resources, communicate regularly. The tutor provides expert assistance and progress monitoring for the group [3].

Context of the Study

The subject of Anatomy is taught to undergraduate students primarily using traditional teaching learning methods like lectures and small group tutorials. These methods do not involve the students actively in the teaching learning process to a very great extent. Seminars prepared and presented by students are an example of collaborative learning [3] which is student centred and promotes active learning leading to a better comprehension of the subject. It will motivate students towards self directed learning, encourage them to try different audiovisual methods of teaching learning and stimulate them to visualize and create their own charts, models, etc as teaching aids. Further it will train them to gather research material for their topic. Self assessment of their own participation can help students develop awareness of their skills in a group [4].

Aim

To promote the practice of active learning in 1st year MBBS students.

Objectives

1. To motivate undergraduate students towards self directed learning by participating in seminars.
2. To assess students' perceptions of the on the influence of seminars on their problem solving skills, communication skills, team work, time management, use of audiovisual aids and student teacher interaction.
3. To gather suggestions from students on how to improve seminars as a teaching learning method.

Material and Methods

This project was implemented on 120 1st MBBS students in the department of Anatomy.

Permissions of the Dean of the Institute and the Head of the Department of Anatomy were obtained. A list of seminar topics was prepared from 1st MBBS Anatomy curriculum by discussions with faculty members. Topics for the seminars were announced to the 1st MBBS class one month in advance. Each group (about 10 students) was assigned to a teacher who acted as a facilitator for that group. Students presented the seminars in the presence of the entire class and faculty using audiovisual media, models, charts, videos, skits within the stipulated time. Student feedback was taken pertaining to various aspects of seminars using a questionnaire having a 3 point Likert scale and by asking open ended questions. Data was tabulated using Microsoft Excel and was analysed.

Results

Students were administered anonymised questionnaires with 10 closed ended (3 point Likert scale) and 4 open ended questions at the end of seminars for their feedback on the various aspects of seminars. Their responses were analysed.

Student Responses to Open Ended Questions

1. How has Participating in and Attending Seminars Benefitted you?

Most of the students opined that seminars are an effective way study Anatomy, for revision and for better conceptual understanding of a topic. Seminars motivated them to self study, improved their teamwork, self confidence, communication skills, interaction with teachers and colleagues.

2. Which Aspects of the Seminars did you like?

Students especially liked the skits, mnemonics, charts, models, other audiovisual aids prepared by students and the interactive sessions during and following the seminars. They found seminars to be a fun filled and stimulating way to study Anatomy.

3. Give your Suggestions to Improve the Effectiveness of Seminars.

Students suggested that Seminars should be conducted more frequently, more audiovisuals aids

should be included, more time allocation should be there, and that there should be an award for the best seminar.

4. Are you Satisfied with the Guidance you Received from your Teacher in charge?

All students were satisfied with the guidance they received from their in charge teacher.

Table 1: Student responses to questionnaire on 3 point Likert scale

Sr. No.	Concept	Agree %	Disagree %	Not sure %
1.	Seminars are an effective way to study Anatomy.	52	26	22
2.	Seminars have motivated you towards self study.	58	24	18
3.	Participating in Seminars improves communication skills.	93	3	4
4.	Participating in Seminars enhances teamwork amongst students	88	2	10
5.	Participating in Seminars helps you to develop time management skills.	40	30	30
6.	Participating in seminars has increased your problem solving skills	42	22	36
7.	Participating in seminars has helped you to use audiovisual aids more effectively.	67	17	16
7.	Seminars increase student teacher interaction.	90	4	6
8.	Seminars should be continued in the forthcoming years.	77	11	12
9.	Seminars should be incorporated in the university curriculum	48	24	28

Discussion

In this education innovation project 1st MBBS students presented group seminars in Anatomy following which were asked to give feedback on various aspects pertaining to these seminars.

93% of the students opined that seminars helped them to improve their communication skills, 88% said that seminars led to a better teamwork, 67% reported that seminars helped them in their use of audiovisual aids, 90% reported that seminars led to enhanced student teacher interaction and 77% suggested that seminars should be continued in the forthcoming years.

52% of students found seminars to be an effective way to study Anatomy and 58% said that seminars motivated them towards self study.

However, only 40% students felt that seminars helped them in their time management skills, 42% felt that seminars improved their problem solving skills, while 48% felt that seminars should be incorporated in the university curriculum.

Verma Vivek et al [5] in 2009 carried out a similar study on 40, 1st year MBBS students. They carried out pre and post seminar tests and analysed student feedback following seminars. Post seminar test scores were significantly higher than pre seminar scores. Assessing students response for motivation due to seminars to self directed learning, 5% students showed very high, 50% showed high, 42.5% moderate, and 2.5% showed very low motivation. Most students agreed that group seminars increased their interest in learning in context with actual clinical situations, improved self learning skills and increased their confidence in expressing knowledge.

Kothari Ruchi et al [6] in 2012 in their study on students' perceptions towards seminars found that 94% of students found seminars to be informative, 89% found them to be a good source of extra knowledge, 90% found them to be a good method for revision, 62% were in favour of introducing seminars in the curriculum and 88% reported that participating in seminars diminished their fear of public speaking.

Minhas PS[7] et al in 2012 reported that a majority of students (68.8%) preferred a method that contained peer-led seminars and instructor-led lectures, they suggested that integration of active and passive learning into undergraduate courses may have greater benefit in terms of student preference and performance than either method alone. Brunton [8] et al in 2000 concluded that in the opinion of the students, seminars were a more effective way of learning, more relevant to self-development and more interactive. Seminar-based learning was considered to be more amenable to self-direction than formal didactic lectures.

Shankar PR [9] in 2011, found that seminars help students revise the organ system covered and understand its clinical importance, promote teamwork and organization, and support active learning.

Kadmon [10] et al in 2011, concluded that competent implementation of integrative didactical

methods is more important to successful teaching and the subjective gain of knowledge than knowledge transfer by traditional classroom teaching. They found that small group tutorials lead to greater satisfaction but not to better learning results. Interactive learning in large groups might be might be an effective alternative to small group tutorials in some cases and be offered as an option.

De Jon [11] et al, 2010 mentioned that interactive learning in large groups might be might be an effective alternative to small group tutorials and be offered as an option.

Sprujit A [12] et al in 2012 found that the didactic approach and facilitating methods used by the teachers, the group composition, size and atmosphere, the amount of active student participation and interaction and assessment influenced seminar learning.

Conclusion

The findings of this project suggest that group seminars presented by students are an effective way to inculcate the practice of active learning amongst students.

Besides motivating students towards self directed study, seminars also improve other desirable attributes like communication skills, teamwork, improved use of audiovisual aids and lead to a better student teacher interaction. Seminars can be used in combination with other teaching formats to generate a more stimulating and challenging educational environment.

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Original Article

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Morphometric Study of Foramen Magnum in Adult Indian Skulls

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Abstract

Introduction: The dimensions of the foramen magnum are clinically important because vital structures passing through it may endure compression such as in cases of foramen magnum herniation, foramen magnum meningiomas and foramen magnum achondroplasia.The current studyamined to measure the anteroposterior diameter, transverse diameter, area and index of foramen magnum in adult Indian skulls. *Materials and Method:* The present study was carried out on foramen magnum of 55 dry adult skulls of known sex (36 male skulls and 19 female skulls) from bone library of department of Anatomy, GMC Aurangabad. The anteroposterior diameter and transverse diameter of foramen magnum were measured using digital vernier caliper. Area and index of foramen magnum were calculated using both diameters. *Results:* The mean value of anteroposterior diameter in males was 34.99 mm whereas that in females was 33.75mm.Also, The mean value of transverse diameter in males was 28.53 mm whereas that in females was 27.41mm.The mean area of foramen magnum was 765 Sq.mm.in males and 728 Sq mm. in females. The index of foramen magnum was 81.79 in males and 81.39 in females. *Conclusion:* The anteroposterior and transverse diameters, area and index of foramen magnum of male skulls were greater than females. This study of the morphometric analysis of foramen magnum will be helpful to anatomists, anaesthetists, radiologists and neurosurgeons and anthropologists.

Keywords: Foramen Magnum; Skulls; Morphometric analysis.

Introduction

Foramen magnum is the largest foramen in the skull. It is formed by the four portions of the occipital bone (two lateral, one squamous, and one basal) and can present different shapes [1].

It lies in an anteromedian position and leads into the posterior cranial fossa. It is oval, wider behind, with its greatest diameter being anteroposterior. It contains the lower end of the medulla oblongata, meninges, vertebral arteries and spinal accessory nerve [2].

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The foramen magnum dimensions are clinically very important because the above mentioned vital structures passing through it may endure compression such as in cases of foramen magnum herniation, foramen magnum meningiomas and foramen magnum achondroplasia [3].

Concerning its site, measures of the occipital region seems to be an alternative to determinate certain characteristics of cadaveric remains in cases where human fragments are greatly damaged by insults (fire, explosions, and mutuliations), as the basicranium is protected by large and strong tissues, such as muscle, tendons and ligaments [4,5].

The knowledge of foramen magnum diameters is needed to determine some malformations such as Arnold Chiari syndrome, which shows expansion of transverse diameter [6].

The diameters and area of the foramen magnum are greater in males than in females, hence its dimensions can be used to determine sex in the medicolegal conditions, especially in the following

circumstances, such as explosions, aircraft accidents and war fare injuries [6,7].

Materials and Methods

Skulls were collected from bone library of department of Anatomy GMC Aurangabad Maharashtra. The present study was carried out on foramen magnum of of 55 dry adult skulls of known sex (36 male skulls and 19 female skulls). The skulls with pathological lesions and damage when excluded. Measurements were taken using digital vernier caliper. Readings were taken twice and mean of two readings was taken to avoid error.

The following parameters of foramen magnum were measured-

1. Anteroposterior Diameter of Foramen Magnum (APFM)

It is the maximumanteroposterior diameter of foramen magnum. It was measured from the basion (the midpoint of the anterior margin of the FM) to the opisthion(the midpoint of the posterior margin of the FM) [Figure 1].

2.Transverse Diameter of Foramen Magnum (TFM)

The maximum transverse diameter was measured as maximum internal width of foramen magnum along the transverse plane [Fig. 2].

The APFM and TFM were measured with digital vernier caliper.

The area of the FM was calculated using different formulas based on the study byRoutalet al[8]. formula based on the height and width of the foramen magnum:

$A = ¼ \times ð \times w \times h$

Foramen magnum index was calculated using the formula:

Transverse diameter / Anteroposteriordiameter × 100.

The Statistical Methods: Results were expressed as mean ± standard deviation. Unpaired 't' test was used to compare between males and females. P value of 0.05 or less was considered for statistical significance.

Observation and Results

The following table depicts mean values of different parameters of foramen magnum in present study.

All mean values of parameters in males were slightly higher than those in females. However when

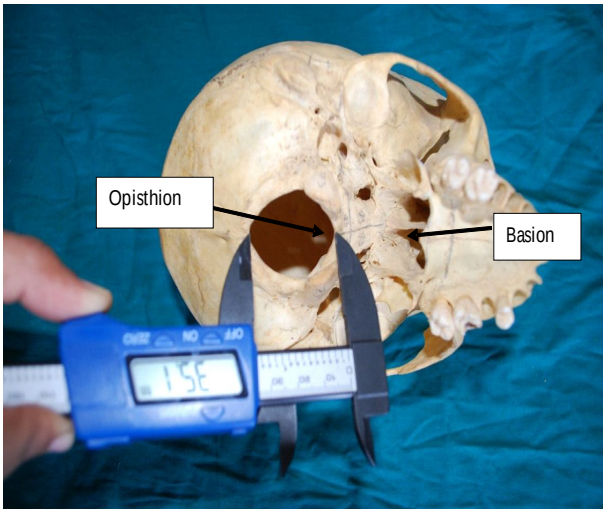

Fig. 1: Illustrating measurement of APFM

Fig. 2: Illustrating Measurement of Transverse Diameter of Foramen Magnum

Table 1: Mean and standard deviation of different parameters of foramen magnum observed in present study

Sr. No.	Parameters	Females (Mean±SD)	Males (Mean ± SD)	Total (Mean ± SD)
1.	APFM (mm)	33.75 ± 2.55	34.99 ± 2.19	34.13±2.17
2.	TFM (mm)	27.41 ±1.93	28.53 ± 1.58	28.02±1.94
3.	Area of FM (Sq. mm)	728.96 ± 96.65	765 ± 98.81	753.44±98.72
4.	Index Of FM	81.39 ± 5.00	81.79 ± 6.04	82.37±6.16

unpaied "t" test was applied, the mean anteroposterior diameter and mean tranverse diameter and Index of foramen magnum in male skulls were notsignificantly higher than in female skulls.

Discussion

The mean anteroposterior diameter of the foramen magnum of male skulls (34.9 mm) of present study was similar to the observations of Sayee [9] on male skulls of Karnataka (34.2 mm), however it was lower than the observations made by Routal [8] on Gujarati male skulls (35.5mm) and Suazo [10] on Brazilian male skulls (36.5 mm).

In female skulls the mean longitudinal diameter of the foramen magnum of present study was correlated with the observations of Sayee [9] on Karnataka female skulls (33.5mm) and Wantanabe [11] on Japanese female skulls (33.7mm), but it was lower than reported Suazo [10] on Brazilian female skulls (35.6 mm). However the mean longitudinal diameter of the foramen magnum of female skulls of present study was higher than values reported by Routal [8] on Gujarati female skulls.

The following table depicts the comparison of previous studies-

Also, genderwise mean values of morphometric study of foramen magnum by Murlidharet al [15] and Jain et al [16] are compared with current study in the below tables.

Table 2: Comparison of various Parameters of foramen magnum in previous studies with the current study

Sr. No.	Studies	APFM (mm)	TFM (mm)	AREA OF FM (Sq. mm)
1.	Gapert et al[4]	34.71±1.91	29.36±1.96	801.78±85.43
2.	Maculasco et al[12]	34.90±2.26	29.40±2.93	807.86±107.58
3.	BabuRaghuvendra et al[13]	32.57± 2.08	28.91±1.76	722.66±78.20
4.	Vismutha SP et al[14]	29.72±1.89	24.73±2.05	577.52±64.36
5.	Present study	34.13±2.71	28.02±1.94	753.44±98.72

Table 3: Gender wise comparison of APFM and TFM in previous studies with the current study

Authors	APFM (mm)		TFM (mm)	
	Males	Females	Males	Females
Muralidhar et al [15]	33.4	33.1	28.5	27.3
Jain et al [16]	36.9	32.9	31.5	29.5
Present study	34.99	33.75	28.53	27.41

Conclusion

It can be concluded from the present study that the several anatomical parameters such as anteroposterior diameter, transverse diameter, area and index of foramen magnum should be taken into consideration during surgeries involving the craniovertebral junction like while performing surgeries for foramen magnum meningiomas or posterior cranial fossa lesions and also in determining Arnold Chiari Syndrome. It can also be of immense importance in forensic and anthropological investigation.

This study of the morphometric analysis of foramen magnum will be helpful to anatomists, anaesthetists, radiologists and neurosurgeons and anthropologists.

Abbrevations Used

APFM- Anteroposterior diameter of foramen magnum

TFM- Transverse diameter of foramen magnum

FM- Foramen magnum

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Original Article

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Palmar Dermatoglyphic Study in Diabetes Mellitus in Davangere District

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Abstract

Background and Objectives: Diabetes mellitus is one of the most common endocrine disorders affecting almost 6% of the world's population. The global prevalence of diabetes mellitus is rapidly increasing as a result of population ageing, urbanization and associated lifestyle changes. The present study was to identify patterns of dermal ridges on finger tips and palms in Diabetics and non Diabetics which will be helpful in predicting the onset of Diabetes Mellitus in early detection programme. *Source of data:* The present study was carried out on 80 Diabetic patients in S.S. Institute of Medical Sciences and Research Centre, Davangere which was compared with 80 normal healthy individuals. *Method:* The palm prints and finger prints of patients and controls were taken by INK Method as described by CUMMINS and MIDLO. The Parameters like arches, loops, whorls, patterns in interdigital areas and 'atd' angle in both hands were noted. *ResuIts:* Arch patterns were significantly reduced in the finger tips of diabetics, with no significant difference in the mean counts of ulnar & radial loops between diabetics & controls. However whorl pattern was found to be significantly decreased in Diabetics when compared to controls. The frequency of patterns in interdigital areas I3 was increased where as decreased in I2 & I5 in diabetics significantly. The atd angle was increased in diabetics when compared to controls which were statistically insignificant.

Keywords: Dermatoglyphics; Diabetes Mellitus; Arches; Whorls; Loops; atd Angle.

Introduction

Dermatoglyphics is the scientific study of epidermal ridges and their configurations on the palmar region of hand and fingers and plantar region of foot and toes. The term dermatoglyphics was coined by Cummins and Midlo in 1926 and was derived from Greek words 'derma' means skin and 'glyphics'means carvings [1]. The original ridge characteristics are not disturbed unless the skin is damaged to a depth of about one millimeter [2].

With regard to the high incidence of Diabetes Mellitus in the world, the existence of such relation might be important in the screening programme for prevention of Diabetes Mellitus. If an individual with specific pattern of dermatoglyphics, then the person can be screened for prevention by controlling other risk factors in early detection programme [3].

Dermatoglyphic analysis can be done by

Finger Tip Patterns

a. *Arch(A):* An arch is the simplest pattern. It consists of more or less parallel ridges. The ridges curve the pattern area. The curve is proximally concave.
b. *Loop(L):* It is the most frequent pattern on finger tip. In this configuration, series of ridges enter and leave the pattern area on same side.

1. Ulnar Loop (Lu): In Ulnar Loop, ridges opens on the ulnar side.
2. Radial Loop (Lr): In Radial Loop, ridges open on the radial side.

Triradius: The triradius is located on the finger tip and on the same side where the loop is crossed.

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c. Whorl(W): According to Galton's classification, whorl is any ridge configuration with two or more triradii.

Palmar Pattern Configurations

They include the thenar area, interdigital areas and hypothenar area.

Hypothenar (Hypo): Hypothenar area is situated along the lower part of ulnar border of hand and labelled as 'Hypo'.

Thenar (Th): Thenar area is situated at the base of the thumb and labelled as 'Th' First, Second, Third, Fourth Interdigital Areas (ID1, ID2, ID3, and ID4): The first, second, third, fourth interdigital areas are found in the distal palm in the region of heads of metacarpal bones. Each is bordered laterally by a digital triradii.

atd angle: It is formed by lines drawn from digital triradius 'a' to the axial triradius 't'and from axial triradius 't' to the digital triradius 'd'. The more distal the position of t, the larger the 'atd' angle. 'atd' angle is the most widely used method in interpreting the position of triradius 't' [4].

Method of Dermatoglyphic Printing

The present study was carried out on 80 Diabetic patients in S.S. Institute of Medical Sciences and Research Centre, Davangere, which was compared with 80 normal healthy individuals after obtaining clearance from Instituitional Ethical Committee. Dermatoglyphic prints were taken by the "INK METHOD" as described by CUMMINS and MIDLO (1961) [5] and analysed to find variations in dermatoglyphic features among diabetics & controls.

Subjects were asked to clean their hands with soaps and water after informed written consent. They were also asked to dry their hands but to leave some moisture. The requisite amount of Camel quick drying duplicating ink daub was placed on the glass slab. It was uniformly spread by the rubber roller to get a thin even ink film on the glass slab.The thin film of ink was applied on the palm by passing the inked rubber roller uniformly over the palm and digits taking care that the hollow of the palm and the flexor creases of the wrist were uniformly inked.

Left hand of the subject was then placed on the sheet of paper (kept over the pressure pad) from proximal to distal end. The palm was gently pressed between inter-metacarpal grooves at the root of fingers and on the dorsal side corresponding to thenar and hypothenar regions. The palm was then lifted from the paper in reverse order, from the distal to proximal end. The fingers were also printed below the palmar print by rolled finger print method. *The tips of the fingers were rolled from radial to ulnar side to include all the patterns.* The same procedure was repeated for right hand on separate paper. The printed sheets were coded with name, age, sex, and for case group and control group. The prints were then subjected for detail dermatoglyphic analysis with the help of magnifying hand lens.The details were noted on the same paper with the pencil or pen.

The Parameters like arches, loops, whorls, patterns in interdigital areas and 'atd' angle in both hands were noted. Observations were tabulated and analyzed for statistical significance by applying Chi-square test.

Results

Table 1: Illustrates frequency of distribution of finger tip patterns of diabetics & controls

Patterns	Cases Right Hand	%	Controls Right Hand	%	Cases Left Hand	%	Controls Left Hand	%
Arch	48	13.33	23	7.66	30	8.33	25	8.33
Radial Loop	7	2.33	5	1.66	8	2.66	4	1.33
Ulnar Loop	185	61.66	189	63	184	61.33	167	55.66
WHORL	60	20	82	27.33	67	22.33	99	33

Table 2: Illustrates frequency of distribution of finger tip patterns in diabetics & controls

Patterns	Cases M & F	%	Controls M & F	%	x	p	s/ns/hs
Arch	78	13	47	7.83	8.9	0.003	S
Radial Loop	15	5	9	1.5	1.69	0.19	NS
Ulnar Loop	367	61.16	356	59.3	0.76	0.38	NS
Whorl	127	21.16	181	30.16	12.08	0.0005	HS

X- Chi square test, p-significance, S-significant, NS-not significant, HS-highly significant, M-males, F-females

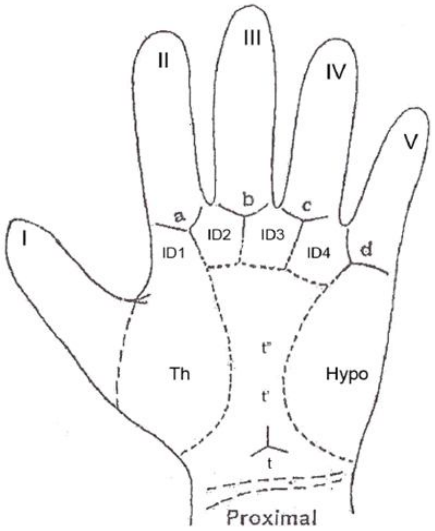

Fig. 1: Palm showing interdigital areas (ID), thenar & hypothenar eminence & atd angle(t).

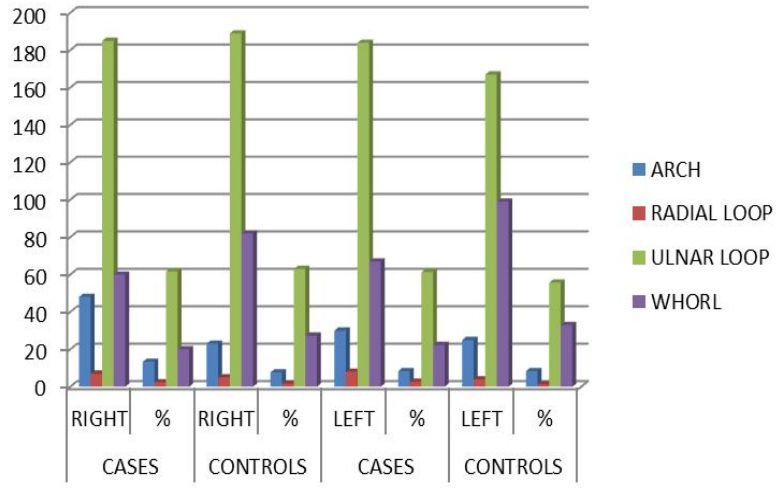

Chart 1: Illustrates number & percentage of patterns of individual fingers in the right & left palm of diabetics & controls

Table 3: Illustrates frequency of interdigital patterns in diabetics & controls

Loop in Interdigital Areas	Cases	%	Controls	%	x	P	s/ns/hs
I1	5	4.16	11	9.16	2.41	0.12	NS
I2	2	1.66	6	5	5.98	0.014	HS
I3	56	46.66	36	30	7.05	0.007	HS
I4	51	42.5	49	40.8	0.06	0.79	NS
I5	6	5	18	15	6.667	0.009	HS

X- Chi square test, p-significance, S-significant, NS-not significant, HS-highly significant

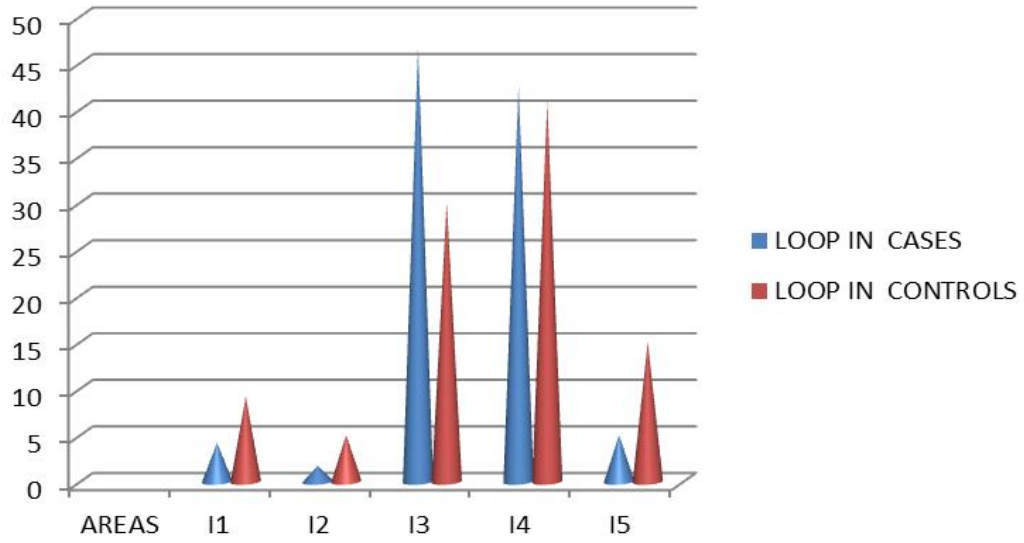

Chart 2: Illustrates percentage of loops in interdigital patterns in diabetics & controls

Table 4: Illustrates mean of atd angle in right hand & left hand in cases & controls

Atd	Right	Right
Angle	Males	Females
Cases	39.5	43.53
Controls	39.7	42.56

Atd	Left	Left
Angle	Males	Females
Cases	44.3	43.53
Controls	38.86	42.53

Atd	Total
Angle	M & F
Cases	42.73
Controls	40.9

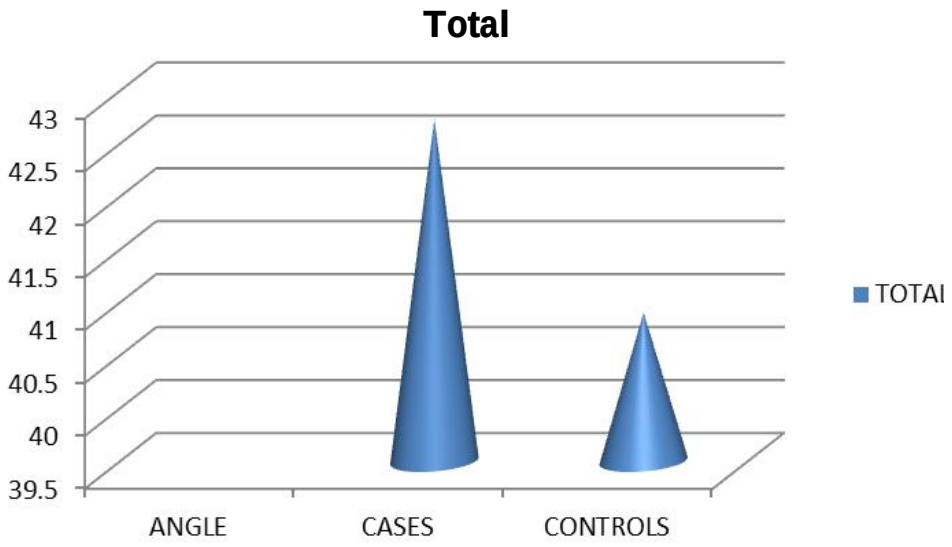

Chart 3: Illustrates mean of atd angle in cases & controls

Discussion

In the present study of 80 diabetics & 80 controls, the frequency of distribution of finger tip patterns in both hands were : arches; diabetics- 13%, controls- 7.83%, whorls; diabetics-21%, controls-30%, ulnar loop; diabetics-61%, controls-59%, radial loop; diabetics-5%, controls-1.5%. Diabetics had significant increased arches than controls. Whorl pattern was found to be significantly decreased in diabetics when compared to controls.

The results of Hashim HMA obtained from Chi-square test and t-test showed the occurrence of whorls of index and little finger increased in double samples of males (54%, 36%) compared to controls(16%,46%) and ulnar loops increased (26%, 64%) compared to Controls (32%,84%).Where as in females, whorls decreased to 38% and ulnar loops increased (16%, 38%) compared to controls 24% and (62%, 6%) respectively [6].

Bandana sachdev observed arches; diabetics- 9.9%, controls- 3.6%, whorls; diabetics- 32%, controls-59%, loop; diabetics- 57%, controls-37%. Diabetics had significant lower arches than controls. Both male and female diabetics showed a significant increase in frequency of loops, and arches and a decreased in the frequency of whorls especially in digit III i.e. Middle finger in right hand of females and left hand of males had chances of type 2 DM [7].

In the present study of 80 diabetics & 80 controls, there was an increase in I_3 pattern (46.66%) which was statistically significant in diabetics when compared to controls (30%), while thenar / I_1, I_4, did not show any statistical significance. There was a decrease in I_2 (1.6%) & hypothenar area (5%) when compared to controls I_2 (5%) & hypothenar area (18%) which was statistically significant. Thenar / I_1: diabetics-4.1%, controls-9.1%, ; I_2 diabetics- 1.6 %, controls- 5%, I_3; diabetics- 46.6 %, controls-30%, I_4; diabetics- 42.5 %, controls-40 % hypothenar area; diabetics- 5%, controls-18 %. Ana tarca observed a spectacular diminution of the pattern frequency for the masculine series, in the interdigital space IV, up to 19.16% versus 48.6% - the value recorded in the men of the reference sample [8].

In the present study, atd angle was decreased in right hand of male diabetics when compared to female diabetics & increased atd angle was seen in left hand of male diabetics when compared to controls. Atd angle was increased in cases when compared to controls. The mean of atd angle in cases was 42.73 & in controls 40.90. These values did not show any statistical significance. Atd in right hand of males: diabetics-39.5, controls-39.7, right hand of females: diabetics-43.53, controls-42.5, left hand of males: diabetics-44.3, controls-38, left hand of males: diabetics-43, controls-42.

Vadgaonkar Rajanigandha observed that there was a statistically significant increase in the atd angle on both hands of both sexes in diabetics when compared to the controls, who showed narrower angles [9]. Manoj sharma observed that there was a statistically significant increase in the right atd angle mean values (43.66) in diabetics when compared to the controls, who showed narrower angles (40) [10].

Conclusion

The following conclusions can be made from present study.

Arch patterns were significantly reduced in the finger tips of diabetics, with no significant difference in the mean counts of ulnar & radial loops between diabetics & controls. However whorl pattern was found to be significantly decreased in the right hand of Diabetics when compared to controls.

The frequency of patterns in interdigital areas I3 was increased where as decreased in I2 & I5 in diabetics significantly.

The atd angle was increased in diabetics when compared to controls which was statistically insignificant.

There were significant differences in the diabetics in various dermatoglyphic features when compared to normal. Hence it is possible to identify the at risk population with the help of dermaoglyphics, which can serve as an aid in the diagnosis of diabetics at an earlier age.

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Original Article

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Variations in the Extensor Tendons of the Hand and a Study of Extenor Digitorum Brevis Manus Muscle

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Abstract

Introduction: A detailed knowledge of the extensor tendons' anatomy is essentialfor understanding the consequences of tendon injuryat various levels. Extensor tendon injuries can cause serious functional impairment but have not received the attention in the literature as flexor tendon injuries.This study focuses on the variant pattern of the chief extensor tendons on the dorsum of hand. This study also throws light on the the relatively rare extensor digitorum brevis manus, a supernumerarymuscle in the fourth extensor compartment of thedorsum of the wrist. *Materials & Methods:* 25 upper limbs (13 right and 12 left) of adult cadavers of unknownage and sex, collected from the dissection room at the Anatomy Department, P.K. Das Institute of Medical Sciences, Vaniamkulam, Palakkad were examined to study the basic arrangement of the extensor tendons of the fingers and to determine the presence of variations of these tendons. *Results*: The number of ED tendons varied from 3 to 8. The incidence of 4 tendons (36%) was the commonest pattern observed in the present study, followed by 5 tendons for ED (20%) and 4 tendons for ED (16%). A single tendon for Extensor digitiminimi was observed in 23 limbs (92%), while the muscle was absent in 2 specimens (8%). The extensor indicis exhibited a single tendon in all the cases. The APL muscle and tendonwere found in all specimens. EPL & EPB were found in all specimens. Two accessory muscles were observed in the dorsum of the hand which were identified asextensordigitorum brevis manus. *Discussion*: The highest number of variations were observed for the tendons of Extensor Digitorum, the number of tendons ranging from 3 to 8. Extensor digitorum brevis manus muscle was observed in two specimens.The variations observed in the present work, could be due to the variable changes the extensor limb myotomespass through, during ontological development; regression, retention, or reappearance.

Keywords: Extensor; Pollicis; Digitorum; Digitiminimi; Indicis; Tendons; Anatomical; Variations; Digitorum Brevis Manus.

Introduction

Several anatomic structures contribute to the extensor mechanism, including the extrinsic muscles of the forearm, intrinsic muscles such as the interosseous and lumbricals, and fibrous structures. The synergisticcontraction of the extensor musculature along withthe long flexors is mandatory for an efficient grip ondifferent objects in daily life. Extensor compartment of the distal segment of the upperlimb is the back of the forearm and the hand. The muscles of this region can be classified into superficial and deep group and through their tendons they act upon the wrist joint and joints of the hand and extend the wrist and fingers. The extensor muscles are in the posterior (extensor–supinator) compartment of the forearm, and all are innervated by branches of the radial nerve.

The extensor tendons are held in place in the wrist region by the extensor retinaculum, which prevents bowstringing of the tendons when the hand is extended at the wrist joint. As the tendons pass over the dorsum of the wrist, they are provided with synovial tendon sheaths that reduce friction for the extensor tendons as they traverse the osseofibrous

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tunnels formed by the attachment of the extensor retinaculum to the distal radius and ulna.

The extensor muscles of the forearm are organized anatomically into superficial and deep layers.

Four of the superficial extensors (extensor carpi radialis brevis, extensor digitorum, extensor digitiminimi, and extensor carpi ulnaris) are attached proximally by a common extensor tendon to the lateral epicondyle. The proximal attachment of the other two muscles in the superficial group (brachioradialis and extensor carpi radialis longus) is to the lateral supra-epicondylar ridge of the humerus and adjacent lateral intermuscular septum.

The extensor carpi radialis longus is inserted into the lateral side of the base of the 2nd meta carpal bone and the extensor carpi radialis brevis is inserted into the dorsal aspect of the base of the second and third metacarpal bones.Extensor carpi ulnaris is inserted on the medial side of the base of the 5th metacarpal bone.

Extensor digitorum arises from the lateral epicondyle of the humerus via the common extensor tendon, the adjacent intermuscular septa and the antebrachial fascia. It divides distally into four tendons, which pass, in a common synovial sheath with the tendon of extensor indicis, through a tunnel under the extensor retinaculum. The tendons diverge on the dorsum of the hand, one to each finger. The tendon to the index finger is accompanied by extensor indicis, which lies ulnar (medial) to it. On the dorsum of the hand, adjacent tendons are linked by three variable intertendinous connections (juncturaetendinae), which are inclined distally and radially. The digital attachments enter a fibrous expansion on the dorsum of the proximal phalanges to which lumbrical, interosseous and digital extensor tendons all contribute.The common tendons of the index and little fingers are joined on their medial sides near the knuckles by the respective tendons of the extensor indicis and extensor digitiminimi.

Extensor digitiminimi is a slender muscle medial to, and usually connected with, extensor digitorum. It arises from the common extensor tendon by a thin tendinous slip and adjacent intermuscular septa. It frequently has an additional origin from the antebrachial fascia. Its long tendon slides in a separate compartment of the extensor retinaculum just behind the inferior radio-ulnar joint. Distal to the retinaculum, the tendon typically splits into two, and the lateral slip is joined by a tendon from extensor digitorum. All three tendons are attached to the dorsal digital expansion of the fifth digit, and there may be a slip to the fourth digit. Extensor digitiminimi is rarely absent, but sometimes it is fused with extensor digitorum.

Abductor pollicis longus arises from the posterior surface of the shaft of the ulna distal to anconeus, the adjoining interosseous membrane, and the middle third of the posterior surface of the radius distal to the attachment of supinator. It descends laterally, becoming superficial in the distal forearm, where it is visible as an oblique elevation. The muscle fibres end in a tendon just proximal to the wrist. The tendon runs in a groove on the lateral side of the distal end of the radius accompanied by the tendon of extensor pollicis brevis. It usually splits into two slips, one of which is attached to the radial side of the first metacarpal base, and the other is attached to the trapezium. Slips from the tendon may continue into opponenspollicis or abductor pollicis brevis. Occasionally the muscle itself may be wholly or partially divided.

Extensor pollicis longus is larger than extensor pollicis brevis, whose proximal attachment it partly covers. It arises from the lateral part of the middle third of the posterior surface of the shaft of the ulna below abductor pollicis longus, and the adjacent interosseous membrane. The tendon passes through a separate compartment of the extensor retinaculum in a narrow, oblique groove on the back of the distal end of the radius. It turns around a bony fulcrum, Lister's tubercle, which changes its line of pull from that of the forearm to that of the thumb, and is attached to the base of the distal phalanx of the thumb.

Extensor pollicis brevis arises from the posterior surface of the radius distal to abductor pollicis longus, and from the adjacent interosseous membrane. The tendon is inserted into the base of the proximal phalanx of the thumb, and commonly has an additional attachment to the base of the distal phalanx, usually through a fasciculus which joins the tendon of extensor pollicis longus. Extensor pollicis brevis may be absent or fused completely with abductor pollicis longus.

Extensor indicis is a narrow, elongated muscle which lies medial and parallel to extensor pollicis longus. It arises from the posterior surface of the ulna distal to extensor pollicis longus, and the adjacent interosseous membrane. Its tendon passes under the extensor retinaculum in a common compartment with the tendons of extensor digitorum. Opposite the head of the second metacarpal it joins the ulnar side of the tendon of extensor digitorum which serves the index finger.

Extensor indicis occasionally sends accessory slips to the extensor tendons of other digits. Rarely its tendon may be interrupted on the dorsum of the hand by an additional muscle belly (extensor indicis brevis manus). An extensor retinaculum, a fibrous band prevents bowstringing of tendon at the wrist levels and separates the tendons into 6 compartments. The first compartment contains the extensor pollicis brevis and the abductor pollicis longus; the second, the extensor carpi radialis longus and extensor carpi radialis brevis; the third, the extensor pollicis longus; the fourth, the four tendons of the extensor digitorum communis plus the extensor indicisproprius; the fifth, the extensor digitiminimi; and the sixth, the extensor carpi ulnaris.

Although extensor variations are common, mostof them are asymptomatic and accidently discoveredduring surgery. Extensor tendon injuries are more frequent than flexor tendon injuries and are very common (61%) as they are not protected as well as the flexor tendons due to their superficial location and lack of overlying subcutaneous tissue. Extensor tendon injuries can cause serious functional impairment but have not received the attention in the literature as flexor tendon injuries.

A detailed knowledge of the extensor tendons' anatomy is essential for understanding the consequences of tendon injuryat various levels. This tendon injury may be either dueto external trauma or spontaneous rupture as in patientswith rheumatoid arthritis and distal radioulnarjoint osteoarthritis.

Many researchers have used magnetic resonance imaging (MRI) to show the details of the musculo tendinous and retinacular structures of the extensorapparatus. They emphasized that understanding of the anatomy of the extensors of the hand and fingers and the acquaintance with their variations by the radiologist is mandatory for better assessment with MRI.

Therefore, the present research was performed to investigate the anatomy of the extensor tendons ofthe fingers, describe their sites of insertions and point out theirvariations. The results of this study might help the clinical radiologist and the surgeons to appreciate and understand these variations for better diagnosis, hand assessment, tendon repair and reconstruction.

Materials & Methods

This study was performed on a total of 25 upper limbs (13 right and 12 left) of adult cadavers of unknownage and sex, collected from the dissection room at the Anatomy Department, P. K. Das Institute of Medical Sciences, Vaniamkulam, Palakkad.

The procedure for this study didnot include any issue that required the approvalof the Ethics Committees of the institution. Upperlimbs of cadavers with obvious injury or scar from surgery were excluded. After the removal of skin and careful dissection of the superficial fascia on the dorsum of each hand, the muscles of the extensor compartments were dissected; the extensor retinaculum (ER) was defined.

The following six muscles were studied in detail.

1. Extensor Digitorum
2. Extensor DigitiMinimi
3. Extensor Indicis
4. Abductor Pollicis Longus
5. Extensor Pollicis Longus
6. Extensor Pollicis Brevis

The number of tendons for each of these muscles, proximal anddistal to the ER, was investigated. The ER was split verticallyto expose the underlying tendons. The tendons were traced to their insertions in the fingers. They were examined to study the basic arrangement of the extensor tendons of the fingers and to determine the presence of variations of these tendons. The incidence of variations in their numbers and sites of attachment were observed. Presence of any supernumerary muscles in the dorsum of hand was also looked for. Then they were photographed usinga digital camera. The obtained data were then tabulated and the percentages were calculated. A tendon was considered single, double or triplebased on the number of separable tendons originating from the muscle at the myotendinous junction.Tendon slips were defined as tendinous divisions distalto the origin of the tendon i.e. splitting of the tendoninto 2 or more separable smaller tendon slips.

Results

Extensor Digitorum (ED)

In 2 upper limb specimens (8%), 8 tendinous slips were observed for extensor digitorum. There was one slip each to little & ring fingers and 3 slips each to ring & middle fingers. (Figure 1).

In 4 specimens (16%), six tendinous slips were observed. There was one slip each to index & middle fingers and 3 slips to ring finger (Figure 2).

In 5 specimens (20%), five tendinous slips were observed. There was one slip each for index, middle & little finger and 2 slips for ring finger.

In 9 specimens (36%), four slips were observed, one for each of the medial four fingers.

In 5 specimens (20%), three slips were observed, one each for index, middle and ring fingers. There were no slips for little finger (Figure 3).

Extensor Digiti Minimi (EDM)

In 23 specimens (92%), a single tendon was observed to the little finger.

In 2 specimens (8%), extensor digitiminimi was absent.

Extensor Indicis (EI)

In all the 25 specimens, a single tendon was observed for extensor indicis, being inserted into the extensor expansion of index finger in all cases.

Abductor Pollicis Longus (APL)

In 22 specimens (88%), the muscle had a single belly & single tendon.

In 3 specimens (12%), the muscle had a single belly and 2 tendinous slips proximal & distal to extensor retinaculum (Figure 4).

Extensor Pollicis Longus (EPL)

In all 25 specimens, the muscle had only one tendinous slip.

Extensor Pollicis Brevis (EPB)

In all 25 specimens, the muscle had only one tendinous slip

In addition to the above observations, two accessory muscles were observed in the present study.

1. A small muscle arose from the lower 1/4th of the posterior surface of ulna. The muscle belly tapered off into a slender tendon, which was inserted into the extensor expansion of middle finger. This limb had only 3 slips for extensor digitorum (Figure 5).
2. An accessory muscle was observed on the dorsum of hand. This muscle originated from the distal most end of posterior surface of radius, medial to Lister's tubercle. 2 tendons arose from the muscle, one tendon joined the tendon of extensor indicis and the other tendon was inserted directly onto the extensor expansion of middle finger (Figure 6).

No separate nerves could be identified supplying the above two accessory muscles.

Discussion

In the present study, the number of ED tendons varied from 3 to 8. The incidence of 4 tendons (36%) was the commonest pattern observed in the present

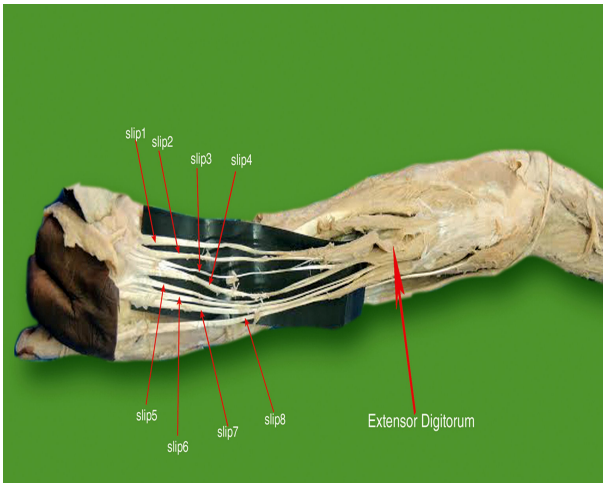

Fig. 1: Photograph showing extensor digitorum with 8 tendinous slips

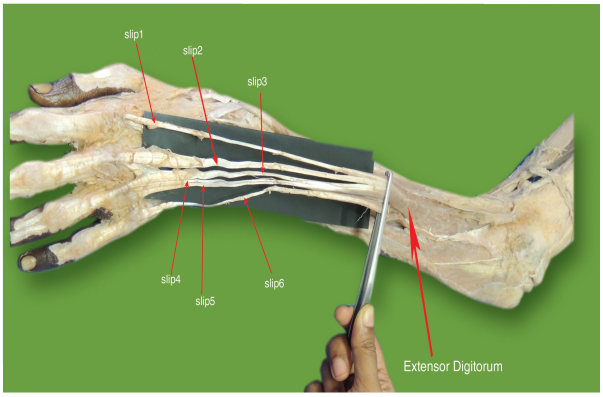

Fig. 2: Photograph showing extensor digitorum with 6 tendinous slips

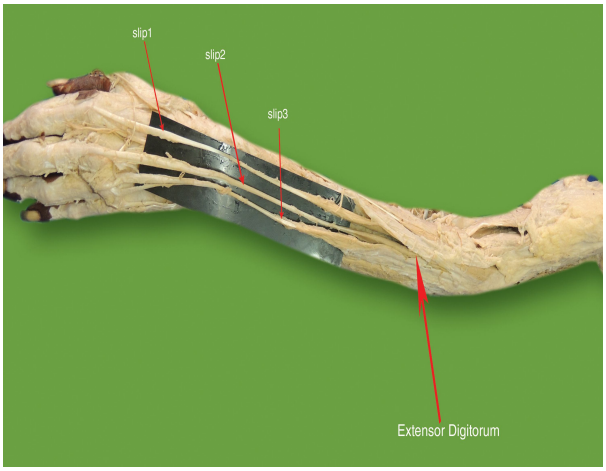

Fig. 3: Photograph showing extensor digitorum with 3 tendinous slips

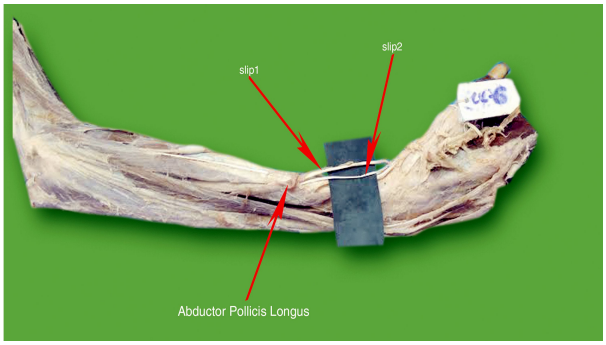

Fig. 4: Photograph showing abductor pollicis brevis with a single belly and 2 tendinous slips

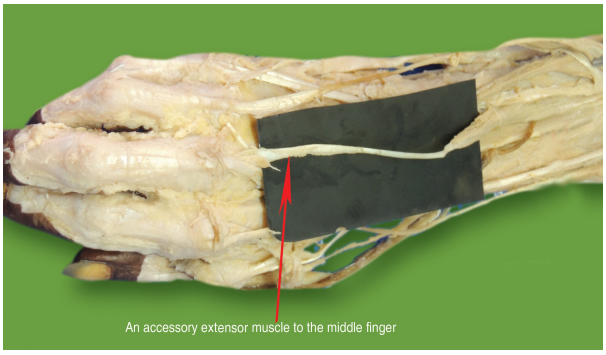

Fig. 5: Extensor digitorum brevis manus muscle arising from lower 1/4th of posterior surface of ulna and inserting into extensor expansion of middle finger

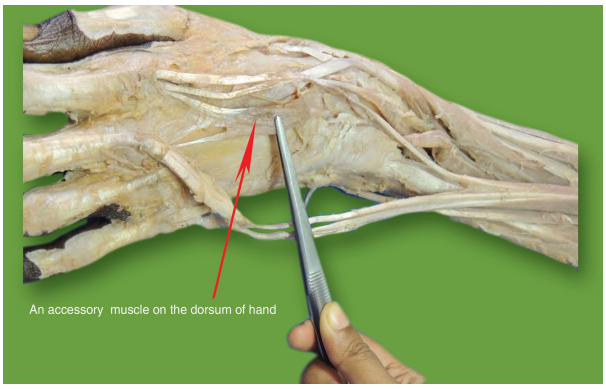

Fig. 6: Extensor digitorum brevis manus muscle arising from distal end of posterior surface of radius and dividing into 2 tendinous slips

study, followed by 5 tendons for ED (20%) and 4 tendons for ED (16%). This observation contrasts with the previous studies. G.A. Abdel-Hamid et al. [1] in his study of 95 specimens has reported the incidence of 6 tendons for ED (40%) being the commonest pattern, followed by 4 tendons (32.6%). El-Badawi MG et al. [2] in his study has reported the highest incidence of 4 tendons for ED, followed by 3 tendons. In the present study, the incidence of 8 tendons was observed in two of the hands(8%), the occurrence of which had not been reported in any previous studies to the best of our knowledge.

In the present study, a single tendon for Extensor digitiminimi was observed in 23 limbs (92%), while the muscle was absent in 2 specimens (8%). This finding is in concordance with the previous studies which had reported 92-95% incidence of a single tendon for EDM [1, 2, 3]. Very few previous studies had reported a complete absence of EDM, which was observed in 2 specimens in the present study.

In the present study, the extensor indicis exhibited a single tendon in all the cases. G.A. Abdel-Hamid et al. [1] had also reported a single tendon for EI in his study. Dass et al. [3] detected a single tendon of EI in 98% of specimens. However, some studies reported a lower incidence [2,4,5,6]. The EI permits independent extension of the index finger and is commonly used for tendon transfer [7, 8].

In the present study, the APL muscle and tendonwere found in all specimens. A single belly and a single tendon for this muscle was observed in 88% of the specimens, where as a single belly and duplicated tendons were seen in 12% of specimens.

In the present study, the EPL muscle and tendonwere found in all specimens. A single tendon was observed in all our specimens. Previous studies have reported a varying incidence regarding the tendons of EPL. G.A. Abdel-Hamid et al. [1] has reported single tendons in 67.4% of hands, whereas the duplicated ones were detected in 32.6% in the same study. Caetano MBF et al. [9] has reported a lower incidence of 8.3% of the duplicated tendons for EPL. Other researches [10, 11] noted the absence of this tendon without referring to its frequency.

In the present investigation, EPB was recorded in all the dissected limbs. EPB has been widely documented in 100% of specimens of the previous studies [12,13].G.A. Abdel-Hamid et al. [1] has reported incidence of EPB in 97.9% of cases. He has also reported absence of EPB in 2.1% cases, which is in concordance with the previous studies, which have reported similar percentages [14,15,16]. The sporadic absence of EPB could be explained because of its phylogenetically young structure [17].

Two accessory muscles were observed in the dorsum of the hand in the present study.

1. One of the muscles originated from the distal most end of posterior surface of radius, medial to Lister's tubercle. 2 tendons arose from the muscle, one tendon joined the tendon of extensor indicis and the other tendon was inserted directly onto the extensor expansion of middle finger.

2. A small muscle arose from the lower 1/4th of the posterior surface of ulna. The muscle belly tapered off into a slender tendon, which was inserted into the extensor expansion of middle finger. This limb had only 3 slips for extensor digitorum to the index, middle & ring fingers. So, there were 2 tendinous slips to the middle finger.

These variant muscles may be representing extensor digitorum brevis manus.

The extensor digitorum brevis manus, a supernumerarymuscle in the fourth extensor compartment of thedorsum of the wrist, is a relatively rare anomalous muscle. The extensor digitorumbrevis manus muscle (EDBM), an anatomic variant of theextensor muscle of the dorsum of the hand, is found inapproximately 2% to 3% of the population.The extensor digitorum brevis manus has also been called the "m. extensor anomalus" and "le muscle manieux" [18]. This muscle was first reported by Albinus in 1734. Since then, approximately 295 cases of extensor digitorumbrevis manus have been reported. Bunnel [19,20] and Souter [21] described that EDBM may represent a failure of proximal migration of ulnocarpal elements of the antebrachialmuscle mass in humans, which is found normally inamphibians.

This muscle generally consists of a single belly, but cases with two bellies with variable sizes alsohave been reported [23, 21]. EDBM is commonly said to arise from the dorsal carpal ligaments, the joint capsule, orthe carpal bone, particularly the scaphoid and the lunate[22]. However, other origins, including the distal radius,ulna, and metacarpals, have been reported [23].

Its insertion has been described as in the extensor hood of the index,middle, ring, or little finger, although multiple insertionsinto more than one finger has been reported [23, 24]. The most common insertion is said to be into the index finger,followed by the middle, and then the index and middle fingers [25]. The nerve supply and blood supply of EDBM has been confirmed to be from the posterior interosseousnerve and artery [25].

Extensor digitorum brevis manus should be included in the differential diagnosis of soft tissue masses on the dorsal aspect of the hand as it may mimic cystic, neoplastic, inflammatory, and infectious masses arising in the dorsumof the wrist. During clinical examination, the EDBM may be confused with abnormal processes such as ganglion, cysts, or soft tissue tumors thereby mimicking numerous abnormal entities which when misdiagnosed may lead to unnecessary surgery [25, 26]. Although usually asymptomatic, the patient may present with a painful dorsal wrist mass, particularly inindividuals performing repetitive movements of the wrist and hand [27].

The presence of these additional muscles in the fourth compartment of the extensor retinaculum, as in the present case, may lead to a condition called "fourth-compartment syndrome," which is manifested by chronic dorsal wrist pain of the fourth compartment. The increased pressure within this compartment may compress the posterior interosseous nerve directly or indirectly [28].

The variations observed in the present work, could be due to the variable changes the extensor limb myotomespass through, during ontological development; regression, retention, or reappearance as explained by Celik et al. [29] and Chevallier et al. [30]. Developmentally, in the forearm, the precursor extensor muscle mass differentiates into a radial portionwhich subsequently divides into superficial anddeep portions. The superficial portion differentiatesinto the ED, extensor carpi ulnaris, and Edm. The deep portion, gives rise to the abductor pollicis longus, extensorpollicis brevis, extensor pollicis longus and EI.

Conclusion

25 upper limbs were examined in the present study to observe the basic arrangement of the extensor tendons of the fingers and to determine the presence of variations of these tendons. Six extensor tendons on the dorsum of the hand were studied in detail. The highest number of variations were observed for the tendons of Extensor Digitorum, the number of tendons ranging from 3 to 8. To know the consequences of the injuries in forearm and hand at various levels. surgeons should be well versed in the extensor anatomy of forearm and hand. Extensor digitorum brevis manus muscle was observed in two specimens. This supernumerary muscle should be included in the differential diagnosis of soft tissue masses on the dorsalaspect of the hand as it may mimic cystic, neoplastic, inflammatory, and infectious masses arising in the dorsumof the wrist. This study will help the radiologists and surgeons to understand the variations for theirdiagnosis and performing hand surgery, especially tendon repair and reconstruction. So, clinicians andsurgeons should be advised to investigate each casethoroughly and individually, using recent techniques.

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Original Article

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Cadaveric Study of Morphology, Capacity & Peritoneal Relations of Gall Bladder

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Abstract

Context: In case of gall bladder disease the surgeon can efficiently handle the case if he is aware of the variations of the extra hepatic biliary apparatus without which the prognosis is unwelcome. *Aims:* The aim of the study is to study the volume, periotoneal relations & variations in the external morphology of the gall bladder, the knowledge of which is important for imaging of gall bladder and surgical procedures on gall bladder such as cholecystectomy and laproscopy surgery. *Settings and Design:* It was an observational study. The observations were made on following parameters – Capacity (Volume), morphological variations, peritoneal investment of the gall bladder, Relation of the fundus of gall bladder to the anterior margin of the liver. *Methods and Material:* The study was conducted on 100 gall bladders obtained from dissection of abdomen of formalin fixed cadavers . The specimen of gall bladder was observed for morphological variations on the visceral surface of the liver in the gall bladder fossa. *Statistical Analysis used:* Percentage for various parameters was calculated. *Results:* In 80% of the cases the capacity of gall bladder was ranging from 40 to 75ml. In 75% of cases the peritoneal investment on the non hepatic surface was 2 / 3rd to 3 / 4th. In 57% of cases the fundus was inframarginal & one case of bilobed gall bladder was observed. *Conclusions:* The gall bladder shows variations which the radiologists and the operating surgeons should keep at the back of their mind while imaging and operating for good surgical outcomes.

Keywords: Gall Bladder; Peritoneal Relations; Volume; Fundus; Marginal.

Introduction

Abdomen is known as Pandora's box and the viscera it contains are well known for their variations in size, shape, relations and vascular supply. The diagnosis of medical and surgical conditions associated with the abdominal viscera is always not possible with precision. As a result most of the diagnosis is done on the operation table. In case of gall bladder disease the surgeon can efficiently handle the case if he is aware of the variations of the extra hepatic biliary apparatus without which the prognosis is unwelcome. Gall bladder lies in the gall bladder fossa on the visceral surface of the liver. It has neck, body and the fundus. The fundus is related to the inferior margin of the liver. Deaver (1911) [1] emphasised the variations of morphology of gall bladder and bile duct especially in the surgery of the aforesaid organ. The present study is a part of study of variations in extrahepatic biliary apparatus in which the variations in the external morphology of the gall bladder are described. The aim of this study is to study the volume, periotoneal relations & variations in the external morphology of the gall bladder, the knowledge of which is important for imaging of gall bladder and surgical procedures on gall bladder such as cholecystectomy and laproscopy surgery.

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Materials and methods

The study was conducted on 100 gall bladders obtained from dissection of abdomen of formalin fixed cadavers in the department of Anatomy,

Patna medical college and hospital over the period of three years. The specimen of gall bladder was observed for morphological variations on the visceral surface of the liver in the gall bladder fossa. The observations were made on following parameters – Capacity (Volume), morphological variations, peritoneal investment of the gall bladder, Relation of the fundus of gall bladder to the anterior margin of the liver. The capacity of the gall bladder was measured by distending the gall bladder with direct injection of the aqueous suspension.

Results

In 80% of the cases the capacity of gall bladder was ranging from 40 to 75ml, while in 12% of cases the capacity range was 25 to 40ml and in 7% of cases the capacity was around 80 to 120ml (Table 1). In 75% of cases the peritoneal investment on the non hepatic surface was 2/3rd to 3/4th, while in 13% of cases it was more than 3/4th and in 12% of cases it was less than 2/3rd (Table 1). In 57% of cases the fundus was inframarginal, while in 26% of cases it was marginal and in 17% of cases it was supramarginal (Table 1).

Bilobedgall bladder was seen in 2% cases in which one of the lobe was attached to a separate mesentery (Figure 1). In 20% of the cadaveric dissections the gall bladder showed evidence of disease. In 12% of cases there was cholelithiasis (Figure1), 3% there was choledocholithiasis and 4% of cases showed adhesion with gross thickening.

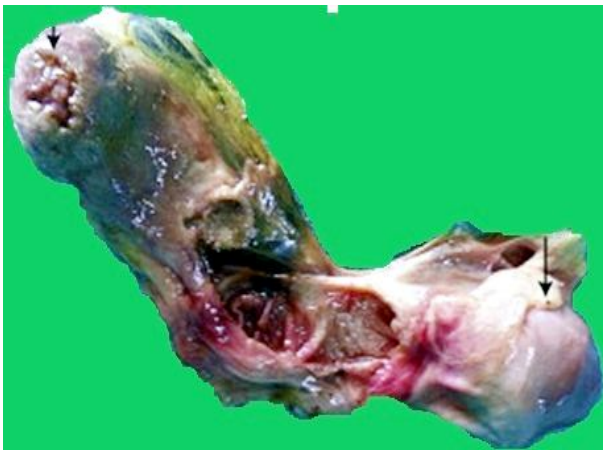

Fig. 1: Bilobed gall bladder with wall thickening and gall stones. Arrow pointing towards peritoneal covering of one of the lobe

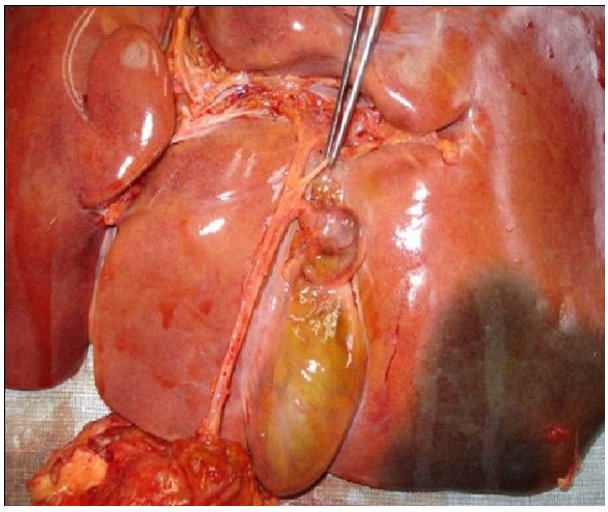

Fig. 2: Inframarginal fundus of the gall bladder

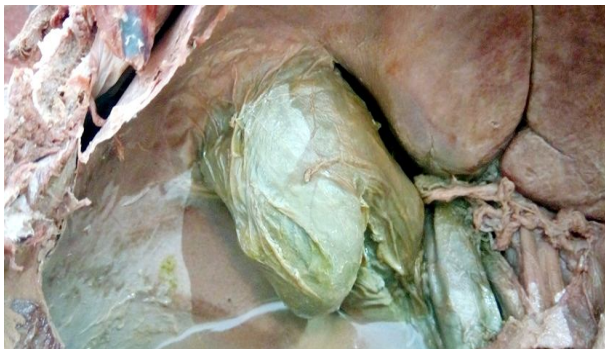

Fig. 3: Gall bladder is distended by aqueous injection. Non hepatic surface completely covered by peritoneum and fundus is supramarginal

Table 1:

Capacity	No. of cases	Extent of peritoneal investment	No. of cases	Level of fundus	No. of Cases
25 to 40 ml	12	2/3rd to 3/4th	75	-	Supramarginal	17
40 to 75 ml	80	More than 3/4th	13	-	Marginal	26
80 to 120 ml	07	Less than 2/3rd	12	-	Inframarginal	57

Discussion

In the present study, the range of capacity of the gall bladder varied from 25ml, to 120ml and the average capacity was 50ml (Figure 2). 80% of gall bladder had capacity ranging between 42ml to 75ml. Nilsell K (1990) [2] has suggested that gallbladder storage capacity is a determining factor of bile acid pool. Decrease in capacity, is seen in gallstone disease, which may be caused by gall bladder fibrosis and shrinkage. Increase in gall bladder volume might be responsible for defective motor function of the gall bladder (Palasciano G) [3].

In the present study two cases of bilobed gall bladder were observed. Similar finding was reported by Tariq Ahmed et al, a rare anatomical variation. Duplication occurs in 1 in 4000 births [4]. More than 300 years ago Huber [5] in Switzerland recorded first "Y" shaped gall bladder in man. However anomalies of this organ are relatively rare. Variations in the form and position of gall bladder are rare as discussed by Gross and Boyden in 1926 [6], Schanner [7], Moosmanand Collier (1951) [8]. A comparative infrequency of such variations has also been reported by, Schachner [7], Latimar [9] and his associates.

In the present study in 2% cases the gall bladder wall showed local thickness with adhesions with surrounding structures. Gall stones with stones in the duct was evident in 15% cases. Afrim Pirraci [10] et al found gall stones in 74% of cases in a population screened by Ultrasound over 80 years of age.

Peritoneal investment of the gall bladder varied to a great extent.In the present study 2/3rd to 3/4th investment was found in 75% of the cases. The hepatic surface of the gall bladder was devoid of peritoneum. More than 3/4th (Figure 3) and less than 2/3rd investment were found in 13% and 12 % respectively. This finding concurs with the study of JabaRajguru [11] et al who found differential peritoneal investment of gall bladder in 7% of cases. (Table 2).

Table 2:

	Peritoneal relations	Volume	Incidence of gall stones and wall thickenings
Present study	2/3rd to 3/4th peritoneal investment – 75% of cases More than 3/4th peritoneal investment – 13% of cases Less than 2/3rd peritoneal investment – 12% of cases.	25 to 40 ml 12% of cases. 40 to 75 ml 80% of cases. 80 to 120 ml 07% of cases.	Wall thickness with adhesions – 2% of cases Gall stones – 15% of cases.
AfrimPirraci			80% in population over 80 years of age on ultrasound examination
Jaba Rajguru et al	Differential peritoneal investment – 7% of cases.		

In the present study one of the bilobed gall bladder was attached to a separate mesentery. Wendel (1898) [12] first reported a case of torsion of Gall bladder suspended by a mesentery. Torsion of gall bladder also has been reported by Short and Paul [13].

Torsion of gall bladder often presents as acute abdomen and often mimics acute cholecystitis. Preoperative diagnosis is difficult and often made during emergency laparoscopy [11].

The relationship of the fundus of the gall bladder to the anterior margin of the right lobe of the liver was extremely variable. The fundus of the gall bladder was inframarginal (Figure2) in 60%, Marginal in 25% and supramarginal (Figure 3) in 15% of the cases.

Thus inframarginal fundus is more commonly observed. This finding small gall bladder observed by Jaba Rajguru [11] et al and Lurje [14] et al who stated that supramarginal variety is difficult to palpate even in the distended state of the viscus. The length of the fundus below the inferior margin could be 0.4 to 2.5cm as noted by Chakka Sreekanth [15]. The fundus is the most susceptible part of gall bladder during laproscopy.

Conclusion

The gall bladder shows variations in relation to volume, number of lobes, peritoneal investment and relation of the fundus to the anterior margin of the liver. The radiologists and the operating surgeons should be keep these rare variations at the back of their mind while imaging and operating for good surgical outcomes.

Key Message

The gall bladder shows variations in relation to volume, number of lobes, peritoneal investment and relation of the fundus to the anterior margin of the liver which is surgically and radiologically important.

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Original Article

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Anatomical Variations of Tributaries Emerging from Hilum to Form Renal Vein

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Abstract

The hila and the adjacent pre-hilar area of seventy-two (35 right and 37 left) kidneys isolated from formalin fixed cadavers were examined. Subsequently, the total number of tributaries emerging from renal hilum to form main renal vein were studied and the variations in them were observed. Thereafter, we calculate and compare our results with similar studies conducted in the past. This information is of importance for surgeons performing nephron sparing surgeries and performing renal transplant operations.

Keywords: Renal Vein; Renal Artery; Renal Transplant Surgery; Hilum.

Introduction

The anatomical knowledge of renal veins and its variations are of extreme importance for surgeons approaching the retroperitoneal region especially with the recent increase in the frequency of renal transplant surgeries [1].

The large renal veins lie anterior to the renal arteries and open into inferior venacava at almost right angles [2].

At the hilum, renal vein is anterior to the renal artery, which is anterior to renal pelvis [3].

Veins from renal segments communicate with one another unlike the arteries and eventually form five or six vessels that unite at the hilum to form single renal vein [4].

The left renal vein is three times longer than the right renal vein. As a result, the left kidney is the preferred side for live donor nephrectomy. The left renal vein may be double, one vein passing posterior and the other anterior to aorta before joining the inferior venacava [2].

In the kidney transplantation operation, accessory veins may be ligated as there is generous venovenous anastomosis throughout the kidneys [5].

Knowledge of anatomy and anomalies of renal veins is necessary for retroperitoneal surgery and venographic procedures in addition to providing safety guidelines for endovascular procedures [6].

Advanced imaging techniques have resulted in increasing use of minimally invasive approaches for nephron sparing surgeries of the kidney. Need for precise knowledge of normal and variant anatomy of vascular pedicle of kidney is therefore justified [7].

Materials and Methods

The hila and the adjacent pre-hilar area of 72 (35 right and 37 left) kidneys isolated from formalin fixed cadavers were examined. The hilum and pre-hilar area of each kidney was dissected carefully. The total number of tributaries emerging from renal hilum to form main renal vein were documented. The arrangements of the structures in the renal hilum and pre-hilar area were analysed to find the most anterior structure entering the hilum.

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Observations and Results

Venous tributaries emerging from hilum to form main renal vein and their percentage incidences are recorded in Table 1.

The presence of single renal vein at hilum was found in 51 kidneys with the incidence of 70.8%. In 27 right kidneys, incidence of single renal vein was observed and calculated as 27/35= 77.14%. Comparatively, the incidence of single renal vein in the left kidneys was observed to be less, i.e. 24/37 = 64.8%

Further, we observed the presence of two tributaries of the renal vein that emerge from the hilum separately and subsequently unite to form a single renal vein outside of the hilum. An incidence of 18.91% (7/37) was detected in the left kidneys as compared to the incidence of 11.42% (4/35) in right kidneys. The total incidence is calculated as 11/72 = 15.27%.

However, a maximum of four tributaries of a renal vein were also observed with an incidence of 2.7% in the total number of kidneys (72). Furthermore, the incidence of four tributaries in right and left kidneys was calculated to 2.8% and 2.1% respectively.

Renal vein or its tributaries are not found as anterior most structures at hilum in 7/35 right kidneys with an incidence of 20% and in 11/37 left kidneys with incidence of 29.7%. In total, 18/72 kidneys with an incidence of 25% did not have renal vein or its tributaries as the anterior most structure. However, in these cases, renal artery or its branches were observed to be the anterior most structure.

Table 1: Number of venous tributaries emerging from hilum to form main renal vein and their percentage incidences

No of tributaries of vein	No of right kidneys	Incidence in %	No of left kidneys	Incidence in %	No of total kidneys	Incidence in %
2	4	11.42	7	18.91	11	15.27
3	3	8.5	5	13.51	08	11.11
4	1	2.8	1	2.1	2	2.7

Table 2: Incidence of single vein at hilum

No of right kidneys	Incidence	No of left kidneys	Incidence	No of total kidneys	Incidence
27	77.14%	24	64.8%	51	70.8%

Table 3: Incidence of renal vein or its tributaries not as most anterior structures

No of right kidneys	Incidence	No of left kidneys	Incidence	No of total kidneys	Incidence
7	20 %	11	29.7 %	18	25%

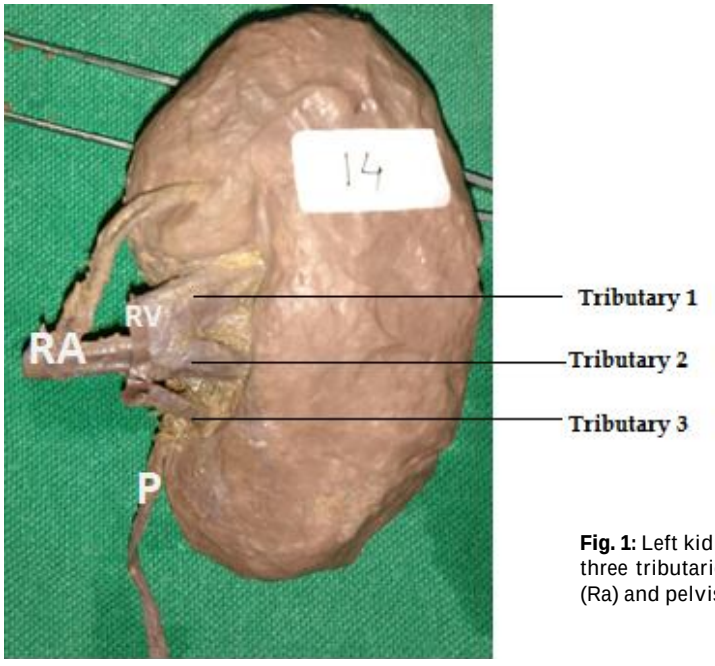

Fig. 1: Left kidney showing renal vein (Rv) formed by three tributaries emerging from hilum, Renal artery (Ra) and pelvis (P) of ureter

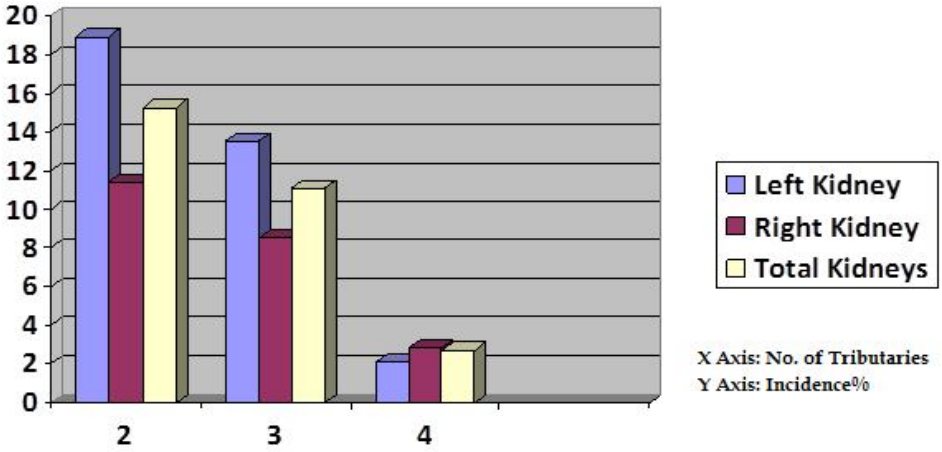

Fig. 2: Comparison of incidences in number of tributaries

Discussion

In this study, incidence of two or more tributaries emerging from hilum to form renal vein was (72-51)/72 =29.1%. Incidence in right kidneys is calculated as (35-27)/35 = 22.8%. Conversely, the incidence of the left kidneys is derived as (37-24)/37 = 35.1%.

The development of the renal veins is a complex process with multiple possible alternative patterns of formation. This is particularly true for the left side because of the communication of the left renal vein with the adrenal, gonadal, phrenic and hemiazygos veins. The anatomical features of the left renal vein (its longer course and complex embryogenesis) add to its complexity and results in sizeable number of clinically significant variations. A familiarity with such venous variations is the first step towards avoiding vascular injury during retroperitoneal procedures [8].

In the study by Satyapal on 306 kidneys, the classification of the drainage pattern of renal veins was done on the basis of the drainage pattern of primary tributaries of the renal vein on both sides (Classified as type IA). This group consisted of two primary tributaries only— an upper and a lower, and occurred in 118 (38.6%) of the 306 kidneys

The existence of more than two tributaries, i.e. upper, middle and lower is classified as type IIA. A maximum of five primary tributaries were identified. Type IIA was noted in 36 (11.8%) cases [9].

In this study, as per the classification type IA by Satyapal, the incidence of the presence of two divisions of the renal vein, which emerged from the hilum separately and united to form a single renal vein outside the hilum, was highest and noted in 15.27% kidneys. This incidence is much less compared to the incidence observedin the study by Satyapal.

Moreover, a maximum of four tributaries of renal vein emerging from the hilum and uniting to form a single renal vein were observed in our study, as compared to maximum five tributaries of renal veinnoted by Satyapal.

The classification type IIA was observed in (8+2/72=10/72=13.88% of kidneys. The incidence of more than two tributaries of main renal vein in our study is slightly more than that found in the study by Satyapal.

In another study, in 31% of the cases, anterior trunk of renal artery is the most anteriorly placed structure at the renal hilum [10].

In our study, in 25% of kidneys instead of renal vein or its tributary, renal artery or its branch was the anterior most structure in hilum.

Conclusion

Nephron sparing surgeries like partial nephrectomy by laparoscopic approach have become the treatment of choice. Such surgical interventions require hilar dissections which are technically more challenging in laparoscopic approach as compared to open surgeries [10].

The study of renal vasculature has become critically important in surgical planning of partial laparoscopic nephrectomies and in renal transplant [11].

Anatomical knowledge of distribution of structures in the renal hilum is important for various urological surgical procedures.

Surgical intervention which requires hilar dissection needs separate clamping of the vessels and renal pelvis which is preferred over en bloc mass stapling of renal hilum. A difficult hilar dissection may result in conversion of laparoscopic operation to an open procedure.

Consequently, the understanding of the anatomical variations in the number of tributaries emerging from hilum to form renal vein is crucial to improvise and successfully perform various renal surgeries.

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A Study on Morphological and Morphometric Features of Foramen Ovale

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Abstract

Background: The foramen ovale is present in spenoid bone which transmits the mandibular nerve, accessory meningeal artery, emissary vein and the lesser petrosal nerve. The most predominant location of foramen ovale is in the infratemporal surface of greater wing of the spenoid bone posterior and lateral to the foramen rotundum and lateral to the lingual and posterior end of the carotid groove. It lies close to the upper end of the posterior margin of the lateral pterygoid plate. The Foramen ovale is situated at the transition zone between intracranial and extracranial structures. Therefore, it is used in various surgical as well as diagnostic procedures. *Materials and Methods:* A total 350 skulls were used for this study. The skulls were collected with I MBBS student from different medical institutions in south India. The following measurements were recorded. Maximum length and width of foramen ovale was measured. Variation in right and left side and sex difference in length and width were calculated, the variations in shape also recorded. *Results*: The mean value of length of left foramen ovale is 9.5±1.92mm and right was 9.1±1.77mm. The maximum length was 12.1mm at left side and it was 11.9mm on right. The mean width was 4.1±0.92mm on right side and it was 3.9±1.01mm on left side. The shape of foramen ovale was ovale in 79% of skulls, almond in 18.28% of skulls and round was 2.57% of skulls. *Conclusion:* the findings of present study conclude that there is no significant difference between sizes of right and left side foramen ovale and found that between male and female foramen ovale sizes also not shown any significance difference. The knowledge of foramen ovale morphometric observations has practical significance to both neurosurgical and functional cranial neuroanatomy.

Keywords: Foramen Ovale; Foramen Rotendum; Base of Skull; Spenoid Bone.

Introduction

The cerebral surface of each greater wing of sphenoid bone forms part of the middle cranial fossa of the skull containing numerous foramina and fissures, which transmits several vessels and nerves. Foramen ovale is located in the posterior part of the greater wing of the spenoid bone for the passing of the mandibular nerve, the accessory meningeal artery, lesser petrosal nerve and an emissary vein. This foramen ovale is normally located in the greater wing of the spenoid bone and it is posteriolateral to the foramen rotundum and it opens into the infratemporal fossa through its other opening on the lateral surface of greater wing [1,2]. The emissary and middle meningeal vein which are transmits through foramen ovale connects cavernous sinus with pterygoid venous plexus [3]. There are some studies which indicates the abnormal morphology of the foramen ovale, such that it can be occasionally covered by ossified ligaments stretching between the lateral pterygoid process and the sphenoid spine [4,5,6] or its venous part may be compartmentalised by a bony spur located antero-medially resulting in doubled foramen ovale. Another study conducted has found foramen ovaleto be divided into 2 or 3 components in 4.5% of the 100 macerated skulls

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studied with some irregularities [1]. Regarding the developmental aspects of foramen ovale, it is situated at the posterior border of greater wing of sphenoid.

The sphenoid bone has both intramembranous and endochondral ossification centres and it consists of the body, the paired lesser wings, and the greater wings. The basisphenoid is derived mainly from presphenoid and postsphenoid centres. The postsphenoid centre is the one which is associated with the development of the greater wing of sphenoid. The first ossification centre appears for alisphenoids and its large portion forms the greater wing of sphenoid by membranous ossification. The mandibular nerve becomes surrounded by cartilage to form the foramen ovale. At 7th foetal month, the foramen ovale can be seen as discrete ring shaped opening in the area of unossified cartilage that can be well recognised 3 years after birth at the latest [7]. The mean length of the foramen ovale is about 3.85 mm in the newborn and about 7.2 mm in adults and its width extends from 1.81mm in the newborn to 3.7 mm in case of adults [8,9].

Information on various foramina of the humanskull gives insight into associations betweenneurovascular anatomy and the cranial morphology. The sphenoid bone, because of its complex structure and intricate embryological origin, should be studied in different anatomical aspects, including its normal and abnormal variation. Foramen ovale is used for various invasive surgical as well as diagnostic procedures such as electroencephalographic analysis of the seizure for patients undergoingselective amygdalohipp-ocampectomy [10], microvascular decompression by percutaneous trigeminal rhizotomy for trigeminal neuralgia[11] and percutaneous biopsy of cavernoussinus tumours [12]. The technique of CT-guided transfacial fine needle aspiration technique through the foramen ovale is used to diagnose squamous cell carcinoma, meningioma, meckeland allows biopsy of deep lesions that would otherwise require craniotomy or open surgical biopsy [13,14]. The present study was conducted to observe the morphometric and morphological features of foramen ovale.

Materials and Methods

A total 350 skulls were used for this study. Theskulls were collected with I MBBS student fromdifferent medical colleges in south India. Skullsin poor conditions or skulls with partly damagedsurroundings of the foramen ovale were notconsidered. Maximum length (Anteroioposterio-diameter) and width (transverse diameter) offoramen ovale were measured with help of Vernier calliper's scale. Variation in right and leftside and sex difference in length and width werecalculated, the variations in shape also recorded.

Results

The mean length of formenovale on left side it was 9.5±1.92mm and 9.1±1.77mm was on right side. The mean length of formenovale in female skulls it was 9.2±1.42mm and 9.3±1.93mm was in male skulls(Table 1). The mean width of formenovale on left side it was 3.9±1.01mm and 4.1±0.92mm was on right side. The mean width of formenovale in female skulls it was 4.12±0.69mm and 3.85±1.09mm was in male skulls (Table 2). The shape of foramen ovale was ovale in 79.2% skulls, almond was 18.28% and 2.5% skulls were round (Table 3). The was no significant difference between any parameter.

Table 1: Length and width of bforamen ovale.

Dimensionsof values	Foramen ovale length(left) mm	Foramen ovalelength(right) mm	Foramen ovale width (left) mm	Foramen ovale width (right) mm
Maximum	12.1	11.9	5.4	5.9
Minimum	6.3	6.1	2.2	1.9
Mean ±SD	9.5±1.92	9.1±1.77	3.9±1.01	4.1±0.92
P- value	P>0.05		P>0.05	

Table 2: Sex deference in Length and width of foramen Ovale

Dimensionsof values	Foramen ovale length female (mm)	Foramen ovalelength male (mm)	Foramen ovale width Female (mm)	Foramen ovale width male (mm)
Maximum	12.1	11.9	5.9	5.4
Minimum	6.1	6.3	2.2	1.9
Mean ±SD	9.2±1.42	9.3±1.93	4.12±0.69	3.85±1.09
P- value	P>0.05		P>0.05	

Table 3: Shapes of foramen ovale

Shape	Right	Left	Total
Ovale	265(75.71%)	289(82.57%)	554(79.1%)
Almond	72(20.5%)	56(16%)	128(18.28%)
Round	13(3.71%)	5(1.42%)	18(2.57%)

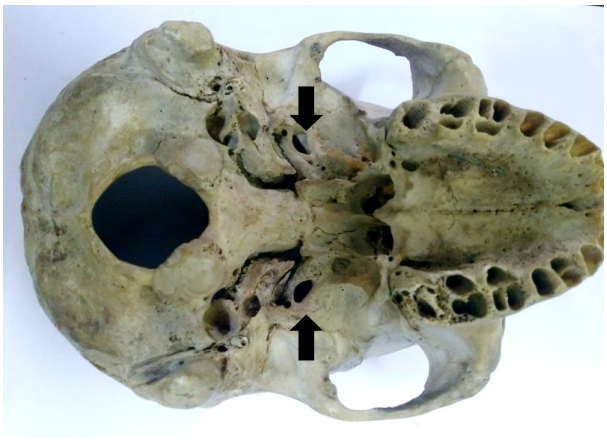

Fig. 1: Showing base of skull with foramen ovale

Discussion

There are several foramina piercing the greater wingof the human sphenoid bone and one amongst them is the foramen ovale. Foramen ovale is present medial to the foramen spinosum and foramen lacerum is locatedmedial to the foramen ovale. It transmits the mandibulardivision of the trigeminal nerve, accessory meningeal branch of the maxillary artery, lesser petrosal nerve andan emissary vein which connects the pterygoid venousplexus in the infratemporal fossa to the cavernous sinus. Foramen ovale is situated at the transition zone between the extra cranial and the intracranial structures [15,16,17].

In our present study the mean length of left foramen ovale is 9.5±1.92 mm and right was 9.1±1.7 7mm. In female it was 9.2±1.42 mm and male was 9.3+1.93 mm. The study of Biswabina Ray et alconducted on a total of 70 sides in 35 dry adult skulls in their study the mean length of foramenovale was 7.46±1.41 mm on right side 7.01±1.41 mm on left side. Mean length of foramen ovalein male was 7.27±1.39 mm and in female was 7.16±1.51 mm. Maximum and minimum length observed was 10.2 mm, 5.1 mm and 10.4 mm, 4.9 mm on right and left sides respectively. Maximum length in male was in 10.4 mm. and in female was 10.2mm. and minimum length was 5 mm in male and 4.9mm was in female skulls [14], this study results are in agreement with present study. Yanagi Sdevelopmental study conducted in Japan anaverage maximal length of foramen ovale was 7.48 mm and average minimal length was 4.17 mm [7]. In study of Lang J the average length of forminaovale was 7.2mm [9]. In Landl MK study reported 6.9mmon right side and 6.8mm on left side with rangelength 5.0- 10.0mm [18]. In an Indian study of Somesh et al mean length of foramen ovale was 7.64 ± 1.194 mm on the right and 7.561 ± 1.123 mm on the left side[19]. In same study of Somesh et al found that the maximal length of foramen ovale was 11 mm and its minimal length was 4.5 mm[19]. In study of Arun the maximum length was 9.8 mmand 2.9 mm was minimum [20]. In study of Osunwoke et al. it was 9.5 mm maximum and minimum was 5.0 mm [21]. The study of Gupta N was similar with the results ofour study which was conducted on 35 dry adult skulls. Their study revealed that the mean length of foramen ovale was 7.228±1.39 mm on right side and 6.48±1.131mm on left side. On left side, mean width was 3.50±0.75 mm and on right side was 3.57±0.70mm [22]. These studies are in agreement with present study.

In present study the mean value of width of right foramen ovale is 4.1+0.92mm and left was 3.9+1.01 mm. In female it was 4.12+0.69 mm and male was 3.85+1.09 mm. The maximum width of foramen ovale was 5.9 mm and minim was 1.9 mm. The study Biswabina Ray et al also reported similar results, in their maximum width of foramen ovale was 5.0 mm on both right and left sides while minimum width was 1.0 mm on right side and 2.2mm on left side. Mean width on right side was 3.21+1.02 mm and 3.29+0.85 mm on left side[14]. In Lang J study the average width was 3.7mm. In Landl MK study reported the average width on right side was 3.4mm and 3. 8mm. In our study the shape of foramen ovale was ovale in 69% of skulls, almond in 29% of skulls and round was 2% of skulls. Biswabina Ray et al study also reported similar results that maximum number of foramen to be ovale shaped 61.4% almond shaped 34.3%, round was 2.9% and slit like was 2.9% [14]. Yanagi et al study also reported similar results [7]. Foramen ovale is considered to be one of the vital foramina situated between intracranial and extra

cranialstructures across transition zone. Its application in thefield of invasive surgery and in diagnostic procedure isunparalleled. Thus, the knowledge of morphometric andmorphology of foramen ovale is essential for surgeons.

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Inheritance of Finger Print Patterns among Medical Students: A Study

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Abstract

Dermatoglyphics deals with study of ridge pattern which includes finger prints, foot prints lip prints etc. Finger prints proved their uniqueness in identification. Studies indicate that similar trends in finger prints run in families. Major patterns of finger prints show inheritance. This paper deals with relationship between major finger print patterns among parents and off spring.

Keywords: Finger Prints; Arches; Loops; Whorls.

Introduction

Human beings are highly developed mammals and are unique in animal kingdom. Like any other living being, each human differs from others (Quetelets law) [1]. No two finger prints match even in homozygous twins.

Identification of an individual by finger prints was first done in India in 1858 by Sir William Herschel to prevent impersonation. Later, Sir Francis Galton systematized it for identification of criminals, which was officially adopted in England in 1894 and was further modified by Sir Edward Henry [2]; hence called Galton system or Henry-Galton system.

Identification of individuals by finger print pattern started at the beginning of 20th century and reached its peak by the beginning of 21st century. It is said that if all the finger print cards in F.B.I. were to be pilled one over the other, they would probably equal to one hundred thirty three times the height of empire state Building [3].

Since then various studies were conducted to study the inheritance of finger prints among family members.

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Anatomy

The pattern of finger print ridges and pores is different in each person. No two people have same pattern of ridges. While it seems that the general pattern of friction ridges may be genetic, the specific pattern or fine detail is unique.

Most human skin is smooth and contains hair follicles and oil glands. The digit, palm and sole areas, however devoid of either, but instead have sweat pores and friction ridges that take various forms and shapes. The function of the friction ridges is to increase grip and the sense of touch. The study of friction ridge patterns is known as *dermatoglyphics*.

Development of primary ridges is a random process. It is dictated by the overall geometry and topography of the volar pad. If the primary ridges appear while the volar pad is still quite pronounced, the individual will develop a whorl pattern. If the primary ridges appear while the volar pad is less pronounced, the individual will develop a loop pattern. Finally, if the primary ridges appear while the volar pad is nearly absorbed, the individual will develop an arch pattern. The timing of these events is genetically linked [4].

Even for identical twins this is true: they may have similar general patterns but the fine details or

'*minutiae*' are different. The development of minutiae is a result of the environment and external stresses and pressures while they are in the womb [5].

This inspired, to take up this study on relationship between finger print pattern of individuals and their parents.

Materials and Methods

The materials used for this were.

1. Ink pad (Black / Blue color)
2. Printed pro forma
3. Consent form
4. Magnifying glass with light source.

Subjects were chosen from medical students studying in Narayana Medical College, Nellore and their parents residing in state of Andhra Pradesh. The procedure and the purpose of examination were explained to them and consent was obtained. Troublesome procedure of using glass plate smudged with printer black ink was avoided as prints from the parents have to be obtained from the houses of students all over the state.

Collection of the Prints

The subjects were asked to wash their hands to remove dust and grease. Ink pad is used to smudge their fingers with ink. Then the smudged fingers were applied carefully in the respective spaces in the pro forma. Only plain prints are obtained. No roll prints are used.

Prints of all the ten digits were taken, and those of only four fingers, namely left index finger, left thumb, right index finger and right thumb are used for the study purpose. These four fingers are chosen because thumb print is the commonly used one for identification and the index finger commonly used in biometrics.

The finger prints thus obtained were categorized into various patterns like loops, whorls, arches and composites.

This study has the approval of institutional ethical committee.

Observations and Results

Plain finger prints of 60 medical students (30 girls + 30 boys) and their parents (60+60) were obtained with informed consent. The finger prints of right thumb, right index finger left thumb and left index finger were acquired in the printed pro forma.

A total 720 finger prints thus obtained, [four finger prints acquired from 180 individuals (60 students + 120 parents)] were categorized into four primary ridge patterns namely loops, whorls, arches and composites. This categorization was done by three different individuals to avoid observer errors.

The results thus obtained were fed into computer and the statistical data is analyzed.

Initially the data of various Primary ridge patterns like loops, whorls, arches and composites are analyzed to see whether the distribution of finger print ridge patterns in the study subjects is correlating with that of other studies or there is any geographical variations.

- Finger print patterns of 30 male and 30 female medical students of Narayana Medical College, Nellore, Andhra Pradesh and their parents. (Total 180 subjects) was studied.
- All the students (voluntarily) participated are within the age group of 18-25.

Discussion

When each finger print pattern is analyzed, Table 1 indicates the major ridge pattern of left index finger of the medical students is correlating statistically significantly with the pattern of finger print of his / her father (P value 0.000), where as they are not correlating with that of his / her mother (P value 0.124) statistically.

Table 2 also indicates that the finger print pattern of left thumb of medical students significantly correlative with that of their father (P value 0.000), where as there is no correlation with that of their mothers (P value 0.209) statistically.

Table 3 also indicates that the finger print patterns of right index finger of medical students are significantly correlating with that of their father (P value 0.038) where as there is no correlation with that of their mothers (P value 0.621) statistically.

Table 4 indicates that the finger print pattern of right thumb shows correlation with that of both parents [(P value 0.000: P value 0.029) Father: Mother) But there is statistically more correlation with that of father than the mother (significantly low P value).

Table 1: Showing relationship between left index finger of student with his/her parents

		FLI			Total	P value
SLI	**A**	**C**	**L**	**W**		
A	1	0	3	2	6	**0.000**
C	0	1	0	0	1	
L	5	1	17	9	32	
W	0	0	11	10	21	
Total	6	2	31	21	60	
		MLI				
SLI	A	C	L	W		
A	1	1	3	1	6	**0.124**
C	0	0	1	0	1	
L	4	0	22	6	32	
W	2	0	10	9	21	
Total	7	1	36	16	60	

Table 2: Showing relationship between left thumb of student with his/her parents

		FLT			Total	P value
SLT	C	L	W	*A		
A	0	3	0	-	3	**0.000**
C	3	2	1	-	6	
L	2	28	8	-	38	
W	0	5	8	-	13	
Total	5	38	17	-	60	
		MLT				
SLT	A	C	L	W		
A	1	0	1	1	3	**0.209**
C	0	1	3	2	6	
L	3	1	29	5	38	
W	0	1	7	5	13	
Total	4	3	40	13	60	

* No Arches for comparison in SLT Vs FLT

Table 3: Showing relationship between right index finger of student with his/her parents

		FRI			Total	P value
SRI	**A**	**L**	**W**	***C**		
A	2	1	1	-	4	0.038
L	4	25	10	-	39	
W	1	7	9	-	17	
Total	7	33	20	-	60	
		MRI				
SRI	A	C	L	W		
A	0	0	2	2	4	0.621
L	2	2	27	8	39	
W	1	0	9	7	17	
Total	3	2	38	17	60	

Table 4: Showing relationship between right thumb of student with his/her parents

		FRT			Total	P value
SRT	A	C	L	W		
A	0	0	2	2	4	0.000
C	0	2	1	0	3	
L	1	0	26	10	37	
W	0	0	2	14	16	
Total	1	2	31	26	60	
		MRT				
SRT	A	C	L	W		
A	2	0	2	0	4	0.029
C	0	1	2	0	3	
L	3	1	26	7	37	
W	1	0	10	5	16	
Total	6	2	40	12	60	

Abbrevations

A	-	Arches
C	-	Composites
L	-	Loops
W	-	Whorls
SLI	-	Student Left Index
SRI	-	Student Right Index
FLI	-	Father Left Index
FRI	-	Father Right Index
MLI	-	Mother Left Index
MRI	-	Mother Right Index
SLT	-	Student Left Thumb
SRT	-	Student Right Thumb
FLT	-	Father Left Thumb
FRT	-	Father Right Thumb
MLT	-	Mother Left Thumb
MRT	-	Mother Right Thumb

Thus the tables 1 to 4 reveal the correlation between finger print patterns of medical students and their parents (father) in this study, indicative of inheritance property of finger print pattern.

Wilder's early studies on twins broaden the evidence of inheritance and he added to the literature two family trees demonstrating the transmission of patterns, one family represented by six children, their parents, and three sisters of the father illustrates the transmission of patterns of the thenar eminence of the palm in this family Both hands of the father carry prominent thenar pattern which are there in the three sisters bilaterally. Out of six children four of them have similar thenar pattern bilaterally and rest of the two have unilaterally, while their mother has no similar thenar pattern in both hands.

In the other family studied by Wilder, several members of the family present a rare calcar pattern. This particular pattern occurs in no more than 1% of individuals of the general population. Interestingly in this family the calcar patterns or their rudiments appeared in seven out of twelve examined [6].

In the family group considered by Cevidalli composing of six individuals of three generations showed inheritance of the palmar hypothenar pattern in its unusual form as a whorl. This hypothenar pattern was present in two siblings, their father and paternal grandmother.

Carriere recorded a Lapp family in which the members showed varying degrees of reduction of palmar main line C, occurring in such frequency in this family to indicate that the condition is hereditary.

Essen- Moller investigated the presence or absence of whorls in twins. Counting on those instances in which both members of twins have no whorls or both have whorls, he reports that the frequency of occurrence of whorls in diazygotic twins is 65.8% in comparison with monozygotic twins where it is as high as 85.7% [7].

Bohmer and Harren studying 100 families with 436 children, emphasize the extreme variability of pattern type among siblings. This variability, they observe, indicates that pattern type is not inherited, but their comments and their tabulated data actually shows hereditary transmission. Their observation on whorl demonstrate, in keeping with the conclusion of most other authors, that in spite of obscurity of the genetic process there is a definite hereditary tendency in the expression of whorl patterns [8].

Elderson, continuing attention to patterns of the index finger and considering rights and lefts separately tabulates the parental combinations and patterns in offspring (about 650 children) and observes that Neither, Arch x Arch nor Arch x composite, yields whorls.

Neither, whorl x whorl nor whorl x composite, yields arches.

a. Arch x loop, Arch x whorl, whorl x loop, composite x loops and loop x loop produces all types of patterns.

b. Possibly, composite x composite – No arches [9].

H M Slatis et al conducted study on the finger print patters of 571 isolated individuals in an Israel community (formerly lived in and around Habban) and proposed a gene theory of finger print inheritance [10].

According to Glenn Langenburg evidence from the finger prints of identical twins who share the same DNA having similar size, shape and pattern type in finger prints shows their inheritable quality [9].

The present study reveals the inheritance property of finger prints as all the four fingers included in the study show correlation with his/ her father (one of the parents). P value less then 0.05, clearly indicating the inheritance properties of finger print patterns.

Summary and Conclusions

The aim of this study is to determine whether there is any correlation between the finger print patterns of an individual and those of his / her parents.

The above aim was accomplished by studying finger print patterns of 30 male and 30 female medical students of Narayana Medical College, Nellore, Andhra Pradesh and their parents. (Total 180 subjects). All the students (voluntarily) participated are within the age group of 18-25 years. This study has the approval of institutional ethical committee Narayana Medical College, Nellore.

The finger prints thus obtained were categorized into various types like loops, whorls, arches and composites. The data thus obtained was fed into computer by using Microsoft Excel and was statistically analyzed.

The analysis of the data revealed the finger print patterns of medical students both males and females showing statistically significant correlation with that of his / her father in respect to all the four fingers studied i.e. left index, left thumb, right index and right thumb. (P value less than 0.05).

The finger print pattern of right thumbs of medical students both males and females also showed statistically significant correlation with that of his / her mother. (P value less than 0.05).

Thus this study shows inheritance property of major ridge pattern of finger prints, as there is statistically significant correlation between the finger print patterns of medical students with parents (either father or mother).

Limitations and Recommendations

This study has its own limitations and can suggest the following recommendations.

The limitations of this particular study include;

1. Small sample size - only sixty medical students and their parents were included. The sample is limited due to difficulty in obtaining finger prints from parents, single / both (non availability / refusal of either or both parent etc.).
2. Study group restricted to a small geographical area, the state of Andhra Pradesh.

With this known limitations the following recommendations are made.

1. Study group should include a large sample.
2. This study indicates strong inheritance traits in the *dermatoglyphics* [all the four finger print patterns under consideration shows similarities with either parent (father)]. Further studies are recommended involving larger number families for conclusive outcomes.

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Original Article

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Variations in the Branching Pattern of Coronary Arteries: A Cadaveric Study

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Abstract

Introduction: Heart is supplied by both right and left coronary arteries. A good knowledge of coronary artery branching pattern and their abnormal branching pattern that occur during fetal development is essential for clinicians. They are associated with high incidence of morbidity and mortality due to congenital heart diseases. Failure to recognize them can lead to inadequate or prolonged procedures and may also lead to misdiagnosis and complications such as accidental ligation. *Aim:* To find out the incidence of any anomalous coronary branching pattern. *Materials& Methods*: Properly embalmed and stored 50 human heart specimenswere chosen for the present study. They were manually dissected to study the course and distribution of coronary arteries. The study was carried out in dissection hall, Department of Anatomy, Rajah Muthaiah Medial College and Hospital (RMMC & H), Annamalai University, Chidambaram, Tamil Nadu, India. *Results:* We found that 48 (96%) heart specimens had normal coronary branching pattern and two (4.0%) anomalous coronary branching patternsout of 50 heart specimens. They are abnormal circumflex artery from posterior aortic sinus and arteriaanastomoticainfundibularis magna, an abnormal communication between anterior interventricular artery and right coronary artery. *Conclusion:* The knowledge about the abnormal branching pattern of coronary arteries will be useful to the cardiac surgeons to improve the knowledge of defects of coronary arteries and planning of angiography, coronary by bypass grafting and other surgical interventions, radiologists for refining interpretation of imagery and anatomists for teaching both undergraduates and post graduates.

Keywords: Coronary Artery; Left Coronary Artery; Right Coronary Artery; Coronary Artery Anomalies; Circumflex Artery.

Introduction

Cardiovascular diseases (CVDs), especially coronary heart disease (CHD), are the leading cause of death all over the world. An estimated 17.5 million people died from CVDs in 2012, representing 31% of all global deaths. Out of this, an estimated 7.4 million deaths were due to coronary heart disease[1]. CVDs are reached epidemic proportionand have now become the leading cause of mortality in India. The Global Burden of Disease study estimate of age-standardized CVD death rate of 272 per 100,000 population in India is higher than the global average of 235 per 100,000 population [2]. The heart is supplied by the right and left coronary arteries namely right coronary artery (RCA) and left coronary artery (LCA). These arteries encircle the base of the ventricles like a crown [3]. The RCA supplies whole of right atrium, most of the right ventricle except a strip along the anterior interventricular groove, postro-inferior one third of ventricular septum and sinoatrial (SA) node and atrioventricular (AV) node [4]. The LCA supplies most of the left atrium and left ventricle except a strip along the posterior and inferior surfaces of the heart and also supplies antero-superior two third of the ventricular septum [4].

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Coronary artery development is a delicate, complex, and finely tuned process that includes multiple interactions among many pathways, especially in the pericardium and the developing myocardium[5]. For instance, coronary arteries are derived from endothelial buds from the truncus arteriosus on the 14th day of intra uterine life. The coronary arteries once established, mature rapidly and the larger branches comes near the surface of the heart, whereas smaller branches ramify into rich capillary beds terminating into the developing muscle fibers. Some of the small arteries make connections with the endothelium based spaces that persist among the trabecula after flattering of the early mesh work. The minute intramural vessels potentially connect to the ventricular cavities from epicardial coronary arteries. In the thick walled neonatal heart right and left ventricular branches from the extra mural coronary arteries enter the myocardium. It is very important to identify the causes of anomalous coronary development, as the coronary arteries may present with many anomalies that occur during fetal development. There are different patterns of anomalous coronary arteries, with variable risk of myocardial ischaemia, malignant arrhythmias, and sudden cardiac death.

It is recommended that angiographic recognition of anomalous coronary arteries is very essential before undertaking any cardiac surgery. Failure to recognize them can lead to inadequate or prolonged procedures and may also lead to misdiagnosis and complications such as accidental ligation [6]. An inadvertent incision of the anomalous artery or failure to perfuse the anomalous vessel during cardiopulmonary bypass may result in acute myocardial infarction (AMI) [7,8]. Therefore, our aim is to find out the incidence of any anomalous coronary branching pattern in our study population of 50 heart specimens.

Materials and Methods

The study of coronary arteries regarding its course and distribution was carried out in dissection hall, Department of Anatomy, Rajah Muthaiah Medial College and Hospital (RMMC & H), Annamalai University, Chidambaram, Tamil Nadu, India, with 50 heart specimens in the age group of 20–65 years from August 2010 to July 2013. The vital organ, heart is located in the thoracic cavity. A transverse incision was made through the manubrium sternum to expose underneath parts. Another incision was made through the parietal pleura in the first intercostal space extending from the lateral sternal border up to the left mid-axillary line. From the ends of the line the second and subsequent ribs were divided inferiorly up to the level of xiphisternal joint.

The lower part of the sternum and the costal cartilage and anterior parts of the ribs were elevated. The parietal pleura extending from back of sternum up to the mediastinum on both sides were divided. The upper part of the sternum was lifted up by dividing the sternopericardial ligaments. The fibrous pericardium was separated from the adjoining structure by dividing the fibrous pericardium. The heart was exposed and delivered out of middle mediastinum by cutting branches of Arch of Aorta, superior and inferior vena cava, pulmonary artery and veins. After the removal of heart specimens from the thoracic cavity, they were preserved in 10% formalin solution for one week. After adequate fixation, the manual dissection was carried out on the hearts.

The visceral pericardium from the sternocostal of the heart was removed. The anterior interventricular branch of the LCA and the great cardiac vein were exposed by scraping the fat from the anterior interventricular sulcus. The branches of the artery to both ventricles and to the interventricular septum which lies deep to it were noted. The artery inferiorly was traced to the diaphragmatic surface and superiorly to the left of the pulmonary trunk. The fat from the coronary sulcus was carefully removed and avoided to prevent any damage to the small anterior cardiac vein crossing from the right ventricle to enter the right atrium directly. The right coronary artery was found in the depth of the sulcus. The course of the artery was traced superiorly to its origin from the right aortic sinus (a swelling at the root of the ascending aorta deep to the right auricle) and inferiorly till it turned on to the posterior surface of the heart. The branches to the right ventricle and atrium were noted. For statistical analysis, the data are expressed as percentage.

Results

We selected 50 heart specimens and we approached with manual dissection method. We found that 48 (96%) heart specimens had normal coronary branching pattern out of 50 heart specimens. Interestingly, we found two (4.0%) anomalous coronary branching patterns with two of the heart specimens. Figure 1, 2, 3 and 4 show

normal coronary branching patterns while figure 5 and 6show the abnormal coronary branching pattern. Out of the two abnormal coronary branching patterns, one is abnormal circumflex artery from posterior aortic sinus which we have reported here while the other one is arteriaanastomoticainfundibularis magna,an abnormal communication between anterior interventricular artery and right coronary artery which was earlier published by us [9].

The RCA arose from the anterior aortic sinus, the artery passed at first anteriorly and slightly to the right between the right auricle and pulmonary trunk. Reaching the atrioventricular (coronary) sulcus, it descended in almost vertically to the right cardiac border, curving around it into the posterior part of the sulcus, where it approached its junction with both interatrial and interventricular grooves, a region appropriately termed the crux of the heart. Branches of the RCA supplied both right atrium and ventricle and, variably, parts of the left chambers and atrioventricular septum. The first branch was the conus artery and it ramified anteriorly on the lowest part of the pulmonary conus and upper part of right ventricle.

Anterior atrial and ventricular rami diverged from the first segment of the right coronary, extending from its origin to the right margin of the heart. The right anterior ventricular rami, ramified towards the cardiac apex. As the RCA approached the crux, it gave off posterior interventricular rami but only one in the interventricular sulcus; this was described as the posterior interventricular artery. The atrial rami of the RCA were described as anterior, lateral (right or marginal) and posterior groups.

LCA arose from the left posterior aortic sinus. In its course, it was found between the pulmonary trunk and the left auricle emerging to reach the atrioventricular sulcus, in which it turned to the left. It reached the coronary sulcus and divided into 3 main branches of which the anterior interventricular (descending) ramus is commonly described as the continuation of LCA. It reached the apex of the heart and turned in to the post (inferior) interventricular sulcus to meet the branches of RCA. This artery had anteriorseptal and anteriorventricular rami, anterior diagonal branch and conus branch.

LCA was found larger than RCA in all cases and was found supplying a major part of myocardium and most of the interventricular septum. During its course, it was found between the pulmonary trunk and the left auricle to reach the atrioventricular sulcus and turned to the left. It was traced to the apex of the heart and was found turning in to the post interventricular sulcus to meet the branches of RCA. The left anterior ventricular artery was found arose from LCA and by trifurcation to give off left diagonal artery. Circumflex artery was found running in the atrioventricular sulcus and curved around to end a little to the left of the posterior of the crux.The left marginal artery was found arising perpendicularly from the circumflex artery and anterior ventricular branches were found arising parallel to the diagonal artery. Atrial rami werealso found arising from the circumflex artery (Fig 1, 2, 3 & 4].

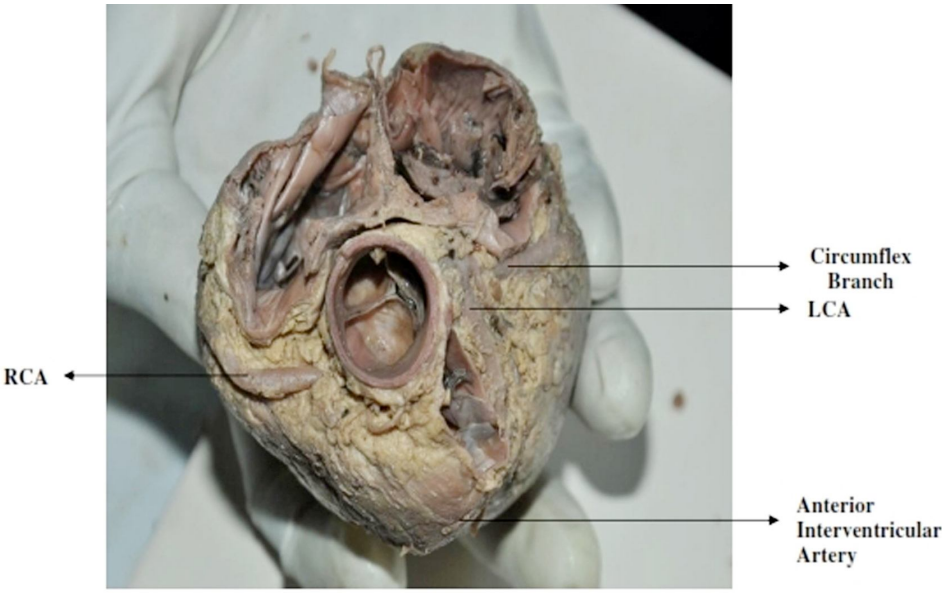

Fig. 1: Showing superior view of coronary arteries commencement

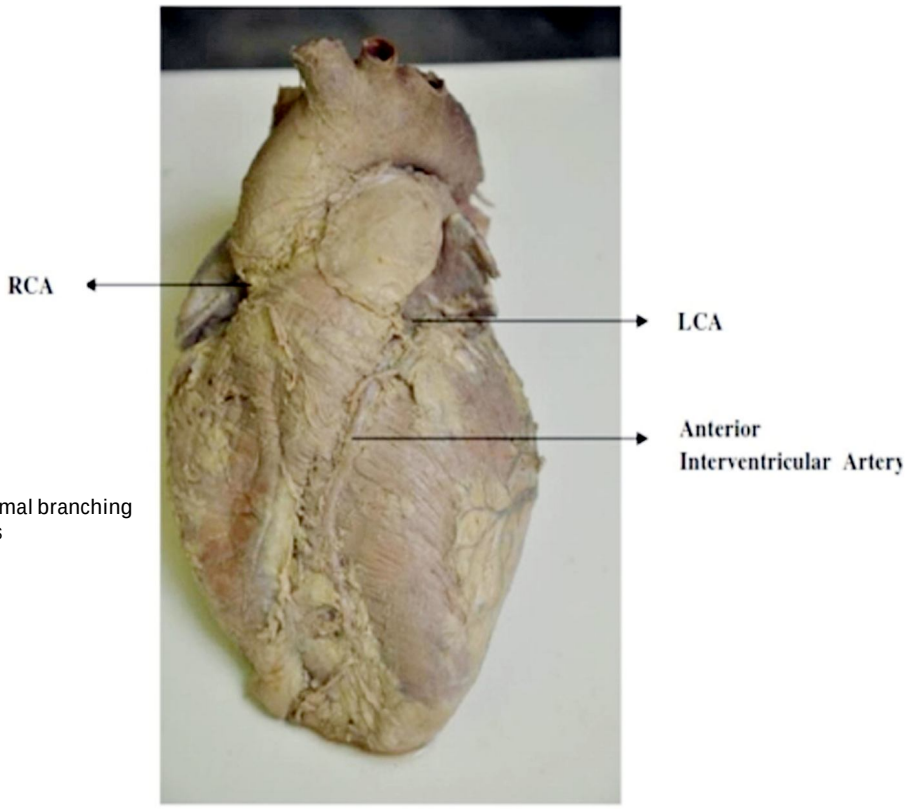

Fig. 2: Showing normal branching of coronary arteries

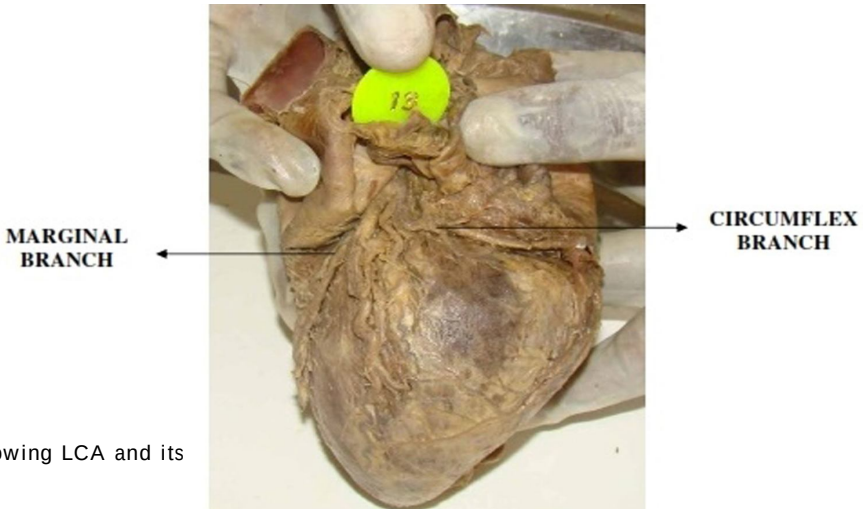

Fig. 3: Showing LCA and its branches

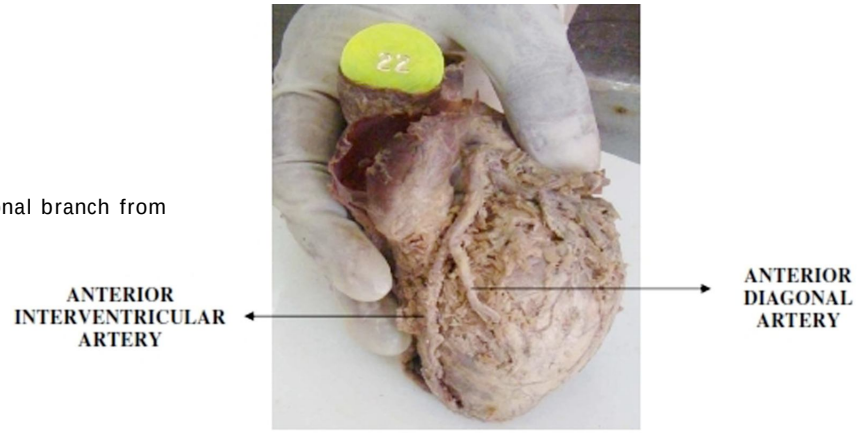

Fig. 4: Showing anterior diagonal branch from anterior interventicular artery

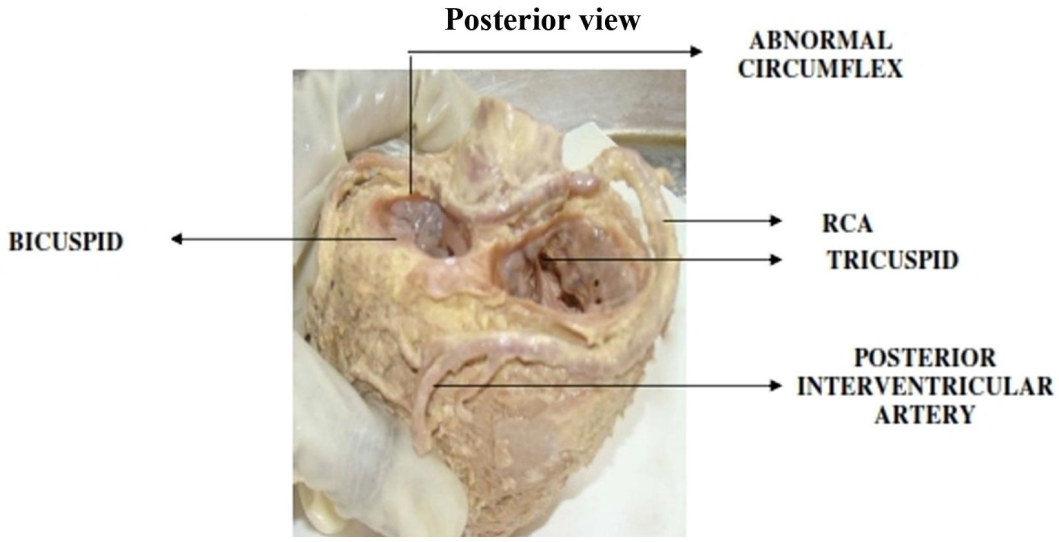

Fig. 5: Showing abnormal circumflex from right posterior aortic sinus both atrium is removed

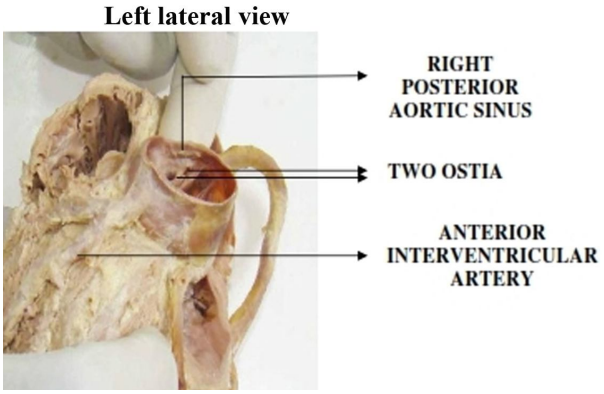

Fig. 6: Showing two ostia are observed in right posterior aortic sinus one for RCA other for abnormal circumflex

As far as the abnormal branching pattern of coronary artery was concerned, we observed an abnormal circumflex artery, found arising from the right posterior aortic sinus by a separate ostium. Then it wound round the posterior aspect of ascending aorta and reached to the left side of it and then ran in the left atrioventricular sulcus, towards the left border of the heart. AV nodal branch arose from it, one centimeter from its commencement and after reaching the left border, it was found giving off left marginal, left atrial and ventricular branches.

The RCA in this specimen was found arising from the same right posterior aortic sinus, from where the abnormal circumflex artery originated. It ran in the atrioventricular sulcus to the right border. It was found giving off the right marginal branch and then approached the posterior aspect of right atrioventricuolarsulcus. Here it was found giving off atrial and ventricular branches and posterior interventricular branch. Then it was found crossing the crux of the heart, where it gave left atrial and ventricular branches (Fig. 5&6).

Discussion

Various patterns of coronary arteries are essential for the clinicians and surgeons.The coronary circulation was studied by many anatomists by manual dissection method and other special methods like injecting contrast dye into the vessels then analysed the X ray picture taken after the dye injection. They found out the normal and abnormal patterns of coronary arteries. And they also correlated the above views with developmental anomalies of the heart. Most of them reported that RCA arose from the anterior aortic sinus of the ascending aorta and passes forward and to the right between the pulmonary trunk and right auricle along the right part of the atrioventricular sulcus and LCA was found arising in majority of cases from left posterior aortic sinus and in some cases from the pulmonary trunk or from pulmonary artery and found that LCA arising from the anterior sinus instead of left posterior aortic sinus. In some cases they found that LCA arising from anterior aortic sinus along with RCA. Our findings are in confirming with most of the previous studies [10,11]

Coronary artery anomalies (CAAs) are a groupofcongenitaldisorders. They aredefinedas variantsofthenormalcoronaryartery[12].The incidence of coronary artery anomalies is approximately 1% among patients undergoing cardiac catheterization[13].The anomalous coronary

arteries are associated with high incidence of congenital heart diseases and some anatomic presentations of coronary anomalies are considered to be high-risk groups. However, mostofthe coronaryanomaliesareasymptomaticand benign but may cause myocardial ischaemia and sudden death. Some of them are fatal if they are associated with other heart diseases [14,15,16]. Majority of people (90%) possesses right coronary dominance, where the posterior interventricular artery is large and arises from RCA. Minority of population (10%) has left coronary dominance, where the posterior interventricular artery is a branch of left coronary artery [17,18]. These peoples are likely to be affected by coronary artery diseases because the entire left ventricle and the interventricular septum are under the nutritional control of LCA. Any obstructionin the LCA may produce output failure of systemic circulation.The technique of selective coronary arteriographyprovides accurate visualization of the artery and its pathology. The recent development of electrocardiographically (ECG)-gated multi-detector row computed tomography (Cardiac CT) allows accurate and noninvasive depiction of coronary artery pathology. A sound knowledge of normal anatomy of the coronary arteries and their variations is therefore absolutely necessary for interpretation of angiography, ECG-gated multi-detector row CT findings and good plan of coronary artery surgery.

The most common coronary branching pattern is the anomalous left circumflex artery and this anomaly arises from a separate ostium within the right sinus, or a very unusual as a proximal branch of the RCA [19,20]. The circumflex artery from the right coronary sinus is among the most common variations and usually is not associated with major complications. However, during surgical interventions, these anomalous coronaries can result in significant complications. Especially, aortic valve operations and valve sparing aortic root remodeling or replacement procedures can be complicated by obstructions of the ectopic coronary ostium or the proximal course near the annulus [21].

Conclusion

Like most other organs, the heart also presents with many variation regarding coronary artery branching pattern. In the present study, we observed normal branching pattern of both right and left coronary arteries, except in two hearts. The present study showed an important and rare occurrence ofan anomalous circumflex artery from posterior aortic sinus. As the left coronary artery is one of the main arteries supplying the heart, a sound knowledge of the variations in its branching pattern is indispensable for the diagnosis and treatment of patients with coronary artery disease.

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Evalution of Placental Grading in Normal and Pregnancy Induced Hypertensive Mothers by Sonological Method; Predicts Neonatal Outcome

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Abstract

Background & Aim: The placenta is essential to fetal well being, growth and development. Ultrasonographic method is the best assessment method for placental evolution throughout antenatal care. Conventional 2D ultrasound has been widely used to study the evolution of placenta during pregnancy. This 2D evolution includes the assessment of the morphology and anatomy of the placenta, identification of its location and placental grading. Grannum. et al.(1979) devised systemic classification of ultrasonographic morphology of placenta based on the changes in the chorionic plate,placental substance and the basal layer, the three separate zones of placenta. *Material & Methods:* The present prospective comparative study is carried out on total 120 cases (59 Normal and 61 Hypertensive mothers) attending the department of Obstetrics and Gynecology and radio diagnosis at padmshri. Dr. D.Y Patil medical research center, Kolhapur. Patients were scanned using Mindray DC-7 real time USG machine with a sector array 3.5 MHz frequency transducers. Patients were asked to maintain a full bladder, for obtaining a better window for USG examination. Scanning Technique- With patient in supine position, jelley was applied over the abdomen and examination was carried out. Multiple longitudinal and transverse scans are necessary to demonstrate the placenta completely. Chi-squire test was carried out for statistical analysis. *Result:* Placental maturity increases with gestational age in normal and high risk cases. In our study we observed hypermature placenta (Grade III) is common in hypertensive mothers. Fetal outcome is found to be directly related to severity of maternal hypertension. *Conclusion*: Thus, we conclude that regular monitoring of placenta in antenatal care is primary tool for fetomaternal surveillance in hypertensive pregnancies.

Keywords: USG Machine; Placental Grading; Placental Morphology; IUGR; PIH.

Introduction

The Placenta is essential to fetal well being, growth and development; it can be demonstrated reliably and accurately by ultrasound. Intrauterine existence of fetus is dependent on placenta [1]. The term "Placenta" was used for the first time in 1559. Placenta is a mirror which reflects the intrauterine status of the fetus. Though it does not become the part of body of neonate, it contributes much for the well-being of the fetus in utero by its protective nutritional & respiratory function. It appears at pregnancy & prepares the fetus for extrauterine life [2]. Ultrasonographic method is the best for placental evolution throughout antenatal care. Ultrasound evidence of the developing placenta can be seen as early as 6 wks of gestation. It appears as an area of high level echoer surrounding a border, representing the developing gestational sac. Approximately at 12 wks of gestation the structure of the placenta can be more clearly discerned [3]. Winsberg F. found in (1973) the first echoscopic description in placental tissue [4]. Conventional 2D ultrasound has been widely used for the evolution of Placenta during pregnancy. This 2D evolution includes the assessment of the morphology and anatomy of the Placenta, identification of its

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location, Placental grading & fetoplacental circulaton [5]. Grannum. et al. (1979) devised systemic classification of ultrasonogaphic morphology of Placenta based on the changes in the chorionic plate, Placental substance and the basal layer, the three separate zones of placenta. The Placenta was grouped in to four grades from zero to three [6].

Grade 0:- Chorionic Plate straight and well defined Placental substance. Homogenous basal layer, no densities.

Grade 1:-Chorionic Plate subtle undulations, Placental substance scattered echogenic area. Basal layer no densities.

Grade 2:- Chorionic Plate indentation extends into Placenta but not to the basal layer.

Grade 3: -Chorionic Plate indentation that extend all the way to the basal layer.

Materials and Methods

The present prospective comparative study is carried out on a total 120 cases after 28 weeks of pregnancy, attending the department of obstetrics and Gynecology and radio diagnosis at Padm. Dr. D.Y. Patil medical research center, Kolhapur. This hospital is around 500 bedded with well equipments and facilities. Clearence of Institutional Ethical Committee was obtained before starting the work. The present cases are divided into normal and pregnancy induced hypertensive groups according to personal history, general examination of patient & recording of Blood Pressure.

A patient with rise of at least 30 mm of Hg & 15 mm of Hg in systolic and diastolic pressure respectively over previous known blood pressure was diagnosed to have Pregnancy induced hypertension. If previous BP was not known, then BP of at least 140/90 mm of Hg was considered abnormal.

B. P. > 140 / 90, without proteinuria and oedema is P.I.H.

Women attending the antenatal clinic in the Department of Obstetrics & Gynaecology who were referred for routine ultrasonography were selected for the study. After explaining the procedure and obtaining consent, these patients were subjected to ultrasonographic examination. Patients were asked to maintain a full bladder, for obtaining a better window for USG examination.

Scanning Technique - With patients in supine position, jelley was applied over the abdomen and examination was carried out. Multiple longitudinal and transverse scans are necessary to demonstrate the placenta completely. Oblique scans are also taken.

59 placentae of normal pregnancy is considered as control group and 61 placentae of Pregnancy Induced Hypertensive (P.I.H.) mothers are taken as study group.

Inclusion Criteria

1. Age group 20 to 35 yrs.
2. Third trimester above 28 wks of pregnancy.
3. Pregnant women having normal blood pressure & Pregnancy Induced Hypertension.

Exclusion Criteria

1. Pregnancies with congenital anomalies
2. Pregnancy with hypertension with proteinuria & oedema
3. Twin pregnancy

Observation Tables and Results

The Table 1 shows 50% of sample size is between age 20 to 25 years.Patients above 30 years of age are only 8.33%

The Table 2 shows 26 to 31 wks pregnancy found 62.5% of total no. of cases taken and 37.5% in between 32 to 37 wks. of gestational age.

The Table 3 shows on placental examination by usg grade 2 is 58.3% in normal and hypertensive mother.

Table 1: Age distribution (yrs)

Age distribution	Frequency(N)	Percentage (%)
20 to 25	60	50
26 to 30	50	41.67
>30	10	8.33
Total	120	100.0

Table 2: Gestational Age distribution (wks)

Gestational Age	Frequency(N)	Percentage (%)
26 to 31	75	62.5
32 to 37	45	37.5
Total	120	100.0

Table 3: Placental Grading

Placental Grading	Frequency(N)	Percentage (%)
Grade I	6	5.0
Grade II	70	58.3
Grade III	44	36.7
Total	120	100.0

Table 4: Association between PIH and Placental Grading

PIH	Placental Grading						Total	
	Grade I		Grade II		Grade III			
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
Present	0	0	22	36.1	39	63.9	61	100
Absent	6	10.2	48	81.4	5	8.5	59	100
Total	6	5.0	70	58.3	44	36.7	120	100
Test	Value	DF	P value		Statistically significant			
Chi-square	41.908	2	0.000		Yes			

Table 5: Association between PIH and Pregnancy outcome

PIH	Pregnancy outcome								Total	
	Live Birth		IUGR		Severe IUGR		Death			
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
Present	1	1.6	40	65.6	18	29.5	2	3.3	61	100
Absent	59	100	0	0	0	0	0	0	59	100
Total	60	50	40	33.3	18	15	2	1.7	120	100
Test	Value	DF	P value		Statistically significant					
Chi-square	116.066	3	0.000		Yes					

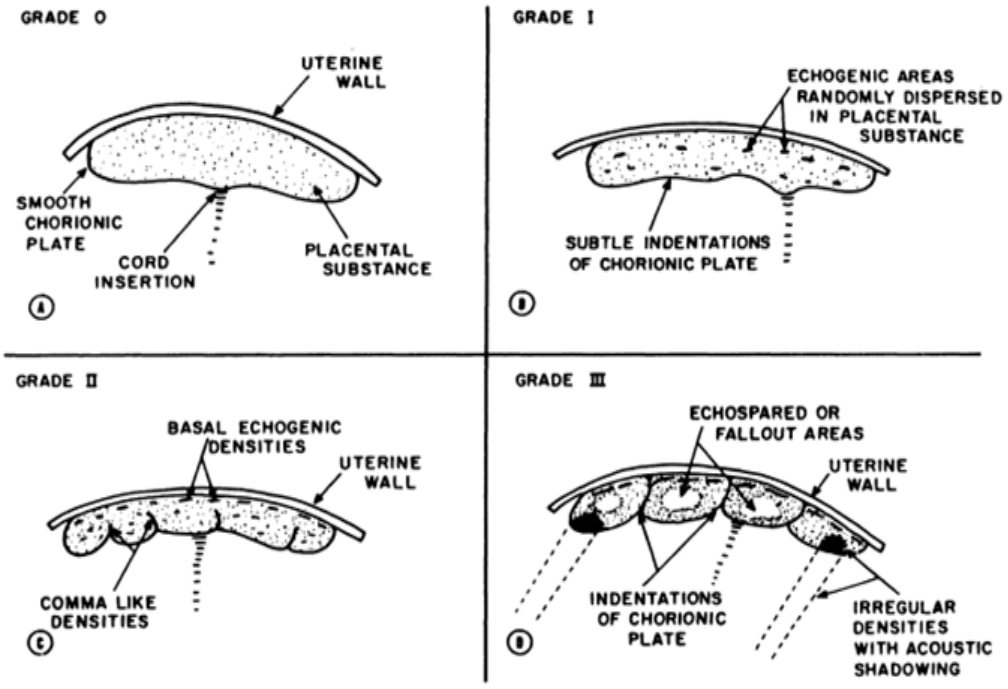

Fig. 1: Shematic diagram illustrating the appearance of the four placental grades (Reproduced with permission from Grannum [8].

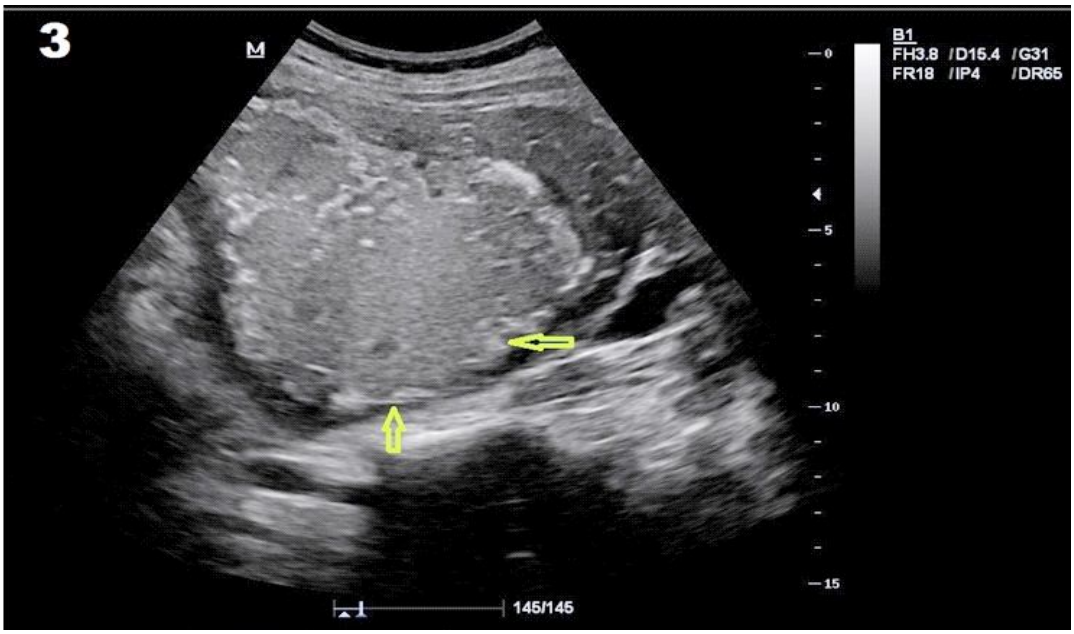

Fig. 2: This image shows placenta grade-II

Table 4 shows Association between PIH and Placental Grading is statistically significant.

This Table 5 shows Association between PIH and Pregnancy outcome is statistically significant.

Discussion

According to Grannum classification Grade II & III of placenta are found in third trimester of patients. USG findings shows III grade placenta in hypertensive mothers. Hopper et al (1984) [7] noted that if the placenta appeared to be grade I prior to 27 wks, grade II prior to 32 wks and grade III prior to 36 wks of gestation, the pregnancy would likely to be complicated with intrauterine growth retardation and preeclampsia. Kazzi et al (1983) [8], Kumari et al (2001) [9] and Dudley et al (1993) [10] also reported the association of grade III placenta with small for gestational age infants. Zhang LY et al (2005) [11] says the grade III placenta maturation before 37 wks of gestation is associated with oligohydramnios and low birth weight and might help to predict placental dysfunction, which needs close monitoring for the benefits of mother and fetus. Ultrasound detection of a grade III placenta at 36 wks gestation in a low risk population helps to predict subsequent development of proteinuria –pregnancy induced hypertension and may help in identifying the growth restricted baby (Mckenna et al 2005) [12].

Proud and Grant (1987) [13] observed in study of 2000 unselected pregnant women the development of mature placental appearance grade III on USG by 34-36 wks gestation in high risk cases was associated with increased risk of low birth weight and perinatal death. My study findings are correlated with above studies so we conclude that hypertension and intrauterine growth retardation showed a strong correlation with accelerated placental maturation.

Sub chorionic fibrin was not found to be increased in this study. Most of the studies (Fox 1967, and Mallik et al 1979) did not record the increase of sub chorionic fibrin in hypertensive disorders. However Bandana Das (1996) noted an increased incidence of sub chorionic fibrin, but it did not affect the fetal outcome [1,14].

Conclusion

As placenta is the mirror image of fetal outcome, on examination of placenta by sonological method there is definitive evidence of changes in placental morphology as well as grading in pregnancy induced hypertensive mothers.

Thus, we conclude that regular monitoring of placenta in antennal care is primary tool for fetomaternal surveillance in hypertensive pregnancies because. It helps us to take timely action, plan the treatment & also counsel the patients in their future pregnancies.

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Original Article

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A Morphometric Study of the Patterns and Variations of the Acromion of the Scapulae in Maharastrian Population

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Abstract

Introduction: In scapula, the acromium process projects forwards almost at right angles from the lateral end of the spine. The coracoacromial ligament lies between tip of acromian and coracoid process and it forms coraco-acromial arch. Below the arch thre is space it gives passage to the tendons of muscles forming musculo- rotator cuff. The morphometric study of the acromion process of the scapula is an important factor implicated in impingement syndrome of the shoulder joint. *Methodology:* This study was carried out on the 100 dry human scapulae of unknown age and sex, 50 were from the right side, and 50 were from the left. Measurements were taken using a vernier calliper and recorded in millimeters. *Result:* In this study shows the mean values of acromian length were 44.8mm. The acromian width mean values were 21.7mm.The acromian thickness was 5.7mm. The distances between acromian and coracoid processes were measured at two points. The distance taken from tip of the acromian process to tip of the coracoid process was found 36.5mm. The distance taken at the base of the coracoid to the tip of the acromian process mean value was 23.6mm. The acromio-glenoid distance observed 26,2mm. The three types of acromion process according to slope, flat was seen in 28 (28%), type II curved in 49 (49%) and type III hooked in 23(23%) of the total samples and also it was found the inferior surface of the acromian smooth in 74 (74%) and rough in 26 (26%) samples. Morphological shapes of the tip of the acromion were recorded as: cobra-shaped, square tip and intermediate-shaped *Conclusion:* Knowledge of the morphometeric values of scapula and acromian process is important for clinicians in understanding andcuring shoulder joint ailments.

Keywords: Scapula; Acromian Process; Morphometry.

Introduction

The scapula (shoulder blade) is a triangular flat bone that lies on the posterolateral aspect of the thorax, overlying the 2nd to 7th ribs. The convex posterior surface of the scapula is unevenly divided by the spine of the scapula into a small supraspinous fossa and a much larger infraspinous fossa. The concave costal surface of the scapula has a large subscapular fossa. The triangular body (blade) of the scapula is thin and translucent superior and inferior to the scapular spine [1,2].

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Acromial morphology has been implicated as contributing to impingement. Bigliani, Morrison and April described 3 types of acromion morphology and noted an increase in rotator cuff tears with type - III or hooked acromion. Since this time the Bigliani morphological classification has been the dominant diagnostic tool for the impingement syndrome and rotator cuff tears [2]. Patients with less slope to their acromion have propensity towards impingement because of subacromial stenosis [3]. The Variations seen in acromial morphologic condition are not acquired from age-related changes and spur formation and thus contribute to impingement disease independent of and in addition to age-related processes.

Materials and Methods

A total of 100 dry human scapulae bones were selected from the anatomy department, IIMSR Warudi Badnapur, Dist. Jalna. 50 were from the

right side, and 50 were from the left. The bones belonged to mature specimens, but the exact ages and gender of the specimens were not known. The bones were isolated and inspected macroscopically. Damaged scapulae bones were excluded from this study. Scapulas were grouped according to the morphology of the acromial type. Measurements were taken using a sliding vernier calliper (accurate to 0.1 mm) and recorded in millimeters. Each of the measurement was taken twice and then average was taken to reduce the bias errors. Data was analyzed using SPSS version 13.0 and mean values presented in tables. Descriptive statistics like percentage Mean and standard deviation were used to analyze the data obtained.

Following measurements were taken.

Morphological Evaluation

Morphological shapes of the tip of the acromion were recorded as: cobra-shaped, square tip and intermediate-shaped [3]. Types of acromion according to its slope:-a) Bigliani type I (flat), b) Type II (curved), and c) Type III (hooked). Types of inferior surface of acromion process according to appearance: rough and smooth types.

Osteometric Evalvation

1. The maximum length of the acromion along longitudinal axis
2. *The maximum breadth of acromion:* The distance between the lateral and medial borders at the midpoint of the acromion process.
3. *The thickness of the acromion:* 1 cm posterior to the anterior border and 1 cm medially to the lateral border.
4. *Acromio coracoid distance-I (AC-I):* Between tip of coracoid process to the tip of the acromion process.
5. *Acromio coracoid distance-II (AC-II):* From the dorsum of the base of coracoid process to the tip of the acromion process
6. *Acromio glenoid distance:* Between Supraglenoid tubercle and the tip of the acromion process.

Results

In the present study we found the mean value of the acromian thickness was 5.7mm in total and 5.7mm in right side and 5.8mm in left side.

The distances between acromian and coracoid processes were measured at two points.

The distance taken from tip of the acromian process to tip of the coracoid process was found 36.6mm in total sample, in right side 36.2mm and 37.2mm in left side.

The distance taken at the base of the coracoid to the tip of the acromian process mean value was 23.6mm in total, 23.7mm left side and 23.9mm in right side.

The acromio-glenoid distance observed 26.2mm in total, 26.5mm in left side and 25.5mm in right side.

We examined the three types of acromion process according to slope, flat was seen in 28 (28%), Cured 49 (49%), Hooked 23(23%) type and also it was found the inferior surface of the acromian smooth in 74 (74%) and rough in 26 (26%) samples.

Table 1: Agedistribution(in years) P value 0.409 (>0.05)

Group	Min value	Max value	Mean+/-SD
GA	2.6	12	7.49+/-2.80
GA+PEA	2.8	12	6.97+/-2.86

Table 2: Sex distribution P value 0.178 (>0.05)

Group	Male	Female	Total
GA	15	25	40
GA+PEA	21	19	40
Total	36	44	80

Table 3: Weight distribution (inkg) P value 0.061 (>0.05)

Group	Min value	Max value	Mean+/-SD
GA	14	40	26.2+/-8.05
GA+PEA	12	35	22.6+/-7.56

Table 4: Duration of surgery (in minutes) P value 0.135(>0.05)

Group	Min value	Max value	Mean+/-SD
GA	90	140	119.8+ / -13.6
GA+PEA	60	180	112.8+ / -25.9

Table 5: VAS P value <0.001

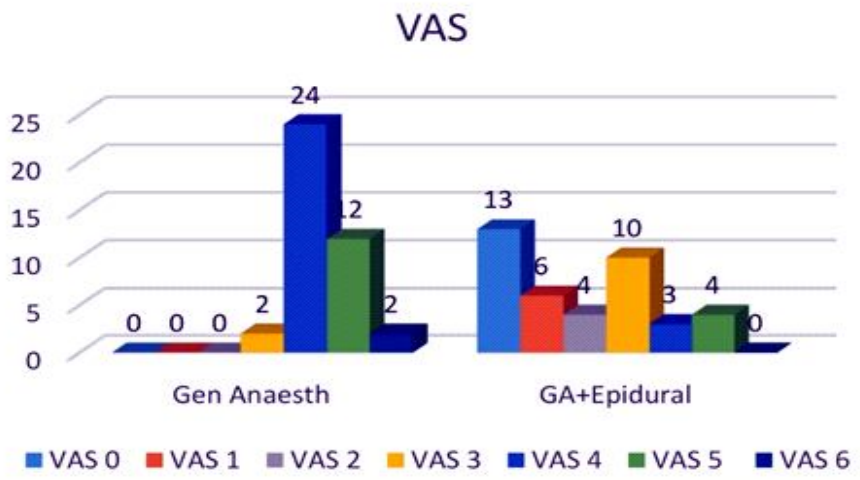
VAS	Min value	Max value	Mean+/-SD
GA	3	6	4.35+ / -0.66
GA+PEA	0	5	1.9+ / -1.72

Table 6: Rescue Analgesia P value=0.018 (<0.05)

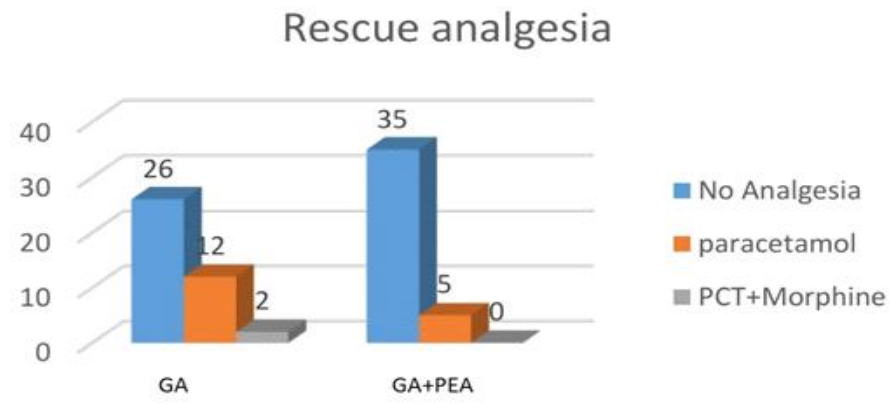
Group	No Analgesia	Paracetamol	Pct+Morphine	Total
GA	26	12	2	40
GA+PEA	35	5	0	40
TOTAL	61	17	2	80

Table 7: Parental satisfaction P value<0.001

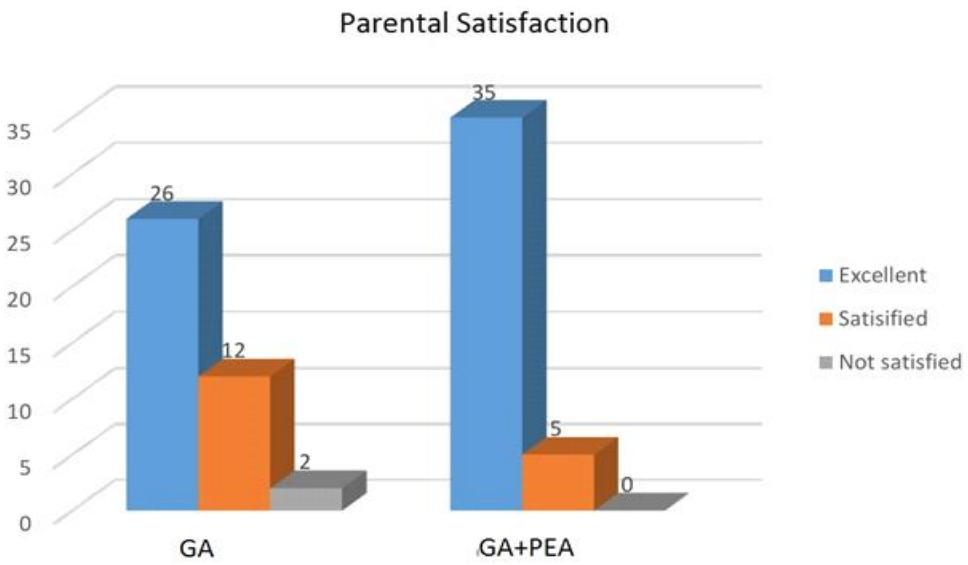
	Excellent	Satisfactory	Not satisfactory	Total
GA	26	12	2	40
GA+PEA	35	5	0	40
Total	61	17	2	80



Graph 1: VAS



Graph 2: Rescue analgesia



Graph 3:

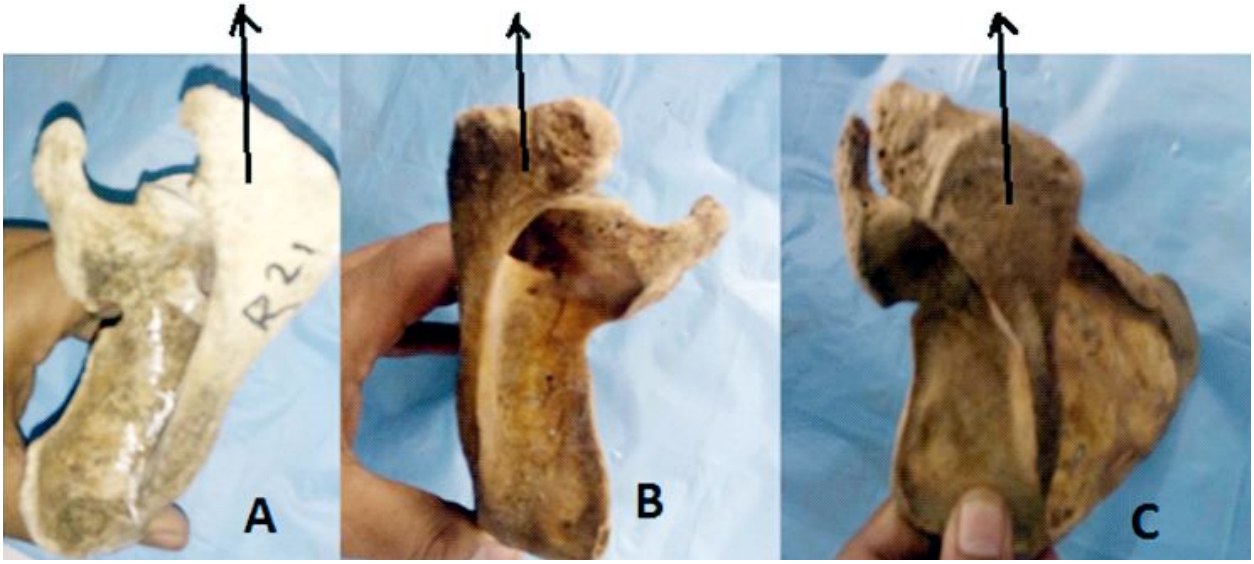
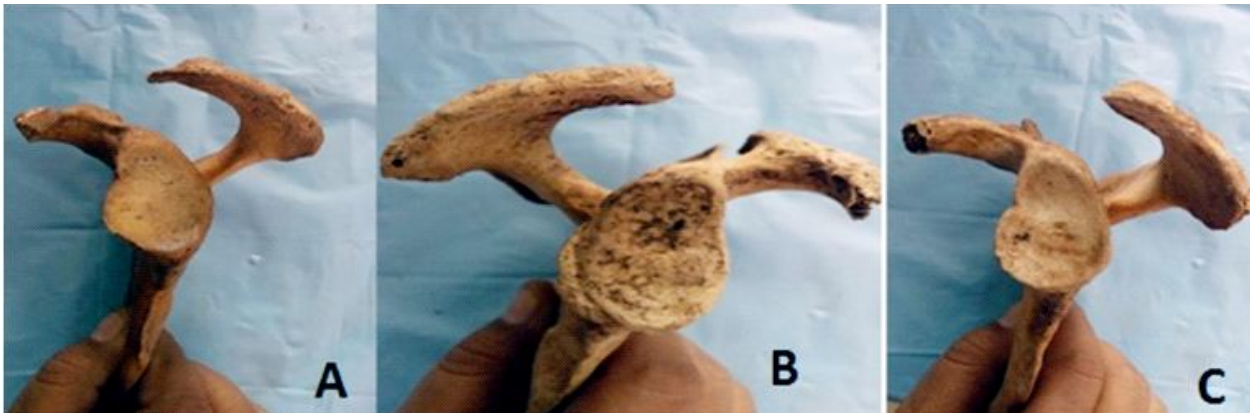


Fig. 1: Showing Morphological shapes of the tip of the acromion (A) intermediate (B) Square tip(C) Cobra shaped



Hooked acromion Flat acromion Curved acromion

Fig. 2: Showing Types of the acromion process according to slope

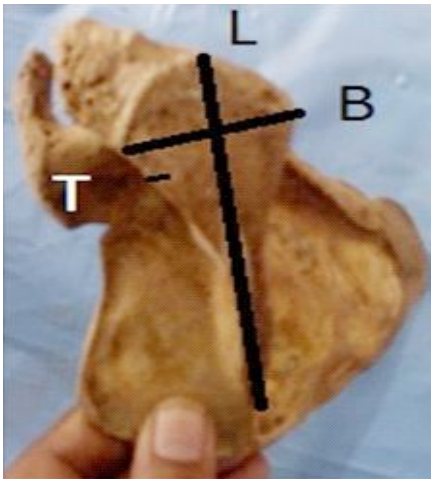


Fig. 3: Showing Acromian. Length(L) Acromian widtch(B) Acromian thickness(T)

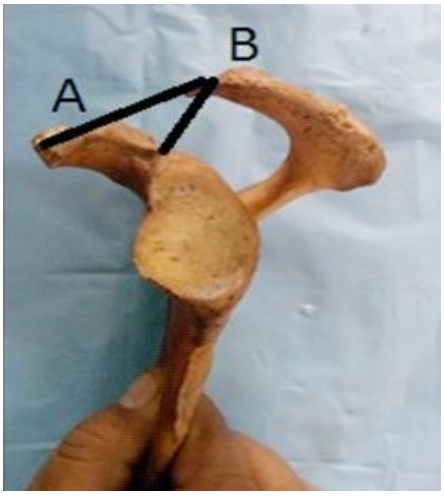


Fig. 4: Showing Acromio-coracoid Distance (**A)** Acromo-glenoid Distance (**B)**

Discussion

We found the mean value of Acromian length, Acromian width and Acromian thickness found to be as 44.8 mm, 21.7 mm and 5.7 mm in total samples respectively. Anetzberger and Putz observed acromial length as 47.00 mm [6]. In an another study Mallon et al took his measurements from x-rays films, recorded the Acromian length of 42.0 mm [7]. Similar studies done by Coskun et al had reportedthe acromian length 44.7 mm width 32.0 mm. Sitha et al observed the same parameters as acromian length 40.0 mm width 23.9 mm thickness [8,9]. These values were very near to the values we found in our study. Mansur et al has observed that the length of the acromion process of right scapulae mean value 46.46 mm and left side mean was 45.57 mm. They had observed that the right acromion process was longer than the left by 0.89 mm [10]. In our study we found that the length of the acromion process of right scapulae mean value 4.52 cm and left side mean was 4.6 cm. left acromion process was longer than the right by 0.80 cm which was also found to be insignificant.

The breadth of acromion process of right scapulae mean value 2.18cm and left scapulae mean value2.15cm was reported in the study of Mansur et al. They reported that the right acromion process was wider than the left by 0.60 mm. In our study we found same results as the right acromian was slightly wider (0.3 cm) than the left side, with the difference being insignificant.

The distance taken from the tip of acromian to the tip of the coracoid process mean value found 3.65cm in total sample and 3.66cm right side as well as 3.62cm in left side. The distance taken at the base of the coracoid to the tip of the acromian process mean value was 2.62 cm in total.

The mean value of the acromio-glenoid distance 2.62cm in total samples and 2.55 cm right side, 2.65cm of left side samples respectively. Mansur et al have observed mean values of acromio coracoids distance on the right and left sides as 39.03 mm and 39.39 mm respectively [10]. Their study showed that there were no statistically differences between right and left side ($t = 0.259$, $p = 0.398$). Similarly, the acromio-glenoid distance was found to be varied from distances 2.55 cm and 2.65 cm on right and left sides respectively.

They noticed that acromio-glenoid distances were same on both sides ($t = 0.150$, $p = 0.440$) According to Sitha et al the coraco-acromian distance 29.5 mm and acromio-glenoid distance18.1mm was observed [9]. The acromio-coracoid and acromio-glenoid distances between both sides in this present study showed no significance difference, were as when compared the mean values with the findings of the Mansur et al the values were slightly less on the other hand the mean values shown by the Sitha et al were much less than our findings. We examined the types of acromion according to its slope. Type - I flat was seen in 28 (28%), type -II curved in 49 (49%) and type - III hooked in 23 (23 %) acromion process. According to Coskun et al type - I flat was seen in 9 (10%), type - II curved in 66 (73%) and type - III hooked in 15 of 90 (17%) acromion process. Among the all three acromian types the curved type was reported more by the coskun et al [8]. In our study we found shape of tip of acromian proceses were cobra shaped 23%, squre shaped 31%, intermediate, 46%. Types of inferior surface smooth 74% and rough 26%.

Conclusion

The acromian process plays important role in formation and provides stability to the shoulder joint. Dimensions of scapula and acromian process are important that they differ in morphology and when classified in to different types show linkage to the shoulder girdle pathologies. Variations in the size and shape of the acromion process which were observed in the current study will be of great help for orthopaedic surgeons to understand the shoulder pathology better .

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Original Article

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Overview of Anterior Nasal Spine in Cadavers and Dried Skulls: A Morphometric Study

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Abstract

Introduction: Morphometric and morphological study of cranium can be helpful in sexual dimorphism. Cranium is the second to pelvis in determining the sexual dimorphism. Fractures of the skull bones are common. Among the fractures nasal bone fractures are more common. Then comes the maxilla and mandible. Various factors can influence the facial bone fractures. They are motor car accidents, sports injury and boxing. Many works have been done on skull bones. The contribution on the study of anterior nasal spine was very less. Only two such case reports have been reported. Considering all these factors an attempt is made to correlate the anterior nasal spine between male and female dried skulls as well as in cadavers. *Material and Methods:* The study was conducted on 32 dried skulls and in 18 cadavers. 20 male and 12 female dried skulls were segregated. The cadaveric dissection includes 13 male and 5 were female cadavers. The morphometric parameters like Vertical Length, Anteroposterior length and breadth were measured by ruler and Vernier calipers. All parameters were spastically analyzed. *Results:* All parameters were less in females as compared to males. *Conclusion:* It was observed that the mean values of vertical length(VL), breadth(BD) and anteroposterior length(AP) of nasal spine were greater than in males as compared to females which was statistically insignificant.

Keywords: Anterior Nasal Spine; Skull; Sexual Dimorphism.

Introduction

For the identification of an individual, race and for the sexual dimorphism, the skull plays very crucial role. Anthropologically, the skull and its bones are second to the pelvic bones in identification of the individual [1]. Study of the skeleton using individual bones and parts of it, exhibiting sexual dimorphism has been reported among different populations [2]. Anthropological study and its knowledge of human skeleton is one of the important parameters in identification of the biological profile [3]. These include human osteology; human growth and development including skeletal pathology. Sexual determination of the human skeletal remains has an important step in its identification. This skillful process is carried out by forensic and anatomy experts.

Krogman states that skull is the most dimorphic and easily sexed portion of skeleton after pelvis, providing up to 92% reliability [4]. Base of the skull is very thick and some bones of the skull are compactly arranged and protected. These areas of the skull tend to withstand both physical insults and inhumation more successfully than any other areas of cranium [5]. Skull bones especially facial bones are more prone to fractures [6]. Among these, nasal bone fractures are more common, and then come maxilla and mandible. The other bones involved in fractures are zygomatic and frontal bones. Facial bone fractures occur for a variety of reasons. These include motor car accidents, sports injuries, boxing and contact between players.

Many works have been done on skull bone. Very little contribution was found on the study of anterior nasal spine. Injuries to the anterior nasal spine are

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also rare. Only two such case studies have been reported [7,8]. Considering all these scenario, an attempt is made to correlate the anterior nasal spine between male and female. This study would also be helpful to the otorhinolaryngologist, dental and plastic surgeons in evaluating some ailments involving the nasal spine and also in doing the operative corrections especially in cosmetic surgeries in relation to anterior nasal spine and its influencing effect on its attachment.

Materials and Methods

In the first part of the study, 18 adult cadavers were enrolled randomly from the department of Anatomy, J.N. Medical College, Belagavi. Among them 13 were male and 5 were female bodies. The anterior nasal spine was exposed after dissecting systematically. The columella of the nose and middle part of the upper lip including philtrum of the face were dissected. The soft tissues in the vicinity of the anterior nasal spine were teased out. The anterior nasal spine was exposed. Nasal septum was retained and its position in relation to the nasal spine was noted.

In the second part of the study, dry skull bones were obtained from the department of Anatomy. Total of 32 dried skulls were selected randomly and they were segregated into male and female by studying the parameters like, supercilliary arches, frontal eminences, weight of the skulls and muscular markings. Among them 20 were male and 12 female skulls and they were studied for the morphometry of anterior nasal spine.

Later, systematic chronological measurements of the anterior nasal spine were recorded as follows.

1. *Vertical Length (VL):* This was taken from the tip of the anterior nasal spine to the margin of bony upper tooth socket.
2. *Breadth (BD):* Maximum breadth which falls at the center of the anterior nasal spine.
3. *Anteroposterior Length (AP)*: From the incisive foramina to the apex of the anterior nasal spine.

Observations

Table 1: Anterior Nasal Spine Measurements in 18 cadavers (Male: 13 and Female: 5)

S. No.	Male Measurements in mm			Nasal Septum	Female Measurements in mm				Nasal Septum
	VL	BD	AP		Sr. No.	VL	BD	AP	
1.	8.89	5.91	6.69	Midline.	1.	8.94	3.31	9.87	Midline
2.	6.67	6.55	7.43	Midline	2.	10.11	3.34	6.80	Midline
3.	9	6.54	7.43	To the left side.	3.	12.84	3.43	5.86	Midline
4.	12.03	6.03	8.16	Midline	4.	7.95	5.48	6.63	Midline
5.	11.55	5.53	10.57	Midline	5.	9.22	6.68	1.9	Midline
6.	16.81	4.19	12.24	Midline		--	--	--	--
7.	10.98	4.89	7.76	Midline		--	--	--	--
8.	10.41	4.83	15	To the left side		--	--	--	--
9.	10.98	6.01	8.30	Midline		--	--	--	--
10.	13.33	5.52	6.51	Midline		--	--	--	--
11.	15.43	5.53	9.89	Midline		--	--	--	--
12.	14.03	6.53	6.65	Midline		--	--	--	--
13.	14.44	10	10	Midline		--	--	--	--

Table 2: Measurement of anterior nasal spine in dried skulls. (Male:20 and Female:12)

Sr. No.	Male Measurements in mm			Sr. No.	Female Measurements in mm		
	VL	BD	AP		VL	BD	AP
1.	15	6	15	1.	13	5	18
2.	16	4	12	2.	20	8	16
3.	12	8	15	3.	13	8	12
4.	17	4	17	4.	15	8	9
5.	12	9	18	5.	16	9	12
6.	19	6	16	6.	13	10	10
7.	14	9	17	7.	8	6	7
8.	10	7	12	8.	15	8	10
9.	17	7	12	9.	14	8	13
10.	15	9	12	10.	15	9	12

11.	12	7	13	11.	8.96	3.40	9.90
12	15	8	13	12.	7.97	5.50	6.65
13.	14	6	16		--	--	--
14.	9.09	6.91	6.70		--	--	--
15.	10.9	6.02	8.31		--	--	--
16.	14.9	5.54	9.90		--	--	--
17.	14.04	6.54	8.98		--	--	--
18.	14.45	10.1	10.2		--	--	--
19.	13.09	6.54	6.65		--	--	--
20.	14.45	11.01	10.1		--	--	--

Results

Anterior Nasal Spine in Cadavers.

The following Results were Observed.

The mean vertical length (VL) in male was 11.9±2.86 and that in female was 9.8±1.86. The range in male and female was 6.67-16.81 and 7.95-12.84 respectively. The median obtained in both male and female was 9.7 and 8.84 respectively.

The mean breadth (BD) in male was 6±1.39 and in female was 4.4±1.54. The range in male and female was 4.19- 10 and 3.31-6.68 respectively. The median obtained was 5.91 and 3.43 in male and females respectively.

The mean anteroposterior length (AP) in male was 8.9±2.51 and in female was 6.2±2.85. The range in male and female was 6.51-15 and 1.9-9.87 respectively. The median obtained was 8.16 and 6.62 in both male and females respectively.

The p value in VL=0.156, BD=0.056 and in AP=0.061.

In Dried Skulls.

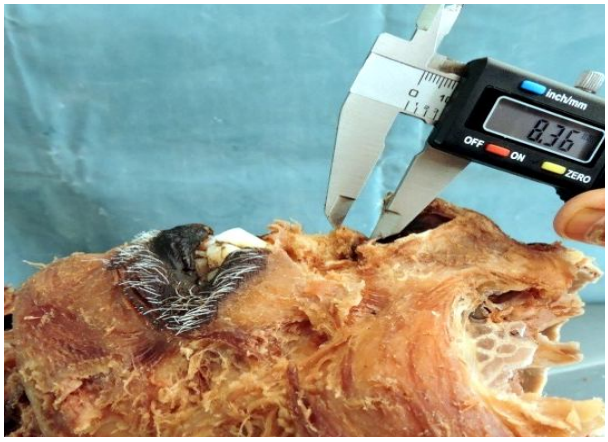
The Following Results were Obtained.

The mean vertical length (VL) in male was 13.9±2.44 and that in female was 13.2±3.52. The range in male and female was 9.09-19 and 7.97-20 respectively. The median obtained in both male and female was 14.24 and 13.5 respectively.

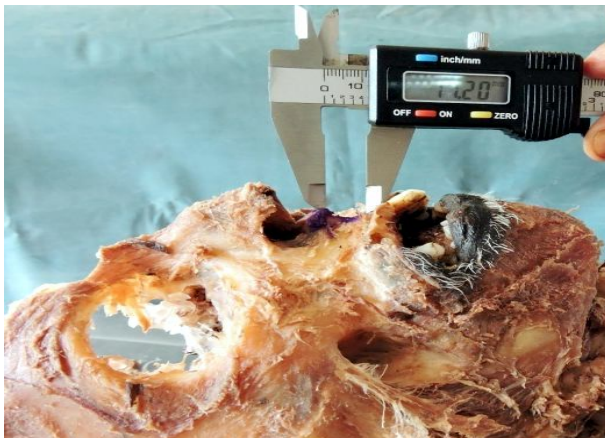
The mean breadth (BD) in male was 7.1±1.837 and in female was 3±1.93. The range in male and female was 4-11.01 and 3.4-10 respectively. The median obtained was 6.95 and 8 in male and females respectively.

The mean anteroposterior length (AP) in male was 12.4±3.44 and in female was 11.3±3.33. The range in male and female was 6.65-18 and 6.65-18 respectively. The median obtained was 12.1 and 11.1 in both male and females respectively.

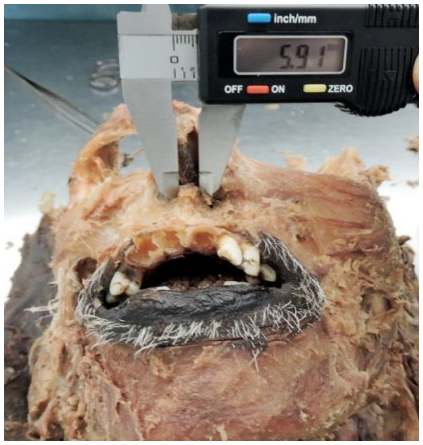
The p value in VL=0.511, BD=0.780 and in AP=0.363.



(Antero posterior Length i.e.AP)

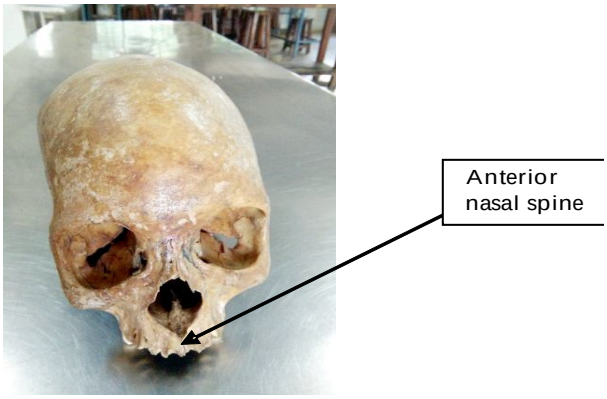


(Vertical Length i.e. VL)

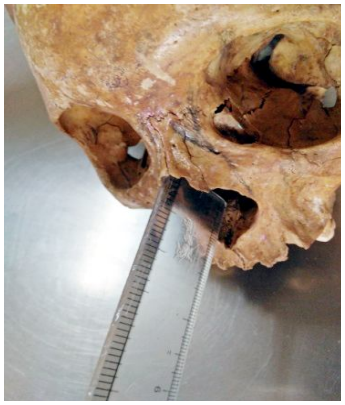


(Breadth i.e.BD.)

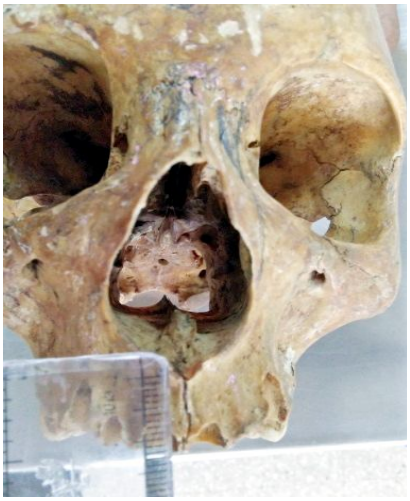
Fig. 1: Measurement with caliper



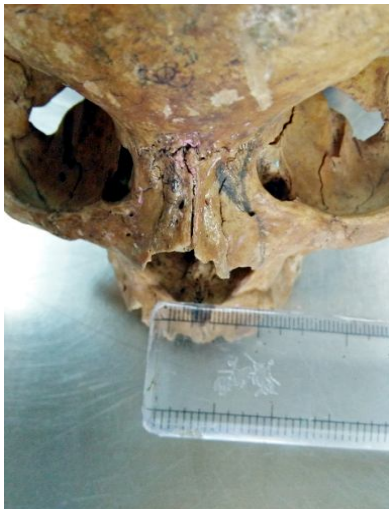
Showing Anterior nasal spine



(Antero posterior Length i.e.AP).



(Vertical Length i.e. VL).



(Breadth i.e.BD.)

Fig. 2: Measurement with Scale or Ruler in dried skulls

Discussion

It is a known fact that, the form and function of the nose are very much influenced by the arrangements of the architectural skeleton which are forming the nose. And it is also the reality that, the shape and arrangements of these are influenced by many factors including the developmental and acquired factors during the permanent formation of the skeleton. So it has becoming imperative to know some of the morphological measurements of the structures and to derive the possibilities and in turn, to have that knowledge in applied concepts, and also to extrapolate the same for clinical applications. Knowing the morphology of anterior nasal spine, helps clinician to know whether it is optimal or deviated from the normal and if so, the range of deviation.

It is undeniable fact and irony that the anterior nasal spine plays quite decisive and influencing role to the clinicians especially while dealing with the diseases of the nose or the cosmetic surgeons like plastic, rhinoplasty and the faciomaxillary surgeons. As some of the destructive diseases especially the granulomatous diseases of the nose like the patients suffering from the lepromatous leprosy, there is high possibility of destruction of the anterior nasal spine. If the facial bones have sustained an impact injury because of fall or road traffic accidents, the anterior nasal spine may be fractured and displaced.

The position and various deviations of the anterior nasal spine influence the shape and position of the base of the columella and the attachments and direction of the nasal septum. It is going to define the projection, height and shape of the tip of the nose as well as the area of the nose gets compromised which is going to have tremendous influence on the function of the nose. Thus the cosmetic and functional problems will be challenging as well.

To correlate and correct these, one should know the fundamental appreciation of the exact position, size and shape of the anterior nasal spine so as to understand the dynamic influence of the same on the neighboring structures and to take remedial measures if possible. In this study, we have analyzed statistically the various morphometric measurements of the anterior nasal spine and these were compared in various variances in both fresh cadavers and dried skull bones. We also compared the same in the male and female cadavers and in dried skulls.

Conclusion

It was observed that the mean values of vertical length (VL), breadth (BD) and anteroposterior length (AP) of anterior nasal spine were greater in males as compared females which was spastically insignificant. We would like to conclude that this study is going to thrust the insight into the various dimensions of the anterior nasal spine and in turn will significantly influence the understanding and application of the same in clinical scenario whenever needed. We also would like to mention that this is the unique rare study being done in this part of the country.

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Original Article

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Estimation of Stature of an Individual from Forearm Length in Maharashtra Population

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Abstract

Background: The estimation of stature from forearm length holds a special place in the field of Forensic Anthrpometry. *Aim:* The aim of present study was to find out a regression equation that could calculate the height of a person precisely from forearm length. In this study the height and forearm length of 200 Ist M.B.B.S. students of Rajarshee Chhatrapati Shahu Maharaj Government Medical College, Kolhapur was measured. The data obtained was subjected to statistical analysis, to derive regression equation. The correlation coefficient was found 0.8146 for forearm length with stature in males and that of in females was 0.6985. Regression coefficient was 3.84 in males for forearm length and stature and 3.09 in females for forearm length and stature. The observed data was subjected to't' test for correlation coefficient. The value of 't' was found to be statistically significant. The regression equations for estimation of statures were formulated using length of forearm. *Conclusion*: A good correlation of stature with forearm length was observed and it was statistically highly significant.

Keywords: Anthropometry; Forearm Length; Height; Stature.

Introduction

Estimation of stature of individual has a significant importance in the field of Forensic medicine and Anthropometry. Establishing the identity of individual from decomposed,mutilated and amputed body fragments has become important in recent times due to natural disasters such as earthquakes,Tsunamis,cyclones,and floods and man made disasters such as terror attacks,bomb blasts,wars and plane crashes.It is important for both legal and humanitarian reasons [1].

The ultimate aim of using anthropometry in medical science is to help the law enforcement agencies in achieving personal identity in case of unknown human remains [2]. The length of ulna has been shown to be a reliable and precise means in predicting stature of a individual [3]. In 1961 Allbrook [4] attempted to develop Standards for estimation of stature from a British sample using ulnar length which was measured from the tip of olecranon process the distal margin of hand with forearm flexed and semipronated. In 1964 Athawale [5] carried out a study on forearm bones .

Many different body parts can be used in the estimation of stature. Certain long bones and appendages can be aptly used in the calculation of height of a person. Many studies have shown the correlation of stature of body appandages but there are inter-racial, inter-geographical differences in measurement of their correlation with stature. What may be true for one race or one region may not be true for the other [1].

Material and Methods

The study was carried out on 200 students of 1st year M.B.B.S. of age group 19-23 years. The procedure, aims and objective were informed and explained in a group. A written valid informed consent was taken from each of the participants. A

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small group of students were taken for measurements each at a fixed time to avoid diurnal variations. The forearm length was measured from tip of olecranon process to midpoint joining radial and ulnar tuberosity using Standard measuring tape with elbow flexed and palm spread over opposite shoulder. The subject included in the study were healthy and free from any apparent symptomatic deformity.

The students were placed in the Standard anatomical position with the head held in the Frankfurt's horizontal plane.The dimensions were taken in 1 cm unit and with measuring tape. The height is maximum distance from vertex to floor. To ensure accurate results all the measurements were done by one person. The measurements were repeated to avoid errors.

The collected data was subjected to statistical analysis for calculation of Mean, Standard deviation, Standard error, correlation coefficient, regression coefficient, value of constant and t -test for correlation coefficient applied to test the statistical significance using Microsoft Excel file.

Results

It is found that as height increases the number of samples increases in males. The maximum number of samples were found at the height range of 175.1-180cm.

But in case of females that as height increases the number of samples decreases. The maximum number of samples were found at height range of 155.1-160cm

The correlation coefficient is found 0.8146 for forearm length with stature in males and that of in females is 0.6985. These values implies that there is positive correlation.

The value of 't' was found to be 13.25 in males and 10.09 in females.This shows that height of individual is related to forearm length.The value of p is <0.0001 in males as well as females.

The significant correlation was further interpreted by linear equation in males and females. Regression equation for height of males is calculated from Table 2 as follows

Height of males [Y]=59.96+3.84[X]

59.96 is intercept and 3.84 is slope, X is forearm length of individual

Regression equation for height of females is calculated from Table 3 as follows

Height of females [Y]=77.80+3.09[X]

77.80 is intercept and 3.09 is slope, X is forearm length of individual.

Table 1: Height Versus number of samples

Height in cm	No. of male students	No. of female students
140-145	-	2
145.1-150	2	8
150.1-155	3	22
155.1-160	6	43
160.1-165	13	21
165.1-170	17	11
170.1-175	19	-
175.1-180	21	2
180.1-185	10	-
Total	91	109

Table 2: Height in relation to forearm length,standard deviation,standard error in males

Height in cm	Minimum forearm length	Maximum forearm length	Average forearm length in cm	Standard deviation	Standard error
140-145	-	-	-	-	-
145.1-150	25	25	25	-	-
150.1-155	25	26	25.6	0.583	0.336
155.1-160	26	27	26.83	0.753	0.308
160.1-165	26	29	27.34	0.852	0.236
165.1-170	27	30	28.7	0.98	0.237
170.1-175	27	31	29.3	0.884	0.203
175.1-180	28	32	29.9	1.396	0.30
180.1-185	28	32	30.6	1.429	0.451

Table 3: Height in relation to forearm length,standard deviation,standard error in females

Height in cm	Minimum forearm length	Maximum forearm length	Average forearm length in cm	Standard deviation	Standard error
140-145	24	24	24	-	-
145.1-150	23	27	24.5	1.195	0.422
150.1-155	22	27	24.8	1.235	0.263
155.1-160	24	28	26.2	0.977	0.149
160.1-165	25	28.5	26.6	0.981	0.214
165.1-170	26	28	27.1	0.985	0.297
170.1-175	-	-	-	-	-
175.1-180	29	29	29	-	-
180.1-185	-	-	-	-	-

Discussion

In 1952 Trotter and Gleser [6] published a definitive study on stature calculation for American Whites and Blacks. All six long bones were measured for maximum length. Different equations for estimation of stature were established for Whites and Blacks and for males and females.

The average height of adult males within a population is significantly higher than that of adult females [3]. The results obtained in this study also show the same results. Allbrook [5] derived regression formulae for estimation of stature from length of ulna as stature=88.94+3.06 [ulnar length]

Our findings correlate with those of Illayperuma et al [3]. They studied 258 subjects in Srilanka and concluded that significant correlation exist between total height and ulna length, indicating strong relationship between two parameters. . In this study the mean value of forearm length in male is 27.85 and that of in female is 26.02.Our findings were correlated with those of Thummar [7] study. He studied 310 subjects 191 males and 119 females in Bhavnagar Gujrat, in India. Stature estimation is also done by Mondal et al. who studied 300 male subjects in Burdwan district of West Bengal in India and derived regression equation [8].

Mohanty et al [9] also derived regression equation between forearm length and total height in population of eastern India. Our findings also correlated with those of Bamne et al. [10], they found regression equation for stature from ulnar length as follows,

In males stature=65.77+3.81 [ulna length] in females stature=70.75+3.46 [ulna length]

Furthermore racial variation in the relationship between ulnar length and height has been clearly demonstrated by comparative studies between Black, White and Asian subjects [11].

Conclusion

After calculating regression equation it is found that there exists a positive correlation between height and forearm length which is similar to previous studies. But there is some difference in the slope and intercept of the equation which may be due to racial variation of the subjects. In this study male students showed higher mean values in each anthropometric measurements than females. Stature and forearm length are positively and significantly correlated with each other ($p < 0.0001$).The regression equation derived from this study can be applied reliably for estimation of stature on population of Maharashtra. If either of the measurement (ulna length or total height) is known,the other can be calculated. This fact will be of practical use in medicolegal investigations and in anthropometry. The regression equation can be of help in artificial limb centres for construction of prosthesis required in cases of amputations, trauma, frost bite etc. The study is helpful to provide database for biometrics.

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A Study on Shapes of Pterion in Human Adult Skulls

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Abstract

Pterion is the bony land mark which lies in the norma lateralis of the skull. It forms the floor of temporal fossa. It is almost H-shaped which is formed by the articulation of four bones with each other i.e. frontal, parietal, the greater wing of sphenoid and temporal bones. It is bony land mark to find out the place of anterior division of middle meningeal artery in the cranium. Here the bones are very thin which can be broken easily in the clinical process for drainage of subdural haemorrhage. It is having a great clinical significance. The study on variations of pterion is important in practice of radiologists, neurosurgeons, forensic medicine, anthropologists and forensic dentologist because, epipteric type of pterion sometimes is considered as fractured skull. 250 human adult skulls of known gender were examined on both sides. Four types of pterion were observed – sphenoparietal 65.19%, frontotemporal 15.19%, stellate 14.21% and epipteric 5.31%. The pterion is points of sutural confluence seen in the norma lateralis of the skull. The patterns of formation exhibit population based variations. These findings should be of use in surgical approaches and interventionsvia the pterion.

Keywords: Skull; Pterion; Sphenoparietal; Frontotemporal; Stellate; Epipteric.

Introduction

The pterion is one of the most interesting bone meetingpoints in craniofacial osteology and its complex morphology derives from the fact that 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 [1].

The importance of the pterion is its relation to the middle men in geal artery, Broca's motor speech area on the left side and surgical intervention relating to pathologies of the sphenoid ridge and optic canal [2].

Murphy has described four types of pterion– sphenoparietal type where the greater wing of sphenoid articulates with parietal bone to form letter H; frontotemporal type where the squamous part of temporal articulates with frontal bone; stellate type where all bones articulate in the form of letter K and epipteric type wherea sutural bone is lodged between the four bones forming the pterion [3,4].

Pterion is a small area in the temporal fossa, which contains the junction of the frontal, greater wing of sphenoid, parietal and temporal sutures. It usually lies 4 cm above the midpoint of the superior border of zygomatic arch and 3.5 cm behind the frontozygomatic suture and marks the anterior branch of the middle meningeal artery and Sylvian point of the brain. Its position can be estimated roughly by a shallow palpable hollow, approximately 3.5 cm above the center of the zygomatic bone. It is H-shaped. The pterion is covered by the origin of temporalis muscle and temporalis fascia. Whereas inside the cranium it relates with the many structures like anterior division of middle meningeal vessels, sylvian fissure, area numbers 44 and 45, tip of the lesser

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wing of sphenoid bone and base of the posterior margin of the orbital plate of frontal bone. This area is very important for surgeons because here the bones are very thin and can easily be broken by the surgeons and neurosurgeons in their clinical work. Most important surgery is done for the drainage of haematoma formed after the accident, where the collection of blood occurs in subdural space, to drain the collected fluid or blood, the burr hole is done at the pterion site [4,5,6,7]. A Knowledge of the surface anatomy of the middle meningeal artery is important for accurate positioning of burr hole to evacuate extradural hematoma. Morphological studies on various foramina and processes of skull maybe helpful in neurosurgery and forensic medicine practice[8,9,10,11].

Materials and Methods

The present study was undertaken in different medical and dental institutions in Karnataka, India. We have observed differentshapes of pterion like sphenoparietal frontotemporal, stellate and epipteric.

Results

Four types of pterion were observed in the 250skulls (500 sides) examined. Sphenoparietal type 68.18% in males, 59.72% in females and 65.19% intotal; frontotemporal type 9.09% in males, 26.38%in females and 15.19% in total; stellate type

Table 1: Types of pterion in Male and Female, Right andLeft

	Types of pterion			
	Sphenoparietal (%)	Frontotemporal (%)	Stellate (%)	Epipteric (%)
Male (132)	68.18	9.09	15.90	6.81
Female (72)	59.72	26.38	11.11	2.77
Total (204)	65.19	15.19	14.21	5.39
Right	34.80	6.37	6.37	3.92
Left	30.39	8.82	7.84	1.47

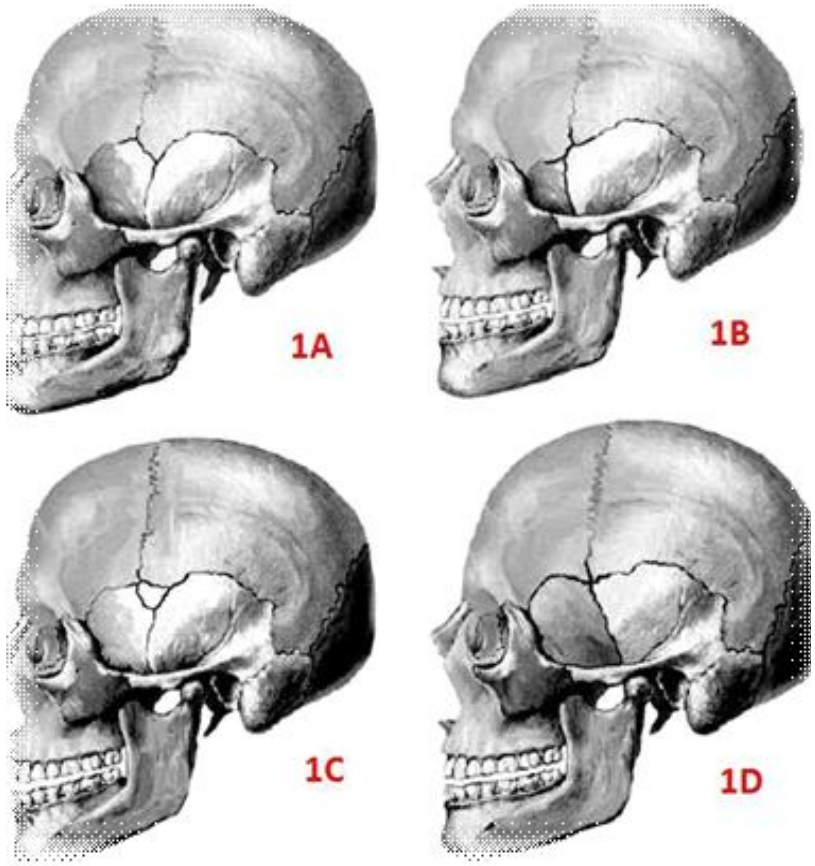

Fig. 1: Types of pterion (sphenoparietal (1A), frontotemporal(1B), epipteric(1C), stellate(1D)

15.90% in males, 11.11% in females and 14.21% in total; epiteric type 6.81% in males, 2.77% in females and 5.39 % in total. Sphenoparietal type was observedin more cases – 34.80% on right and 30.39% onleft, frontotemporal type was seen in 6.37% of cases on right and 8.82% on left; stellate type in 6.37% on right and 7.84% on left; epipteric type in 3.92% on right and 1.47% on left (Table 1).

Discussion

The type and location of the pterion and its relation tosurrounding bony landmarks is important. Such detailed information can only readily be obtained from an examination of dry skulls. However, as imaging techniques continue to develop, it may become possible to use these to determine more precise relationships between bony landmarks and the underlying soft tissues. Since the shape and location of the sutures associated with the pterion are variable, the pterion has been classified according to its shape,with four groups being described depending on the shape of the sutures between the associated bones: sphenoparietal, frontotemporal, stellate and epipteric [Figure 1][7]. An accurate knowledge of the location and relations of the pterion is important in relation to surgical intervention, particularly with respect to the course of the branches of the middle men in geal artery and Broca's motor speech area on the left side. The distances between the pterion and the lesser wing of the sphenoid and optic canal are of practical importance in surgical approaches to the seregions via the pterion. Both the type of pterion and the associated measurements variations present between different racial groups, and hence the need for accurate and upto-date data when performing intracranial surgery guided by recognizable bony landmarks [2].

The present study were observed Four types ofpterion in the 250 skulls examinedand the results were, Sphenoparietal type 65.19%,Frontotemporal type 15.19%, Stellate type 14.21%, Epiteric 5.39%. Murphy [3] study results in correlation with present study, in their study 388 skulls of Australian aborigine observed thatSphenoparietal type 73%, Frontotemporal type 7.5%, Stellate type 18.5%, Epiteric 1%. Matsumura G et al [12] study results are in agreement with our present study, in their study 614 Japanees Skulls found that Sphenoparietal type 79.1%, Frontotemporal type 2.6%, Stellate type 17.7%, Epiteric 0.6%. In study of Indian subcontinent study Saxena et al [13] found that Sphenoparietal type 84.72%, Frontotemporal type 10.01%, Epiteric 5.17%. In an Turkish study of 300 skulls by Ersoy etal.[4] the results were Sphenoparietal type 87.35%, Frontotemporal type 3.47%, Stellate type 8.98%, Epiteric 0.2%. In an another study of 26 Turkish male skulls by Oguz O [2] found that Sphenoparietal type 88%, Frontotemporal type10%, Stellate type 2%. In a Kenyan study by Mwachaka PM [13] the results were Sphenoparietal type 66%, Frontotemporal type 15%, Stellate type 12%, Epiteric 7%. In an Indian study done by Hussain Saheb et al [6] found that Sphenoparietal type 69.25%, Frontotemporal type17.35%, Stellate type 9.7%, Epiteric 3.7%. in an another study by Seema D [14] it is observed that Sphenoparietal type 94%, Frontotemporal type 1%, Stellate type 3%, Epiteric 2%. Sutural morphology of the pterion in the Indian population does not differ much from that ofother populations. These findings may be of useful in surgical approaches, interventions via the pterion.

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Case Report

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Skulls with Multiple Wormian Bones: Reports of Two Cases

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Abstract

Wormian bones have been described as small irregular ossicles which are present within the cranial sutures and fontanelles. A vast majority of these wormian bones are located in the lambdoid suture (lambda). Two dry adult human skulls were found during medicolegal examination out of which one skull showed persistent metopic suture and a series of sutural bones while the other showed the presence of only wormian bones. The incidence of metopic suture varies in different races and can be due to various causes. The metopic suture is a dentate-type suture extending from the nasion to the bregma. It fuses at around 18 months to 7 years after birth, by which time most of the increase in breadth of the forehead is complete. When the metopic suture persists into adulthood it is known as "metopism". Presence of more than ten sutural bones is unusual. It may warrant further investigations to identify an underlying pathology of hereditary disorder that has affected the skull growth at an early stage of development. The presence of metopic suture simulates the fracture of frontal bone, therefore it should be properly ruled out in x-rays by radiologists and neurosurgeons. The anatomical knowledge of Wormian bones is clinically important as they are markers for diseases and important in the primary diagnosis of brittle bone disease like osteogenesis imperfecta.

Keywords: Lambdoid Suture; Wormian Bones; Metopic Suture.

Introduction

Wormian bones have been described as small irregular ossicles which are present within the cranial sutures and fontanelles. A vast majority of these wormian bones are located in the lambdoid suture (lambda) [1]. Nearly 40% of skulls contain sutural bones in the vicinity of the lambdoid suture [2].

The next most common sutural bone is the epipteric bone found near the anterolateral fontanelle [3].

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The human frontal bones begin to ossify in the mesenchyme via two ossification centers at approximately eight weeks gestation [4]. The primary centres are one near each frontal tuber [5]. At birth, the frontal bone is seen to be divisible into two symmetrical halves by a median suture, the frontal suture (metopic suture).

The two halves begin to fuse together at the upper part during the second year and the fusion gradually extends downwards till the two halves are completely united by the eighth year [6].

The metopic suture fuses at around 18 months after birth, by which time most of the increase in breadth of the forehead is complete [5]. When the metopic suture persists into adulthood it is known as "metopism". It is rare to find this suture in adults and its presence is not considered pathological [4].

In the present study, we studied two skulls in which one skull presented with multiple sutural or wormian bones along the lambdoid suture and presence of metopic suture. Another skull showed only wormian bones along the lambdoid suture.

Case Reports

Case 1: A dry adult human skull was found during medicolegal examination. Anthropologic examination revealed it to be a female skull of about 30 years with persistent metopic suture and a series of sutural bones. It showed a complete persistent metopic suture (Fig. 1) extending from nasion to bregma. The total numbers of Wormian bones present were 21. Out of these, 2 were present along the posterior part of sagittal suture (Fig. 2), 1 along the occipitomastoid suture on the left side (Fig. 3) and the rest 18 were along the lambdoid suture (Fig. 3 and 4). Out of these 18, 8 were present on the left side and 10 on the right side. Apart from this, multiple small wormian bones were found along the coronal suture near the anteroinferior angle of the parietal bone on both sides.

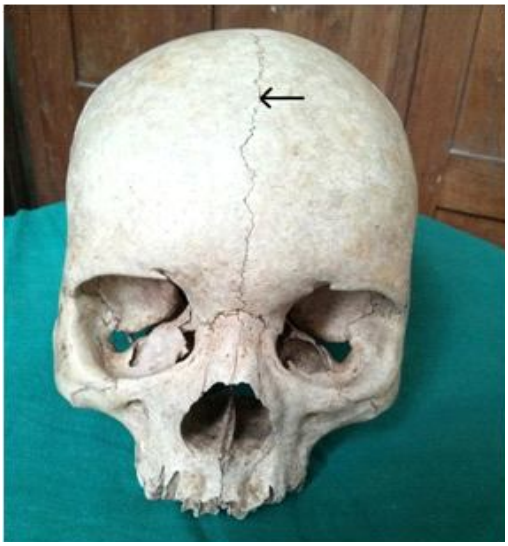

Fig. 1: Black arrow showing persistent metopic suture

Fig. 2: Norma occipitalis showing wormian bones along posterior part of sagittal suture and lambdoid suture

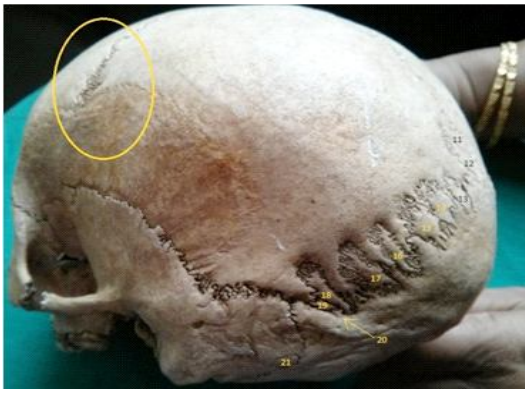

Fig. 3: Left oblique view of skull showing wormian bones along coronal suture, lambdoid suture and occipitomastoid suture

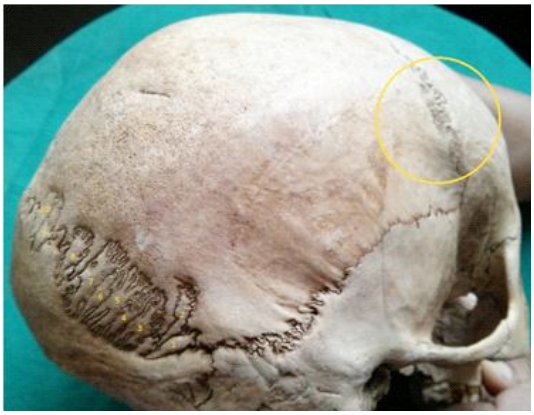

Fig. 4: Right oblique view of skull showing wormian bones along coronal suture and lambdoid suture

Case 2: Another dry adult human skull was found during medicolegal examination. Anthropologic examination revealed it to be a male skull of age between 30-40 years with a series of sutural bones along the lambdoid suture. The total numbers of Wormian bones present were 16. Out of these, 2 were present along the right side (Fig. 5), and the remaining 14 were along the left side (Fig. 5 and 6).

Fig. 5: Norma occipitalis showing wormian bones along posterior part of sagittal suture and lambdoid suture

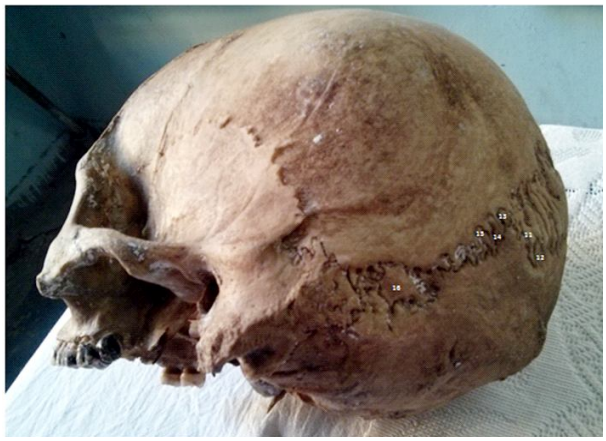

Fig. 6: Left oblique view of skull showing wormian bones along lambdoid suture

Discussion

Presence of more than ten sutural bones is unusual. It may warrant further investigations to identify an underlying pathology of hereditary disorder that has affected the skull growth at an early stage of development and as they can be easily misunderstood for a fracture of frontal bone or even for sagittal suture in radiological images [2]. Significant sutural bones as against normal developmental variants were considered to be those more than 10 in number, measuring greater than 6 mm and arranged in a general mosaic pattern. They were found in all the cases of osteogenesis imperfecta but not in the normal skulls [3].

Najjar suggested that the incidence is lower in fetuses (11.3%) than in adults (62.1%-76.2%). Incidence of Wormian bones in humans varies from 8% to 15% in a random population and reaches 54% in a mentally impaired population. The incidence of wormian bone is more among the female skulls (64.80%) [7].

The incidence of metopic suture varies in different races and can be due to various causes, such as abnormal growth of cranial bones, growth interruption, heredity, sexual, hormonal influence, atavism, cranial malformations and hydrocephalus [2]. Agarwal (1979) reported the finding of 38.17% in Indian Skulls [8]. Chandrashekhran P (1985) showed 3% each in Maharastrian and South India respectively [9]. Bilodi AK et al (2003) at Chisapni (Nepal) in 51 skulls reported 11.4% complete metopism, incomplete metopic suture 7.84% [10]. Mangal giri AS et al (2010) reported that 3.95 % had complete metopism in central India[11].

Earlier studies revealed that the metopic suture was associated with the Wormian bones [2]. Hussain Saheb S et al has reported the metopism in 125 Indian skulls, according to them the complete metopic suture was found in 3.2% of cases and incomplete metopic suture in 26.4% of the skulls [12].

Conclusion

The anatomical knowledge of Wormian bones is clinically important as they are markers for some diseases and important in the primary diagnosis of brittle bone disease like osteogenesis imperfecta. The present case report reveals the presence of multiple Wormian bones along the lambdoid sutures and in the posterior fontanelle which may lead to problems in posterior approach to the cranial cavity.

The presence of metopic suture simulates the fracture of frontal bone, therefore it should be properly ruled out in x-rays by radiologists and neurosurgeons.

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Case Report

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Accessory Right Renal Vein and Variation in the Drainage of Right Testicular Vein Associated with Right Bubonocele

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Abstract

Introduction: Variations in the number, the course and the termination of renal veins are less common than those involving renal arteries. Of these, variations involving right renal vein are more common than those of the left renal vein. But variations involving both renal vein and gonadal vein on the same side are quite rare. *Case Report*: Herein, we present a case report of accessory right renal vein which was receiving the right testicular vein observed during routine dissection. The cadaver also had a right sided incomplete inguinal hernia (Bubonocele). *Conclusion*: These variations are clinically relevant in the context of the harvest of the kidneys for renal transplant, renal angiography, portocaval shunting procedures, laparoscopic procedures involving the retroperitoneum and management of the abdominal trauma by Trans-Abdominal Retro-Peritoneal (TARP) approach.

Keywords: Accessory Right Renal Vein; Right Testicular Vein; Incomplete Inguinal Hernia; Bubonocele.

Introduction

Normally each kidney is drained by a single renal vein which is formed by the union of segmental veins. Though both the renal veins drain into inferior vena cava (IVC) directly, the level of their opening may be at a slightly different level because of different levels of the hila. Normally, testicular vein on the right side opens directly into IVC and on the left side, it opens into the left renal vein. Variant anatomy involving these veins has a great clinical significance in cases of surgeries involving kidneys and testes.

Case Report

During routine dissection of a formalin-fixed male cadaver, whose age at the time of death was 19 years, it was observed that there was an accessory right renal vein draining the lower pole of the kidney (right inferior renal vein) and terminated into the Inferior Vena Cava (IVC) 0.6 cm below the main renal vein. This accessory right renal vein was anterior to the right renal artery and renal pelvis. The main renal vein was of normal calibre and had normal relations at the hilum. The right testicular vein, in this cadaver, was found to be coursing up normally but draining into right inferior renal vein at right angles instead of directly into IVC (Figure 1 and Figure 2). The opening of the right renal vein into IVC was located 1.2 cm below the opening of left renal vein into IVC. Left renal vein and left testicular vein showed normal anatomy. Right and left ureters were normal. The pampiniform plexus on the right side and the right testis were normal. Dissection of the right inguinal canal, in this cadaver, showed an incomplete indirect inguinal hernia i.e. bubonocele.

Discussion

Variations in renal veins are not much reported as compared to variations in renal arteries. Presence of variations in renal venous drainage is quite uncommon according to Bergman et al. However there are incidences of more than one renal

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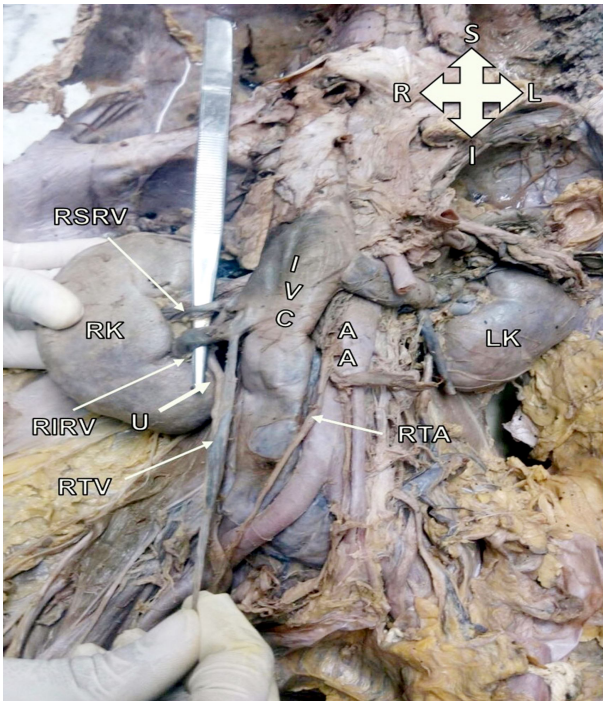

Fig. 1: Dissection photograph showing Right Testicular Vein draining into Right Inferior Renal Vein

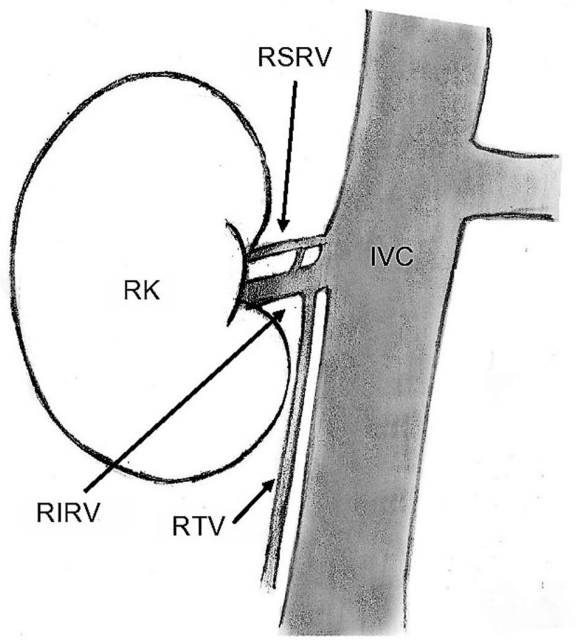

Fig. 2: A Schematic Diagram showing the variations depicted in Figure 1

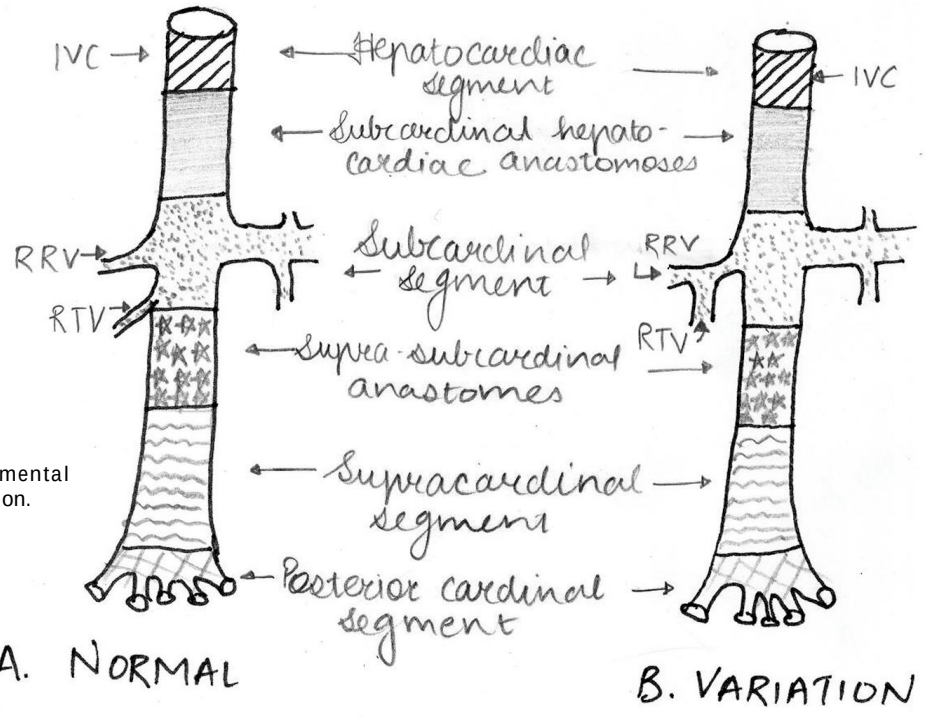

Fig. 3: Developmental basis of the variation.

Abbreviations
Right Kidney (RK)
Left Kidney (LK)
Inferior Vena Cava (IVC)
Right Superior Renal Vein (RSRV)
Right Inferior Renal Vein (RIRV)
Right Testicular Vein (RTV)
Right Testicular Artery (RTA)
Abdominal Aorta (AA)
Ureters (U)

veindraining the right kidney. Multiple renal veins occur in only 1% cases on left side while 28% on the right side [1]. Fernandes RMP et al have reported three renal veins draining the right kidney in an elderly male cadaver – superior right renal vein (SRRV), middle right renal vein (MRRV) and inferior right renal vein (IRRV). In that cadaver, they also found that the right testicular vein was draining into IRRV at 0.3 cm from its drainage into IVC [2]. Greweldinger et al mentioned that additional renal vein may act as an alternate collateral route if the inferior vena cava has been interrupted between these veins [3]. Some other renal vein variations reported are the retro aortic left renal vein opening into the left common iliac vein, a circumaortic venous ring and a retro aortic bifid left renal vein [4].

Favorito LA et al had dissected 24 male fetuses and found that in 4.2% of cases the right testicular vein was draining into the right renal vein. They also found that in 12.5% of cases the right testicular vein was draining at the junction of the right renal vein into IVC [5].

Gupta R et al found variations in gonadal veins in a series of 60 cadavers, of which 40 were male and 20 were female. Out of 40 male cadavers, in 4 cases (10%), they found the right testicular vein draining into the right renal vein and in 2 cases (5%) they found the right testicular vein to be bifurcating and draining into both the right renal vein and IVC [6].

Asala et al found 2 out of 150 (1.3%) cases in which the right testicular vein was draining into the renal vein. These authors noticed that the variations were found in 21.3% of the specimens [7]. Paraskevas et al found, during routine dissection of a male cadaver, the right testicular vein to be draining into the right renal vein at right angles [8].

Most of these variations in renal veins may be asymptomatic and may be reported only in CT scans or on autopsy or found during dissection of a cadaver as happened in the present case. The level of opening of renal veins into IVC is important for interventional radiologists to place the catheter and to create a shunt in porto-renal shunt procedures.

Embryological basis of the Variation

Anastomosis between the supra-cardinal and the sub-cardinal veins, which occur bilaterally, forms the renal segment of IVC. Testicular vein develops from caudal part of sub-cardinal vein and drains into the supra-sub cardinal anastomosis. On the right side, this supra- sub cardinal anastomosis and also a small portion of sub-cardinal vein are incorporated into the formation of IVC, so the right testicular vein usually drains into the IVC. On the left side, this supra-sub cardinal anastomosis forms part of left renal vein into which the left testicular vein drains [9]. Variations of the testicular veins are caused by dysplasia of the sub cardinal venous system in the seventh to eighth week of embryogenesis. In the present case, the drainage of the right testicular vein into the right renal vein may be because the caudal portion of the right sub cardinal vein has migrated to the right renal vein portion of sub cardinal sinus [8] or a part of right renal vein could have been formed by right supra-sub cardinal anastomosis and hence received the right testicular vein (Figure 3).

Clinical Significance of the Variation

Variations of the testicular vein may influence blood flow, temperature and spermatogenesis in the testis and result in some pathological conditions such as varicocele which are regarded as the causes of male infertility [10]. Drainage of right testicular vein at right angles into right renal vein may cause varicocele on the right side because of increased hydrostatic pressure. It is important for the surgeon to bear in mind the likely presence of testicular vein variations regarding its number, site of termination and accessory anastomotic channels or collateral branches that should be ligated to exclude any recurrence of varicocele. Such a recurrence hazard has been estimated as high as 5–20% in patients suffering from varicocele. Knowledge of variations such as these should be kept in mind by radiologists during endovascular procedures like therapeutic remobilization and angioplasties. Multiple vascular variations near the hilum of the kidney are present in seemingly normal patients and a sound knowledge of such variations is very important for urologists and surgeons operating in the retroperitoneal region for harvesting kidneys and for portocaval shunts.

This case report is presented for its rarity and for increasing awareness about variations of right renal vein and right testicular vein during pre-operative evaluation.

Key Messages

1. Presence of accessory renal veins should be looked for while harvesting kidneys from donors for transplantation surgery and during portocaval shunts.
2. Presence of abnormal drainage of testicular vein should be kept in mind while investigating and treating varicocele and male infertility.

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Short Communication

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Skin Blood Flow in Diabetic Peripheral Neuropathy: A Focused overview of Patho-Anatomical Diagnosis and Therapy

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Abstract

The aim of this short communication article was to explore the literature background behind cutaneous circulatory changes in diabetic peripheral neuropathy (DPN). Measurement of skin blood flow using Laser doppler flowmetry and thermography for amplitude, flow rate and volume was indicative of autonomic dysfunction in DPN, and treatment using Alpha-lipoic acid, Frequency modulated rhythmic electromagnetic stimulation, Pentoxifylline and Ruboxistaurin were shown to improve skin blood flow in subjects with DPN.

Keywords: Neuroanatomy; Structural Endocrinology; Diabetic Neuropathy; Cutaneous Circulation.

The aim of this short communication article was to explore the literature background behind cutaneous circulatory changes in diabetic peripheral neuropathy (DPN).

Urbancic-Rovan et al [1] studied basal skin blood flow (BSBF) and its differences in dynamic components (1) among 25 diabetic patients without autonomic neuropathy (D) and 18 with (DAN) and 36 healthy control subjects (C), and (2) among the upper and lower extremities. The mean flow, mean amplitude of the total spectrum and mean amplitudes at all frequency intervals were highest in C, followed by DAN and lowest in D.

Hauer et al [2] determined changes in hand skin blood flow in diabetic men using liquid crystal contact thermography to assess the relative effects of autonomic neuropathy and microangiopathy in 34 diabetic and 12 age-matched nondiabetic men. After ice-cold water immersion, right-hand recovery in diabetic men was found to be abnormally slow compared with nondiabetic men.

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Jin et al [3] assessed the effect of alpha-lipoic acid on skin blood flow 13 control subjects and 19 patients with diabetic neuropathy using the laser Doppler blood flow technique, and found no significant differences in absolute values of skin blood flow but symptoms were reduced after alpha-lipoic acid treatment.

Frequency Rhythmic Electrical Modulation System (FREMS):Bocchiet al [4] evaluated the changes in laser Doppler flow in the volar part of the forearm before, during and after FREMS in diabetics and 10normal controls,and observed an increase of 0.1Hz vasomotion power spectra only in the diabetic group, which suggested that FREMS was able to synchronize smooth cell activity, inducing and increasing 0.1Hz vasomotion.

Isoform-specific protein kinase C beta inhibitor, Ruboxistaurin:Brooks et al [5] studied the effects of ruboxistaurin (RBX) on skin microvascular blood flow (SkBF) and evaluated the relationship between endothelial and neural control of SkBF in patients with diabetic peripheral neuropathy (DPN) in 11 placebo- and 9 RBX (32 mg/day)-treated patients. The study did not find significant differences for post-iontophoresis SkBF: endothelium-dependent; endothelium-independent; and C fiber-mediated vasodilatation.

Another study by Caselliniet al [6] investigated the effects of the isoform-selective PKC-beta inhibitor ruboxistaurinmesylate on endothelium-dependent and C fiber-mediated SkBF in 20 placebo-

and 20 ruboxistaurin-treated (32 mg/day) DPN patients and found improvements in endothelium-dependent and C fiber-mediatedSkBF at the distal calf increased for the drug-treated group.

Pentoxifylline: Rendell and Bamisedun[7] measured skin blood flow usinglaser Doppler in 24 pentoxifylline-treated diabetic patients with sensory neuropathy. On the lower extremity, there was an increase in laser Doppler measured flow score (FS) both at 35 degrees and at 44 degrees C, with both FSDW (35 degrees) and FSDW (44 degrees) beingincreased at six months.

Measurement of skin blood flow using Laser doppler flowmetry and thermography for amplitude, flow rate and volume was indicative of autonomic dysfunction in DPN, and treatment using Alpha-lipoic acid, Frequency modulated rhythmic electromagnetic stimulation, Pentoxifylline and Ruboxistaurin were shown to improve skin blood flow in subjects with DPN.

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